STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC For a State Pollution Discharge Elimination System Permit Renewal and Modification	DEC No.: 3-5522-00011/00004 SPDES No.: NY-0004472
In the Matter of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations Inc.'s Joint Application for CWA § 401 Water Quality Certification	DEC App. Nos. 3-5522-00011/00030 (IP2) 3-5522-00105/00031 (IP3)

PREFILED TESTIMONY OF JOHN R. YOUNG, PH.D. IN SUPPORT OF ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC AND ENTERGY NUCLEAR OPERATIONS, INC.

CLOSED CYCLE COOLING

ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC, AND ENTERGY NUCLEAR OPERATIONS, INC.

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February 28, 2014

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I. INTRODUCTION

Q: Please identify yourself.

A: My name is John R. Young, Ph.D. I am a Senior Scientist and Vice President at ASA Analysis & Communications, Inc. ("ASA"), an environmental consulting firm based in Lemont, Pennsylvania. In this capacity, I provide technical direction for ASA's applied statistics and environmental monitoring services. My business address is 921 Pike Street, Lemont, PA 16851-0303.

Q: Are you the same John R. Young who previously submitted testimony in these proceedings?

A: Yes. I previously submitted direct and rebuttal testimony in these proceedings on July 22, 2011; September 30, 2011; May 30, 2012; June 29, 2012; and May 31, 2013. I testified in person before this Tribunal on October 24 and 25, 2011; August 2, 2012; and July 17, 2013.

Q: Are you offering testimony on behalf of Entergy in support of its application for State Pollutant Discharge Elimination System ("SPDES") Permit Renewal (DEC. No. 3-5522-00011-00004, SPDES No. NY0004472) and a Water Quality Certification (DEC App. Nos. 3-5522-00011/00030 (IP2) and 3-5522-00105/00031 (IP3)) for Indian Point Units 2 and 3 (collectively, the "Proceedings")?

A: Yes. I am offering my testimony with respect to Issue for Adjudication No. 1 concerning the feasibility of constructing and operating closed-cycle cooling ("CCC") towers as proposed by New York State Department of Environmental Conservation ("NYSDEC") Staff at the Indian Point facility. This testimony

describes two reports prepared by ASA entitled *Biological Input to Benefits Analysis of Cylindrical Wedgewire Screen and Closed Cycle Cooling Alternatives for Indian Point Energy Center* (the "December 2013 Benefits Input Report") and *Biological Input to "Wholly Disproportionate" Analysis of Cylindrical Wedgewire Screen and Closed Cycle Cooling Alternatives for Indian Point Energy Center* (the "December 2013 Wholly Disproportionate Input Report"). I understand that the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report have been previously provided to the parties to the Proceedings, and I adopt these reports as part of my prefiled testimony as Entergy Exs. 300 and 301, respectively.

Q: What is the purpose of your testimony?

A: I will offer my expert testimony that the report "*Indian Point Closed-Cycle System Retrofit Evaluation* (Tetra Tech June 2013) (the "Tetra Tech Report") prepared on behalf of NYSDEC Staff cannot support a site-specific best technology available ("BTA") determination for the CCC retrofit proposed by NYSDEC Staff, or a determination of whether it meets SEQRA requirements, because it provides no analysis of the efficacy of the proposed CCC retrofit and no analysis of whether the proposed CCC retrofit will impact endangered Atlantic and shortnose sturgeon.

I also will offer my expert testimony concerning the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report, which provide the biological inputs to the analyses conducted by NERA Economic Consulting ("NERA") that are presented in the two reports *Benefits*

and Costs of Cylindrical Wedgewire Screens or Cooling Towers at IPEC (December 2013) (hereinafter the "December 2013 Benefit-Cost Report") and *"Wholly Disproportionate" Assessments of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (December 2013) (hereinafter the "December 2013 Wholly Disproportionate Report"), which I understand are Entergy Exs. 296D and 297, respectively. These two reports assessed the theoretical benefits attributable to the reduction in entrainment and impingement mortality of cylindrical wedgewire screens ("CWWS") and CCC, using generally accepted metrics for evaluating the biological benefits of cooling water intake technologies. This testimony and the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report are intended to assist this Tribunal in determining whether CCC is BTA on a site-specific basis at Indian Point and whether CCC meets the requirements of the State Environmental Quality Review Act ("SEQRA").

II. QUALIFICATIONS

Q: Please describe your academic background as well as any specializations and work experience relevant to your testimony.

A: I previously described my academic background, relevant specializations and work experience in prefiled direct testimony that I submitted in these Proceedings during administrative hearings in Albany, New York on October 24, 2011. *See* Hearing Tr. pp. 1297; 4-10, 1298:2-7, 20; 1299:7-23, 1300:23-1301:6. I refer to and incorporate that testimony by reference in this prefiled testimony.

III. THE TETRA TECH REPORT INCLUDES NO ANALYSIS OF THE EFFICACY OF THE PROPOSED CCC RETROFIT

Q: Are you familiar with the Tetra Tech Report?

A: Yes. I have reviewed the Tetra Tech Report.

Q: Does the Tetra Tech Report include an analysis of the impingement and entrainment reductions that would be achieved by the CCC system proposed by NYSDEC Staff?

A: No. The Tetra Tech Report states only that "[t]he project will also significantly reduce fish entrainment." Tetra Tech Report at 96. This statement is a qualitative assertion of fact that is backed up by no citations to any supporting information and as such does not itself appear to qualify as an expert opinion informed by analysis that can be used to determine whether the proposed technology is BTA, or satisfies SEQRA requirements.

Q: Is the statement in the Tetra Tech report that the proposed CCC retrofit will "significantly reduce fish entrainment" accurate?

A: It is difficult to say whether such a qualitative statement is accurate. However, to the extent this statement is based on the same information relied upon by Mr. Nieder in his previous testimony that a CCC retrofit at Indian Point would reduce entrainment losses by approximately 98%, due to a similar percentage reduction in intake flow volumes associated with CCC (*see, e.g.*, Nieder June 29, 2012 Prefiled Rebuttal at 30, citing NYSDEC's November 2003 Indian Point Permit Fact Sheet (Entergy Ex. 26)), it is not accurate.

Q: Why is the representation of a 98% reduction in entrainment associated with a CCC retrofit at Indian Point not accurate?

A: The estimated 98% reduction in entrainment (*i.e.*, efficacy) ascribed to CCC systems is a direct result of reduced intake flows associated with the technology, and as such does not account for the substantial periods during the year when, due to salinity levels in the Hudson River, a CCC system at Indian Point would not be able to operate and meet applicable air quality standards. The monthly and annual extent of the inability of CCC to be operated during periods of high salinity is described in the Enercon report entitled *Analysis of Closed-Loop Cooling Salinity Levels Indian Point Units 2 & 3* (November 2010) (the "Salinity Report"), which I understand is Entergy Ex. 310. I used Enercon's estimates of monthly and annual CCC inoperability in the Salinity Report to calculate actual entrainment reductions that would be achieved by a CCC system at Indian Point, on both a monthly and an annual basis. The results of my analysis are presented in the ASA report entitled *Biological Assessment of Closed-Loop Cooling Flow Scenarios* (November 2010) (the "ASA CCC Flow Report") that is Appendix D to the Salinity Report. *See* Entergy Ex. 310 at 37-49. I understand that the ASA CCC Flow Report has been previously provided to the parties to the Proceedings, and I adopt the ASA CCC Flow Report as part of my prefiled testimony.

As explained in the Salinity Report, and presented in the ASA CCC Flow Report, the percentage of time that a CCC system installed at Indian Point would not be able to operate and meet air quality standards, during which the plant would instead have to operate in once-through mode, ranges from approximately 57% (to meet $PM_{2.5}$ NAAQS) to 87% (to meet $PM_{2.5}$ SIL) on an annual basis, and from 25% (to meet $PM_{2.5}$ NAAQS in May) to 94% (to meet $PM_{2.5}$ SIL in July)

during the key entrainment months of May through July. *See* Salinity Report at 28 and ASA CCC Flow Report at 39. Without an analysis of the impacts of salinity levels on the ability of the specific CCC retrofit proposed by NYSDEC Staff to operate, the true reductions in impingement and entrainment achieved by NYSDEC Staff's proposed system remains unquantified and the Tetra Tech Report is unsuitable for making a BTA determination for the proposed CCC retrofit. Likewise, without an analysis of the true efficacy of the proposed CCC retrofit, the Tetra Tech Report is insufficient to make a determination regarding whether NYSDEC Staff's proposed CCC retrofit satisfies SEQRA requirements.

Q: Have you estimated the impact of periods of high salinity on the efficacy of a CCC system at Indian Point?

A: Yes. The impact of periods of high salinity on the efficacy of a CCC system at Indian Point is the subject of the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report addressed in Sections IV and V of this testimony. The analysis in these reports is based on the operation of the circular hybrid mechanical draft cooling tower arrangement discussed in the reports entitled, *Economic and Environmental Impacts Associated with Conversion of Indian Point Units 2 and 3 to a Closed-Loop Cooling Water Configuration*, dated June 2003 (Entergy Ex. 7A) and *Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configurations*, dated February 12, 2010 (Entergy Ex. 7). I understand from counsel for Entergy that no party to the Proceedings is advancing the circular hybrid mechanical draft cooling towers discussed in those reports.

However, because Tetra Tech did not perform an air quality impact analysis of NYSDEC Staff's proposed configuration or reach any conclusions regarding the ability to meet air quality requirements, and no other information has been provided by NYSDEC Staff, my testimony is based on the conclusions that Enercon drew with respect to site-specific barriers to large-scale CCC at Indian Point based on the relevant, available information as it was presented in the Salinity Report.

Q: Are there any other potential aquatic impacts not covered by the Tetra Tech Report?

A: Yes. The Tetra Tech Report makes no mention, let alone presents an analysis, of potential construction impacts on endangered Atlantic and shortnose sturgeon. As noted in the document entitled *New York State Environmental Quality Review Act: Entergy Response to the Tetra Tech Report and the Powers Engineering Report* (Entergy Exs. 296, 296A, 296B, 296C, 296D, 296E, 296F, 296G, 296H, 296I) (the "TRC Response Document"), construction activities associated with the proposed CCC retrofit would occur close to the Hudson River shoreline. *See* Response Document at 3-62. These activities will require clearing and blasting of a "significant area of the IPEC site" and are likely to involve substantially increased barge traffic (approximately 1,215 barge loads) to remove blast materials in the vicinity of habitat utilized by the endangered Atlantic and shortnose sturgeon. *See* Response Document at 3-62. Without an assessment of potential impacts to these endangered species, the Tetra Tech Report is inadequate to make a BTA determination for the CCC retrofit proposed by NYSDEC Staff or

to determine whether it meets SEQRA requirements.

IV. DECEMBER 2013 BENEFITS INPUT REPORT

Q: Can you briefly summarize the purpose of the December 2013 Benefits Input Report?

A: On May 31, 2013, I submitted (along with prefiled testimony) a report entitled *Biological Input to Benefits Analysis of the Cylindrical Wedgewire Screen Alternative for Indian Point Energy Center*, dated March 2013 (hereinafter the "March 2013 Benefits Input Report; *see* Entergy Ex. 185B). As I explained in my May 2013 prefiled testimony, the March 2013 Benefits Input Report extended the updated estimates of CWWS efficacy (expressed as entrainment losses and age-1 equivalents) contained in the document *Update of 2mm CWWS Performance Estimates Based on 2011 IPEC Wedgewire Laboratory Study (Objective 2)* (the "2011 Update"; Entergy Ex. 21) to include updated estimates of theoretical total lost harvest, in terms of fishery yields and production forgone, thus providing the biological inputs used by NERA to perform a benefits analysis for CWWS in its report entitled *Benefits and Costs of Cylindrical Wedgewire Screens at Indian Point Energy Center*, dated March 2013, which is Entergy Ex. 185. *See* J. Young May 31, 2013 Prefiled Direct at 2. Dr. David Harrison and I testified before this Tribunal regarding these two reports on July 17, 2013. *See* Hearing Tr. at 6193-6348.

The December 2013 Benefits Input Report uses the same methodology applied to CWWS in the March 2013 Benefits Input Report to provide estimates of fishery yields and production forgone for CCC, which serve as biological

inputs to NERA's analysis in its December 2013 Benefit-Cost Report (Entergy Ex. 296D).

Q: Can you refresh our memories regarding the meaning of "lost yield," "production forgone," and "total lost harvest"?

A: Lost yield refers to the theoretical reduction in the harvest of identified recreationally or commercially important species due to entrainment and impingement mortality. Production foregone is an estimate of the theoretical biomass that would have been produced had individual aquatic organisms not suffered impingement or entrainment mortality. It is generally a measure of the theoretical biomass of prey that would not be available (here, in terms of fish) for consumption by predators. Total lost harvest is the total theoretical change to the commercial and recreational harvest, taking into account both lost yield to the fishery (direct) and production foregone (indirect).

Q: What metrics do you provide in the December 2013 Benefits Input Report?

A: The December 2013 Benefits Input Report provides species-specific estimates of theoretical total lost harvest (as metric tons and thousands of fish) for the following technology alternatives, as summarized in Tables 3-1 and 3-2:

Case 0 = regulatory baseline;
Case 1 = current technology;
Case 4.1c = expected CWWS performance;
Case 4.2c = upper bound of CWWS performance;
Case 4.3c = lower bound of CWWS performance;
Case 15 = CCC with historical service water flows;
Case 15.5 = CCC with maximum service water flows;
Case 15.6 = CCC operating in hypothetical "dual mode" to achieve SIL compliance;

Case 15.7 = CCC operating in hypothetical "dual mode" to achieve NAAQS compliance.

See Entergy Ex. 300 at 9-10.

Q: Does the December 2013 Benefits Input Report present the same metrics as the March 2013 Benefits Input Report?

A: The March 2013 Benefits Input Report provided theoretical lost harvest estimates only for cases 1 and 4.1c (identified as "Case 4" in the March 2013 Benefits Input Report). The theoretical lost harvest values for Cases 0, 4.2c and 4.3c (upper and lower bound CWWS) were added to the December 2013 Benefits Input Report to carry through the calculations of entrainment losses and age-1 equivalents for those three cases in Table 1 of the 2011 Update (Entergy Ex. 21).

Q: Can you describe the theoretical lost harvest values related to CCC that are included in the 2013 Benefits Input Report?

A: The theoretical lost harvest values related to CCC are cases 15, 15.5, 15.6 and 15.7. Case 15, which represents theoretical lost harvest that would be associated with CCC operating at historical service water flows, is an extension of the efficacy estimates included for that case in Table 1 of the 2011 Update (Entergy Ex. 21). Case 15.5 represents theoretical lost harvest that would be associated with CCC operating at maximum water service flows for Units 2 and 3. Case 15.5 efficacy values were not included in Table 1 of the 2011 Update, but were included in Table 11 of Young (2010) (*Biological Analysis of Selected Cooling System Alternatives for Indian Point Energy Center*; Entergy Ex. 8F).

Cases 15.6 and 15.7 represent estimates of theoretical lost harvest that would be associated with a hypothetical "dual mode" operation at Indian Point in

which the facility would switch between once-through and CCC modes depending on the salinity levels in the Hudson River, which affect the ability of CCC towers to meet applicable air quality standards. Specifically, Case 15.6 represents theoretical lost harvest that would be associated with dual mode operation necessary to meet the $PM_{2.5}$ SIL and Case 15.7 represents theoretical lost harvest that would be associated with dual mode operation necessary to meet the $PM_{2.5}$ NAAQS. The theoretical lost harvest estimates for Cases 15.6 and 15.7 expand on the estimates for these same scenarios that were presented in Table 4 of ASA's CCC Flow Report (Entergy Ex. 310 at 46).

Q: Can you briefly summarize the results of the December 2013 Benefits Input Report?

A: As shown in Table 3-1 of the December 2013 Benefits Input Report, the theoretical annual lost harvest associated with the proposed 2mm CWWS (Case 4.1c), which includes both the direct lost yield and the indirect effects of production forgone, is approximately 13 metric tons for all species, as compared to the theoretical lost harvest of approximately 100 metric tons associated with the current intake technology at Indian Point (Case 1). The difference, 87 metric tons, is the theoretical annual potential benefit of the proposed CWWS in terms of increased harvest for the species in question at Indian Point.

As shown in Table 3-2 of the December 2013 Benefits Input Report, the theoretical annual lost harvests associated with CCC are similar to CWWS, approximately 6 metric tons at historical service water flows (Case 15) and 9.4 metric tons with maximum service water flows (case 15.5), resulting in theoretical

annual potential benefits of approximately 94 and 91 metric tons, respectively. However, once the requirement to meet air quality standards is taken into account (*i.e.*, operating in "dual mode" due to Hudson River salinity levels), the theoretical lost harvests increase to approximately 93 metric tons to meet the $PM_{2.5}$ SIL (Case 15.6) and 68 metric tons to meet the $PM_{2.5}$ NAAQS (Case 15.7). Thus, the theoretical potential benefits of CCC, when operated in dual mode to meet air quality standards, range from only about 7 metric tons to about 32 metric tons.

Q: You have noted that the estimates of potential benefits in the December 2013 Benefits Input Report are "theoretical," why is that?

A: As was the case for the March 2013 Benefits Input Report, the estimates of potential benefits associated with installation of alternative intake technologies are theoretical because they assume that fish eggs, larvae and small juvenile fish saved by installing an alternative technology necessarily would translate into larger populations of harvestable fish, which is contradicted by an analysis of more than 30 years of Hudson River fish population data. *See* Entergy Ex. 3. In addition, the theoretical increased harvests calculated in the December 2013 Benefits Input Report are very likely to overestimate the true benefits for the following reasons:

- All production forgone was assumed to be converted to biomass of striped bass, the top predator and most commercially valuable member of the RIS. In reality, some of the increased production resulting from decreased entrainment mortality would be converted to a large number of less

valuable species instead.

- Only a single trophic transfer (*i.e.*, transfer from a lower level to a higher level in the food chain) was assumed to be needed, *i.e.*, striped bass would directly prey upon the entrained or impinged organisms. Particularly for entrainable life stages, a series of trophic conversions may occur before the biomass would be incorporated in the top predator. Each conversion would result in a 90% loss of biomass, thus only 1% would be transferred when two predation events occur, and 0.1% if three events are required.
- The fishery for anadromous clupeids (American shad, alewife, and blueback herring) is either closed entirely or severely constrained at levels below the fishing mortality rate used in this analysis. Thus, the estimated landings for these species, and the value of the landings, although already very small, is an overestimate of what would be permitted under current regulations.
- The assumed fishing mortality rate for striped bass (F = 0.31) is substantially higher than the current target rate of 0.18. Thus, the estimated increase in striped bass harvest would overestimate the currently permitted level.
- All fish that die as a result of fishing at the assumed rate of fishing are assumed to be harvested.

V. DECEMBER 2013 WHOLLY DISPROPORTIONATE INPUT REPORT

Q: Can you briefly summarize the purpose of the December 2013 Wholly Disproportionate Input Report?

A: The December 2013 Wholly Disproportionate Input Report provided the biological inputs to NERA's December 2013 Wholly Disproportionate Report (Entergy Ex. 297), which provides an economic assessment of the CWWS and CCC technologies proposed as BTA for reducing entrainment and impingement at Indian Point.

Q: What metrics do you provide in the 2013 Wholly Disproportionate Inputs Report?

A: Like the December 2013 Benefits Input Report, the December 2013 Wholly Disproportionate Inputs Report provides species-specific estimates of theoretical lost harvest as metric tons of fish for Cases 0, 1, 4.1c, 4.2c, 4.3c, 15, 15.5, 15.6 and 15.7. In addition, the December 2013 Wholly Disproportionate Inputs Report provides, for the same Cases, species-specific estimates of impingement and entrainment losses and age-1 equivalents.

Q: Were these metrics calculated in the same manner as in the December 2013 Benefits Input Report and previous reports?

A: Yes. The estimates of theoretical lost harvest in Tables 3-1 and 3-2 of the December 2013 Wholly Disproportionate Input Report were calculated in the same manner (and indeed are the same) as in the December 2013 Benefits Input Report. The estimates of impingement and entrainment losses and age-1 equivalents were calculated in the same manner as in previous reports, *e.g.*, the 2011 Update (Entergy Ex. 21), with the addition of Cases 15.5, 15.6 and 15.7.

Q: Do the theoretical harvest values in the December 2013 Wholly Disproportionate Input Report also overestimate the true benefits of any

particular intake technology?

A: Yes. The December 2013 Wholly Disproportionate Input Report is just as likely to overestimate the true benefits of the intake technologies for the reasons I explained above for the December 2013 Benefits Input Report.

VI. SUFFICIENCY OF DATA, METHODS AND CONCLUSIONS

Q: In your professional opinion, did the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report reliably apply scientifically accepted principles to estimate theoretical lost yield and production foregone?

A: Yes. The methods used for the calculations are the same methods used by EPA and recommended in EPRI guidance. *See, e.g.,* Entergy Ex. 68.

Q: In your professional opinion, did the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report have sufficient data to reach reliable and scientifically sound conclusions to estimate theoretical lost yield and production foregone?

A: Yes, subject to the assumptions discussed above and in the Reports, which result in an overstatement of such losses.

Q: In your professional opinion, do the December 2013 Benefits Input Report and the December 2013 Wholly Disproportionate Input Report provide scientifically reliable results as to the theoretical estimate of lost yield and production foregone?

A: Yes, subject to the assumptions discussed above and in the Reports, which result in an overstatement of such losses.

Q: Do you hold your opinions to a reasonable degree of scientific certainty?

A: Yes.

END OF TESTIMONY

BIOLOGICAL INPUT TO BENEFITS ANALYSIS OF THE CYLINDRICAL WEDGEWIRE SCREEN ALTERNATIVE FOR INDIAN POINT ENERGY CENTER

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March 2013

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1 INTRODUCTION

As part of the State Pollution Discharge Elimination System (SPDES) permit renewal process for the Indian Point Energy Center (IPEC), Barnthouse et al. (2008) concluded that operation of the facility with a once-through cooling system had not caused any adverse environmental impacts, specifically with respect to reductions of the population sizes of 8 representative important species (RIS). They also concluded that since IPEC operations had not caused any population reductions, there was no reason to expect that populations would necessarily increase if IPEC ceased once-through cooling.

Additional analyses were conducted for the SPDES renewal in 2010 by ASA Analysis & Communication, Inc. (ASAAC) that quantified the theoretical effects of various intake alternatives for IPEC on impingement and entrainment of the 8 RIS (Young 2010). These 8 taxa comprised 95% of individuals collected in entrainment sampling and 94% of individuals in impingement sampling during the most recent studies (CHG&E et al. 1999). As part of this analysis ASAAC estimated the numbers of fish impinged and entrained, and numbers lost to impingement and entrainment (after incorporating impingement and entrainment survival rates). In addition, using the conservative assumption that reduced entrainment and impingement losses would translate to larger population sizes, ASAAC estimated the potential equivalent age 1 fish lost to impingement and entrainment, the potential lost yield to the fishery, and the potential amount of biomass that would have been produced by those organisms lost to entrainment and impingement (production forgone).

The equivalent age 1 losses, lost yield, and production forgone are all considered potential effects because these estimates depend upon the underlying assumption of a linear translation of entrainment and impingement losses to losses of older fish. The Barnthouse et al. (2008) analysis demonstrated that it is not reasonable to expect that reductions in impingement and entrainment mortality will actually lead to larger populations.

Portions of the 2010 analysis, but not the lost yield and production forgone estimates, were revised to reflect additional information on Cylindrical Wedgewire Screen (CWWS) effectiveness obtained during 2010 and 2011 laboratory studies (NAI & ASAAC 2011a and 2011b), and additional information of effectiveness of closed cycle cooling alternatives during periods of high ambient salinity (ASAAC 2010).

Because the benefits of the CWWS Alternative are principally the reductions in impingement and entrainment losses that would occur, relative to current levels of mortality, the loss estimates for the CWWS alternative must be compared to those using current technology. This report documents the data sources and methodology for the loss estimates expressed as potential additional weight and numbers of fish harvested. The methodology and data sources of the original analysis were presented in Young (2010). This report presents the methods used to update the original lost yield and production forgone estimates to potential harvest changes if CWWS were installed at IPEC.

2 METHODS

The input data used to produce the potential increases in harvest for the CWWS Alternative are the estimates of lost yield and production forgone for each of the RIS in Table 24 in Young (2010). These values have been adjusted for entrainment and impingement survival rates determined from actual site-specific studies. As shown in Table 24, lost yield estimates were developed for American shad, striped bass, white perch, and *Alosa* sp. (river herrings). Production forgone estimates were developed for these species as well as bay anchovy and Atlantic tomcod. In Table 24 there were typographical errors in the impingement data for both lost yield and production forgone. These errors were corrected for the present analysis (Table 2-1 and Table 2-2).

The lost yield and production forgone values were calculated according to the methodology of Rago (1984) under the assumption that natural mortality (M) and fishing mortality (F) act concurrently throughout the year. The annual natural and fishing mortality rates used for fully recruited adult fish were:

	M	F
American shad	0.90	0.33
Striped bass	0.15	0.31
White perch	0.79	0.15
River herrings	1.49	0.10

The fishing mortality rate for striped bass (0.31) was the target fishing mortality rate used by the Atlantic States Marine Fisheries Commission (ASMFC) at the time the original analysis was conducted. This fishing mortality rate would therefore estimate the potential striped bass harvest under the management plan. The F values assumed for American shad and river herrings reflected fishing intensities at a period prior to the closure of these fisheries, and therefore do not reflect current conditions. However, use of these values permits an assessment of potential yields from these stocks should the fisheries be opened again in the future.

The estimates of lost yield and production forgone were converted to changes in fishery harvest using the methodology of USEPA (2006). Estimates of direct harvest (H_d) for each of the RIS are simply the calculated lost yield values. Estimates of indirect harvest (H_i) were calculated as:

$$H_i = \frac{LY_{s=SB}}{PF_{s=SB}} \times 0.1 \sum_s PF_s$$

The indirect harvest is found by summing the production forgone over all the RIS, including striped bass, and converting that to additional striped bass biomass at a trophic conversion efficiency of 10%. The portion of that additional biomass that is harvested is determined from the ratio of striped bass lost yield ($LY_{s=SB}$) to striped bass production forgone ($PF_{s=SB}$). The calculation is performed separately for entrainment and impingement. Although the production forgone would have served many predatory species in addition to striped bass, the conversion of all production forgone to striped bass biomass is done as a conservative measure since striped bass are by far the most economically valuable of the RIS, or other local predatory species.

The direct harvest and indirect harvest are then summed to obtain the total additional harvest in weight. The number of additional fish harvested is determined by dividing the weight of

additional harvest by the mean weight of a harvested fish, as estimated from the values of M, F, and mean weight at age:

	Mean Weight (kg) of Harvested Fish
American shad	1.80
Striped bass	3.31
White perch	0.14
River herring	0.17

The estimates of harvest include only those fish actually kept by either commercial or recreational fishermen. Additional fish are caught and released due to seasonal restrictions, size limits, or the intentional desire to release fish without imposing mortality. Since both the commercial and recreational values are dominated by striped bass, the particular characteristics of the striped bass fishery must be considered. First, the additional Hudson River striped bass that could be produced by reducing entrainment and impingement in the Hudson could be captured in the Hudson River, in New York waters outside the Hudson River, and in the coastal fishery from the mid-Atlantic region to Canada. Waldman et al. (1990) reported on the striped bass tagging studies from 1985-1988 on the Hudson River. From 1985-1986, a total of 18,512 bass were tagged and 1,129 were recaptured over the following two years. A total of 9,414 fish were tagged from 1986-1987 and 380 were recaptured the following year. The percentage of recaptures occurring in the river and coastal waters varied each year of the study. Recaptures within the Hudson River occurred in New York (13-29%) and New Jersey (1-4%). However, a majority (67-86%) of the recaptured fish were outside the Hudson River: coastal waters of New York (39-47%), New Jersey (11-15%), Connecticut (5-10%), Rhode Island (1-7%), Massachusetts (1-6%), Maine (0-2%), Virginia (0-1%), and Nova Scotia (0-1%). McLaren et al. (1981) reported on a tagging study from 1976-1977. The percentage of tagged fish recovered outside of the river (66%) was similar to Waldman et al. (1990) but the northern extent of recoveries was Massachusetts. Thus the benefits of additional striped bass, should there actually be any, would be spread over a wide area, but the majority of the fishery benefits would most likely occur in New York (either in the Hudson River or coastal waters).

The update of the original CWWS result to incorporate new information on screen performance was presented in testimony at the CWWS portion of the hearings on August 2, 2012 (Testimony of John R. Young). The original estimate of equivalent age 1 losses (summed over the RIS) for the 2-mm CWWS alternative was 0.275 million fish. The updated estimate of equivalent age 1 losses, after incorporating the new information on screen efficacy from the laboratory studies and adjusting for velocity reductions over the screen arrays, was 0.241 million fish. The entrainment lost yield and production forgone estimates for each species for the CWWS alternative were therefore adjusted by the factor 0.241/0.275 = 0.876.

Table 2-1. Estimates of lost yield and production forgone for current technology from Table 24 of Young 2010. Corrected impingement and total values in parentheses.

Taxon	Lost Yield (kg)			Production Forgone (kg)		
	Entrained	Impinged	Total	Entrained	Impinged	Total
Bay anchovy	0	0	0	5,373	7 (0)	5,380 (5,373)
American shad	12	32 (3)	44 (15)	340	1,277 (11)	1,616 (351)
Striped bass	88,821	0 (1,526)	88,821 (90,348)	247,082	0 (2,997)	247,083 (250,080)
Atlantic tomcod	0	3 (0)	3 (0)	2,963	10 (7)	2,974 (2,970)
White perch	83	1 (32)	85 (115)	6,649	24 (1,277)	6,673 (7,925)
Alosa sp.	125	3,114 (14)	3,239 (139)	7,761	7,783 (263)	15,544 (8,024)
Total	89,042	3,149 (1,575)	92,191 (90,617)	270,168	9,102 (4,555)	279,270 (274,723)

Table 2-2. Estimates of lost yield and production forgone for 2-mm CWWS technology from Table 24 of Young 2010. Corrected impingement and total values in parentheses.

Taxon	Lost Yield (kg)			Production Forgone (kg)		
	Entrained	Impinged	Total	Entrained	Impinged	Total
Bay anchovy	0	0	0	410	0	410
American shad	0	1 (0)	1 (0)	11	48 (0)	59 (11)
Striped bass	13,360	0 (59)	13,360 (13,420)	50,146	0 (116)	50,146 (50,262)
Atlantic tomcod	0	0	0	48	0	49
White perch	34	0 (1)	34 (35)	3,437	1 (48)	3,438 (3,486)
Alosa sp.	14	120 (0)	135 (15)	1,162	297 (8)	1,458 (1,169)
Total	13,409	122 (61)	13,531 (13,470)	55,214	346 (173)	55,560 (55,387)

3 RESULTS

The estimates of lost yield and production forgone for the 2-mm CWWS alternative presented in the Alternatives Report (Young 2010) have been updated to reflect the new information on screen efficacy and current velocities that would be expected in the river when the screen array is installed. The revised lost yield and production forgone estimates have been used to estimate the lost harvest for the RIS that would result from the entrainment and impingement losses. So that the incremental benefits of a CWWS system can be assessed, losses with the current technology (variable speed cooling water pumps and Ristroph screens) are also presented (Table 3-1). These estimates serve as input to the economic cost-benefit analysis.

The estimated potential annual lost harvest with the current intake technology at IPEC is 31,884 fish, of which 30,266 would be striped bass (Table 3-1). These fish represent approximately 100,000 kg of harvest. With a CWWS intake, the corresponding loss estimates would be 4,238 fish (3,942 striped bass), and 13,110 kg of harvest. Additional conservatism (tendency to overestimate the losses) could be added by adjusting these values for the small fraction of entrained and impinged fish that were not included in the RIS. The appropriate adjustment factor for non-RIS would be a multiplier of 1.05.

Table 3-1 Average annual potential fishery losses due to IPEC operation under current configuration and with 2-mm cylindrical wedgewire screens.

Alternative	Taxon	Annual Organism Losses (Millions of fish)			Annual Fishery Harvest Losses (number of fish)			Annual Fishery Harvest Losses (kg of fish)						
								Direct			Indirect			
		Entrain	Impinge	Total	Direct	Indirect	Total	Entrain	Impinge	Total	Entrain	Impinge	Total	Total
Current configuration (variable speed pumps, outages, and Ristroph Screens) (Case 1)	Bay anchovy	385.7	0.001	**385.7**	0	0	**0**	0	0	**0**	193	0	**193**	**0**
	American shad	0.6	0.000	**0.6**	8	0	**8**	12	3	**15**	12	1	**13**	**15**
	Spottail shiner	0.0	0.000	**0.0**	0	0	**0**	0	0	**0**	0	0	**0**	**0**
	Striped bass	190.2	0.005	**190.2**	27,255	3,000	**30,255**	88,821	1,526	**90,348**	8,882	153	**9,035**	**100,292**
	Atlantic tomcod	1.2	0.001	**1.2**	0	0	**0**	0	0	**0**	107	0	**107**	**0**
	White perch	17.7	0.054	**17.7**	817	0	**817**	83	32	**115**	239	65	**304**	**115**
	Alosa sp	50.2	0.009	**50.2**	804	0	**804**	125	14	**139**	279	13	**292**	**139**
	Total	**645.6**	**0.070**	**645.7**	**28,884**	**3,000**	**31,884**	**89,042**	**1,575**	**90,617**	**9,712**	**232**	**9,944**	**100,561**
Cylindrical Wedgewire Screens (Case 4)	Bay anchovy	126.5	0.000	**126.5**	0	0	**0**	0	0	**0**	10	0	**10**	**0**
	American shad	0.0	0.000	**0.0**	0	0	**0**	0	0	**0**	0	0	**0**	**0**
	Spottail shiner	0.0	0.000	**0.0**	0	0	**0**	0	0	**0**	0	0	**0**	**0**
	Striped bass	86.3	0.000	**86.3**	3,550	392	**3,942**	11,709	59	**11,768**	1,171	6	**1,177**	**13,066**
	Atlantic tomcod	0.0	0.000	**0.0**	0	0	**0**	0	0	**0**	1	0	**1**	**0**
	White perch	11.6	0.002	**11.6**	221	0	**221**	30	1	**31**	80	2	**83**	**31**
	Alosa sp	12.2	0.000	**12.2**	75	0	**75**	13	0	**13**	27	0	**28**	**13**
	Total	**236.8**	**0.003**	**236.8**	**3,846**	**392**	**4,238**	**11,751**	**61**	**11,812**	**1,289**	**9**	**1,298**	**13,110**

4 DISCUSSION

The updated estimates of lost yield and production forgone incorporate additional information on the effectiveness of CWW from experimental studies, and information on the expected performance of a CWW system as it would be installed in the Hudson River at IPEC. The loss estimates incorporate several significant conservative assumptions that will tend to overestimate the true losses, i.e. will overestimate the benefits of installing alternative technology. These conservative measures are:

1. The assumption that fish saved by installing alternative technology would produce larger populations of fish in the estuary. Analysis of more than 30 years of monitoring data provides no basis for the validity of this assumption.
2. Species which currently have restrictions on the fishery will be harvested at the rates modeled. Harvest of American shad and river herrings is currently prohibited or greatly restricted. All fish from the Hudson are currently covered by a consumption advisory.
3. All indirect fishery benefits (derived from assumed increases in production forgone) would be converted to striped bass, the species with highest monetary value.

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STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC For a State Pollutant Discharge Elimination System Permit Renewal and Modification	DEC No.: 3-5522-00011/00004 SPDES No.: NY-0004472
In the Matter of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations Inc.'s Joint Application for CWA § 401 Water Quality Certification	DEC App. Nos. 3-5522-00011/00030 (IP2) 3-5522-00105/00031 (IP3)

PREFILED TESTIMONY OF MARC J. LAWLOR IN SUPPORT OF ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC AND ENTERGY NUCLEAR OPERATIONS, INC.

CLOSED CYCLE COOLING AND STATE ENVIRONMENTAL QUALITY REVIEW ACT

ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC, AND ENTERGY NUCLEAR OPERATIONS, INC.

By its attorneys,

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February 28, 2014

TABLE OF CONTENTS

I. INTRODUCTION

Q: Please state your name, current position, and business address.

A: My name is Marc Lawlor. I am a Senior Project Manager at TRC Environmental Corporation ("TRC"). My office is located at 1200 Wall Street West - 5th Floor, Lyndhurst, NJ 07071 and the headquarters of TRC is located at 21 Griffin Road North, Windsor, CT 06095.

Q: Are you offering this testimony on behalf of Entergy in support of its application for SPDES Permit Renewal (DEC No.: 3-5522-00011/00004, SPDES No.: NY-0004472) and a Water Quality Certification (DEC App. Nos. 3-5522-00011/00030 (IP2) and 3-5522-00105/00031 (IP3)) for Indian Point Units 2 and 3 (the "Proceedings")?

A: Yes.

Q: Please state the purpose of your testimony.

A: I understand that New York State Department of Environmental Conservation ("NYSDEC") Staff and Riverkeeper each have proposed the installation and operation of closed-cycle cooling ("CCC") as the best technology available ("BTA") to minimize adverse environmental impacts consistent with the requirements of 6 NYCRR § 704.5 and 33 U.S.C. § 1326(b). I also understand that the Administrative Law Judges ("ALJs") for the Proceedings have determined that one aspect of determining the availability of a technology is whether that technology is reasonably likely to obtain the necessary permits or other authorizations for construction and operation. In addition, I understand that CCC proposals are subject to review under New York's State Environmental Quality Review Act ("Act"). Accordingly, the purposes of my testimony are to

(1) provide my opinion as to whether the Tetra Tech Report (defined below) provides sufficient analyses of the potential significant adverse impacts to the environment to satisfy the requirements of SEQRA; and (2) provide my opinion as to whether the Tetra Tech Report contains sufficient analyses of feasibility and permitting success.

In, particular, this testimony describes the report prepared by TRC entitled *New York State Environmental Quality Review Act: Entergy Response to the Tetra Tech Report and the Powers Engineering Report* (Entergy Exs. 296, 296A, 296B, 296C, 296D, 296E, 296F, 296G, 296H, and 296I) ("TRC Response Document"), which I am incorporating herein and adopt as part of my testimony. The TRC Response Document serves two functions. First, it evaluates the engineering feasibility and likely permitting success of the CCC configurations proposed by Tetra Tech on behalf of NYSDEC Staff (the "Proposal"), as presented in the *Indian Point Closed-Cycle System Retrofit Evaluation* (Tetra Tech June 2013) (the "Tetra Tech Report").[1] Second, it assesses the potential significant adverse environmental impacts of the construction and operation of the Proposal. This testimony and the TRC Response Document are intended to assist this Tribunal in making findings necessary or appropriate pursuant to 6 NYCRR § 704.5 and the State Environmental Quality Review Act ("SEQRA"), as prescribed

[1] The TRC Response Document also assesses CCC proposals submitting by Powers Engineering on behalf of Riverkeeper, Inc., as presented in the Revised Closed Cycle Cooling Feasibility Assessment for Indian Point Energy Center Unit 2 and Unit 3 for Best Technology Available Report (Powers Engineering October 24, 2012), and subsequently limited by the November 22, 2013 letter from Mark Lucas to ALJs Villa and O'Connell (the "Powers Report"). I understand that Riverkeeper has recently withdrawn the Powers Report and, in an email from Riverkeeper counsel dated February 24 at 8:45 pm, declined to specify what CCC proposals it actually will be advancing. My testimony is therefore limited to addressing the Tetra Tech proposal. If Riverkeeper in fact advances some other CCC proposal, then to the extent necessary I will address such proposal in rebuttal.

in the August 8, 2010 Interim Decision and what I understand are applicable orders of this Tribunal.

Q: Have you testified in these proceedings previously?

A: Yes. I submitted prefiled direct and rebuttal testimony in these proceedings on May 31, 2013 and June 28, 2013, respectively. I also testified in person in these proceedings in hearings held on July 15 and 16, 2013.

II. QUALIFICATIONS

Q: Please describe your academic background as well as any specializations and work experience relevant to your testimony.

A: I previously described my academic background, relevant specializations and work experience in prefiled direct testimony that I submitted in these proceedings during administrative hearings in Albany, New York on July 15, 2013. Hearing Tr. 5476:7-5479:18. I refer to and incorporate that testimony by reference in this prefiled testimony. Briefly, I have over 30 years of multidisciplinary environmental consulting experience, including environmental impact assessment under New York's SEQRA (including analysis of consistency with the federal and New York State CZMA-based programs) and the National Environmental Policy Act ("NEPA"). Throughout my career, I have overseen and participated in the development of over 100 environmental impact statements ("EISs") and Environmental Assessments ("EAs") pursuant to SEQRA and NEPA.

While the Proposal is of a large magnitude, with the potential to cause large impacts to a broad range of environmental resource categories, and therefore is atypical compared to smaller-scale projects, TRC has experience performing comparable analyses of large projects.

Q: Please describe the team of professionals that prepared the TRC Response Document.

A: I served as project manager in preparing the TRC Response Document, overseeing outside consultants and an interdisciplinary group of TRC professionals (collectively the "TRC CCC Team") who worked on different portions of the TRC Response Document corresponding to their areas of expertise.

Entergy also has retained a team of additional outside experts, made available to TRC. Outside experts consulted by the TRC Team are as follows:

- ENERCON was consulted to evaluate the engineering feasibility of the Proposal. Prior to finalizing the TRC Response Document, ENERCON reviewed and approved the discussion of engineering feasibility. Burns and Roe Enterprises, Inc. ("BREI") also was consulted by ENERCON to evaluate engineering feasibility of the Proposal. I understand that Mr. Beaver will be providing testimony regarding engineering feasibility.
- Saratoga Associates was consulted to evaluate aesthetic impacts of the Proposal. TRC consulted with Saratoga Associates to develop analysis specific to the Proposal and to draft the evaluation of aesthetic impacts contained in the TRC Response Document. Prior to finalizing the TRC Response Document, Saratoga Associates reviewed and approved the discussion of aesthetic impacts. I understand that Matt Allen will be providing testimony regarding Saratoga Associates' review of aesthetic impacts.

- NERA Economic Consulting ("NERA") was consulted to assess potential adverse impacts implicating the electricity system. NERA also assessed the costs and benefits of the Proposal and Entergy's proposed cylindrical wedgewire screen ("CWWS") installation for purposes of SEQRA (and separately considered economic issues with respect to the "wholly disproportionate test" applicable under section 704.5). Prior to finalizing the TRC Response Document, NERA reviewed and approved the discussion of electrical system impacts and the benefit-cost analysis. I understand that Drs. Lawrence Barnthouse, John Young, and Mark Mattson were consulted on the efficacy of the Proposal for purposes of NERA's evaluation. Drs. David Harrison and John Young will be providing testimony regarding NERA's review of electrical system impacts and the benefit-cost analysis.
- Young/Sommer, LLC was consulted to assess the implications of municipal and county permitting for the Proposal. Prior to finalizing the TRC Response Document, Young/Sommer, LLC reviewed and approved the discussion of municipal and county permitting and I understand that Kevin M. Young will be providing testimony regarding the same.
- CDM Smith was consulted to provide information on the potential impacts of water-borne pathogens subject to air dispersion, including *Legionella pneumophila*.
- Puckorius and Associates, Inc. was consulted to assess potential adverse impacts to water quality and the adequacy of water treatment protocols

contained in the Proposal. Prior to finalizing the TRC Response Document, Dr. Paul Puckorius reviewed and approved the discussion of water quality and water treatment. I understand that Dr. Puckorius will be providing testimony regarding water quality and water treatment.

In addition, the TRC CCC Team members responsible for the different subject areas, and their qualifications, are as follows:

- **Paul Martin** – Aquatic ecology. Paul Martin earned a B.S. degree in Biology from Carleton College, and an M.S. degree in Zoology from the University of New Hampshire. Mr. Martin is an ecologist with over 25 years of experience in environmental studies and impact assessments, biological studies and surveys, aquatic resource and watershed studies, and environmental permitting. Mr. Martin is a member of the New England Estuarine Research Society, the American Fisheries Society, and the Society of Wetland Scientists. Mr. Martin has worked on environmental impact assessment for the Meriden Power Plant in Meriden, CT and over 28 environmental assessments for hydroelectric facilities in 14 states. In addition, he has worked on environmental assessment and projects related to energy transmission, water and sewage facilities, and a variety of other construction projects. Mr. Martin has published numerous articles on environmental analysis and fisheries, and currently served as TRC's Director of Permitting for the Eastern United States, in which capacity he managed over 80 staff members in multiple offices.
- **Theodore Main** – Air quality. Mr. Main's qualifications are separately

presented in his accompanying prefiled direct testimony in this Proceeding.

- **Anthony Agresti** – Noise. Anthony Agresti earned a B.A. degree in Meteorology from Kean College of New Jersey. Mr. Agresti has over 26 years of experience preparing noise analyses and impact assessment and designing and implementing noise monitoring programs for power generation facilities, compressor stations, and industrial facilities. He is a full member of the Institute of Noise Control Engineering and a licensed Noise Control Officer in the State of New Jersey. Mr. Agresti has worked on noise analyses and impact assessments for a variety of facilities, including the Bowline generation facility in Haverstraw, New York, and a variety of wind power and conventional electric generation and transmission facilities throughout the United States.
- **Colin Duncan** – Terrestrial ecology. Colin Duncan earned a B.S. degree in Plant and Soil Science from the University of Massachusetts – Amherst and a M.S. degree in Natural Resources Science from the University of Rhode Island. Mr. Duncan has over 26 years of experience in wetland and hydric soil mapping, wetland and wildlife habitat mitigation design, and project management. Mr. Duncan holds certifications as a Professional Soil Scientist and a Professional Wetland Scientist. He has worked on wildlife habitat assessment for a variety of electric power generation and transmission facilities, including the Athens generating station on the Hudson River. Mr. Duncan also has worked on wildlife habitat

assessment for a variety of development projects. He is a member of several wetlands and soil conservation professional organizations, and has published articles discussing wildlife studies and development.

- **Brian Dempsey** – Transportation. Brian Dempsey earned a Bachelor's degree in Civil Engineering from Villanova University and an M.B.A. from Fordham University. Mr. Dempsey has 26 years of experience in traffic engineering and analysis. He is a licensed professional engineer and professional traffic operations engineer. Mr. Dempsey has worked on a variety of traffic study projects for electric generation facilities, including the Bowline generation facility in Haverstraw, NY, prior traffic studies at IPEC, and studies at a variety of facilities throughout New York. He has also conducted traffic analysis for several municipalities in New York, and is a fellow of the Institute of Transportation Engineers.
- **Adam Slayton**– Navigation. Adam Slayton earned a Bachelor's degree in Physics from the University of Maine. Mr. Slayton has twelve (12) years of experience in environmental consulting providing data analysis, research, computer modeling, and GIS analysis for a variety of clients in the fields of electric generation and transmission.
- **Timothy Sara** – Historical and Archaeological Resources. Timothy Sara earned a B.A. degree in Anthropology and Geography from SUNY Binghamton and a M.A. in Anthropology from Hunter College of the City University of New York. Mr. Sara has over 28 years of experience in cultural resources management and historic preservation planning. He is a

Registered Professional Archaeologist. Mr. Sara has experience with the National Historic Preservation Act and cultural resource preservation, and has worked on archaeological studies of a variety of energy and industrial sites. He is a member of the Society for American Archaeology, the International Association of Caribbean Archaeologists, and the New York Archaeological Council.

- **Marc Lawlor** – Environmental Justice.

III. TRC RESPONSE DOCUMENT

A. Overview

Q: What standards were applied to the preparation of the TRC Response Document?

A: Entergy is not advancing cooling towers as BTA. The TRC Response Document is therefore limited to establishing whether the Tetra Tech Report has evaluated the potential significant adverse environmental impacts of constructing and operating the Proposal pursuant to SEQRA. In conducting this evaluation, the TRC CCC Team relied on SEQRA statute and regulations, the SEQR Handbook, Interim Decision, and their professional experience in preparing EISs and EAs for reviews under SEQRA and NEPA. SEQRA requires a reasonable identification of potential significant adverse environmental impacts, and mitigation of significant adverse impacts identified.

To make a determination of significance under SEQRA one must identify all relevant environmental impacts, provide a thorough analysis of the potential impacts, and include a written explanation of the reasoning in concluding that a proposed action may cause, or will not cause, significant adverse environmental

impacts under SEQRA (6 NYCRR § 617.7). Under NYSDEC's SEQR Handbook, the magnitude (*e.g.*, severity, size, extent, etc.) and importance (*e.g.*, geographic scope, number of people impacted, duration and probability of occurrence, etc.) of each potential impact must be evaluated to determine the significance of an impact. Without this analysis, the indicators for determining significance under SEQRA, as set forth in 6 NYCRR § 617.7, cannot be evaluated.

Q: Does the TRC Response Document contain analyses beyond those required under SEQRA?

A: Yes. The TRC Response Document also summarizes the engineering feasibility and likely permitting success of the Proposal pursuant to 6 NYCRR § 704.5 based on the analysis of the qualified TRC CCC Team and additional outside experts named above.

Q: Please describe the organization and different sections of the TRC Response Document.

A: The TRC Response Document is organized into four sections. The first chapter is an introduction—it provides the framework for the Report, the relevant permitting history for Entergy's Indian Point Energy Center ("IPEC"), and an explanation of how the Report relates to TRC's 2013 Report entitled *Environmental Report New York State Environmental Quality Review Act in Support of the Draft SEIS for a State Pollutant Discharge Elimination System (SPDES) Permit (No. NY-0004472) Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC* (Entergy Exs. 184, 184A, 184B) (the "TRC Report"), and NERA's 2013 report

entitled *Wholly Disproportionate Assessments of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (Entergy Ex. 297).

Chapter 2 provides a summary of ENERCON's assessment of the engineering feasibility of the Proposal.

Chapter 3 provides an assessment of the potential adverse environmental impacts of construction and operation of the Proposal. It includes an assessment of potential impacts to the following resource categories: electricity, water treatment/water quality, air quality and related health effects, noise, visual resources, land use, zoning and local approvals, terrestrial ecology, archaeological and historic resources, transportation and navigation, environmental justice and aquatic ecology. Consistent with the TRC Report, the TRC Response Document assesses and characterizes potential adverse impacts via a set of impact categories: NONE (NO IMPACT), SMALL, MODERATE, LARGE, and BENEFICIAL. Each of these impact categories is explained more fully on pp. 10-11 of my May 31, 2013 prefiled direct testimony in this proceeding. In evaluating potential adverse impacts, the TRC Response Document also summarizes additional feasibility and permitting issues identified for the Proposal.

Chapter 4 summarizes and presents conclusions on the engineering feasibility, permitting, and potential significant adverse environmental impacts of the Proposal.

B. SEQRA Analysis

Q: Was your review of the Proposal limited in any material way?

A: Yes. As explained in the TRC Response Document, the Tetra Tech Report contains substantial omissions and information gaps related to SEQRA, making it

inadequate for purposes of making a determination of significance under SEQRA. Specifically, the Tetra Tech Report fails to include analyses of environmental impacts to numerous resource categories. The Tetra Tech Report fail to provide *any* SEQRA analysis of potential environmental impacts to the following resource categories:

- Electricity
- Cooling Water Treatment/Water Quality
- Air Quality
- Noise
- Terrestrial Ecology
- Navigation
- Aquatic Ecology
- Environmental Justice
- Archaeological and Historic Resources.

Q: Despite these substantial omissions and information gaps was the TRC CCC Team able to identify potential environmental impacts of the Proposal in accordance with SEQRA?

A: Yes. As described above, the TRC Response Document identified potential adverse environmental impacts of constructing and operating the Proposal for eleven resource categories pursuant to SEQRA. Because the Proposal lacks sufficient detail to conduct the appropriate SEQRA analyses, the TRC Response Document undertook its own analyses and/or noted the lack of information necessary to conduct the requisite SEQRA analysis.

Q: Did the TRC Response Document identify adverse impacts from construction and operation of the Proposal?

Yes. The TRC Response Document identified adverse impacts from construction and operation of the Proposal, some of which are or could potentially be significantly adverse. Table 1.1 of TRC Response Document provides a summary the major conclusions, which are presented in more detail below.

Table 1-1
Tetra Tech Report Adequacy of Data Provided and SEQRA Impact Assessment (NYSDEC Staff Proposal)

	Is Report Analysis Adequate	Does Existing Data Indicate Potential for Significant Adverse Impact	Characterization of Impact per this Response	Can Proposal Proceed with Current Level of Information and Characterization of Impact
Electricity	NO	YES (Construction – extended outages)	Construction: MODERATE - LARGE	NO
Cooling Tower Water Treatment/Water Quality	NO	YES (Operation - Water Treatment affecting Air Quality)	LARGE	NO
Air Quality	NO	YES (Operation)	LARGE	NO
Noise	NO	YES (Construction and Operation)	Construction: MODERATE - LARGE Operation - LARGE	NO
Visual Resources	NO	YES (Construction and Operation)	LARGE	NO
Terrestrial Ecology	NO	YES (Operation)	MODERATE - LARGE	NO
Transportation and Navigation	NO	YES (Construction [1] – Transportation)	MODERATE - LARGE	NO
Environmental Justice	NO	YES (Operation) [2]	LARGE	NO

[1] With use of heavy duty trucks to transport the bulk of the blast spoils.
[2] With the characterization of potential LARGE Air Quality impacts.

Q: Please summarize the TRC Response Document's conclusions on potential significant adverse environmental impacts of constructing the Proposal.

A: The SEQRA analysis presented in the TRC Response Document concluded that construction of the Proposal would result in the following adverse impacts:

- Electricity—MODERATE TO LARGE
- Water Quality—insufficient information to draw definite conclusion, but the potential for adverse impacts exists
- Noise—MODERATE TO LARGE
- Visual Resources—LARGE
- Terrestrial Ecology—SMALL TO MODERATE
- Archaeological and Historic Resources— insufficient information to draw definite conclusion, but the potential for adverse impacts exists
- Transportation—SMALL TO MODERATE or MODERATE TO LARGE (depending on the mix of barge and/or truck use)
- Navigation—SMALL TO MODERATE
- Environmental Justice—insufficient information to draw definite conclusion, but the potential for adverse impacts exists
- Aquatic Ecology—NONE TO SMALL

Q: Please summarize the TRC Response Document's conclusions on potential significant adverse environmental impacts of operating the Proposal.

A: The SEQRA analysis presented in the TRC Response Document concluded that operation of the Proposal would result in the following adverse impacts:

- Electricity—SMALL

- Cooling Water Treatment/Water Quality— insufficient information to draw definite conclusion, but the potential for adverse impacts exists
- Air Quality—LARGE
- Noise—LARGE
- Visual Resources—LARGE
- Terrestrial Ecology—MODERATE TO LARGE
- Archaeological and Historic Resources—NO IMPACT
- Transportation—NONE TO SMALL
- Navigation—insufficient information to draw a conclusion
- Environmental Justice—LARGE
- Aquatic Ecology—NONE TO SMALL

1. Electricity

Q: Please describe the potential adverse impacts to electricity as a result of constructing the Proposal.

A: Briefly, the TRC Response Document (*see* Section 3.2) concluded that construction of the Proposal would cause MODERATE to LARGE potential adverse impacts based on the need to replace power losses during construction outages. It is my understanding that Dr. Harrison's testimony provides further detail on the potential adverse impacts as a result of constructing the Proposal.

2. Water Quality

Q: Please describe the potential adverse impacts to water quality as a result of constructing the Proposal.

A: As set forth in the TRC Response Document (*see* Section 3.3.2), the Proposal lacks sufficient information to make a conclusion on the adverse impacts to water quality resulting from construction; however, the potential for adverse impacts exists depending on whether appropriate stormwater management and dewatering practices are used during construction. Since the Proposal provides no information on these practices, no conclusion can be reached.

Q: Please describe the potential adverse impacts to water quality and cooling tower treatment as a result of operating the Proposal.

A: As set forth in the TRC Response Document (*see* Section 3.3.4), the Proposal lacks sufficient information to make a conclusion on the adverse impacts to water quality resulting from operation; however, the potential for adverse impacts exists depending on whether blowdown water is appropriately managed prior to discharge, and whether post-construction stormwater is appropriately managed and treated. Since the Proposal provides no information on these practices, no conclusion can be reached on the potential adverse impacts to water quality.

Further, as set forth in Section 3.3.5 of the TRC Response Document, the Proposal fails to provide any analysis of the potential for Legionnaires' Disease as a result of operating the cooling towers. Legionnaires' Disease is a potentially lethal form of pneumonia caused by inhaling aerosols that contain the pathogen *Legionella pneumophila*. Legionnaires outbreaks are known to be caused by the operation of inadequately disinfected wet cooling towers. Yet, the Proposal provides no information on appropriate cooling tower water treatment or the risk of Legionnaires outbreaks. Accordingly, a definitive conclusion on the potential

adverse impacts associated with cooling tower water treatment cannot be reached. (*See* TRC Response Document Section 3.3.5 and Appendix F)

3. Air Quality

Q: Please describe the potential adverse impacts to air quality as a result of operating the Proposal.

A: While PM_{10} and $PM_{2.5}$ are known to be emitted by cooling towers, the Proposal fails to provide any analysis of the health effects and/or environmental impacts of these emissions, as required by NYSDEC Policy CP-33, Assessing and Mitigating Impacts of Fine Particulate Matter Emissions (Entergy Ex. 306). Without this analysis, conclusions on the adverse impacts to air quality as a result of operating the Proposal cannot be made conclusively, but are potentially LARGE. (*See* TRC Response Document Section 3.4).

4. Noise

Q: Please describe the potential adverse noise impacts as a result of constructing the Proposal.

A: Large construction projects can result in potential significant noise impacts and the quantification of those impacts is routine for projects being evaluated under SEQRA. The Tetra Tech Report acknowledges that blasting, excavation, trucking and use of heavy equipment will occur during the extensive construction period for the Proposal, but provides no analysis of the potential impacts to noise from these activities. Considering these known construction activities, construction of the Proposal has the potential for MODERATE to LARGE impacts, but a detailed noise analysis remains necessary. (*See* TRC Response Document Section 3.5.2).

Q: Please describe the potential adverse impacts to noise as a result of operating the Proposal.

A: While the Tetra Tech Report failed to provide noise emissions level data, it did provide unexplained, non-verified estimates of the operational noise generated by the Proposal. Assuming these estimates to be true, TRC took information on the physical properties of the proposed towers, and topographic data to model the expected noise levels from the Proposal using the commercially-available CadnaA model. The results of this modeling demonstrate that the Proposal will increase noise levels above NYSDEC's impact criteria (6 dBA, as set forth in NYSDEC Policy DEP-001, Assessing and Mitigating Noise Impacts, Entergy Ex. 308) at many locations in the surrounding areas. The results also show that noise levels would exceed noise standards established by the applicable Village of Buchanan Code. Accordingly, the potential adverse noise impacts from operation of the Proposal are LARGE. (*See* TRC Response Document Section 3.5.3 to 3.5.5).

5. Visual Resources

Q: Please describe the potential adverse impacts to visual resources as a result of constructing and operating the Proposal.

A: As set forth in the TRC Response Document (*see* Section 3.6), impacts to visual resources due to construction of the Proposal are expected to be LARGE based on the typical construction impacts from a project of this scope and magnitude. The Proposal's operational impacts to visual resources are likewise expected to be LARGE because of their unprecedented scale and scope in the Hudson Valley and

the unusually large number of visual resources of statewide and national significant that would be impacted. Impacts to visual resources as a result of constructing and operating the Proposal are addressed more fully in the accompanying prefiled testimony of Matthew Allen of Saratoga Associates.

6. Terrestrial Ecology

Q: Please describe the potential adverse impacts to terrestrial ecology as a result of constructing the Proposal.

A: Construction of the Proposal will permanently disturb and alter approximately 16 acres of previously undisturbed forested lands and wildlife habitat, which represents an estimated 23% of a 70-acre block of contiguous mixed forest. Yet the Tetra Tech Report provides no evaluation of construction impacts to this area. Potential adverse impacts to terrestrial ecology from construction of the Proposal will be SMALL to MODERATE based on the disturbance of the 16 acres of forested land, fragmentation of the forested habitat block from a portion of the shoreline riparian habitat, and extended (three to four years) noise impacts to wildlife in the forested block as a result of blasting and construction. (*See* TRC Response Document Section 3.8.2).

Q: Please describe the potential adverse impacts to terrestrial ecology as a result of operating the Proposal.

A: The Tetra Tech Report does not contain an analysis of the potential adverse impacts to terrestrial ecology from operation of the Proposal. Based on TRC's noise modeling, the Proposal will result in long-term operational noise levels of 65 to 80 dBA (which are typical of a noisy urban environment) within the 70-acre

forested block of land. Further, there is the potential for listed (threatened/endangered) species to occur within the 70-acre area, including within the estimated 16 acres that will be permanently disturbed by operation of the Proposal. Accordingly, TRC expects impacts to terrestrial ecology to be MODERATE assuming no listed species are present in the area, and MODERATE to LARGE if listed species are present. Impacts cannot be conclusively determined without an ecological survey to establish the presence or absence of listed species, which was not performed in the Tetra Tech Report (*See* TRC Response Document Section 3.8.3).

7. Archaeological Resources

Q: Please describe the potential adverse impacts to archaeological resources as a result of constructing the Proposal.

A: There are two known archaeological sites on the IPEC site. Yet, the Tetra Tech Report does not identify the presence of these two archaeological sites, nor does it evaluate the potential impact of constructing the Proposal within and/or near these known sites. The New York State Historic Preservation Office has recommended that Phase II studies of the two sites be conducted to evaluate the sites for potential listing on the State Register and the National Register of Historic Places ("NRHP"). Should the Phase II studies determine that the sites are eligible for inclusion on the NRHP, then impacts to these resources will have to be avoided or mitigated. Accordingly, while the Proposal lacks sufficient information to make the necessary evaluation pursuant to SEQRA, the potential for adverse impacts to archaeological resources clearly exists and requires evaluation. (*See* TRC

Response Document Section 3.9).

8. Transportation and Navigation

Q: Please describe the potential adverse impacts to transportation and navigation as a result of constructing the Proposal.

A: The Proposal will require approximately 110,000 truck trips over a three to four year period (approximately 235/day) to remove the blasting spoils; alternatively, 9,000 truck trips over three to four years if barges are utilized to remove portions of the spoils. In addition, the Proposal requires approximately 600 construction workers on a daily basis, and regular deliveries of materials, though no estimate of the number of deliveries is provided. The Tetra Tech Report acknowledges that off-site road improvements and on-site parking will be needed to accommodate the increased construction traffic. Despite these acknowledged circumstances, the Tetra Tech Report fails to evaluate the potential adverse impacts to local roadways and intersections, and also fails to determine whether the necessary off-site road improvements and on-site parking improvements are feasible or sufficient. The Tetra Tech Report also fails to account for the required helicopter pad landing area, per NRC requirements; currently the pad is located in the parking area in front of the General Support Building, but this area has been designated as a construction staging area in the Proposal.

Accordingly, the potential transportation impacts due to construction of the Proposal are SMALL to LARGE, depending on whether barges can be utilized for the removal of blasting spoils. The potential impact to navigation due to construction of the Proposal are SMALL to MODERATE depending on

whether a disposal site for the blasting spoils is located such that barges do not remain on the Hudson River for extended, indefinite periods of time. (*See* TRC Response Document Section 3.10).

9. Environmental Justice

Q: Please describe the potential adverse impacts to environmental justice as a result of operating the Proposal.

A: The Tetra Tech Report does not evaluate impacts to environmental justice as required by NYSDEC Policy CP-29 (Entergy Ex. 307). Residences within an environmental justice community are located just to the north of IPEC, approximately 0.75 miles from the northern array of the Proposal. Cooling towers are known to emit PM_{10} and $PM_{2.5}$, which can affect breathing and the respiratory system, cause damage to lung tissue, cancer, and premature death. In addition, the cooling towers have the potential to emit water borne pathogens, such as *Legionella*, which present human health risks. Moreover, there is a demonstrated potential for violation of particulate matter (PM) standards with operation of the Proposal. Considering the proximity of an environmental justice community to the location of the Proposal, the potential for adverse (and disproportionate) impacts is LARGE. (*See* TRC Response Document Section 3.11).

C. SEQRA Conclusions

Q: Based on TRC's Analyses does the Tetra Tech Report and its Proposal meet SEQRA mandates?

A: No. The TRC Response Document identified significant deficiencies and omissions in the Tetra Tech Report's identification of potential significant adverse impacts. Further, the TRC Response Document identified MODERATE to

LARGE impacts across numerous resource categories due to the Proposal. Mitigation of these impacts has not been identified or analyzed by Tetra Tech or NYSDEC Staff. Accordingly, the Tetra Tech Report does not meet the SEQRA mandate to identify all potential significant adverse impacts, and provide for mitigation of significant adverse impacts identified.

D. Feasibility And Permitting Conclusions

Q: In evaluating potential adverse impacts, what feasibility and permitting issues did the TRC CCC Team identify?

A: The TRC Response Document identifies the following feasibility and permitting issues related to the Proposal: engineering, stormwater management, groundwater contamination management, cooling water treatment and management, air emissions, noise emissions, visual resource impacts, land use approvals, and archaeological resources.

1. Engineering

Q: Please summarize the engineering feasibility conclusions of the TRC Response Document.

A: Briefly, the TRC Response Document concludes that the Proposal lacks sufficient detail to establish its site-specific engineering feasibility at IPEC, and that upon further evaluation these technologies are not feasible at IPEC. Sam Beaver of ENERCON will be presenting more fulsome testimony on the substance of Chapter 2 (engineering feasibility) and the supporting Appendix A of the TRC Response Document, as well as the Report's conclusions on engineering feasibility.

2. Stormwater Management

Q: Please summarize the potential stormwater management feasibility issues created by the Proposal.

A: As set forth in the TRC Response Document (*see* Section 3.3.2), the Tetra Tech Report fails to provide a stormwater management plan for construction of the Proposal. While it does provide that post-construction stormwater will be managed through the use of a perimeter ditch that intercepts stormwater runoff and conveys it to a concrete-lined channel to the Hudson River, it fails to consider any proposed treatment for the water quality volume as required by New York State Stormwater Management Design Manual (August 2010) (Entergy Ex. 309). Without the requisite analysis for construction and post-construction stormwater management, the Tetra Tech Report fails to establish that stormwater can be managed appropriately within the proposed construction schedule, and without affecting the estimated costs or configuration of the Proposal.

3. Groundwater Contamination Management

Q: Please summarize the potential groundwater contamination management feasibility issues created by the Proposal.

A: The Tetra Tech Report acknowledges that piping for its proposed Unit 2 cooling tower will pass through an area where radiological contamination is present and being monitored, and that without an acceptable method for its management the feasibility of installing the Unit 2 cooling tower cannot be established. (*See* TRC Response Document Section 3.3.2). No method, however, is proposed by Tetra Tech or NYSDEC Staff.

4. Cooling Water Treatment Management

Q: Please summarize the potential cooling water treatment management feasibility issues created by the Proposal.

A: As set forth in the TRC Response Document (*see* Section 3.3.3), the Tetra Tech Report fails to evaluate the need for treatment of cooling water given Hudson River water chemistry and biological properties. Dr. Paul Puckorius evaluated the need for cooling water treatment and impacts of such treatment on the feasibility of the Proposal. He is submitting separate testimony on the same, which establishes that cooling water treatment is necessary for the Proposal and will significantly impact its feasibility at IPEC.

Dr. Puckorius' analysis also establishes that blowdown water from the Proposal will include amounts of chlorine in excess of the current Draft SPDES permit limits, and increased concentrations of total suspended solids ("TSS"). As a result, a dechlorination system will be needed prior to discharge and other water quality treatment may be necessary as well. (*See* TRC Response Document Section 3.3.4). The Tetra Tech Report does not account for these treatments, which may affect the Proposal's configuration, costs and construction timeline.

5. Air Emissions

Q: Please summarize the potential air emissions feasibility issues created by the Proposal.

A: Briefly, the Tetra Tech Report does not evaluate the PM emissions from operation of the Proposal or establish that the requisite approvals are obtainable. Theodore Main of TRC will be submitting separate testimony on this subject; his analysis establishes that the Proposal is unlikely to obtain the necessary federal and New

York permit approvals, and therefore, may be required to operate on an intermittent or limited basis for extended periods of time during the year. (*See* TRC Response Document Section 3.4).

6. Visual Resources

Q: Please summarize the potential visual resource feasibility issues created by the Proposal.

A: Briefly, Matt Allen of Saratoga Associates will be submitting separate testimony on this subject. His testimony will demonstrate that the Proposal is of unprecedented physical scale in the Hudson River Valley and has the potential to form visible plumes, the frequency of which has not been conclusively established. Accordingly, the Tetra Tech Report fails to establish that the Proposal is consistent with New York State's coastal policies and the New York State Coastal Zone Management Plan ("CMP") policies #24 and #25. (*See* TRC Response Document Section 3.6).

7. Noise Emissions

Q: Please summarize the potential noise emissions feasibility issues created by the Proposal.

A: Quantitative noise modeling of the Proposal by TRC (based on noise emission level data presented in the Tetra Tech Report) establishes that its operation will exceed the Village of Buchanan's performance standards for maximum allowable noise levels associated with non-residential uses, and increase noise levels above the NYSDEC noise impact criterion. Accordingly, the Proposal contravenes applicable law.

8. Land Use

Q: Please summarize the potential land use feasibility issues created by the Proposal.

A: The TRC Response Document included an analysis of whether the Proposal will receive the requisite land use, zoning and other local approvals. Mr. Kevin Young will be submitting separate testimony setting forth the conclusions of that analysis. Briefly, that analysis demonstrates that the Proposal is not reasonably likely to obtain the necessary permits and authorizations under Village Law and County Law for its construction and operation at IPEC. (*See* TRC Response Document Section 3.7).

9. Archaeological Resources

Q: Please summarize the potential archaeological resource feasibility issues created by the Proposal.

A: As discussed above, a Phase II evaluation of the two archaeological sites located at the IPEC site is necessary in order to fully evaluate the potential adverse impacts to archaeological resources from construction of the Proposal. If the Phase II evaluation results in a determination that the archaeological sites are eligible for listing on the NRHP then the Proposal may have to be altered to avoid impacts to the sites, or mitigation will be required. The entire Phase II and III process could take approximately 18 months to complete. The Tetra Tech Report does not take into account this potentially considerable construction schedule delay for the Proposal. (*See* TRC Response Document Section 3.9).

END OF TESTIMONY

NEW YORK STATE ENVIRONMENTAL QUALITY REVIEW ACT

ENTERGY RESPONSE DOCUMENT

To the Tetra Tech Report and the Powers Engineering Report

In Support of the Draft SEIS for a

State Pollutant Discharge Elimination System (SPDES) Permit (No. NY-0004472)

Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC

December 13, 2013

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EXECUTIVE SUMMARY

Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC (collectively, "Entergy") respectively own nuclear-powered steam electric generation Stations 2 and 3 that comprise the Indian Point Energy Center (individually, "Unit 2" and "Unit 3"; collectively, "IPEC" or "the Stations") (Figure ES-1). This document responds to two (2) separate reports (hence, this document is entitled the *Entergy Response Document* (the "Response")), submitted by New York State Department of Environmental Conservation Staff ("NYSDEC Staff") and Riverkeeper.

The first report has been prepared on behalf of the NYSDEC Staff and evaluates, subject to considerable data availability and variability, ClearSky™ cooling towers in a single configuration as the sole possible closed-cycle cooling technology (the "Tetra Tech Configuration" and the "NYSDEC Staff Proposal") (Figure ES-2) at IPEC as presented in the *Indian Point Closed-Cycle System Retrofit Evaluation* ("Tetra Tech Report") (Tetra Tech June 2013).

The second report has been prepared on behalf of Riverkeeper and proposes approximately 20 possible configurations at IPEC of a variety of closed-cycle cooling technologies ("Riverkeeper Proposal"), as presented in the *Revised Closed Cycle Cooling Feasibility Assessment for Indian Point Energy Center Unit 2 and Unit 3 for Best Technology Available Report* (the "Powers Report") (Powers October 24, 2012).

This Response specifically addresses the NYSDEC Staff and Riverkeeper Proposals, as reflected in the Tetra Tech and Powers Reports, in a manner consistent with applicable law, in the following ways, by:

- Summarizing the findings of ENERCON Services Inc. ("ENERCON") and Burns and Roe Enterprises, Inc. ("BREI") with respect to the engineering feasibility assessment of constructing and operating the Tetra Tech and the Powers Proposals on a site-specific basis at IPEC within the State Pollutant Discharge Elimination System ("SPDES") permit and Water Quality Certification ("WQC") time periods. This is known as engineering feasibility.

- Summarizing the findings of the Biology Team (of AKRF, Inc. ("AKRF"), Normandeau Associates, Inc. ("Normandeau"), ASA Analysis & Communication, Inc. ("ASAAC") and LWB Environmental Services, Inc. ("LWB") with respect to the efficacy of these Proposals at IPEC. This is known as efficacy.

- Summarizing the findings of TRC Environmental Corporation ("TRC"), Saratoga Associates, National Economic Research Associates, Inc. ("NERA"), Laura C. Green, Ph.D., D.A.B.T., CDM Smith, and Puckorius & Associates, Inc. ("Puckorius") with respect to the potential significant adverse environmental impacts from constructing and operating these Proposals at IPEC, if feasible. This is known as State Environmental Quality Review ("SEQRA").

- Summarizing the findings of Young/Sommer LLC, TRC, and Saratoga Associates, P.C. with respect to the reasonable likelihood of acquiring necessary, applicable permits. This is known as Permitting.

Substantial omissions and information gaps relating to SEQRA and permitting exist in the Tetra Tech and Powers Reports. These omissions and their materiality are identified, and, where

reasonably practicable, this Response identifies existing information supporting the engineering feasibility, efficacy, permitting availability and SEQRA conclusions.

Nonetheless, as summarized below, the conclusions of this Response are as follows:

- Neither the NYSDEC Staff Proposal nor the Riverkeeper Proposals establish engineering feasibility at IPEC on a site-specific basis. To the contrary, various, significant feasibility and operability challenges exist, several of which are not likely to be resolved, and which, cumulatively, have a profound detrimental impact on the Station.

- Even assuming engineering feasibility is established, neither the NYSDEC Staff Proposal, nor the Riverkeeper Proposals establish reductions in impingement and entrainment during the license renewal period.

- Even assuming feasibility and credible impingement and entrainment reductions over the license renewal period are established, neither the NYSDEC Staff Proposal, nor the Riverkeeper Proposals address the potential significant adverse environmental impacts from constructing and operating these Proposals at IPEC in conformity with SEQRA. Given the scope, magnitude and duration of the Proposals, the level of impact assessment performed by Tetra Tech and Powers is at variance with what SEQRA requires and actually is customarily performed in TRC's experience. Further, a review of available information indicates numerous large and moderate impacts which stand in the way of a successful SEQRA determination.

- Even assuming best technology available ("BTA") and SEQRA mandates are met, neither the NYSDEC Staff Proposal, nor the Riverkeeper Proposals address the reasonable likelihood of acquiring the various permits and authorizations required for their Proposals to be implemented. To the contrary, available analyses and history for the IPEC Site establishes that needed permits will not be granted, and that litigation will result (the outcome of which cannot be predicted), with the result that successful permitting may not occur or may occur over a schedule that undermines any benefits of the Tetra Tech and Riverkeeper Proposals.

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LIST OF ACRONYMS

Acronym	Description
°F	degrees Fahrenheit
%	percent
§	Part
µg/m3	micrograms/cubic meter
ACHP	Advisory Council on Historic Preservation
Algonquin Pipeline	Algonquin Natural Gas Pipeline
AKRF	AKRF, Inc.
ALJs	Administrative Law Judges
ANSI	American National Standards Institute
APE	Area of Potential Effect
ASA	Applied Science Associates, Inc.
ASAAC	ASA Analysis & Communication, Inc.
BACT	Best Available Control Technology
BREI	Burns and Roe Enterprises, Inc.
BTA	best technology available
CAA	Clean Air Act
cfs	cubic feet per second
CMP	Coastal Zone Management Plan
CO_2	carbon dioxide
CP	NYSDEC Commissioner Policy
CP-29	Commissioner Policy 29: Environmental Justice and Permitting
CTI	Cooling Technology Institute
CWWSs	Cylindrical Wedgewire Screens
CZMA	Coastal Zone Management Act
dB	decibels
dBA	A-weighted decibel
DEIS	Draft EIS
DOE	Determination of Eligibility
DSEIS	Draft Supplemental Environmental Impact Statement
ECL	Environmental Conservation Law
EIS	Environmental Impact Statement

Acronym	Description
EJ	environmental justice
ENERCON	ENERCON Services, Inc.
Entergy	Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC
ER	Environmental Reports
FEIS	Final EIS
frc	free residual chlorine
GDEIS	Generic DEIS
GP	General Permit
gpm	gallons per minute
Hz	hertz
IPEC (the Stations)	Indian Point Energy Center (Unit 2 and Unit 3)
kV	kilovolt
kW-month	kilowatt per month
L_{10}	noise level exceeded 10% of the time
L_{90}	noise level exceeded 90% of the time
Leq	Equivalent Noise Level
LOLE	loss-of-load expectation
LOS	Levels of Service
LSEs	load-serving entities
LWB	LWB Environmental Services, Inc.
mg/l	milligrams per liter
mgd	Million gallons per day
MMBtu	Million British Thermal Units
MOA	Memorandum of Agreement
MWe	megawatt electrical
MWh	million megawatt hours
NAAQS	National Ambient Air Quality Standards
NERA	National Economic Research Associates, Inc.
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
Normandeau	Normandeau Associates, Inc.
NRC	Nuclear Regulatory Commission

Acronym	Description
NRCNA	National Research Council of the National Academies
NRHP	National Register of Historic Places
NYCA	New York Control Area
NYCRR	New York Codes, and Rules and Regulations
NYISO	New York Independent System Operator
NYPA	New York Power Authority
NYSDEC	New York State Department of Environmental Conservation
NYSDEC Staff	New York State Department of Environmental Conservation Staff
NYSDEC Staff Proposal	NYSDEC Staff's combined best technology available (BTA) and New York State Environmental Quality Review Act (SEQRA) submission
NYSDEC Visual Policy	NYSDEC Program Policy on Assessing and Mitigating Visual Impacts
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSHPO	New York State Historic Preservation Office
O&R	Orange & Rockland Utilities
OPRHP	Office of Parks, Recreation and Historic Preservation
ORP	oxidation reduction potential
PCTWCL	Preferred Cooling Tower Water Condition Limits
PM	particulate matter
PM-10	particles with an aerodynamic diameter less than 10 micrometers
PM-2.5	particles with an aerodynamic diameter less than 2.5 micrometers
Powers Report	Revised Closed Cycle Cooling Feasibility Assessment for Indian Point Energy Center Unit 2 and Unit 3 for Best Technology Available Report
ppm	parts per million
PSC	New York State Public Service Commission
PSU	practical salinity units
PTE	potential to emit
Puckorius	Puckorius & Associates, Inc.
RAPCE	Regional Air Pollution Control Engineer
RCP	Reliability Contingency Plan
Response	Entergy Response Document
RGGI	Regional Greenhouse Gas Initiative

Acronym	Description
river	Hudson River
Riverkeeper	Riverkeeper, Inc.
Riverkeeper Proposal	Revised Closed Cycle Cooling Feasibility Assessment for Indian Point Energy Center Unit 2 and Unit 3 for Best Technology Available Report
RNA	Reliability Needs Assessment
SASS	Scenic Area of Statewide Significance
SCFWHs	Hudson River Significant Coastal Fish and Wildlife Habitats
SCS	SEQRA Comparative Summary
SEIS	Supplemental EIS
SEQRA	State Environmental Quality Review Act
SIL	Significant Impact Levels
SIP	State Implementation Plan
SLC	St. Lawrence Cement
SPDES	State Pollutant Discharge Elimination System
SPLs	sound pressure levels
SPX	SPX Cooling Technologies
SWPPP	Stormwater Pollution Prevention Plan
TDS	total dissolved solids
Tetra Tech Configuration	ClearSky™ cooling towers in a single configuration as its preferred closed-cycle cooling technology
Tetra Tech Report	Indian Point Closed-Cycle System Retrofit Evaluation
TOC	Total organic carbon
TRC	Total Residual Carbon
TSP	Total Suspended Particulate
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United State Geological Survey
Village Code	Buchanan Village Code
WQC	Water Quality Certification
ZBA	Village Zoning Board of Appeals

1.0 INTRODUCTION

Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC (collectively, "Entergy") respectively own the two (2) operating nuclear-powered steam electric generation stations, known as Stations 2 and 3, that comprise the Indian Point Energy Center (individually, "Unit 2" and "Unit 3,"; collectively, "IPEC" or "the Stations"). This document (the "Response") responds to two (2) separate reports submitted by New York State Department of Environmental Conservation Staff ("NYSDEC Staff") and Riverkeeper, Inc. ("Riverkeeper"), as described below.

The first report has been prepared on behalf of NYSDEC Staff and evaluates, subject to considerable data unavailability and variability, ClearSky™ cooling towers in a single configuration as its preferred closed-cycle cooling technology (the "Tetra Tech Configuration") configuration at IPEC, as presented in the Indian Point Closed-Cycle System Retrofit Evaluation ("Tetra Tech Report") (Tetra Tech June 2013). TRC has been advised and understands that the Tetra Tech Report was prepared as the technical analysis for NYSDEC Staff's proposed modification of the November 2003 State Pollutant Discharge Elimination System ("SPDES") Permit. Entergy also understands that the Tetra Tech Report is submitted as the NYSDEC Staff joint best technology available ("BTA") and New York State Environmental Quality Review Act ("SEQRA") submission (the "NYSDEC Staff Proposal").

The second report has been prepared on behalf of Riverkeeper and proposes approximately 20 possible configurations at IPEC of a variety of closed-cycle cooling technologies ("Riverkeeper Proposal"), as presented in the *Revised Closed Cycle Cooling Feasibility Assessment for Indian Point Energy Center Unit 2 and Unit 3 for Best Technology Available Report* (the "Powers Report") (Powers Engineering October 24, 2012). TRC understands that a November 2013 Order of the Administrative Law Judges ("ALJs") requires that Riverkeeper advance only a single configuration for each Unit, identified in Riverkeeper's Proposal dated November 22, 2013.

This Response specifically addresses the NYSDEC Staff and Riverkeeper Proposals, as reflected in the Tetra Tech and Powers Reports, in a manner consistent with applicable law, in the following ways, by:

- Summarizing the findings of ENERCON Services Inc. ("ENERCON") and Burns and Roe Enterprises, Inc. ("BREI") with respect to the engineering feasibility assessment of constructing and operating the Tetra Tech and the Powers Proposals on a site-specific basis at IPEC within the State Pollutant Discharge Elimination System ("SPDES") permit and Water Quality Certification ("WQC") time periods. This is known as engineering feasibility.

- Summarizing the findings of the Biology Team (of AKRF, Inc. ("AKRF"), Normandeau Associates, Inc. ("Normandeau"), ASA Analysis & Communication, Inc. ("ASAAC") and LWB Environmental Services, Inc. ("LWB") with respect to the efficacy of these Proposals at IPEC. This is known as efficacy.

- Summarizing the findings of TRC Environmental Corporation ("TRC"), Saratoga Associates, National Economic Research Associates, Inc. ("NERA"), Laura C. Green, Ph.D., D.A.B.T., CDM Smith, and Puckorius & Associates, Inc. ("Puckorius") with respect to the potential significant adverse environmental impacts from constructing and

operating these Proposals at IPEC, if feasible. This is known as State Environmental Quality Review ("SEQRA").

- Summarizing the findings of Young/Sommer LLC, TRC, and Saratoga Associates, P.C. with respect to the reasonable likelihood of acquiring necessary, applicable permits. This is known as Permitting.

Briefly and as described throughout this Response, substantial omissions and information gaps relating to engineering feasibility, efficacy, SEQRA and permitting exist in the Tetra Tech and Powers Reports. Neither the Tetra Tech Report nor the Powers Report establishes that their closed-cycle cooling technologies proposed at IPEC are feasible from either an engineering or permitting perspective. The Powers Report contains numerous fundamental engineering feasibility omissions, which ENERCON concluded fails to establish, includes no efficacy analysis, no SEQRA analysis, and no permitting analysis. The Tetra Tech Report likewise does not reach a engineering feasibility determination, and ENERCON has concluded is not feasible as proposed feasibility (Chapter 2.0, Appendix A). The Tetra Tech Report also concedes the fact that SEQRA analyses remain to be done, and omits material permitting assessments, among other things; moreover, the report does not provide any assessments of the Proposals.

These omissions and their materiality are identified in this Response, such as the fact that the Tetra Tech Report includes no air quality analysis for the NYSDEC Staff Proposal, although Tetra Tech acknowledges the need for and materiality of this analysis. Similarly, the Powers Report provides no air quality or noise impact assessment of the closed-cycle cooling options presented on behalf of Riverkeeper. This Response provides certain information supporting the engineering feasibility, efficacy, SEQRA and permitting conclusions that was reasonably available. Thus, by way of example, this Response identifies clear evidence based on noise modeling that operation of the cooling towers exceeds the Buchanan Village Code ("Village Code") and NYSDEC Staff-recommended Noise Guidance. Likewise, this Response addresses the material ClearSky™ cooling tower recirculation effects at IPEC. Neither of these, nor various others, were addressed in the Tetra Tech or Powers Reports. Moreover, the Reports do not provide an appropriate level of impact analysis to determine their significance under SEQRA.

Table 1-1 summarizes the status of the Tetra Tech Report relative to the adequacy of its information to allow for the identification and assessment of the potential for significant adverse impacts associated with construction and operation of the NYSDEC Staff Proposal, as required by SEQRA. Table 1-1 also presents a summary of the characterization of the potential significant adverse impacts of the NYSDEC Staff Proposal in this Response (Chapter 3.2 – 3.12). Given the lack of analyses provided by Tetra Tech and the identified potential for a set of potential significant adverse impacts, the NYSDEC Staff Proposal could not be implemented at IPEC. The same analysis would hold for the Riverkeeper Proposal.

The following subsections summarize the history and current status of IPEC in terms of the SPDES Proceeding and SEQRA. The information is excerpted from the Entergy Environmental Report ("ER") (TRC March 29, 2013) that describes and assesses its proposed BTA, Cyclindrical Wedgewire Screens ("CWWS"), as part of the SEQRA process. Reference can be made to that document for the complete project background and status.

Table 1-1
Tetra Tech Report Adequacy of Data Provided and SEQRA Impact Assessment (NYSDEC Staff Proposal)

	Is Report Analysis Adequate	Does Existing Data Indicate Potential for Significant Adverse Impact	Characterization of Impact per this Response	Can Proposal Proceed with Current Level of Information and Characterization of Impact
Electricity	NO	YES (Construction – extended outages)	Construction: MODERATE - LARGE	NO
Cooling Tower Water Treatment/Water Quality	NO	YES (Operation - Water Treatment affecting Air Quality)	LARGE	NO
Air Quality	NO	YES (Operation)	LARGE	NO
Noise	NO	YES (Construction and Operation)	Construction: MODERATE - LARGE Operation - LARGE	NO
Visual Resources	NO	YES (Construction and Operation)	LARGE	NO
Terrestrial Ecology	NO	YES (Operation)	MODERATE - LARGE	NO
Transportation and Navigation	NO	YES (Construction [1] – Transportation)	MODERATE - LARGE	NO
Environmental Justice	NO	YES (Operation) [2]	LARGE	NO

[1] With use of heavy duty trucks to transport the bulk of the blast spoils.
[2] With the characterization of potential LARGE Air Quality impacts.

1.1 BACKGROUND

IPEC is located on the east shore of the Hudson River ("river") in Buchanan, Westchester County, New York (Figure 1-1). IPEC currently operates using a once-through cooling system where water from the river is drawn in through intake structures employing state-of-the-art optimized Ristroph-type screens and fish return systems. Non-contact cooling water is discharged back to the river via a combined discharge canal, subject to and with the benefit of SPDES Permit No. NY0004472.

In 1992, Entergy's predecessors-in-interest at IPEC submitted a timely and complete SPDES Permit renewal application to NYSDEC. In that same year (and prior to Entergy's acquisition of IPEC), NYSDEC Staff determined that its then-proposed renewal and modification of the SPDES Permit was an Unlisted Action under SEQRA and issued a Positive Declaration requiring the preparation of an Environmental Impact Statement ("EIS") (NYSDEC 2003). The Hudson River facility owners, including Entergy's predecessors, agreed to participate in the SEQRA process, subject to an express reservation of rights that remains in effect today (Con Edison 1992). The predecessor owners of the facilities prepared a consolidated (or generic) Draft EIS ("DEIS") that was submitted to NYSDEC in July 1993. NYSDEC Staff established a schedule for SEQRA-related technical analysis from 1993 to 1999. A revised Generic DEIS ("GDEIS") for IPEC (as well as for the then existing Roseton and Bowline facilities on the Hudson River) was

submitted to NYSDEC on December 14, 1999 (by CHG&E, Southern Energy, New York - successor to Orange & Rockland Utilities ("O&R"), Con Edison, and the New York Power Authority ("NYPA")). NYSDEC Staff issued a Notice of Complete Application on February 28, 2000, and opened a public comment period lasting through June 24, 2000.

In 2002, certain parties commenced a proceeding to compel NYSDEC Staff to take action on IPEC's pending SPDES Permit renewal application (Matter of Brodsky v. Crotty, Sup. Ct., Albany County, Keegan, J. Index No. 7136-02). On May 14, 2003, the court issued an order reflecting the parties' consensus and requiring, among other things, that NYSDEC Staff complete the Final EIS ("FEIS") for IPEC (and Roseton and Bowline) by July 1, 2003, and issue a draft SPDES Permit for IPEC no later than November 14, 2003. NYSDEC Staff published the FEIS on June 25, 2003.

On November 12, 2003, NYSDEC Staff issued a draft SPDES Permit for IPEC. That draft SPDES Permit contained certain NYSDEC Staff-proposed modifications, including a then-conceptual, undefined closed-loop (or closed-cycle) configuration, provided certain conditions precedent (relating to licensing status, permitting and technical feasibility, among other things) were established. The draft SPDES Permit also authorized Entergy to consider and propose any alternative technology to cooling towers. In late 2003, Entergy and others requested an adjudicatory hearing on the NYSDEC Staff-proposed modifications contained in the draft SPDES Permit, commencing the SPDES Proceeding that currently is pending before NYSDEC ALJs Maria E. Villa and Daniel P. O'Connell, as described in this next section.

1.2 CURRENT SEQRA FRAMEWORK

On August 13, 2008, the NYSDEC Assistant Commissioner (who was then delegated decision-making authority upon the NYSDEC Commissioner's recusal) issued an Interim Decision in the SPDES Proceeding, which reiterated that SEQRA, New York Environmental Conservation Law ("ECL") art. 8 and 6 New York Codes, and Rules and Regulations ("NYCRR") Part ("§") 617, applied to NYSDEC's SPDES Permit renewal for IPEC. The Assistant Commissioner then determined that the ALJs' future recommended decision would constitute a Draft Supplemental Environmental Impact Statement ("DSEIS") under SEQRA. The NYSDEC Commissioner's current delegee, the Region 4 Director, is expected to review the ALJs' recommended decision.

In the Interim Decision, the Assistant Commissioner determined that the relationship between the NYSDEC BTA determination (required under 6 NYCRR § 704.5) and the SEQRA review process (6 NYCRR § 617) is a sequential one. That is, NYSDEC Staff are to first apply the defined four (4-) step, site-specific analysis to determine the appropriate BTA technology at IPEC. Once the BTA determination is made, the proposed BTA technology will then be reviewed in accordance with SEQRA and will be subject to modification in order to achieve SEQRA goals (NYSDEC 2008). The Interim Decision made clear that, as a result of SEQRA, a BTA selection could be required to be discarded, and a new BTA selection made.

The Interim Decision further defines the application of SEQRA in the SPDES Proceeding. It specifies that the appropriate vehicle to address environmental information, e.g., relating to NYSDEC Staff's proposed SPDES modification to retrofit IPEC with cooling towers, is a Supplemental EIS ("SEIS") to be prepared in accordance with 6 NYCRR § 617. The Assistant Commissioner noted that the June 25, 2003 FEIS issued by NYSDEC did not examine IPEC in a site-specific manner, and that the 2003 FEIS expressly contemplated further scrutiny of the environmental impacts associated with proposed site-specific BTA for the Stations.

In the Interim Decision, the procedural and substantive requirements for satisfying SEQRA also were defined. This included the requirement for NYSDEC Staff and other parties to examine their BTA Proposals consistent with SEQRA's mandates, i.e. for each party to analyze the potential significant adverse environmental impacts of its BTA Proposal, including socio-economic impacts.

The ALJs have set the schedule for considering SEQRA matters that involves phasing the SEQRA analyses and includes permitting considerations consistent with the ALJs' order, dated December 14, 2012, which set the level of detail for presenting evidence whether a technology is reasonably likely to receive necessary permits. Phasing for SEQRA involves submission of multiple SEQRA ERs or portions of ERs.

In accordance with the defined SEQRA procedures and schedule per the SPDES Proceeding at IPEC, Entergy prepared and submitted a SEQRA ER on March 29, 2013 presenting its proposed BTA, CWWSs, including as compared to IPEC's current operations (TRC March 29, 2013). In that ER, the potential adverse environmental impacts of constructing and operating CWWSs at IPEC were evaluated for their significance. No potential significant adverse environmental impacts were identified, and no substantial permitting hurdles were identified. Nothing at trial altered these conclusions.

This Response represents Entergy's SEQRA submission with respect to NYSDEC Staff and Riverkeeper's respective proposed BTA technologies. As companion to this Response and as part of the SPDES Proceeding a separate report has been prepared that addresses the benefits and costs of the alternative technologies proposed by the parties involved in the Proceeding (Entergy, NYSDEC and Riverkeeper). The purpose of this companion report - *Wholly Disproportionate Assessments of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (NERA 2013) - is to provide a comparative benefit-cost analysis of the alternative technologies proposed at IPEC, including biological efficacy.

Thus, together - the initial CWWS ER, this Response and the NERA Report - represent Entergy's engineering feasibility, efficacy, SEQRA and permitting submissions, which in conjunction with relevant testimony will support the ALJs' preparation of the SEQRA DSEIS pursuant to the Interim Decision and applicable law.

1.3 ORGANIZATION AND CONTENT OF ENTERGY RESPONSE DOCUMENT

The organization and content of this Response is consistent with the requirements of the Interim Decision and SEQRA law and regulations (ECL art. 8 and 6 NYCRR § 617). This Response is organized as follows:

- Chapter 1.0 presents the background as well as the legal and procedural context.
- Chapter 2.0 provides an assessment of the engineering feasibility of the NYSDEC Staff and Riverkeeper Proposals.
- Chapter 3.0 presents Entergy's assessment of the potential significant adverse environmental impacts of the NYSDEC Staff and Riverkeeper Proposals. Construction and operational impacts are each addressed for the full range of reasonable environmental and socio-economic considerations, including electricity, water treatment/water quality, air quality and related health effects, noise, visual resources, land use, zoning and local approvals, terrestrial ecology, archaeological and historic

resources, transportation and navigation, environmental justice and aquatic ecology. A set of impact level categories or significance levels is applied to the results of the impact assessments (where possible to be conducted), consistent with SEQRA and the initial CWWS ER (TRC March 29, 2013).

An assessment of permittability of the Proposals is also presented, as appropriate.

- Chapter 4.0 summarizes the engineering feasibility, efficacy, permitting, and the potential significant adverse environmental impacts of the Proposals, as applicable. Conclusions are also presented.

A set of appendices support this Response and the detailed analyses summarized in this Response are as follows:

- Appendix A – ENERCON Response to Tetra Tech's Indian Point Closed-Cycle Cooling System Retrofit Evaluation Report.
- Appendix B – Operational Noise Assessment (NYSDEC Staff Proposal).
- Appendix C – Analysis of Municipal and County Permitting for Closed-Cycle Cooling System Retrofit at Indian Point.
- Appendix D – Benefits and Costs of Cylindrical Wedgewire Screens and Cooling Towers at IPEC.
- Appendix E – Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available.
- Appendix F – Legionnaires' Disease Risk
- Appendix G – Water Treatment for Cooling Towers

2.0 ENGINEERING FEASIBILITY OF NYSDEC STAFF AND RIVERKEEPER PROPOSALS

Entergy retained ENERCON and Burns and Roe Enterprises, Inc. ("BREI") to evaluate the NYSDEC Staff and Riverkeeper Proposals. The ENERCON evaluation is presented in its entirety as Appendix A of this Response. The discussion below is a summary of that evaluation, and addresses these major areas of consideration: (1) Whether the Tetra Tech and Powers Reports are sufficient to establish engineering feasibility; and (2) whether, accounting for any insufficiencies, the Tetra Tech and Powers Reports fail to establish feasibility or demonstrate infeasibility.

Regarding the first point, the NYSDEC Staff Proposal (defined as conceptual by Tetra Tech) is not sufficient to establish site-specific engineering feasibility at IPEC and in fact includes several acknowledged "potential fatal flaws" (Tetra Tech 2013) that result in Tetra Tech's inability to reach a feasibility conclusion on a site-specific basis for IPEC (underscored by the absence of conclusions). By way of illustration, the Tetra Tech Report does not contain a comparable level of engineering design information presented in the ENERCON 2003 Report on closed-cycle cooling. Further, ENERCON conducted substantial additional engineering design work to determine that various additional design and constructability issues would challenge the feasibility of a closed-cycle cooling retrofit at IPEC (ENERCON 2010). This demonstrates that conceptual analysis for a major, untried project of the sort proposed by NYSDEC Staff and Riverkeeper for IPEC on a site-specific basis cannot reasonably be determined feasible. Indeed, it is expected that Tetra Tech would identify additional challenges to feasibility if they performed a more detailed engineering design of the sort required to establish site-specific engineering feasibility. The Powers Report is so inadequate as to allow no reasonable conclusion about engineering feasibility.

Regarding the second point, ENERCON has concluded, based on the information provided by Tetra Tech, that the NYSDEC Staff Proposal cannot be considered feasible at IPEC. There are a variety of reasons for this. As discussed at length in ENERCON's 2010 Report, conversion of existing nuclear stations to a closed-cycle cooling configuration is unprecedented, and at IPEC represents an incredibly complex engineering and construction undertaking, with significant uncertainty about whether it can actually be performed, as well as the cost and schedule required. As ENERCON describes, large-scale construction activities at nuclear power plants have routinely experienced significant construction schedule overruns, with the result that conversion to closed-cycle cooling at IPEC may consume the entire license renewal period (Yamayee and Anderson 1983). Under these circumstances, cooling towers can provide no reduction in impingement or entrainment, and therefore cannot satisfy applicable law.

Retrofitting to closed-cycle cooling with ClearSky™ cooling towers is even more challenging as a function of the technology selected by NYSDEC Staff, including its defining attributes and the siting configurations that Tetra Tech has proposed for IPEC. ClearSky™ cooling towers employ a novel technology with limited operating experience (and no assurances of its functionality and performance) on only one (1) in-line cooling tower test cell, and no operating experience in the back-to-back configuration proposed by Tetra Tech. This lack of operational history, and the lack of material establishing its functionality and performance, would eliminate ClearSky™ cooling towers from serious consideration at a large baseload nuclear plant, such as IPEC. This is because, in part, large baseload power plants are essential power sources and provide grid stability, and as such, reliable long-term operation is essential and must be an important element of the technology selection process. This is also because nuclear and electric-system

reliability consideration is resistant to novel technologies for large-scale facilities, particularly those that are dedicated, essential power sources for a major metropolitan area, i.e., proven technology is always preferred.

The feasibility issues and operability concerns of the ClearSky™ cooling towers, based on the information provided in the Tetra Tech Report, are summarized below. Briefly, the feasibility issues and operability concerns discussed below are unresolved by Tetra Tech and challenging, with the conclusion that the configuration as presented in the Tetra Tech Report cannot be considered feasible at IPEC. Again, the Powers Report is so inadequate as to allow no reasonable conclusion about engineering feasibility.

2.1 FEASIBILITY ISSUES

- **Cooling Tower Siting Conflicts:** Based on Entergy personnel walkdown observations and review of Figure 3-3 in the Tetra Tech Report, the proposed cooling towers impact several existing structures, including essential structures and components, the independent spent fuel storage installation, structures and components containing radionuclide material, and IPEC site security. Tetra Tech offers no plan to resolve these conflicts and several essential components are inexplicably displaced with no mention of the impact to the plant's ability to function. The proposed design compromises the plant's ability to generate power as well as its safe and secure operation. Tetra Tech did not address whether these structures are capable of being moved. If capable of being moved, Tetra Tech did not account for the cost and schedule impacts of doing so. The number and significance of the siting conflicts unresolved by Tetra Tech would result in a detrimental effect to IPEC, and as such the NYSDEC Staff Proposal cannot be considered an available technology as defined in the Indian Point Interim Decision (NYSDEC 2008).

- **Algonquin Natural Gas Pipeline ("Algonquin Pipeline") Considerations:** Tetra Tech does not contest the impact of a Unit 3 cooling tower on the Algonquin Pipeline, but provides no details for resolution of the conflict. It is not feasible to conduct construction involving blasting directly on top of and around active gas pipelines. Tetra Tech neither acknowledged, nor evaluated the proposed expansion of the pipelines currently planned by the pipeline owner. Attachment 6 of ENERCON's *Engineering Feasibility and Cost of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Cooling Water Configuration* (ENERCON 2010) highlights the difficulties of relocating the pipeline. Given the increased footprint of Tetra Tech's configuration compared to the round hybrid cooling tower presented in the 2010 report, the impacts would have more extensive effects, as well as affect cost and schedule, which were not discussed in the Tetra Tech Report.

- **Power Transmission Line Impacts:** Tetra Tech's proposed cooling tower location directly interferes with the existing overhead 345 kilovolt ("kV") main transmission lines (and one (1) of the towers) to the power grid and the 138 kV auxiliary power lines from the Buchanan Substation to IPEC. The relocation of these lines (with appropriate clearances) and any underground control cables and the cost are not addressed in the Tetra Tech Report (Figure 2-2).

- **Radionuclide Management:** Tetra Tech acknowledged that evaluation and management of the radionuclide conditions was necessary along the riverfront in order to determine feasibility, and has not yet been performed. Tetra Tech states (p. 28), *"If an acceptable method cannot be identified, construction and excavation could not proceed*

in this area, which is where the CT2 [Unit 2 cooling tower] pipe corridor would be sited. In this case, the proposed Unit 2 retrofit would be infeasible."

- **Closed-Cycle Cooling Retrofit Impact on Condenser:** Tetra Tech did not perform any transient or accident analysis for IPEC post closed-cycle cooling retrofit. A review of the transient and accident analysis is necessary for any significant plant change to ensure that there are no potential impacts to the operation of a nuclear power plant. "BREI reviewed one (1) transient condition in their report, identifying that the increased condenser backpressure would be higher than the low vacuum alarm setpoint during a high pressure steam dump at Unit 3, which would be in excess of the operational limits and would trip the Unit. The BREI analysis was limited to one (1) transient condition and emphasizes the need to identify and resolve any impacts the transient or accident analysis before concluding the feasibility of such a significant plant modification.

  Also several calculations, drawings, technical specifications, and procedures associated with the piping system will be affected by this change which will affect the cost, design and construction schedule. Substantial design detail is currently missing; for example, the Tetra Tech Configuration introduces the need for a thrust block at the tie-in points to existing piping, which is not addressed in their report.

2.2 OPERATIONAL CONCERNS

- **Site Impacts of Cooling Tower Plume:** ClearSky™ towers discharge plumes at lower velocities, at lower height, and with less thermal buoyancy than round hybrids. For these reasons, the ClearSky™ towers have more concentrated and localized plumes at ground level, thus increasing salt deposition, temperatures, and humidity in close proximity to the towers which could adversely impact electrical equipment (Figure 2-3). Specifically, the close proximity of the cooling towers to the existing power blocks and electrical transmission facilities creates a known risk of electrical arcing (discharge of current through air) in the switchyard. This is a workplace hazard and may lead to a reactor scram (or shutdown of the nuclear reactor) resulting in forced outages, the implications of which Tetra Tech has not evaluated and may substantially impact electric-system function.

- **Cooling Tower Recirculation Effects:** As a result of the long rectangular configuration of the ClearSky™ cooling towers as sited by Tetra Tech, the cooling tower would be subject to significant recirculation. Recirculation would have a direct adverse impact on the operational efficiency of the plant. Over the historical meteorological data analyzed (2001 – 2008), the peak combined operational power loss would be 97.1 megawatts electrical ("MWe") and would have occurred mid-afternoon in June when the electricity demand is high. At these peak conditions, the combined parasitic and operational power losses of Tetra Tech's closed-cycle cooling configuration would be 137.5 MWe. This is approximately 15% higher than what Tetra Tech lists as the combined peak operational and parasitic power losses and represents a greater than six (6)% reduction in IPEC power output; and it would worsen under wind conditions more conducive to recirculation.

- **Fiberglass Cooling Tower Design Constraints:** The Tetra Tech Report does not address the known structural susceptibility of fiberglass cooling towers to wind damage, tornado-generated missiles, and fire. Significant new equipment and structures, like the fiberglass SPX ClearSky™ cooling towers proposed by Tetra Tech, have the potential to

introduce a new missile case. Since it is not known if this missile case will exceed the current site design, detailed analysis and potentially configuration changes must be conducted to eliminate this concern.

- **Permitting and Potential Fatal Flaws:** Tetra Tech acknowledges in Section 3.1 (p. 27) of its report that the permitting process is *"likely to be contentious"* and *"further notes that the uniqueness of a closed-cycle retrofit at an active nuclear facility makes it problematic to draw direct comparison with other retrofit projects."* Tetra Tech will need to address the feasibility issues and operational concerns identified in this Response and may uncover additional fatal flaws or need to re-evaluate those currently identified.

Considerations that may affect the sizing of the cooling towers in the NYSDEC Staff Proposal are unmentioned in the Tetra Tech Report. These include the following:

1. Tetra Tech did not identify the type of fill material and/or address fill degradation impact overtime for the proposed ClearSky™ cooling towers.

2. Tetra Tech did not provide any transient or accident analysis to determine what the proposed closed-cycle cooling retrofit would have on the operation of IPEC, nor did Tetra Tech incorporate the expected cooling tower recirculation effects.

Increasing the number of cooling tower cells to address these issues would increase the impacts noted in the feasibility issues and operability concerns above and would result in additional excavation, pipe routing, and likely introduce new feasibility issues or operability concerns.

In summary, the novelty of the ClearSky™ cooling tower, feasibility issues, and operability concerns listed above are unresolved by Tetra Tech, and as such, the configuration presented in their report cannot be considered feasible. The cost and implementation schedule, which would need to be adjusted to account for the feasibility issues and operational concerns identified above, would also likely be impacted by significant schedule overruns typical of large-scale construction activities at nuclear power plants.

The Powers Report and supplemental information does not provide a reasonable engineering review and technology evaluation insomuch as it lacks essential detail required to establish feasibility. Riverkeeper's selected cooling tower configuration would result in increased circulating water temperature and reduced flow rate, which would impact IPEC's ability to generate electricity and may exceed condenser operational limits during both normal and transient conditions. The Riverkeeper selected closed-cycle cooling configuration would utilize a circulating water flow rate of 600,000 gpm, approximately 29% less than the current IPEC circulating water flow rate of 840,000 gpm. Without sufficient evaluation to conclude that condenser operational limits will not be exceeded, the Riverkeeper selected closed-cycle cooling configuration cannot be considered feasible. For these reasons, the Powers Report that presents the Riverkeeper Proposal is only briefly discussed in this Response. An assessment of the difference in operational power losses between the NYSDEC Staff Proposal and the Riverkeeper Proposal at design wet-bulb temperature and a discussion of the engineering design required for technology selection is provided in Appendix A, Attachment 4.

3.0 POTENTIAL SIGNIFICANT ADVERSE ENVIRONMENTAL IMPACTS

In Chapter 2.0, ENERCON's review of the engineering feasibility of the NYSDEC Staff and Riverkeeper Proposals was summarized. This chapter assesses the potential construction and operational impacts of those Proposals, where possible, focusing on potential significant adverse environmental (including socio-economic) impacts. The resource topics addressed herein include:

- Electricity (reliability, climate change)
- Cooling Water Treatment/Water Quality
- Air Quality
- Noise
- Visual Resources
- Land Use, Zoning and Local Approvals
- Terrestrial Ecology
- Archaeological and Historical Resources
- Transportation and Navigation
- Environmental Justice
- Aquatic Ecology.

3.1 IMPACT ANALYSIS – ENTERGY RESPONSE AND TETRA TECH AND POWERS REPORTS

The impact assessments for construction and operation in this Response are based on the NYSDEC Staff and Riverkeeper Proposals, as documented in their respective Reports. As described in Chapter 1.0, the Reports undertook no SEQRA analyses - except for visual resources, land use and zoning, and archaeological and historic resources - and did not provide information sufficient to evaluate their impact analyses. As a result, per Chapter 1.0, this Response undertook certain analyses not included in the Tetra Tech and Powers Reports. For example, included herein is a quantitative impact assessment of operational noise impacts (Chapter 3.5) of the NYSDEC Staff Proposal.

3.1.1 Response Impact Framework

This chapter of the Response identifies potential significant adverse impacts associated with the NYSDEC Staff and Riverkeeper Proposals at IPEC in accordance with SEQRA, given the level of information provided in the Tetra Tech and the Powers Reports. Consistent with the CWWS ER (TRC 2013), a set of impact level categories (or significance levels), the use of which was not disputed at the trail associated with the CWWS ER, is again employed in this Response.

The impact level categories for biological, physical and socio-economic resources and considerations used in the analyses are defined as follows:

- **NONE (NO IMPACT)** - Environmental effects do not occur or are not detectable (measureable, noticeable).

- **SMALL** - Environmental effects are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource, such as a waterbody, or where

socio-economic considerations are involved, the consideration, such as community character or reliability of the electricity system.

- **MODERATE** - Environmental effects are sufficient to be detectable (measurable, noticeable) and would alter noticeably, but not destabilize important attributes of the resource, such as a waterbody, or where socio-economic considerations are involved, the consideration, such as community character or reliability of the electricity system.

- **LARGE** - Environmental effects are clearly detectable (measurable, noticeable) and would noticeably alter, and are sufficient to destabilize important attributes of the resource, such as a waterbody, or where socio-economic considerations are involved, the consideration, such as community character or reliability of the electricity system.

3.1.2 SEQRA Impact Analyses in the Tetra Tech and Powers Reports

3.1.2.1 Missing SEQRA Impact Analyses

As described in Chapter 1.0, the Tetra Tech and Powers Reports contain substantial omissions and information gaps relating to feasibility, efficacy, SEQRA and permitting. To highlight the status of impact analyses, the Tetra Tech Report DID NOT include any SEQRA impact analyses for:

- Electricity
- Cooling Water Treatment/Water Quality
- Air Quality
- Noise
- Terrestrial Ecology
- Archaeological and Historic Resources
- Navigation
- Environmental Justice
- Aquatic Ecology.

The Powers Report DID NOT include any SEQRA analyses for:

- Electricity
- Cooling Water Treatment/Water Quality
- Air Quality
- Noise
- Visual Resources
- Land Use
- Terrestrial Ecology
- Transportation and Navigation
- Environmental Justice
- Aquatic Ecology.

3.1.2.2 SEQRA Characterization of Tetra Tech and Powers Reports

The lack of information on existing environmental conditions and the lack of impact analyses across so many resources, including those with the potential for significant adverse environmental impacts, provide no basis on which to fully understand the significance of the

Proposals per SEQRA. The two key characteristics in determining significance as required by SEQRA – magnitude and importance (NYSDEC 2010) – are inadequately addressed or not addressed at all. Magnitude assesses such factors as severity, size or extent of an impact. Importance relates to such issues as: how many people are going to be impacted by the project; the geographic scope of the project; duration and probability of occurrence if the project proceeds (or doesn't proceed) (NYSDEC 2010). Furthermore, the SEQR Handbook states:

> *Generally, bigger impact (larger "magnitude") projects are more likely to need more detailed analysis. The characteristic of "importance" requires us to look at an impact in relation to the whole action. The short or long term or cumulative nature of the impacts also need to be considered.*

Given the lack of analysis, detailed or otherwise, for so many resources for which adverse, and potential significant adverse impacts could result from construction and operation of the NYSDEC Staff and Riverkeeper Proposals, the Reports are inadequate to make a determination of significance. A determination of significance must include (per the SEQRA Handbook):

- Identification of all relevant environmental impacts
- Thorough analysis of the potential impacts
- Written explanation of the reasoning in concluding that the action (i.e., the NYSDEC Staff and Riverkeeper Proposals) may cause, or will not cause significant adverse environmental impacts as defined in SEQRA § 617.7.

Some of the selected criteria as indicators for determining significance per SEQRA (§ 617.7) are noted below, most of which clearly are not addressed in the Tetra Tech and Powers Reports or for which this Response has determined that a significant adverse impact could potentially result from the Proposals:

> *(i) a substantial adverse change in existing air quality, ground or surface water quality or quantity, traffic or noise levels...;*
>
> *(ii) the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species or animal or plant, or the habitat of such a species; or other significant adverse impacts to natural resources;*
>
> *(iv) the creation of a material conflict with a community's current plans or goals as officially approved or adopted;*
>
> *(v) the impairment of the character or quality or important historical, archaeological, architectural, or aesthetic resources or of existing community or neighborhood character;*

As described in the following chapters, the impact analyses performed in this Response have identified adverse impacts from construction and operation of the Proposals, some of which are or could potentially be significantly adverse. These impacts were not identified in the Tetra

Tech or Powers Reports and they were not evaluated. As such, the Tetra Tech and Powers Reports are materially deficient.

3.2 ELECTRICITY

This chapter describes the potential impacts on the New York State electricity system from construction and operation of the NYSDEC Staff Proposal and Riverkeeper Proposal to install closed-cycled cooling at IPEC. The impacts are based upon information in the Reports, supplemented by other data where necessary. Although the Reports provide information on outages and ongoing electricity power losses, neither one assesses the impacts on the New York State electricity system.

This chapter also includes information on the potential New York electricity system impacts if the IPEC Units were not available for an extended period, including the possibility of an extended outage due to blasting or other conditions.

3.2.1 Construction

The Tetra Tech Report (p. 24) estimates that the NYSDEC Staff Proposal would require construction outages of 30 weeks at Unit 2 and 35 weeks at Unit 3. These estimates are lower than prior estimates of 42 weeks for both units by ENERCON (2003). The shorter outage duration estimates in the Tetra Tech Report reflect assumptions that the construction period for Unit 2 would overlap partially with a regularly scheduled maintenance outage of five (5) weeks for Unit 2, and that aggressive work schedules would reduce the outage duration by eight (8) weeks for Unit 2 and seven (7) weeks for Unit 3. The Tetra Tech Report does not substantiate these assumptions.

The construction outage durations in the Tetra Tech Report (p. 24) imply power losses of 11.2 million megawatt hours ("MWh") for IPEC as a whole (Appendix D). This potential power loss to the New York State electricity system resulting from construction of the NYSDEC Staff Proposal represents about 65% of total generation at IPEC in 2012 (NYISO 2013) and about 12% of total electricity consumption in southeastern New York State (defined as NYISO Zones G through K) in 2012 (NYISO 2013a). The electricity market response to these power losses would be replacement generation from existing power plants. Based on the need to replace these power losses during the outage year, the construction outage associated with the NYSDEC Staff Proposal would likely have a MODERATE to LARGE impact on the electricity system southeastern New York State.

The Powers Report (p. 54-55) notes the need for construction outages to site closed-cycle cooling at IPEC, but it does not provide estimates of outage durations for the two (2) IPEC Units. In the absence of outage duration estimates, the electricity system impacts of construction outages for the Powers Report are not evaluated in this Response.

3.2.2 Operation

Operation of the NYSDEC Staff Proposal would cause ongoing power losses of two (2) types, parasitic losses and efficiency power losses. The parasitic losses relate to powering the larger water pumps and two (2) new fans per cooling tower. The Tetra Tech Report (p. 19) estimates that parasitic losses would cause capacity reductions of 20.2 MW per unit or 40.4 MW for IPEC as a whole. This potential parasitic loss represents about two (2)% of total capacity at IPEC (NYISO 2013). Assuming continuous operation of the closed-cycle cooling system throughout

the year, the potential parasitic loss would reduce IPEC generation by 353,904 MWh per year (Appendix D), or about two (2)% of total IPEC generation in 2012 (NYISO 2013).

The potential parasitic loss for the NYSDEC Staff Proposal would be partially offset by the removal of the existing Ristroph-type traveling screens. Tetra Tech does not provide estimates of the potential reduction in current parasitic losses for the NYSDEC Staff Proposal. ENERCON estimates that operating the existing screens requires 4,210 MWh per year at Unit 2 and 5,190 MWh per year at Unit 3, or a combined 9,400 MWh per year for IPEC as a whole (ENERCON Memo 2013). ENERCON estimates that for the NYSDEC Staff Proposal, the existing screens would need to be operated about 10% as much of the time as they currently do. Thus, the NYSDEC Staff Proposal would reduce parasitic losses for operating the existing screens by 8,460 MWh. The net parasitic losses of the NYSDEC Staff Proposal, assuming continuous operation of the closed-cycle cooling system throughout the year, would be 345,444 MWh per year, or about two (2)% of total IPEC generation in 2012 (NYISO 2013a, p. 30).

Operation of the NYSDEC Staff Proposal also would cause efficiency losses because the facility would operate beyond the original condenser design conditions. The Tetra Tech Report (p. 25) estimates efficiency losses of 16 MW for Unit 2 and 4 MW for Unit 3, or 20 MW for IPEC as a whole. This potential efficiency loss represents about one (1)% of total capacity at IPEC (NYISO 2013a, p. 30). Assuming continuous operation of the closed-cycle cooling system throughout the year, the potential efficiency loss would reduce IPEC generation by 175,200 MWh per year (Appendix D), or about one (1)% of total IPEC generation in 2012 (NYISO 2013).

Assuming continuous operation of the closed-cycle cooling system throughout the year, the net parasitic and efficiency losses would reduce generation at IPEC by a total of 520,644 MWh per year. This represents about three (3)% of IPEC generation in 2012 (NYISO 2013a, p. 30). The market response to these power losses would be replacement generation from existing power plants. Thus, based on the Tetra Tech Report estimates - supplemented by corrections to take into account the effects of change in operation of the Ristroph screens - the ongoing power losses related to operation of the NYSDEC Staff Proposal would have a potential SMALL impact on the electricity system in southeastern New York State for the years in which it would operate.

The Powers Report (p. 40-41) provides estimates of parasitic and efficiency power losses related to operation of a closed-cycle cooling system at IPEC for various system designs. The total power losses for 44-cell towers (consistent with the 44-cell towers evaluated in the Tetra Tech Report) are 23.1 - 24.8 MW for Unit 2 and 17.4 - 20.6 MW for Unit 3. These estimates are similar—but somewhat lower—than the sums of parasitic and efficiency losses from the Tetra Tech Report (36.2 MW for Unit 2 and 24.2 MW for Unit 3). Thus, based on the Powers Report estimates, the power losses related to operation of the NYSDEC Staff Proposal (assuming continuous operation of the closed-cycle cooling system throughout the year) also would have a potential SMALL impact on the electricity system in southeastern New York State for the years in which it would operate.

3.2.3 Impacts if IPEC Were Not Available

If the IPEC Units were not available to contribute energy and capacity to the New York State electricity system for an extended period, including the possibility of an extended outage due to blasting or other conditions, there would be LARGE impacts on the electricity system as reflected by decreases in the reliability of the New York electricity system, increases in wholesale energy and capacity prices, and related increases in New York State consumer expenditures. Moreover, if the IPEC Units were not available, New York State goals on climate change, air

quality, and fuel diversity would be compromised. As discussed in the *Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available Report* (Appendix E), a state-of-the-art wholesale electricity energy market model was used, along with information on relevant capacity markets and up-to-date data on market conditions, to develop empirical analyses of the potential impacts if IPEC were not available on wholesale energy and capacity prices, consumer expenditures, and New York State environment and energy goals. This chapter presents the results of the NERA analyses. Detailed information on the methodology and results of the analyses is provided in the *Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available Report* (Appendix E).

3.2.3.1 NERA Analyses: Overview

NERA developed up-to-date empirical analyses of the potential electricity system impacts if IPEC were not available in terms of the following:

1. New York State reliability concerns
2. New York State wholesale capacity prices
3. New York State wholesale electric energy prices
4. New York State consumer power expenditures
5. Greenhouse gas emissions in relation to New York State climate change goals
6. Local air emissions in relation to New York State air quality goals
7. New York State fuel diversity in relation to New York State goals.

NERA's empirical results for the wholesale energy price and related system impacts are based on a state-of-the-art electricity market model, PROMOD IV - which has been extensively used in analysis of electricity markets in New York State and throughout North America - and on up-to-date projections of model inputs. NERA's analysis of capacity price impacts is based upon the capacity market framework in place in New York State. To provide an indication of the nature of the potential near-term effects of IPEC not being available, we model the five (5-) year period from 2015 to 2019.

3.2.3.2 Potential Reliability Impacts

All else equal, loss of IPEC from the New York State electricity system would have LARGE impacts on reliability in New York State. Electricity system reliability refers to the ability of the system to provide power under projected demand conditions and typically is measured in terms of loss-of-load expectation ("LOLE"), which is the expected number of days in a given year in which lack of sufficient electricity capacity would cause customer load to be involuntarily cut off. The maximum LOLE level allowed by New York State electricity system regulators is 0.1—i.e., a situation in which an involuntary load cutoff would be expected to occur on one (1) day per ten (10) years when electricity capacity was not sufficient to meet demand.

The National Research Council of the National Academies ("NRCNA") and the New York Independent System Operator ("NYISO") have evaluated the potential effects on electricity system reliability if IPEC were not available. The NRCNA, an independent group of experts organized by the National Academy of Sciences, performed detailed analyses of various potential scenarios. In one scenario, the NRCNA assumed baseline growth in capacity around the time of IPEC retirement but no new capacity added specifically to address the retirement. In this

scenario, the NRCNA concluded that LOLE in New York State would increase to over 13 times the allowable level (NRCNA 2006, p. 62). The NRCNA also developed scenarios with significant capacity additions and demand reductions to address IPEC retirement, but it noted that *"[a]ll these measures will take time to implement, and several factors may converge to make it even more difficult"* (NRCNA 2006, p. 73).

Recent studies by NYISO also conclude that IPEC retirement would pose serious reliability challenges for New York State. In its *2012 Reliability Needs Assessment ("RNA")*, the most recent version, NYISO concluded that LOLE in New York State would rise to almost five (5) times the allowable level in 2016 assuming baseline conditions for other capacity, demand, and transmission (NYISO 2012, p. 43). NYISO reiterated the reliability risks of IPEC retirement in the *2013 Power Trends* report (NYISO 2013, p. 43) and testimony to the New York State Senate Energy and Telecommunications Committee in September 2013 (NYISO 2013a).

The prior studies indicate that substantial amounts of additional generation capacity and perhaps also transmission capacity would be necessary to prevent violations of New York State's reliability standard if IPEC were not available to the electricity system. The New York State Public Service Commission's ("PSC") ongoing Reliability Contingency Plan ("RCP") proceeding was initiated to develop a contingency plan concerning IPEC-related system needs. In November 2013, the PSC adopted a series of "no regrets" transmission measures and an incremental energy efficiency program as part of the contingency plan, which it described as providing system benefits irrespective of IPEC's future operating status.

The price and consumer expenditures impacts presented in the *Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available Report* (Appendix E) assume that regulated contingency action as outlined in the RCP with respect to transmission and energy efficiency increases are implemented for the purposes of this analysis, although they were approved without regard to the status of IPEC. NERA presumes that additional actions - including reactivation of capacity that has been mothballed or slated for retirement - are taken to meet the reliability requirements if IPEC were not available. These adjustments are consistently applied in the modeling of capacity price and electric energy price impacts.

3.2.3.3 New York State Capacity Price Impacts

New York State capacity prices would increase substantially if IPEC were not available, leading to increased electricity capacity payments by load-serving entities ("LSEs"). Capacity markets are designed to provide financial incentives to electricity generators in order to provide sufficient capacity to meet electricity demand in all periods. The increase in capacity prices reflects the increased value of capacity on the system and is required to induce market-based solutions that would mitigate the reliability impacts if IPEC were not available. Capacity prices in these markets are measured in dollars per kilowatt of installed capacity per month ("kW-month").

Table 3.2-1 shows estimates of increases in capacity prices during summer months in the New York Control Area ("NYCA") –which represents the entire state – if IPEC were not available.[1] NYCA prices are estimated to increase by between $2.34/kW-month and $3.23/kW-month. The increases represent between 32% and 72% of baseline projected capacity prices.

[1] Capacity prices are reported in nominal dollars to facilitate exposition of the underlying calculations. Electric energy prices and consumer expenditures are reported in constant 2012 dollars. NERA converted nominal dollars to constant 2012 dollars using projected GDP price deflators in OMB (2013, p. 6).

Table 3.2-1 Increases in New York Control Area Summer Capacity Prices if IPEC Were Not Available (nominal$/kW-month)				
Year	Base	IPEC Not Available		
		Price	Change	% Change
2015	$4.42	$7.61	$3.20	72%
2016	$5.51	$8.74	$3.23	59%
2017	$6.24	$9.27	$3.02	48%
2018	$6.31	$8.88	$2.57	41%
2019	$7.19	$9.53	$2.34	32%
Source: NERA calculations as explained in Appendix E.				

3.2.3.4 New York State Wholesale Electric Energy Price Impacts

Table 3.2-2 summarizes estimates of the average annual increases in New York State wholesale electric energy prices from 2015 to 2019 if IPEC were not available. The increases range from $2.27 to $2.57 per MWh. Baseline statewide average annual wholesale electric energy prices are projected to be about $39/MWh during this period; thus, the overall New York State impacts represent an increase of about six (6)% from baseline prices. Electricity price increases in the densely populated Southeastern New York region would be substantially greater than the statewide average, as shown in the *Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available Report* (Appendix E).

Table 3.2-2 Increases in New York State Wholesale Energy Prices if IPEC Were Not Available (2012$/MWh)				
Year	Base	IPEC Not Available		
		Price	Change	% Change
2015	$37.88	$40.26	$2.39	6.3%
2016	$38.34	$40.91	$2.57	6.7%
2017	$39.05	$41.37	$2.32	5.9%
2018	$39.09	$41.36	$2.27	5.8%
2019	$39.90	$42.29	$2.39	6.0%
Source: NERA calculations as explained in Appendix E.				

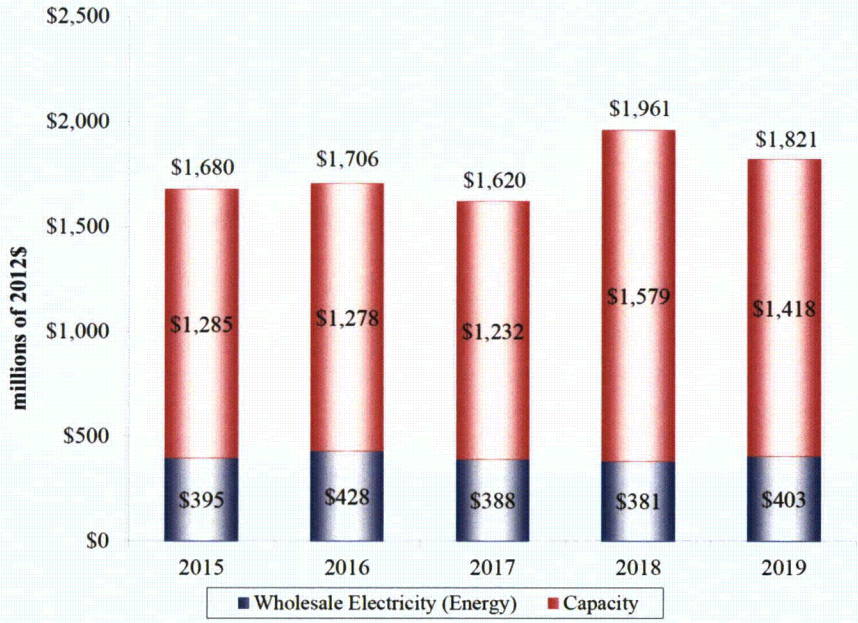
3.2.3.5 New York State Consumer Expenditure Impacts

New York State residents currently face among the highest retail electricity prices in the nation. Retail electricity prices include components based on wholesale electricity and capacity prices (as well as other components). With IPEC unavailable, substantial increases in retail prices and commensurate increases in power expenditures for New York State consumers would result.

Figure 3.2-1 shows estimates of the increases for New York State consumer expenditures over our modeling period if IPEC were not available. These values include the effects of both increased capacity prices and increased wholesale electricity prices. New York State consumers would pay increased annual expenditures for electricity that range from about $1.6 billion to about $2.0 billion per year. The total projected increase in New York State consumer payments for electricity from 2015 to 2019 is projected to be almost $9 billion if IPEC were not available.

The impacts do not, however, include any costs for constructing or reactivating facilities to meet reliability requirements that would be required in addition to market prices.

Figure 3.2-1
Increases in New York State Consumer Power Expenditures if IPEC Were Not Available
(millions of 2012$)



3.2.3.6 Regional Greenhouse Gas Emission Impacts

IPEC produces virtually no power without producing carbon dioxide ("CO_2") emissions, but empirical modeling indicates that much of the power to replace IPEC generation would come from fossil-fired power plants that produce CO_2 emissions. If IPEC were not available, replacement generation would lead to substantial initial increases in CO_2 emissions, increasing the cost of achieving climate change goals as embodied in the Regional Greenhouse Gas Initiative ("RGGI"). RGGI is an agreement among nine (9) northeastern states to provide an overall regional cap on CO_2 emissions based upon target reductions set by the individual states.

Table 3.2-3 shows estimated initial increases in CO_2 emissions across the RGGI region if IPEC were not available. We report results for the RGGI region rather than just New York State because the climate change effects of CO_2 emissions do not depend on the location of the emissions and because generators from outside New York State would produce different levels of electricity if IPEC were unavailable. The average annual initial CO_2 emissions increase if IPEC were not available would be about 6.7 million tons.[2] The table also shows New York State's CO_2 reduction goals for the RGGI program in each year relative to the state's target emission

[2] RGGI sets an overall cap on emissions, so increases resulting from replacement generation would have to be offset by reductions in emissions from other covered sources. Nonetheless, the initial or gross increases in emissions provide a useful sense of the extent to which replacing the lost output associated with cooling towers at IPEC would make achievement of the caps more difficult and/or more costly.

level for 2014. In each year of the modeling period, the estimated increase in CO_2 emissions in the RGGI region is many times larger than New York State's target CO_2 reduction.

Table 3.2-3
Increases in Regional CO_2 Emissions if IPEC Were Not Available (million tons)

Year	Base	IPEC Not Available			Change As % of NYS RGGI Goals	
		Emissions	Change	% Change	Reduction Goal	Change / Goal
2015	115.7	122.3	6.6	5.7%	0.9	747%
2016	117.9	124.6	6.6	5.6%	1.7	381%
2017	120.5	126.8	6.2	5.2%	2.4	260%
2018	119.9	127.0	7.1	5.9%	3.2	221%
2019	120.0	126.9	6.9	5.8%	4.0	172%

Source: NERA calculations as explained in Appendix E.

3.2.3.7 New York State NOx Emission Impacts

Replacement generation if IPEC were not available also would lead to significant initial increases in nitrogen oxides ("NO_x") emissions, which are important for air quality requirements related to ozone concentrations. Table 3.2-4 shows increases in NO_x emissions if IPEC generation were not available. On average, loss of IPEC from the electricity system would increase annual NO_x emissions by about 3,000 tons. As part of its state implementation plan ("SIP") for the New York Metropolitan Area particulate matter (PM-2.5) non-attainment area, New York aims to reduce NO_x emissions from relevant point sources, including power plants, by 1,100 tons between 2007 and 2017. The table shows that the annual increases in New York State NO_x emissions if IPEC generation were not available are about three (3) times the NO_x reduction goal for New York State's SIP.

Table 3.2-4
Increases in New York State NOx Emissions if IPEC Were Not Available (tons)

Year	Base	IPEC Not Available			Change As % of NOx SIP Goal
		Emissions	Change	% Change	
2015	17,723	20,841	3,119	18%	284%
2016	17,574	20,867	3,292	19%	299%
2017	18,203	21,562	3,359	18%	305%
2018	17,792	20,373	2,582	15%	235%
2019	17,815	20,319	2,504	14%	228%

Source: NERA calculations as explained in Appendix E.

3.2.3.8 Fuel Diversity Impacts

Regulators in New York State have raised concerns for many years about the state's reliance on natural gas-fired generation, especially in downstate areas, and about the adverse implications for fuel diversity if IPEC were not available. A 2008 NYISO white paper on fuel diversity stated that *"comparatively limited downstate fuel diversity poses certain risks for the New York City and Long Island areas"* (NYISO 2008, p. 3-6) and that *"closure [of IPEC] could exacerbate New York City's existing dependence on natural gas for power production"* (NYISO 2008, p. 3-6).

NYISO's *2013 Power Trends* report notes that the state's reliance on natural gas-fired generation has more than doubled in recent years, from 27 million MWh in 2004 to almost 60 million MWh in 2012 (NYISO 2013, p. 35). The report also notes that increased reliance on natural gas for power generation means that any disruption in natural gas supply could have significant implications for system reliability, and volatility in natural gas prices could cause large swings in power prices for New York State power consumers (NYISO 2013, pp. 35-36).

Table 3.2-5 shows the additional natural gas that would be consumed by power plants in New York State if IPEC were not available. Annual natural gas usage for electricity would increase by about 94 Million British Thermal Units ("MMBtu") if IPEC were not available, an increase of more than 18% over base case levels. This increase is roughly equivalent to the annual natural gas usage of 1.4 million New York State households, based on average annual natural gas consumption of 69 MMBtu per household for all fuel uses (EIA 2013).

Table 3.2-5
Increases in New York State Electricity Sector Natural Gas Consumption if IPEC Were Not Available (million MMBtu)

Year	Base	IPEC Not Available		
		Consumption	Change	% Change
2015	497	593	95	19%
2016	510	601	91	18%
2017	513	611	97	19%
2018	518	611	93	18%
2019	512	608	95	19%

Source: NERA calculations as explained in Appendix E.

3.2.4 Conclusion

The analyses summarized above indicate that the lack of availability of IPEC could have LARGE near-term impacts on the New York State electricity system. This conclusion is based on potential adverse near-term impacts on reliability, increases in wholesale electricity energy prices and capacity prices, increases in consumer power expenditures, as well as potential impacts on important New York State goals related to greenhouse gas emissions, local air emissions, and fuel diversity.

3.3 COOLING TOWER WATER TREATMENT AND WATER QUALITY

3.3.1 Introduction

Both the construction and operation of cooling towers at Indian Point present the potential for significant adverse water quality impacts and interrelated air quality impacts. Construction of the towers, a project that is major in magnitude and duration, requires extensive site clearing, blasting and grading activities (including the dewatering of excavated areas) in close proximity to the Hudson River at a longstanding industrial site, and therefore may pose stormwater management challenges. More importantly, operation of the towers implicates major considerations regarding the quality of the water within the towers and the water treatment required to manage that volume of water for its intended purpose. These water treatment considerations include the recognized need to manage water quality to prohibit fouling, microbial growth and, with respect to known human health concerns, the demonstrated potential for certain types of cooling towers, particularly those identified in the Tetra Tech

Proposal, to harbor, grow and disperse airborne pathogens (ENERCON 2013, Puckorius 2013 (Appendix G)). These water treatment chemicals concentrate and, upon blowdown to the Hudson River, must be consistent with applicable effluent limitations and water quality standards. As a result and as detailed below, water quality concerns associated with the construction and even more so the operation of cooling towers at Indian Point are substantial and complex.

Despite the unprecedented scope of proposed site preparation activities and the well-known chemical treatment protocols associated with operation of cooling towers, neither the Tetra Tech Report nor the Powers Report addresses water quality issues associated with their respective Proposals. Both Proposals omit any assessment of water treatment in cooling towers, and how such treatment affects air quality particulate emissions from cooling tower drift or the quality of the water blowdown from the tower and into the Hudson River. Specifically with respect to these operational concerns, the Reports do not adequately address:

- The quality of the source water body (i.e., its chemical and biological content), here the Hudson River with its well documented turbidity and salinity, as the source for cooling tower makeup water and the corresponding need for treatment of that water. (Hudson River Estuary (ed. Levinton and Waldman 2006), specifically summaries on p. 5-6 (salinity and turbidity)).

- The use of water treatment chemicals required to *"prevent deterioration, inefficient operation and excessive maintenance of all cooling water contacted equipment from corrosion, deposition and biological contamination from the water used in the cooling system,"* (Puckorius 2013). Importantly, as discussed here and detailed in Chapter 3.4 (air quality), water treatment has direct and indirect effects on cooling tower drift rates (i.e., the quantity and quality of water droplets exiting the cooling tower), and therefore air quality considerations.

- The impact of water treatment chemicals on cooling tower blowdown discharged to the Hudson River.

The absence of meaningful analysis in the Proposals raises a series of substantive issues. For example, as described in this chapter, the chemical treatment of cooling tower water required to manage, among other things, the risk of dispersal of waterborne pathogens subject to air dispersal, renders the asserted cooling tower drift rate of 0.0005% by SPX (Marley) infeasible. Consequently, particulate emissions from the cooling towers are certain to exceed emissions levels calculated on the basis of a presumed 0.0005% drift rate, exacerbating significant adverse air impacts (Chapter 3.4). These and potentially additional water quality issues require further evaluation.

3.3.2 Construction Impacts

Neither the NYSDEC Staff Proposal nor the Riverkeeper Proposal explicitly addresses stormwater management or dewatering requirements during construction. Both Proposals result in substantial land disturbance, including extensive excavation and blasting to remove bedrock, including in areas that are subject to ongoing monitoring for existing soil and water conditions. Best management practices for large-scale construction projects, particularly those of extended duration, are functionally different than what is currently in place, and must account for the Proposals and on-site conditions (6 NYCRR § 750). While it is reasonable to

assume generally that stormwater management could be achieved, site-specific factors at IPEC require a credible basis for such a determination. Tetra Tech and Powers have provided none.

An example illustrates the dynamic: Under the NYSDEC Staff Proposal, trenching in portions of the congested riverfront area of the IPEC Site must accommodate two (2) ten (10) foot diameter supply lines and two (2) 12-foot diameter return pipes (the Riverkeeper Proposal would require even more extensive excavation). Tetra Tech reports that portions of each piping corridor for the NYSDEC Staff Proposal are located below the average river water level, with the result that slurry walls may need to be installed to reduce groundwater intrusion. Furthermore, the supply piping for the Unit 2 cooling tower passes through an area where a radiological condition is being monitored. Although use of slurry walls may reduce the rate of river water and/or groundwater intrusion into excavations, no methods for managing construction dewatering effluent or construction stormwater runoff were presented in the Tetra Tech Report. In addition, no methods for addressing potentially contaminated groundwater entering excavations, including schedule and cost implications, were provided.

As a result, Tetra Tech's statement that the feasibility of installing a closed-cycle cooling system for Unit 2 is questionable unless acceptable means and methods for addressing management of groundwater contamination are found (p. 28, 30), must be resolved before the feasibility of its Proposal can be established. Schedule and cost implications also must be addressed by Tetra Tech.

3.3.3 Operational Impacts

The operation of cooling towers is discussed in greater detail in Chapter 2.0 and Appendix A of this Response. Briefly, by way of relevant background, water used to cool the condensers will be pumped from the Hudson River into the cooling towers where that water will be cooled via evaporation and the discharge of water vapor to the atmosphere. As a consequence of this operational dynamic, over time, the quantity of water within this "closed loop" is reduced via the evaporative cooling process, resulting in (a) an increasing concentration of chemical and biological constituents within this closed loop system, and (b) the need to supplement the water within this system to "makeup" for the amount lost to evaporation, drift and blowdown through the continuous addition of river water. Entrainment of air-borne particles also occurs.

As indicated in the Proposals, the source of the cooling water is the Hudson River, which has a demonstrated (but variable) salinity (total dissolved solids ("TDS")) and turbidity (total suspended solids ("TSS")), with salinity typically highest during the summer. Because TSS and TDS, particularly as concentrated as contemplated by the Tetra Tech Report (at three (3) cycles of concentration), impacts cooling tower function and performance in clear and direct ways, the presence of this material has to be accounted for and carefully managed, or cooling tower function and performance degrades (Puckorius 2013). No large-scale cooling tower using saline or turbid water operates without water treatment (SPX (Marley) 2009a, GE WPH Chapter 31). Likewise, none operates without controlling biological and microbial growth (SPX (Marley) 2009a, GE Power and Water Chapter 26 2013). As discussed below, Puckorius & Associates, Inc. (Puckorius 2013), establishes the chemical treatment profile for the NYSDEC Staff Proposal. Despite this, neither the Tetra Tech nor the Powers Reports address the need for and profile for water treatment, or its implications on water quality and air quality.

To address the ever-increasing concentrations of chemicals or other constituents within the cooling system (including the tower itself) as the systems cycle from one (1) to three (3) cycles of concentration, the water in the tower is "blown down" or released to the river, thereby removing

water with a higher concentration of chemicals and contaminants and replacing it (via the makeup water) with water with lower concentrations of these constituents. Thus, a critical operational issue and balancing act is presented by the need to maintain a certain water quality within the tower (through the application of chemical treatment protocols, discussed further below), while also assuring that the blowdown from the tower to the Hudson River meets applicable effluent limits or other discharge criteria, if possible. Neither the Tetra Tech nor the Powers Reports evaluates this balancing act or demonstrates that it can be done consistent with applicable water quality and air quality (Chapter 3.4) regulatory requirements.

To understand the significance of the omissions in the Tetra Tech and Powers Reports, Entergy retained Paul Puckorius from Puckorius & Associates – a leading water quality/water treatment consultant with extensive experience with cooling tower operations. His findings are discussed below, beginning with the well-known fact that closed-cycle cooling tower performance and efficiency are directly affected by the physical and chemical characteristics of the raw water supply, as well as the chemicals that must be added to control bio-fouling, control suspended solids, prevent macro-fouling, limit scale and corrosion, and reduce the risks of disease transmission (Puckorius 2013). Because the Hudson River exhibits highly variable salinity levels, and can transport variable and at times high concentrations of suspended solids, iron, nutrients, and biological organisms (macro and micro-organisms), at a minimum constituents in the raw water would require the addition of water treatment chemicals to minimize their impact on condenser performance, cooling tower heat exchange surfaces (i.e., film fill), drift eliminators and other equipment that comes in contact with the concentrated circulating water necessary for plant cooling (Puckorius 2013). The discussion below also describes the interplay between the need for and use of water treatment, and the efficiency of a cooling tower in terms of achieving asserted drift rates, which is a fundamental component in the evaluation of particulate emissions from the towers.

3.3.3.1 Hudson River Water Chemistry/Biology

In order to understand the water treatment needs for the Tetra Tech Report, it is necessary to understand Tetra Tech's assumptions with respect to cooling tower operation (using Hudson River water). Tetra Tech (p. 13) indicates that the ClearSky™ cooling tower would operate at three (3) cycles of concentration. Three (3) cycles of concentration means that the chemical or biological constituents in the Hudson River water will be raised to three (3) times their initial levels, before being blown down or released from the tower. Tetra Tech asserts that cooling tower makeup water would be obtained through reuse of discharged service water (previously obtained from the Hudson River), although no mechanism for establishing the condition of service water discharged or controlling the cooling tower makeup flow rate was provided (as an aside, at three (3) cycles of concentration, the cooling tower makeup flow rate would be approximately 38,000 gallons per minute ("gpm") for Units 2 and 3 (Tetra Tech p. 13)). Because ENERCON reports that the average annual service water flow rate over the period 2001 through 2007 approached 49,000 gpm (ENERCON 2010), operation at three (3) cycles of concentration would require a means to divert excess service water flows to an alternative outfall, the details and consequences of which are not addressed by Tetra Tech.

The Tetra Tech Report also acknowledges that three (3) cycles of concentration would result in maximum TDS concentrations within the tower of 24,000 ppm (Tetra Tech p. 12). Importantly, SPX (Marley), the ClearSky™ cooling tower vendor, recommends a limit of 5,000 ppm TDS in the concentrated cooling tower water (SPX 2009), which would be substantially exceeded (particularly, at three (3) cycles of concentration), having operational ramifications unaddressed

by Tetra Tech (Puckorius 2013). Tetra Tech never mentions that TDS exceeds the tower manufacturer's specification, or the implications thereof.

As described in Chapter 3.4.3, a study by Applied Science Associates, Inc. ("ASA") examined Hudson River salinity in the vicinity of the IPEC cooling water intake structures over a ten- (10-) year period (ENERCON 2010a, Appendix F). The study concluded that historically there have been (and will continue to be) periods when the Hudson River salinity significantly exceeds 7,000 ppm TDS. Under such conditions, and with a cycle rate of three (3), the circulating water TDS concentration would approach 24,000 ppm. In short, Tetra Tech's calculated TDS levels have critical ramifications for water treatment of the towers, and also critical implications beyond water quality and relate directly to the quantity of particulate emissions exiting the tower, as discussed in greater detail in Chapter 3.4.3.

The Tetra Tech Report and the Powers Report also do not assess the presence of suspended solids in Hudson River water, which when concentrated in the cooling tower could periodically exceed 420 ppm at three (3) cycles of concentration (which is in addition to the contribution of salinity to TDS as discussed above). The Hudson River, as with most estuaries, is a well documented "sink for sediment," Hudson River Estuary, p. 41. Specifically, TSS concentrations in the Hudson River water range substantially seasonally and locationally from 17 milligrams per liter ("mg/l") to over 800 mg/l, and over a tidal cycle (the latter, by a factor of three (3) to four (4), Hudson River Estuary, p. 41-47). In the vicinity of Indian Point, levels of 35 mg/l are routinely experienced, and levels can potentially approach 140 to 180 mg/l.

This level of suspended solids, absent treatment, will degrade cooling tower performance, typically by plugging cooling tower fill, with a corresponding fill functionality loss (contributing to drift), and requiring early and frequent fill replacement (contributing to operability and cost). Indeed, SPX (Marley) indicates that the accumulation of foreign matter on the surface of cooling tower fill can reduce cooling efficiency by interfering with air and/or water flow (SPX 2013) and that in severe cases; "fill fouling" can jeopardize the structural integrity of a cooling tower (SPX 2013). TSS also will result in the accumulation of a substantial amount of sediment in the cooling tower basins requiring frequent cleaning and other degradation of fill material, such as through possible abrasion of cooling tower fill material (Puckorius 2013). As a consequence, water treatment would be required to reduce sediment and iron deposits in the cooling water piping, condenser, heat exchange equipment, cooling tower film fill and cooling tower basin (Puckorius 2013).

In addition, the presence of iron in Hudson River water is not addressed by either Report, and this could also contribute to deposit development in the cooling tower basin and fill. Hudson River water can periodically have an iron concentration of up to 5.8 ppm (Puckorius 2013). At three (3) cycles of concentration, the circulating water iron concentration would exceed 15 ppm and at one and a half (1.5) cycles, it would be 11.6 ppm. SPX (Marley) recommends a maximum of three (3) ppm iron in cooling tower circulating water to maintain efficient operations (SPX 2009).

Finally, neither Report addresses the nutrient levels associated with Hudson River water such as organics derived from decaying vegetation or aquatic life, phosphates and ammonia from agricultural runoff, urban runoff, and discharges from upstream industrial and sanitary wastewater treatment facilities (Puckorius 2013). These nutrients will concentrate in the circulating water and contribute to microbiological growth in the cooling tower fill, drift eliminators, circulating water heat exchange surfaces and other cooling water contacted equipment (Puckorius 2013). These nutrients will also increase the need for additional

microbiological control chemicals and bio-mass dispersants to minimize any bio-deposition (Puckorius 2013).

3.3.3.2 Cooling Tower Chemical Conditioning Program

To address these many and well-known issues, a cooling tower chemical conditioning program is required. The selection and maintenance of chemicals needed to prevent deterioration, inefficient operation and excessive maintenance of all cooling water-contacted equipment from corrosion, deposition, and biological contamination is necessary (Puckorius 2013). It also must address potential risks of contamination from pathogenic bacteria, as well as any environmental risks associated with the return of blowdown water to the Hudson River (Puckorius 2013). Typically, makeup water quality and the resulting discharge concentrations in cooling tower blowdown caused by evaporation must be analyzed or modeled to determine with any certainty the chemicals needed to control corrosion, deposition, and biological contamination (Puckorius 2013). Further, to be effective, the chemical conditioning program must consider the maximum concentrations of constituents needing treatment that are expected in the concentrated cooling tower circulating water for any reasonable period of time or at any reasonable frequency rate. Neither Tetra Tech nor Powers performed any such analysis. As such, Puckorius & Associates, Inc. were asked to perform a limited analysis for this Response.

Specifically, Puckorius developed protocols for water treatment based on a review of TSS and iron concentrations in Hudson River makeup water, and recognizing cooling towers effectively "scrub" dust and dirt from the air passing through the tower (Puckorius 2013). A key principle is that the use of chemical dispersants substantially reduces the potential for sediment fouling (Puckorius 2013, GE WPH Chapter 31), and is therefore routine and normative. Importantly, as discussed in Chapter 3.4.3, use of chemical dispersants has air quality consequences as well, such as the adverse effect on drift rates (i.e., an increase in drift and associated air emissions from the towers) (SPX 2009, CTI ATC-140 1994).

The following list identifies projected water treatment chemicals/requirements for the NYSDEC Staff Proposal at the IPEC Site (Puckorius 2013).

1. **Suspended Solids Control** - The chemical needed is a water soluble polymer, such as sodium polyacrylate, which would be continuously maintained in the cooling tower circulating water at dosages of 5 to 10 mg/l (Puckorius 2013). This chemical is a dispersant and has some surfactant properties (Puckorius 2013). Because it has surfactant properties, it would contribute to an increase in cooling tower drift (SPX 2009).

2. **Iron Oxide Control** - The chemical needed is a specialty water soluble co-polymer, such as sodium sulfonated styrene maleic anhydride, which may be maintained at dosages of 3 to 5 mg/l, but may be as high as 10-20 mg/l when iron levels exceed 15 mg/l (Puckorius 2013). This chemical is a dispersant and has some surfactant properties (Puckorius 2013). As such, it would also contribute to an increase in cooling tower drift (SPX 2009).

3. **Microbiological Deposit Control** - The chemical needed is a solution of sodium hypochlorite (bleach), which typically is used when the circulating water pH is 7.5 or less. If the cooling water pH is above 7.5, the desirable biocide is often a solution of sodium hypobromite (Puckorius 2013). These chemicals are often applied to provide 0.2 - 0.4 mg/l of free halogen residual for several hours per day for general microbiological

control (Puckorius 2013). However, in order to address the possible presence of *Legionella* bacteria (responsible for Legionnaire's Disease) (Section 3.4.6), the Cooling Technology Institute (formerly Cooling Tower Institute) recommends the following treatment program (CTI 2008):

- If "clean water" is used as cooling tower makeup, a continuous level of free residual chlorine ("frc") of 0.5 - 1.0 ppm is needed; or
- If "clean water" is used as cooling tower makeup, a level of frc of 1.0 - 2.0 ppm for no less than one (1) hour per day is needed.

Cooling Technology Institute ("CTI") uses the term "clean water" in its guidelines, which means water without suspended solids. As a consequence, the CTI levels for biocide application would be understated for IPEC, with levels likely to be at least twice as high (Puckorius 2013). These levels of halogen would exceed applicable effluent limitations in the SPDES Permit (discussed below) and, therefore, releasing this water directly to the Hudson River would presumably be unacceptable as a regulatory matter. That being the case, the cooling tower blowdown would require additional chemical treatment, if sufficient space for treatment exists at IPEC, such as the addition of sodium bisulfite or sulfur dioxide to de-halogenate the blowdown prior to discharge (Puckorius 2013). These halogens also have some surfactant properties and, particularly at these levels, should be expected to cause the cooling tower drift rate to increase (Puckorius 2013). This issue is one that particularly requires intensive review, as the NYSDEC Staff and Riverkeeper Proposals employ a technology in which water treatment systems are not fully integrated throughout the tower (Puckorius 2013).

4. **Monitoring and Chemical Feed Systems** – In order to manage the levels of water treatment chemicals in the cooling tower circulating water, specific control equipment and instrumentation would be necessary that are not needed with once-through cooling system operation (Puckorius 2013). This equipment would be required to adjust the chemical dosage levels in the cooling tower circulating water to compensate for natural variations in water quality characteristics of the Hudson River water so that deposition, scaling and corrosion, and microbiological levels are controlled. This equipment involves computerized control and monitoring systems to monitor cooling tower chemistry, as well as the water treatment chemical residuals (Puckorius 2013). These systems are not discussed by Tetra Tech or Powers.

5. **Monitoring of Chemical Addition Performance** - The characteristics of the chemical addition program also would need to be monitored to determine if the formation of deposits and/or microbiological organisms occur prior to causing any equipment degradation or limiting cooling system performance characteristics (Puckorius 2013). This means that the cooling tower film fill needs to be regularly monitored, and the condenser needs to be routinely checked for deposits and plugging (Puckorius 2013). Again, these operational issues go unaddressed in the Proposals.

   Extensive testing of circulating water chemical characteristics and water treatment chemical levels needs to be completed at least twice per shift to ensure that the water treatment program is being administered correctly and effectively (Puckorius 2013). This cost has not been addressed in the Riverkeeper or NYSDEC Staff Proposals.

3.3.3.3 Effect of Water Treatment Chemicals on Cooling Tower Drift

As noted above, by omitting discussion of water treatment, the Tetra Tech and the Powers Reports do not address the impact of water treatment chemicals on the cooling tower drift rate (i.e., the quantity of water, as droplets known as drift, exiting the cooling tower, expressed in gallons per minute). That analysis is essential, and its omission means that air quality considerations are also unknown.

Specifically, SPX (Marley) is clear in its cooling tower materials that use of dispersants, surfactants and microbiocides negates its cooling tower drift rate "guarantee" of 0.0005% (SPX 2009, CTI ATC-140 1994). This is because dispersants, surfactants and microbiocides all exacerbate drift, a fact underscored by SPX's acknowledgement that its drift rate guarantee is based solely on a lab scale model using purified water. Because IPEC would not operate under these circumstances, the actual drift rate using Hudson River (not purified) water and needed water treatment chemicals must be evaluated. Neither Tetra Tech, nor Powers have done so. However, the Puckorius Report (2013) establishes that use of Hudson River water, and necessary treatment chemicals, would result in a substantially greater drift rate (and associated particulate emissions) than asserted by Tetra Tech using the presumed drift rate of 0.0005% (Puckorius 2013).

Moreover, the CTI Test Code referenced in the SPX (Marley) "guarantee" is ATC 140 – the Isokinetic Drift Test Code. The purpose of ATC 140 is to *"describe instrumentation and procedures for the testing and evaluation of drift from water-cooling towers." See* ATC 140, § 1.2. Section 2 of ATC 140 prescribes the "Conditions of Test" and includes requirements related to the quality of water within the tower. Specifically, Section 2.3.8.2 of ATC 140 states that *"[s]urface active agents (surfactants and/or dispersants) can significantly effect [sic] drift eliminator performance and their use should be discontinued beginning three to five days prior to and extending through the drift test" (emphasis supplied). Thus, the very testing protocol to determine compliance with the "guaranteed"* drift rate requires that all surfactants and dispersants (that would be used in normal operations at IPEC) be purged from the tower during a three (3) to five (5) day period prior to the test and throughout the testing period. As discussed above, the use of surfactants and dispersants is required. Therefore, the conditions specified by the "guarantee" simply cannot be satisfied on a site-specific basis for towers operated at IPEC, or reconciled with air quality requirements that compel the analysis of emissions to represent the potential to emit in order to understand potential human health and environmental impacts (Chapter 3.4).

3.3.4 SPDES Permit Considerations

The Tetra Tech Report and the Powers Report do not assess whether the presence of cooling tower water chemicals in the blowdown would comply with the effluent limitations in the SPDES Permit for IPEC. Currently, there is a limit in the amount of total residual chlorine that can be discharged in once-through cooling water (a maximum of 0.2 mg/l total residual chlorine ("TRC") for no more than nine (9) hours per week for both units) and only one (1) unit can be chlorinated at any given time. This condition remains in the Draft SPDES Permit.

This current level of chlorination would not be sufficient to control general biological levels in the cooling tower water nor would it be sufficient for control of *Legionella* bacteria (Puckorius 2013). The levels of nutrients and microbiological organisms being concentrated in the cooling tower water at three (3) cycles are expected to need at least two (2) to three (3) times this level for general microbiological control, and much more for control of *Legionella*, as recommended

by the CTI for "clean water," and are expected to be higher on an IPEC-specific basis (Puckorius 2013).

The result of higher chlorination requirements would be the need to install a dechlorination system to reduce the TRC in the blowdown to acceptable levels for discharge (Puckorius 2013). If sufficient space is available for such an operation, the system would presumably use a reducing chemical such as sodium bisulfite or sulfur dioxide to be fed into the blowdown water prior to discharge that reacts with and destroys the chlorine residual. It also utilizes an Oxidation Reduction Potential ("ORP") monitoring and chemical feed control system to feed and control the proper level of reducing agent (Puckorius 2013).

NYSDEC Staff may mandate additional SPDES Permit limitations, which would require further treatment of the blowdown prior to discharge, the site-specific feasibility and added cost of which is not considered in either Report. For example, based on TSS concentrations in the makeup water, post-treatment of cooling tower blowdown for suspended solids removal may be necessary, particularly if the cooling towers were operated at three (3) cycles of concentration.

3.3.4.1 Stormwater

The Powers Report does not address post-construction stormwater management. The Tetra Tech Report indicates that construction of the proposed ClearSky™ cooling towers would require clearing and blasting on the IPEC Site (estimated in this Response at 16 acres), thereby exposing a highly impermeable bedrock surface. To address post-construction stormwater runoff, the NYSDEC Staff Proposal evaluated sizing requirements for two (2) stormwater events: the 25-year, 24 hour storm and the 50-year, 24 hour storm. The analysis by Tetra Tech assumed that the increase in site stormwater runoff would be intercepted by a perimeter ditch surrounding the proposed cooling towers and conveyed through a concrete lined channel to the Hudson River. The analysis did not consider any proposed treatment for the water quality volume, required for redevelopment projects or new development projects, as specified in the *New York State Stormwater Management Design Manual* (August 2010). Thus, in addition to lacking any meaningful analysis of construction-related stormwater impacts and cooling tower operational impacts to water quality associated with their Proposals, neither Report addresses post-construction stormwater management issues and the ability to manage them appropriately given the proximity of the Hudson River.

3.3.5 Risk of Legionnaires' Disease

As Puckorius & Associates, Inc. and CDM Smith (2013) (Appendix F) provide, cooling towers are well-known sources of waterborne pathogens, providing a warm water environment for their propagation and subsequent dispersal through air (Puckorius 2013, CDM Smith 2013). As shown in Figure 2-2 of Appendix A, the ClearSky™ condensing modules are located above the wet section of the cooling towers. As such, they are not saturated by the circulating water flow rate containing water treatment chemicals as is the cooling tower fill. Nevertheless, cooling tower drift, which contains the same constituents as the circulating water, will wet these surfaces during operation. Because of this, these surfaces are also subject to sediment fouling and biological growth, including growth of waterborne pathogens (Puckorius 2013).

For example, as CDM Smith (2013) indicates, Legionnaires' Disease is a potentially lethal form of pneumonia caused by inhaling aerosols that contain the pathogen, *Legionella pneumophila* (Fraser et al. 1977, McDade et al. 1979, Hoge & Breiman 1991). Numerous outbreaks (as well as isolated cases) of Legionnaires' Disease, and a more mild disease-form, Pontiac Fever

(collectively, these diseases are termed Legionellosis), have been reported (White et al. 2013, Walser et al. 2013). The sources of many of these outbreaks have been cooling towers, as determined by epidemiology combined with serological testing; and *Legionella* have been measured in the drift from cooling towers (Tyndal 1983).

CDM Smith (2013) also points out that an investigation of an outbreak of Legionnaires' Disease in Pas-de-Calais, France, indicated that pathogenic *Legionella* released from a cooling tower can infect people located as far as six (6) kilometers from the source (Nguyen et al. 2006). The source of this outbreak was a "powerful industrial cooling tower" at a petrochemical plant, which infected at least 86 members of the surrounding communities, of whom 18 (that is, 21% of the confirmed cases) died.

Despite considerable knowledge regarding control of the outgrowth of *Legionella* in cooling towers (see, for example, WHO 2007; Cooling Technology Institute 2008), outbreaks due to insufficiently disinfected cooling towers continue to occur (CDM Smith 2013). For example, in July through September of 2012, in Quebec City, Quebec, Canada, emissions from a five- (5-)-story office building cooling tower caused Legionnaires' Disease in at least 180 people, of whom 13 died (7%) (CBC News 2012, available at http://www.cbc.ca/news/canada/montreal/new-legionnaires-cases-in-quebec-city-raise-total-to-180-1.1143198).

CDM Smith (2013) also indicates that White et al. (2013) described 19 cases of Legionnaires' Disease, including three deaths, from *Legionella pneumophila* (serogroup 1) that had emanated from a cooling tower in Christchurch, New Zealand.

White and colleagues (2013) note that Legionnaires' Disease:

> *. . . has an important impact on population health accounting for 2–15% of community-acquired pneumonia hospitalizations per year [Stout & Yu, 1997; Holst et al., 1980]. The United Kingdom Health Protection Agency estimate a 10–15% case-fatality risk [Joseph, 2002] whereas the United States Centers for Disease Control and Prevention estimates 5–30% [Marston et al., 1994], rising to 80% for the most at risk groups [Dierderen, 2008].*

German researchers Walser and colleagues (2013) add:

> *Despite mandatory reporting for legionellosis in several countries, the true number of cases is probably highly underestimated. For instance, approximately 600 infections are annually reported in Germany. However, the actual number of community-acquired cases of pneumonia caused by Legionella infections per year is estimated at 15,000–30,000 by CAPNETZ (network of excellence for the Community Acquired Pneumonia) calculations (Robert-Koch-Institut, 2012; vonBaum and Lück, 2011). Thus, 4% of pneumonia cases in Germany, which were not acquired in the hospital, are caused by Legionella infection and up to 80% of these by Legionella pneumophila (vonBaum et al., 2008). The problem of underestimation is also known from other European countries (ECDC, 2010) and other continents (Center for Disease Control and Prevention, 2011).*

Summaries of some relatively recently published outbreak-investigations are tabulated below in Table 3.3-2 (CDM Smith 2013). In each case, the outbreaks were tied to emissions from wet cooling towers, and in 16 of these 19 outbreaks, the association was confirmed by stereotyping

and/or molecular subtyping of *Legionella* bacteria from patients and from the water in the cooling towers.

Table 3.3-2
Published Studies on Outbreaks of Legionellosis Tied to Cooling Tower Emissions (2001 through 2012)
(Adapted from Walser et al. 2013)

City/County (Country) Year	Confirmed Cases	Lethality Rate (%)	Reference
Alcoy (Spain) 1999-2000	177	6%	Fernández et al. 2002
Melbourne (Australia) 2000	125	3%	Greig et al. 2004
Barcelona (Spain) 2000	54	6%	Jansá et al. 2002
Murcia (Spain) 2001	449	1%	Garcia-Fulgueiras et al. 2003
Cerdanyola (Spain) 2002	113	2%	Sabria et al. 2006
Hereford (Great Britain) 2003	28	7%	Kirrage et al. 2007
Rome (Italy) 2003	15	7%	Rota et al. 2005
Pas-de-Calais (France) 2003/2004	86	21%	Nguyen et al. 2006
Lidköping (Sweden) 2004	30	7%	Hugosson et al. 2007
Cherokee County, Georgia (USA) 2004	7	29%	Phares et al. 2007
Christchurch (New Zealand) 2005	19	16%	White et al. 2013
Sarpsborg (Norway) 2005	56	6%	Nygard et al. 2008
Ontario (Canada) 2005	82	28%	Gilmour et al. 2007
Vic-Gurb (Spain) 2005	55	6%	Sal Ferré et al. 2009
Pamplona (Spain) 2006	146	0%	Castilla et al. 2008
Amsterdam (Netherlands) 2006	31	10%	Sonders et al. 2008
Rhymney/Cynon Valley (Great Britain) 2010	22	7%	Keramarou and Evans 2010
Ulm, Neu-Ulm (Germany) 2010	64	8%	Freudenmann et al. 2011
Edinburgh (Great Britain) 2012	50	4%	McCormick et al. 2012

Thus, the risks of such outbreaks are a real potential, and must be accounted for under SEQRA. Despite these known serious risks, the Tetra Tech and Powers Reports fail to address and assess the significant potential human health risks from inadequately disinfected cooling towers. The Tetra Tech and Powers Reports also fail to address the potential environmental injustice of introducing this human health risk to the surrounding communities.

3.4 AIR QUALITY

3.4.1 Introduction

For Proposals, such as those described in the Tetra Tech Report and the Powers Report, each of which involves the introduction of substantial new sources of air pollution, applicable permitting law and SEQRA require an analysis of impacts to air quality, all consistent with federal and New York law. With regard to air emissions, the Tetra Tech Report states only that:

"PM10/PM2.5 will be emitted from cooling towers; emission estimates and permitting requirements evaluated separately by NYSDEC" (Tetra Tech, Table 3-1). To date, NYSDEC Staff has not provided any such analysis. Similarly, the Powers Report is silent on whether operation of the proposed cooling towers reasonably can be expected to receive the necessary permits for construction and operation. Substantial information suggests that it cannot.

The operation of cooling towers is described in Chapter 2.0 and in more detail in Appendix A of this Response. As relevant to air quality, cooling towers perform their cooling function via sensible heat transfer (direct cooling) and latent heat transfer (evaporation) from a large volume of circulating water, resulting in a portion of the water spray (so-called "drift") leaving the tower and entering the atmosphere. Drift consists of minute water droplets which contain dissolved and suspended particulate material and other contaminants found in the makeup water which is required to replace water lost through evaporation, drift and cooling tower operation. As the drift droplets rise in the atmosphere, the water evaporates leaving the residual particulate material and/or other contaminants to disperse within the ambient air. Particulate material consists of all types of TDS and TSS, including microbiological and potentially pathogenic organisms in the cooling water, as discussed in Chapter 3.3.

Cooling towers are typically designed with devices called "drift eliminators." The term is a misnomer in that these devices do not entirely eliminate drift. Instead, they reduce drift emissions to a small percentage of the circulating cooling water, depending upon a variety of factors such as the cooling tower fill, the tightness of construction (i.e., no gaps), and the chemicals used to treat the cooling tower water (Chapter 3.3), among other things. The "drift rate" is a term that means the percentage of water that is circulating within the "closed loop" system (traveling from tower to condenser and back again) that escapes the tower as liquid water droplets. For purposes of a simple example, if a cooling tower is circulating 100 gallons per minute, and one (1) gallon per minute exits the tower as drift, the drift rate is 1/100 or 1%. Depending upon tower-specific conditions, drift rates can be very low, and in ideal circumstances may approach 0.0005%. However, as applied to very large cooling towers, such as those in the NYSDEC Staff and Riverkeeper Proposals circulating 700,000 gallons per minute and depending on the water source (and its corresponding treatment), the quantity of drift can still be quite large (*e.g.*, using a 0.001% drift rate as an example only, the quantity of drift would be 14 gallons per minute for both towers (or seven (7) gallons per minute each).

As discussed in Chapter 3.3, as the number of cooling tower cycles of concentration increase, the concentration of dissolved and suspended particulates increases, leading to similar increases of particulates within the drift. Entrainment of particulates also results as a function of tower operation. Thus, particulate emissions increase with increasing cycles of concentration, and the cycles of concentration must be accounted for when evaluating air quality. Even without accounting for their cycles of concentration, the towers described in the Tetra Tech and Riverkeeper Proposals will be significant sources of particulate emissions for which a full air quality analysis is necessary – something that is entirely lacking in the NYSDEC Staff and Riverkeeper Proposals.

This chapter identifies the substantive and significant omissions of the NYSDEC-proposed ClearSky™ cooling towers at the IPEC Site and the Riverkeeper Proposal of similar mechanical draft cooling towers, with respect to air quality. Specifically, it addresses:

- The regulatory framework governing air quality and new sources of air emissions
- The cooling tower drift rate

- The highly variable salinity (as a TDS) and turbidity (as TSS) of the Hudson River and the contribution to particulate emissions from the towers of these factors
- The particle size distribution of liquid water droplets and subsequent particulate matter size fraction.

3.4.2 Regulatory Context and Permitting Requirements

The Clean Air Act ("CAA") is the comprehensive federal law that regulates air emissions from stationary sources. Among other things, the CAA requires the United States Environmental Protection Agency ("USEPA") to establish two (2) sets of National Ambient Air Quality Standards ("NAAQS") – one to assure the protection of public health (primary standards) and another to assure the protection of public welfare (secondary standards). The NAAQS are based on scientific studies of the harmful effects of air pollutants and are designed to protect the health of the most sensitive individuals in the general population with an adequate margin of safety to ensure against direct adverse health effects. NAAQS are subject to periodic review and revision based on the results of additional scientific studies as recommended by the Clean Air Scientific Advisory Committee, the body of scientists and educators that provides independent advice to the USEPA Administrator. In the initial promulgation of NAAQS, USEPA established standards for what it then called Total Suspended Particulate ("TSP"), as one of the criteria pollutants.

In 1987, in response to the results of continued scientific research, USEPA replaced the earlier TSP standard with a particulate matter ("PM") standard (PM-10) (particles with an aerodynamic diameter less than ten (10) micrometers). The standard focuses on smaller particles that are likely responsible for adverse human health effects because of their ability to reach the lower regions of the human respiratory tract (USEPA 2009). The PM-10 standard applies to particles with a diameter of ten (10) micrometers or less (0.0004 inches or one-seventh the width of a human hair). USEPA's primary NAAQS (i.e., the NAAQS deemed protective of human health) for PM-10 is 150 micrograms/cubic meter ("$\mu g/m^3$"), measured as an average daily concentration.

Major concerns for human health from exposure to PM-10 include: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, are especially susceptible to the effects of particulate matter. Recent scientific research studies suggested that fine particles may be even more likely to cause serious adverse human health effects. As a result, on October 17, 2006, USEPA established a new NAAQS for PM-2.5 (particles with an aerodynamic diameter less than 2.5 micrometers) of 35 $\mu g/m^3$ measured as a daily average concentration from continuously monitored ambient levels (the 24-hour PM-2.5 concentration); on December 14, 2012, USEPA set 12 $\mu g/m^3$ measured as an annual concentration (i.e., the average of 365 daily concentrations, or the annual PM-2.5) (78 FR 3086 January 15, 2013 National Ambient Air Quality Standards for Particulate Matter - Final Rule).

Investigators at USEPA and elsewhere have attempted to determine whether some components, types or other attributes of ambient PM are more harmful than others. To date, evidence from these numerous studies has been insufficient to rule out any PM-subtypes as not being harmful to human health or the environment. Overall, as stated by USEPA (2011):

> *We . . . conclude that the currently available evidence is too limited to provide support for considering a separate indicator for a specific $PM_{2.5}$ component or source category of fine particles or for eliminating any individual component or*

> *source category from the mix of fine particles included in the $PM_{2.5}$ mass-based indicator.*

USEPA (2012) adds:

> *We assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption, because $PM_{2.5}$ varies considerably in composition across sources, but the scientific evidence is not yet sufficient to allow differentiation of effect estimates by particle type. The Integrated Science Assessment for Particulate Matter (PM ISA), which was twice reviewed by CASAC [the Clean Air Science Advisory Committee], concluded that "many constituents of $PM_{2.5}$ can be linked with multiple health effects, and the evidence is not yet sufficient to allow differentiation of those constituents or sources that are more closely related to specific outcomes"* (USEPA 2009).

Once the PM-2.5 NAAQS were established, USEPA designated areas of the country as either not attaining (non-attainment) or as achieving (attainment) the PM-2.5 ambient standards. Non-attainment of the PM-2.5 standard occurs when the existing ambient background concentrations of PM-2.5 are shown through ambient monitoring to consistently exceed the standard. Under those circumstances, a State Implementation Plan ("SIP") must be submitted by the state government that has areas designated as non-attainment with NAAQS (non-attainment areas are geographically assigned at the county level by USEPA). The SIP is an enforceable plan that explains how the state intends to comply with NAAQS in accordance with the CAA.

IPEC is located in Westchester County, which is in NYSDEC Region 3, Metropolitan Air Quality Control Region. Westchester County is currently classified as in attainment with the PM-10 NAAQS, but as in non-attainment with the two (2) PM-2.5 NAAQS. A review of recent monitoring data from Westchester County indicates that the County has attained the PM-2.5 NAAQS but has yet to be designated as being in attainment by USEPA. In June 2013, NYSDEC submitted a reclassification request and maintenance plan to the USEPA for approval, which is currently under review. NYSDEC has indicated that it may require well over a year to implement the redesignation once promulgated by USEPA. In the interim, and pending redesignation by USEPA of Westchester County, the NYSDEC Staff Proposal and the Riverkeeper Proposal must be evaluated under a non-attainment review (6 NYCRR § 231-5 New Major Facilities And Modifications To Existing Non-Major Facilities In Non-attainment Areas, And Attainment Areas Of The State Within The Ozone Transport Region; § 231-12.6 Significant impact levels in non-attainment areas), which restricts new major sources of PM-2.5 to a maximum contribution to ambient PM-2.5 concentrations of 1.2 $\mu g/m^3$, the so-called significant impact level ("SIL").

In non-attainment counties like Westchester County, USEPA requires the implementation of measures to reduce background concentrations of PM-2.5 so that the ambient standard will be achieved. New major sources of PM-2.5, e.g., those sources having a PM-2.5 potential to emit ("PTE") greater than 100 tons per year (or a modification to an existing source greater than ten (10) tons per year) and proposed to be sited in a PM-2.5 non-attainment area, or those having a PTE of greater than 250 tons per year, must demonstrate that their particulate emissions will not result in contravention of the PM-2.5 ambient standards or significantly contribute to a PM-2.5 non-attainment area. The PTE calculation is carefully prescribed, and designed to ensure that all potential emissions are accounted for, so that installations, once constructed, do

not emit more than was projected when the installation was approved (6 NYCRR § 231-5). Potential to emit is defined as the maximum capacity of a facility or source to emit any air contaminant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or source to emit any air contaminant, including air pollution control equipment and/or restrictions on the hours of operation, or on the type or amount of material combusted, stored, or processed, are treated as part of the design provided the limitation is federally enforceable (6 NYCRR § 201-2 Definitions). Further, the PTE demonstration must be made through an air quality modeling analysis as part of the 6 NYCRR § 201 Air Permitting process.

Neither Tetra Tech nor Powers have performed a PTE analysis. However, TRC did so in 2010 for closed-cycle cooling designed to address the IPEC design heat load. Consistent with that 2010 analysis, and accounting for the Tetra Tech specification of three (3) cycles of concentration and the ENERCON Response to the Tetra Tech and Powers Reports (Appendix A), emissions from the NYSDEC Staff and Riverkeeper Proposals exceed PTE calculated in 2010, perhaps substantially. As a result, the NYSDEC Staff and Riverkeeper Proposals both are expected to have a PM-2.5 PTE in excess of 100 tons per year, designating these Proposals as major sources under 6 NYCRR § 231-5 in non-attainment locations and potentially major sources in attainment areas, and may exceed the attainment thresholds under a proper drift rate that has yet to be established, and as such are obligated to demonstrate compliance with the ambient standards. Both Tetra Tech and Powers have failed to perform these analyses.

Furthermore, in accordance with NYSDEC Policy CP-33, "Assessing and Mitigating Impacts of Fine Particulate Matter Emissions," emissions of PM need to be quantified to determine if a proposed project could have a potential for significant adverse health and/or environmental impacts (NYSDEC 2003). If primary PM-10 emissions from a proposed project do not equal or exceed 15 tons per year (the *de minimis* threshold for PM-10), then the PM-2.5 impacts from a proposed project are deemed insignificant, and no further assessment is required. The potential particulate emissions from both the NYSDEC Staff and Riverkeeper Proposals, as calculated by TRC, exceed the 15 ton per year threshold. Consequently the Proposals are subject to NYSDEC CP-33 assessment requirements. Both Tetra Tech and Powers failed to address or incorporate CP-33 in their assessment of the environmental effects of the proposed cooling towers.

3.4.3 Drift Rate

In support of ENERCON's 2003 Report on closed-cycle cooling, SPX (Marley) selected a cooling tower with a drift rate of 0.001% for IPEC site-specific conditions. In 2007, ENERCON contacted SPX (Marley) regarding the performance of drift eliminators. SPX (Marley) indicated that it could guarantee a drift rate of 0.0005% from its drift eliminators; however, SPX (Marley) underscored that the guarantee was subject to a series of conditions (Arnston 2007):

> In order to guarantee the 0.0005% drift performance *the attached Preferred Water Condition document and the below drift clarification language would have to be included* to clarify possible causes of drift and the effects on testing: 'Marley XCEL plus drift eliminators have been proven to achieve drift levels less than 0.0005% *per 3rd party CTI tests*. Because of this, and the predicted drift rate for this tower, our proposal conforms to the specified drift rate of 0.0005%. *However, it should be noted that drift rate is extremely sensitive to cooling tower circulating water quality irrespective of the eliminator design. Certain water treatment chemicals containing glycol and surfactants, frequently used as biodispersants and antifoam agents, are known to cause elevated drift rates.*

> *Failure to meet the specified drift levels due to water chemistry issues fall outside the scope of the contract. Please refer to Section 2.3.8, General Water Quality, of CTI Test Code ATC 140 and to Marley's "Preferred Cooling Tower Water Condition Limits. ... Drift rates of 0.0005% are extremely difficult to measure using methods described in CTI Test Code ATC 140. Should drift testing be required, further discussion should occur to minimize inaccuracies of any test results and to reach a mutually agreeable test plan.'*

Thus, the supposed guarantee provided by SPX (Marley) is a conditional guarantee, one that is subject to compliance with the Preferred Cooling Tower Water Condition Limits ("PCTWCL") provided by SPX (Marley) (SPX 2009) and the referenced section of the CTI Test Code ATC 140. Further, SPX (Marley) has indicated that the CTA tests to which it refers are small-scale lab tests using distilled or purified water.

3.4.4 Preferred Cooling Tower Water Condition Limits

The PCTWCLs include the following limits that cannot be satisfied, for the reasons given, on a site-specific basis at IPEC:

1. **TDS: 5,000 ppm (mg/l) for Total Dissolved Solids ("TDS")** – Tetra Tech itself confirms that this limit will be substantially exceeded, noting that the expected maximum circulating TDS concentration within the towers will be 24,000 ppm (mg/l) – or nearly five (5) times the limit provided in the PCTWCLs. Moreover, SPX (Marley) acknowledges TDS concentrations above the PCTWCLs *"may require thermal performance degradation,"* meaning that overall plant performance, not just the drift rate, would be impacted at the expected TDS levels.

2. **Chlorine: One (1) ppm free residual intermittently (shock), or 0.4 ppm continuously maximum for "clean water," accounting for the fact that excess can attack sealants, accelerate corrosion, increase drift and embrittle PVC** – The Tetra Tech Report makes no mention of the need to chlorinate the circulating water within the cooling towers to manage bio-fouling and control the growth and potential dispersion of Legionella (among other things). However, the header to the PCTWCLs notes that *"[b]iological treatment and control of Legionella and other potentially health-threatening bacteria is essential. Consult a competent water treatment expert or service company,"* and also notes that *"[b]iocidal treatment is required for all cooling tower installations."* Tetra Tech does not appear to have engaged in such consultations to determine whether the chlorine limits would be exceeded on a site-specific basis, notwithstanding the undisputed need for biocide treatment.

3. **Drift Effects:** The PCTWCLs include the following note on contaminants and chemicals that may increase the drift rate: "Certain contaminants or treatment chemicals such as surfactants, glycols, bio-dispersants and antifoams may increase drift rate. When minimizing drift is vital, the circulating water shall have a surface tension of at least 65 dynes per centimeter and a total organic carbon ("TOC") level below 25 ppm. *Reclaim or re-use waters in particular may contain contaminants which increase drift rate either directly or by necessitating the use of treatment chemicals which increase drift rate.*" (Emphasis in original reference, SPX 2009). According to Dr. Puckorius, chemicals needed for suspended solids control, iron oxide control, microbiological control (i.e., residual chlorine) are dispersants and surfactants, which are necessary for proper operation of the cooling tower.

Thus, compliance with the PCTWCLs cannot be achieved at IPEC, and as such an operational drift rate of 0.0005% is not a correct assumption for either the NYSDEC Staff or Riverkeeper Proposals for cooling towers at IPEC. Indeed, there is evidence at other large stations, including in estuarine conditions, that drift rates are substantially higher, e.g. 0.0015% at Crystal River Power Plant, Florida (Dominion 2009).

3.4.5 Hudson River Salinity

As discussed in Chapter 3.3, the Hudson River is a tidal estuarine system with diurnal and seasonal changes in salinity that significantly change the TDS content of the proposed cooling tower circulating water over time. ASA estimated salinity on an annualized basis at the IPEC intake (ASA 2010).

Specifically, ASA performed a statistical analysis of the salinity data at each of the United States Geological Survey ("USGS") stations located at Hastings-on-Hudson (Hastings), Tomkins Cove (Tomkins), and West Point. The analysis revealed a decrease in salinity to the north (upriver), from Hastings to Tomkins to West Point. Mean salinity at Hastings was 6.29 psu, Tomkins was 2.09 psu, and West Point was 0.79 psu, with the 90th percentile salinity values of 10.88 psu (Hastings), 4.96 psu (Tomkins) and 2.63 psu (West Point). Lowest salinity, as determined by the mean and 90th percentile salinity values for the periods of record, occurred in April and is correlated with high freshwater discharge. The highest mean and 90th percentile salinity values occurred in September at Hastings and West Point, primarily as a function of reduced freshwater discharge and corresponding saltwater intrusion.

The decadal (2000-2009) salinity time series at IPEC, equated to Tompkins, was generated to provide a long-term estimate of salinity under a variety of environmental conditions. The ASA analysis showed that salinities were typically higher in the summer and fall seasons, consistent with the observations at the USGS stations. Some years (2000, 2001, and 2006) showed extended periods of salinity exceeding five (5) psu for three (3) month periods with peaks exceeding seven (7) psu.

The variability in the annual salinity of the Hudson River was not accounted for or addressed by either the Tetra Tech or the Powers Reports. Therefore, both the NYSDEC Staff and Riverkeeper Proposals failed to capture the actual worst-case operating conditions of the cooling towers and consequently neglected to address the variability in the particulate emissions resulting from cooling tower drift.

3.4.6 Particulate Size Fractionation

The particle size fraction of the evaporated liquid drift droplets is also related to the salinity of the circulating water within the cooling tower as well as the drift droplet distribution of liquid droplet particle sizes within the emitted cooling tower drift. As noted above, there is considerable variability in the Hudson River salinity. Consequently, this causes variability in the drift droplet distribution and ultimately in the evaporated particulate particle sizes.

The Powers Report incorrectly suggests that the PM-2.5 fraction of the total particulate matter resulting from the evaporated liquid drift is 15%. However, in the absence of a quantifiable and reproducible particle size distribution, the air quality compliance demonstration as required by NYSDEC (6 NYCRR § 231) must be performed with the assumption that the particulate emissions from TDS in the cooling tower drift are entirely PM-10 and PM-2.5. This is consistent with the USEPA AP-42 emission factor calculation for PM-10 (USEPA Emissions Factors & AP

42, Compilation of Air Pollutant Emission Factors - Chapter 13.4 http://www.epa.gov/ttnchie1/ap42/).

Attempts have been made by researchers to quantify the fraction of total particulate emitted as PM-2.5 and PM-10. One method uses the drift water droplet size emitted by the drift eliminator and evaporates the water leaving the solid particulate as an evaporated nucleus (Reisman & Frisbie 2001). This method is entirely dependent on the drift droplet size spectrum of the water droplets, which has been generated under laboratory conditions using distilled water which, of course, does not represent actual cooling tower operating conditions and is of little value for real world applications. The actual tower operating conditions include a mixture of chemicals in the circulating water including surfactants, biocides, and anti-scaling agents (Chapter 3.3), in addition to the brackish Hudson River water being used for makeup. Some of the factors affecting the drift droplet spectrum estimates include:

- The specific construction material used for the drift eliminator bed.
- The installation method for bedding material within the tower (e.g., any small voids allowing spray to penetrate the bed cause radically different drift spectrum characteristics).
- The specific circulating water chemistry (e.g., surfactants, biocides, TDS, and salinity of makeup water).

Changes in any of these factors may radically change the drift droplet spectrum. As such, there is considerable uncertainty regarding the calculation method for determining the fraction of emitted particulate matter that consists of PM-2.5.

Based on an understanding of the aforementioned body of knowledge, the drift droplet distribution is highly uncertain and unique for each tower and operation. In light of this uncertainty, particulate emissions must be assessed assuming they consist of entirely of PM-10 (for the PM-10 analysis) and entirely of PM-2.5 (for the PM-2.5 analysis) which is consistent with USEPA requirements.

3.4.7 Conclusion

In order to evaluate the environmental impacts of the NYSDEC Staff Proposal and the Riverkeeper Proposal in accordance with air quality law and SEQRA, a comprehensive air quality assessment of the potential particulate emissions must be prepared. For instance, SEQRA requires that, in making a determination of significance, identified relevant areas of environmental concern must be thoroughly analyzed to determine if there is the potential for a significant adverse impact on the environment (§ 617.7 (b)(3)). Cooling towers are known sources of PM emissions. Consequently, these issues should have been analyzed in the Tetra Tech and Powers Reports, but were not. Both Reports fail to address the air quality impacts associated with particulate emissions from the cooling towers, and each Report fails to evaluate compliance with the PM-10 and PM-2.5 NAAQS consistent with applicable law and standard regulatory practices. As such, both Reports fail in their obligation to provide a SEQRA-compliant impact assessment and sidestep the critical air quality considerations from their respective Proposals.

Given the absence of applicable analyses, as well as the inappropriate selection of drift rates and fractionalization formulae which are neither site-specific, nor established, there is no assurance

that air quality analysis under federal and New York law, including SEQRA, would authorize the NYSDEC Staff or Riverkeeper Proposals. To the contrary, prior work performed by TRC indicates that no authorizations will result, and that air quality impacts can be characterized as LARGE, even if Westchester County were to be deemed in attainment.

3.5 NOISE

A detailed noise impact analysis typically includes a baseline assessment of existing noise levels near the project area, modeling of cooling tower noise levels, estimation of noise levels during cooling tower operation at nearby noise sensitive areas, and a comparison of these noise levels to the Village Code (Chapter 211) limits as well as NYSDEC's noise guidance. None of these analysis components were conducted by Tetra Tech for the NYSDEC Staff Proposal.

The Tetra Tech Report provides a limited and essentially qualitative discussion of potential noise impacts associated with construction and operation of the NYSDEC Staff Proposal. With respect to construction-related noise impacts, the Tetra Tech Report states that *"[e]ffects of blasting and other construction activities on dust and noise would need to be analyzed in detail to determine effects on land use in the study area"* (p. 95). While conceding its relevance, no meaningful discussion of construction-related noise impacts is provided by Tetra Tech.

With respect to operation of the ClearSky™ cooling towers in the NYSDEC Staff Proposal, Section 3.3 of the Tetra Tech Report, states that operating sound levels are regulated by the Village Code (Chapter 211), which establishes maximum sound pressure levels ("SPLs") for various frequency ranges to be enforced *at the property boundaries* at IPEC (p. 31, p. 94). This means that any analysis must evaluate sound levels at the property boundaries. Tetra Tech does not do so. Instead, it presents the "*baseline cooling tower sound pressure levels*" in a tabular form. However, in conjunction with Figure 3.1 of the Report, this table shows that SPLs, for a noise-mitigated design, beyond the IPEC property line will exceed the maximum levels permitted under the Village Code (Chapter 211), although the scope and extent of those exceedences is not addressed. For example, Table 3-2 of that Report indicates that the maximum sound pressure level allowed under the Village Code (Chapter 211) for the frequency range of 20 to 75 hertz ("Hz") is exceeded (according to Table 3-3) at distances of at least 100 meters from the towers (p. 31). Figure 3-3 of the Report shows that the proposed cooling towers are within 100 meters of the IPEC Site property boundary. Instead, the Tetra Tech analysis, however inadequate, establishes that the NYSDEC Staff Proposal would not conform to applicable law. No further discussion of operational noise levels is provided in the Tetra Tech Report, nor is any discussion provided on whether additional noise mitigation measures are available or practical. Further, key sensitive receptors, such as residences, a school, and public park areas are located in close proximity to the NYSDEC Staff Proposal cooling towers (northern array), yet no analysis was provided, either regarding the potential noise impacts or compliance with local laws.

The Powers Report lacks any noise analysis or evaluation of noise impacts – construction or operation. Rather, the Report simply states that it expects Entergy to be able to carry out blasting and construction activities in compliance with the applicable Village Code (Chapter 211) regulations. Given that lack of noise impact analysis, the Powers Report does not meet the requirements of SEQRA to provide an evaluation of potential significant adverse impact and the reasonable likelihood of its occurrence (6 NYCRR § 617.9(b)(5)).

As discussed further below, a limited operational noise assessment was performed by TRC for this Response utilizing the limited operational SPLs provided in the Tetra Tech Report and

available historical ambient noise monitoring data in the project vicinity. It confirms non-compliance with the state and local law.

3.5.1 Summary of Noise Measurement and Concepts

Noise is measured logarithmically and typically on the decibel A-weighted ("dBA") scale. The dBA scale has been shown to provide a good correlation with the human response to noise and is the most widely used descriptor for community noise assessments (Harris 1991). The ability of an average individual to perceive changes in noise levels is well documented. Generally, an increase of less than three (3) dBA above ambient noise levels is barely perceptible to most listeners, a five (5) dBA increase is readily noticeable, and a ten (10) dBA increase is perceived as a doubling of the noise level (NYC OEC January 2012). In order to provide context to a given dBA level, noise levels associated with common machinery or environments are provided in Table 3.5-1.

Table 3.5-1
Common Sounds and Noise Levels

Sound Source	Sound Source (dBA)
On Platform by Passing Subway Train	100
On Sidewalk by Passing Heavy Truck	90
On Sidewalk by Typical Highway	80
Typical Urban Area	60-70
Typical Suburban Area	50-60
Quiet Suburban Area at Night	40-50
Source: NYC OEC January 2012.	

In addition, certain noise descriptors appear in certain sections below. An Equivalent Noise Level ("Leq") is the equivalent noise level over a specified period of time (i.e., one- (1-) hour). It is a single dBA value that includes all of the varying sound energy in a given duration. Statistical Noise Levels are the A-weighted noise levels that are exceeded a certain percentage of the time. For example, the L_{90} is the noise level exceeded 90% of the time and is often considered the background or residual noise level, representing the lower range of noise levels without intrusive sources of noise, such as passing trains, cars, aircraft, etc. The L_{10} is the noise level exceeded ten (10)% of the time and is a measurement of intrusive noises, such as aircraft overflight.

3.5.2 Construction Impacts

Construction projects can result in potential significant noise impacts. The potential for impact can be associated with the magnitude of the increase in noise over existing levels, the absolute noise level of construction, and the duration of the construction activity (FHWA 2012). The Tetra Tech Report acknowledges that the ENERCON construction schedule estimate of 12 to 13 years for closed-cycle cooling at IPEC, *"is not unreasonable given the volume of blasting and spoils removal that would have to occur, and the limitations placed on construction activities by local ordinances and seasonal weather concerns."* (Tetra Tech 2013 Appendix B (p.3 of July 6, 2010 memorandum)). Quantification of construction noise levels and their potential to result in adverse impacts is routinely conducted for projects in New York State, in particular for long-term construction projects (FHWA 2012) and for projects of smaller scale and shorter duration than the Proposals by NYSDEC Staff and Riverkeeper (Caithness 2013, CPV Valley 2008, Gateway 2010).

Construction-related noise impacts are particularly important to address for large scale projects with a protracted schedule as is the case with the NYSDEC Staff and Riverkeeper Proposals. The Tetra Tech Report acknowledges the magnitude of the Project, including that approximately two (2) million cubic yards of blasting spoils will need to be excavated and moved from the IPEC Site. Spoils, if not removed by barge, would be removed by *"a steady stream of heavy duty trucks entering and exiting the site via surface streets"* (p. 33). The Report also acknowledges that the transportation process by itself could result in noticeable noise, but does not quantitatively address potential adverse noise impacts of these activities. The Report further states that if spoils are removed by barge, then a conveyor system would be used with screens to exclude rock fragments larger than 12 inches in diameter (p. 34). This suggests that rock crushing operations may also be required, but was not discussed or evaluated. Since no construction analysis is provided for a project of this magnitude and duration, the Tetra Tech Report is materially deficient.

Construction of the NYSDEC Staff Proposal will require large numbers of on-site construction equipment, such as backhoes, dump trucks, excavators, etc., and also include detonation of blasting charges. For general reference, Table 3.5-2 lists typical construction equipment and their associated noise levels measured at a distance of 50 feet.

Table 3.5-2
Noise Levels of Major Construction Equipment

Equipment Type	Noise Level (dBA) At 50 Feet
Concrete Mixers/Trucks	85
Dump Trucks	84
Front Loaders	80
Graders	85
Bulldozers	85
Backhoes	80
Rock Crusher	89 (at 100 feet)
Excavator	85
Rock Drill	85
Blasting	94

Sources: (FHWA 2006) except for Rock Crusher (NYSDEC 2001).

Construction noise impact potential for the NYSDEC Staff Proposal at the IPEC Site is addressed through the NYSDEC Noise Policy (NYSDEC 2001), and Section 119-5(B) of the Village Code (Chapter 119). The NYSDEC Noise Policy includes a procedure for initially screening all facets of construction that produce noise including land clearing and for equipment operation for excavating, hauling or conveying materials (NYSDEC 2001). When the initial review of noise levels associated with the equipment and activities indicate that a *"marginal or significant noise impact may occur, **further evaluation is required**"* (emphasis added). The Noise Policy further states that *"in determining the potential for an adverse impact, consider not only ambient noise levels, but also the existing land use, and whether or not an increased noise level or the introduction of a discernible sound, that is out of character with existing sounds, will be considered annoying or obtrusive."* (NYSDEC 2001).

Section 119-5(B) of the Village Code prohibits *"construction, demolition and the use of chain saws ... between the hours of 7:00 p.m. and 8:00 a.m., except in the event of an emergency*

requiring immediate construction or demolition" unless such activities result in noise that cannot be heard beyond the property boundary by a person with normal hearing.

Considering the scope, extent and duration of the activities necessary to construct the NYSDEC Staff Proposal - i.e., blasting, excavation, trucking, and use of heavy equipment - construction of the Proposal would appear to have the potential to result in MODERATE to LARGE noise impacts, particularly if the bulk of the blast spoils are moved by truck. A detailed construction-based noise analysis, which Tetra Tech did not undertake, is therefore necessary to determine and characterize the potential construction noise impacts associated with the NYSDEC Staff Proposal.

3.5.3 Operational Impacts

Existing Noise Conditions

Tetra Tech did not present any existing ambient noise level data in their Report. Existing noise level data are necessary for quantifying the potential for noise impacts. TRC used ambient noise level data for the area from noise monitoring that was conducted in September 2001 and January 2002. Measurements were conducted within approximately a one (1) mile radius of the IPEC Site (TRC 2003). Monitoring of existing noise levels was conducted at eight (8) nearby noise sensitive areas during daytime and nighttime hours. The monitoring locations, their approximate distance and direction from the approximate acoustic center of the two (2) proposed ClearSky™ cooling tower arrays, and the results of the monitoring program are summarized in Table 3.5-3. Significant land use changes have not occurred in the vicinity since that time and, therefore, the data obtained from these previous monitoring programs are considered reasonably representative of current conditions for purposes of this Response.

Table 3.5-3
Average Measured Noise Levels (dBA)

Location	Approximate Distance (feet) / Direction	Daytime			Late Night		
		L_{90}	L10	Leq	L_{90}	L10	Leq
Saint Patrick's Church	5,200 / SW	41	50	48	42	48	46
16th Street / Broadway	4,300 / S	38	51	50	40	46	45
Pheasant's Run	4,000 / S	36	47	45	36	44	42
Buchanan Town Hall	4,000 / SE	44	59	55	38	45	46
Bleakley Avenue / Broadway	1,600 / E	45	61	58	38	44	42
Elementary School	3,400 / SE	36	N/A[1]	N/A[1]	36	N/A[1]	N/A[1]
Residence on Broadway	3,900 / S	38	N/A[1]	N/A[1]	40	N/A[1]	N/A[1]
China Pier	4,400 / NE	51	55	54	N/A[2]	N/A[2]	N/A[2]

Notes: N/A: Data not available.
[1] Only the L_{90} was measured at these locations as only L_{90} was required for the type of analysis conducted.
[2] Noise monitoring was not conducted at night as there was no nighttime use of this facility at that time.

Source: TRC 2003.

3.5.4 Applicable Standards and Guidelines

3.5.4.1 Village Code (Chapter 211)

Chapter 211-23(C)(3) of the Village Code establishes performance standards for maximum allowable noise levels associated with non-residential uses. The standard is based upon octave band ranges. Octave bands define the range of frequencies of a particular noise, from lower pitched to higher pitched sounds. The compliance point for these performance standards is measured at the property line within which the noise source is located.

These types of performance standards (based on octave band ranges) have been superseded because modern sound level meters no longer measure noise in octave band ranges. However, the American National Standards Institute ("ANSI") S1.11-1966 (R1976) standard provides a method for converting these frequency ranges into octave band center frequencies on which performance standards are based today (ANSI 1976). Therefore, for the purposes of this discussion, the octave band ranges and associated decibel levels contained in Chapter 211-23 of the Village Code have been converted to their associated octave band center frequencies in accordance with the procedures set forth in ANSI S1.11. Table 3.5-4 provides the standards from the Village Code, the associated current ANSI octave band center frequencies, and the equivalent SPLs.

Table 3.5-4
Village Code (Chapter 211)

Ordinance as In Village Code		Ordinance Converted to Current ANSI S1.11 Standard	
Octave Frequency Ranges (Hz)	Sound Pressure Level (dB)	Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)
20 to 75	65	63	61
75 to 150	55	125	53
150 to 300	50	250	48
300 to 600	45	500	43
600 to 1,200	40	1,000	40
1,200 to 2,400	40	2,000	38
Greater than 2,400	35	4,000	34

Source: Village Code, Chapter 211.
ANSI 1976.

As an aid to understanding the Village Code (Chapter 211), sounds are typically composed of many different frequencies, each defined in units of Hz and measured in decibels ("dB") (Harris 1991). Each frequency relates to a certain pitch of sound with lower frequencies, such as might be generated by a bass guitar, and higher frequencies, such as might be generated by a flute. In reality, most sounds in the environment are composed of many different frequencies. The most common way to describe environmental sound is to use the dBA level, which is the total level of all frequencies of sound combined into a single number, with an A-weighting factor to account for human sensitivity to certain frequencies (Table 3.5-1) (USEPA 1978). For reference purposes, the combined octave band center frequencies in the Village Code (Chapter 211) equate to an overall dBA level of 47 dBA. The Village Code (Chapter 211) also outlines various correction factors for sources, although none appear to be applicable to the operational noise characteristics of the proposed ClearSky™ cooling towers.

3.5.4.2 New York State Department of Environmental Conservation Noise Guidance

NYSDEC guidance entitled "*Assessing and Mitigating Noise Impacts*" discusses various aspects of noise and suggests steps for performing noise assessments (NYSDEC Policy DEP-001). Further, it provides procedures for evaluating the significance of increases in noise levels.

The guidance recommends that, for non-industrial areas, the SPL should probably not exceed ambient noise levels by more than six (6) dBA at a given receptor. The addition of any noise source, irrespective of location, should not raise the ambient noise level in a non-industrial area above a maximum of 65 dBA. This is the "upper end" limit since 65 dBA allows for undisturbed speech at a distance of approximately three (3) feet. Noise levels within industrial or commercial areas should not exceed 79 dBA.

The NYSDEC guidance explicitly states that the six (6) dBA increase above ambient is to be used as a general guideline, while other factors should also be considered. For example, in settings with very low ambient noise levels, a greater increase may be acceptable. Application of the NYSDEC guidance has historically been required, and an increase over ambient conditions of six (6) dBA or more over existing minimum L_{eq} noise levels has historically been categorized as a significant noise impact in scoping documents for SEQRA projects in New York where operational noise is generated by proposed industrial operations (Caithness 2013, CPV Valley 2008). The six (6) dBA increase impact criterion was also considered to be a significant noise impact by Riverkeeper in its comments on the 2009 Draft Supplemental Generic Environmental Impact Statement for Gas Fracking in New York State (Riverkeeper 2010). The six (6) dBA increase impact criterion was therefore used as the threshold for characterizing potential significant noise impacts associated with operation of the ClearSky™ cooling towers.

Additionally, the quantification of construction-related noise and evaluation of potential impacts has also been historically required for projects under SEQRA where construction noise has the potential to result in MODERATE to LARGE noise impacts, notably, even for projects of a much smaller scale and shorter duration than the NYSDEC Staff Proposal (Caithness 2013, CPV Valley 2008, Costco 2010, NYCDEP 2005, Gateway 2010).

3.5.5 Noise Modeling Analysis

The Tetra Tech Report does not include noise emission level data for the ClearSky™ cooling towers. The Report provides only a tabular estimate of the operational noise levels generated at distances of 50 meters and 100 meters from the towers with no detail on how these sound levels were calculated. The noise levels presented in the report are for noise-mitigated cooling towers (i.e., with low noise fans and splash noise attenuation).

For the purposes of this Response, TRC developed noise emissions data for the cooling towers by evaluating the following factors - the sound levels that were calculated by Tetra Tech at given distances from the towers (Table 3-3), the physical dimensions of the proposed towers, and the number of cells per tower.

The commercially available CadnaA model (DataKustik 2006) was then used to develop a noise model of the proposed ClearSky™ cooling tower arrays. The model included source noise levels (in this case, the noise emissions levels calculated for the cooling towers), existing topographic features of the IPEC Site and surrounding area, the existing major IPEC buildings, and sound reflection or barrier effects, to determine sound levels as a function of distance from the source

(i.e., the towers). Credit (noise attenuation) was taken for a partially absorptive ground cover over the entire area. No credit was taken for tree cover. Details regarding the modeling input, output data and source data are provided in Appendix B of this Response.

3.5.5.1 Noise Impacts

Results of the noise modeling by TRC are depicted as a contour map (to a distance of approximately 1.5 miles from the cooling towers) (Figure 3.5-1). The model-predicted sound levels were compared to existing ambient levels measured at discrete receptor locations where ambient noise level data were available (Table 3.5-3). Table 3.5-5 presents the calculated noise levels, at the locations indicated, resulting from operation of the ClearSky™ cooling towers; the ambient noise levels as measured by TRC in 2001 and 2002; the combined sound levels (existing plus predicted ClearSky™ cooling towers operation); and, the calculated increases over existing ambient conditions.

Table 3.5-5
ClearSky™ Cooling Towers - Operational Noise Levels and Increases Over Existing Conditions (dBA)

Location	Calculated ClearSky™ Noise Levels	Existing Late Night Leq[1]	Combined Future Late Night Leq	Increase over Existing Nighttime Leq
1. St. Patrick's Church	49	46	51	5
2. 16th Street / Broadway	51	45	52	7
3. Pheasant's Run	49	42	50	8
4. Buchanan Town Hall	52	46	53	7
5. Bleakley Avenue / Broadway	60	42	60	18
6. Buchanan-Verplanck Elementary School	51	36[2]	51	15
7. Residence on Broadway	52	40[2]	52	12
8. China Pier[3]	56	54	58	2
9. Lents Cove Park	61	N/A[4]	N/A	N/A
10. Charles Point Marina	66	N/A[5]	N/A	N/A

Notes:
N/A: Data not available.
[1] Daytime ambient data used for the Buchanan-Verplanck Elementary School location.
[2] Leq data not available. Noise level is the L_{90}.
[3] Noise monitoring was not conducted at night at this site as there is no nighttime use of this facility.
[4] Ambient data were not available for this location. Potential noise impacts at this location, which is noted in the Tetra Tech Report to be a location where cooling tower noise could potentially be audible (p. 94), could therefore not be quantitatively evaluated.
[5] Ambient data were not available for this location.

Except for the two (2) locations where ambient information was not available, the L_{eq} noise descriptor was used in evaluating impacts associated with operation of the ClearSky™ cooling towers, as is typically conducted when considering the NYSDEC noise guidance. The L_{90} descriptor was used at the two (2) locations where L_{eq} data were not available. The data shown in Table 3.5-5 reveal that increases in noise over existing conditions due to operation of the ClearSky™ cooling towers would be as high as 18 dBA at residential locations, well above the

NYSDEC impact criterion of six (6) dBA. Therefore, operation of the ClearSky™ cooling towers would likely result in LARGE noise impacts.

The Charles Point Marina was included as a receptor location in the analysis to evaluate cooling tower operational noise levels at this recreational area. The calculated noise level for the marina, as provided in Table 3.5-5 is 66 dBA. Comparing this operational level to typical sound levels for various uses (Table 3.5-1), operation of the NYSDEC Staff Proposal would result in sound levels that are typical for an urban environment at this marina, which is located in an area that is better characterized as rural/suburban.

3.5.5.2 Compliance with Village Code (Chapter 211)

In addition to NYSDEC guidance, the operational noise levels of the ClearSky™ cooling towers were compared to the Village Code (Chapter 211) performance standards to determine if compliance would be achieved. Table 3.5-6 presents the calculated ClearSky™ cooling towers operational noise levels compared to these performance standards.

Table 3.5-6
Operational Noise Levels Compared to Village Code (Chapter 211)

Location	Octave Band Center Frequency (Hz)						
	63	125	250	500	1000	2000	4000
Village Code (Chapter 211)	**61**	**53**	**48**	**43**	**40**	**38**	**34**
1. St. Patrick's Church	63	57	54	47	37	23	0
dB Exceeded By	**2**	**4**	**6**	**4**	**---**	**---**	**---**
2. 16th Street / Broadway	65	59	56	49	40	26	0
dB Exceeded By	**4**	**6**	**8**	**6**	**---**	**---**	**---**
3. Pheasant's Run	64	58	54	47	37	21	0
dB Exceeded By	**3**	**5**	**6**	**4**	**---**	**---**	**---**
4. Buchanan Town Hall	66	60	57	50	40	25	0
dB Exceeded By	**5**	**7**	**9**	**7**	**---**	**---**	**---**
5. Bleakley Avenue / Broadway	72	68	65	59	51	42	30
dB Exceeded By	**11**	**15**	**17**	**16**	**11**	**4**	**---**
6. Buchanan-Verplanck Elementary School	64	59	55	48	39	24	0
dB Exceeded By	**3**	**6**	**7**	**5**	**---**	**---**	**---**
7. Residence on Broadway	65	60	57	50	41	29	6
dB Exceeded By	**4**	**7**	**9**	**7**	**1**	**---**	**---**
8. China Pier	67	63	61	55	46	37	17
dB Exceeded By	**6**	**10**	**13**	**12**	**6**	**---**	**---**
9. Lents Cove Park	74	70	65	58	52	44	34
dB Exceeded By	**11**	**17**	**17**	**15**	**12**	**6**	**---**

The data shown in Table 3.5-6 indicate that the ClearSky™ cooling tower operational noise levels would exceed the Village Code (Chapter 211) performance standards, with exceedences of up to 17 decibels in some octave bands. Notably, these performance standards apply at the IPEC property line, and the exceedences listed above are *at receptor specific locations* well beyond the IPEC property line. Thus, the calculated exceedences would be even larger if they were

calculated at the actual property line. For example, near the IPEC Site northern property boundary at Lent's Cove, the estimated noise level exceedence would be approximately 19 dBA (in at least two (2) octave bands).

The results of the noise modeling, on an octave band basis, are also provided as a contour map (Figure 3.5-2). The contours represent, for each octave band in the ordinance, the outermost distance from the NYSDEC Staff Proposal required to comply with the limits in the Village Code (Chapter 211). The noise modeling results in this figure demonstrate that compliance with the Village Code would not be achieved within any part of the Village of Buchanan in most of the regulated octave bands.

Therefore, with reference to the Village Code (Chapter 211) performance standards, operation of the ClearSky™ cooling towers as proposed by NYSDEC would not comply with applicable Village law.

3.6 VISUAL RESOURCES

3.6.1 Introduction

This chapter summarizes the review and evaluation of the Tetra Tech Report with respect to the assessment of visual impacts from construction and operation of the ClearSky™ cooling towers as part of the NYSDEC Staff Proposal. The Powers Report is also evaluated to the extent practicable given its substantial lack of information. This chapter has been co-authored by Saratoga Associates and TRC.

The NYSDEC Staff and Riverkeeper Proposals would be located in the lower Hudson River Valley, a region of exceptional scenic, historic, and recreational importance that includes numerous sites and areas recognized at the state and the local levels for high scenic and aesthetic value. Scenic and cultural resources of the region have been memorialized, protected, and enhanced through regulatory designations such as Scenic Area of Statewide Significance ("SASS"), State Parks, National Register of Historic Places, Scenic Byway, American Heritage River and National Heritage Area.

Assessment and mitigation of potential visual impact is an established component of the environmental assessment process. SEQRA compliance is described in the NYSDEC Program Policy on Assessing and Mitigating Visual Impacts ("NYSDEC Visual Policy") (DEP-00-2), which provides a mechanism to comply with the balancing provisions of SEQRA related to environmental aesthetics (NYSDEC 2000, p. 1). According to the NYSDEC Visual Policy, Department Staff must evaluate the potential for adverse visual and aesthetic impacts on receptors outside of the facility or property. When a facility is potentially within the viewshed of a designated aesthetic resource, Department Staff will require a visual assessment, and in the case where significant impacts are identified, require an applicant to employ reasonable and necessary measures to either eliminate, mitigate or compensate for adverse aesthetic effects (NYSDEC 2000, p. 2).

Regulatory protection of scenic resources is also provided by the New York State Department of State ("NYSDOS"), which is responsible for administering the New York Coastal Zone Management Plan ("CMP"). The CMP provides a series of policies for management of coastal zone resources, including aesthetics. CMP policies #24 and #25 are aimed at preventing impairment of SASS and enhancing natural and man-made resources that contribute to the overall attractiveness of areas in the coastal zone.

As further discussed below, the Tetra Tech Report fails to provide information necessary to fully evaluate the potential impact of the NYSDEC Staff Proposal on the scenic resources of the region. The Report fails to:

- Fully identify and assess construction-related impacts including, but not limited to removal of existing vegetation, site excavation, size and placement of construction cranes, construction of site roads, contractor parking, lay down areas and dust generation.
- Provide a basis for concluding visible plumes would occur infrequently.
- Consider plume formation under non-plume abated operating conditions.
- Provide baseline photographs of sufficient quality for accurate review of photo simulations.
- Provide photo simulations from vantage points beyond five (5) miles.
- Adequately describe the physical scale and visual dominance of the ClearSky™ cooling towers.
- Address visual impact from key scenic resources of statewide significance.
- Consider plume visibility from distances beyond ten (10) miles.
- Address the effect of site lighting on nighttime plume visibility.
- Evaluate the consistency of the NYSDEC Staff Proposal with Policies #24 and #25 as required by SEQRA.

Considering these deficiencies, the Tetra Tech Report does not provide adequate information for NYSDEC Staff to render an informed decision concerning the potential visual impact of the ClearSky™ cooling towers on the scenic resources of the lower Hudson River Valley region.

Because the Riverkeeper Proposal includes no relevant information, a comparable assessment in this Response cannot be made.

Visual impact assessment is a standard SEQRA scoping requirement for industrial projects in the Hudson Valley. Recent projects in the Hudson Valley of comparatively smaller scale and lesser potential visual impact than the NYSDEC Staff Proposal (and the Riverkeeper Proposal) have been denied for being inconsistent with CMP Policies, based in part on perceived adverse impacts to the aesthetic resources of the region. In 2005, NYSDOS objected to the consistency certification submitted by St. Lawrence Cement ("SLC") due, in large part, to the visual impact of the proposed project's waterfront loading terminal and inland manufacturing plant on the scenic cultural and historic resources of the region. Similarly, in 2000, NYSDOS objected to the consistency of the proposed Athens Generation Plant due, in part, to the potential visual impact of the proposed plant's plume (NYSDOS 2005).

3.6.2 Construction Impacts

Section 4.7 (p. 77) of the Tetra Tech Report addresses construction-related impacts that are expected. It provides no meaningful description of construction activities that may impact the regional viewshed, including, but not limited to:

- The degree of vegetation removal and site excavation
- Access roads, contractor parking and lay down areas
- Dust
- Heavy duty truck traffic
- Use of cranes.

While certain of these issues are mentioned in the Tetra Tech Report, no specific information concerning how these activities may adversely affect visual quality is provided.

The necessity of this analysis is particularly apparent on the issue of construction cranes. It is probable that construction of the proposed cooling towers will require several large cranes for a substantial portion of the construction period. Cranes necessary to construct the cooling towers will likely be 200 to 300 feet in height; far taller than the estimated 91 foot height of the cooling towers (in the NYSDEC Staff Proposal). The duration of construction, four (4) to six (6) years, is an extended period of time for cranes of this size to be in place and operating. The presence of such cranes at the IPEC Site is likely to have an adverse impact on the surrounding, well documented, high quality visual resources.

The Tetra Tech Report does not provide basic information concerning construction activities at the IPEC Site, let alone evaluate the impact of such activates on the scenic resources of the region. To fully evaluate construction related impacts, consistent with SEQRA requirements, additional information is needed concerning the on-site acreage to be cleared of existing vegetation, excavation area, size and placement of construction cranes, location of site roads, and dust generation. Without this information, the requisite analysis of potential visual impacts to the Hudson River and other sensitive resources cannot be completed. Based on the information provided, and considering the typical impacts from construction of a project of this scope and magnitude, the potential impacts to visual resources would likely be LARGE.

There is no information at all presented in the Powers Report concerning potential visual impacts from construction of the Riverkeeper Proposal at IPEC. Information is needed concerning on-site clearing, excavation, use of construction cranes, location of site roads, and dust generation. Given the scale, magnitude and duration of anticipated construction work, the Report does not meet the standards of SEQRA for evaluating and determining the potential significance of this aspect of the Proposal. Considering the typical impacts from construction of a project of this scope and magnitude, the potential impacts to visual resources from the Riverkeeper Proposal would also likely be LARGE.

3.6.3 Operational Impacts

Section 4.0 of the Tetra Tech Report provides a discussion of the regulatory and resource management framework, assessment methodology, existing conditions, and the effects of the Tetra Tech Configuration on visual resources of the region. However, this analysis is incomplete and deficient in many ways, as described below, and does not provide sufficient information for regulatory decision-makers and the general public to understand the visual characteristics of the regional and local landscape setting, and the resultant impact on scenic resources. Therefore,

this chapter of the Response provides its assessment and critique in terms of Report-specific statements or conclusions.

3.6.3.1 Visible Plumes

Plume Frequency - The Tetra Tech Report (p. 14) acknowledges that numerous other studies and reports have concluded that a visible plume of the size potentially produced at IPEC would be unacceptable given the facility's location near notable scenic resources. The ClearSky™ towers were selected by Tetra Tech for evaluation because they utilize a hybrid (wet/dry) plume-abatement technology that is designed to minimize visible plume formation to the maximum extent practicable for closed-cycle cooling technology.

The Tetra Tech Report assumes that the towers will be operated in plume-abatement mode at all times when meteorological conditions are conducive to plume formation (p. 14). The Report concludes, due to this assumed operating parameter, plumes would be visible primarily during winter weather conditions when temperatures are less than 27°F (dry bulb) and relative humidity of 90% or more. The Tetra Tech Report assumes these conditions are expected to occur less than two (2)% of the year, and over one-half of these occurrences would be during night hours due to the short winter days, according to Tetra Tech (p. 79).

The Tetra Tech Report provides no basis to confirm the ClearSky™ towers can, or should be operated in abatement mode at all times, or the basis supporting the conclusion that plume-abatement technology will result in infrequent plume formation largely limited to winter months.

The ClearSky™ tower is designed to operate in either plume-abated or non-abated mode. The ClearSky™ towers may, at times, be operated in non-abatement mode, due to the energy use requirements of plume-abated operation. Non-abatement mode operation would result in visible vapor plumes when ambient meteorological conditions exceed the threshold for plume formation. Considering a higher temperature and lower relative humidity threshold for plume formation (compared to plume-abated operation) visible plumes could occur at any time of year when operating in non-abated mode.

In order to determine the effectiveness of plume-abatement technology, an operating plan would need to be developed considering factors such as historical meteorological data, operational efficiency and cost, among other issues. An operating plan would establish parameter conditions under which the cooling towers would be required to operate in plume-abated mode and when they could be operated in non-plume-abated mode. These parameters would need to be developed in consultation with NYSDEC and other regulatory agencies, and would likely be memorialized as a permit condition, assuming a permit could be issued at all. The Tetra Tech Report does not include an operations plan or identify operating parameter conditions.

Without an operating plan, we assume maximum plume abatement for visual assessment, despite the substantial energy penalty for continuously operating the towers in plume-abatement mode. Even in plume abated mode, however, visible plumes will exist under certain conditions.

Plume Dimension - The Tetra Tech Report asserts that plume abatement is the *"de facto baseline"*; (p.14) however, the Report includes visual analyses of both a 90th percentile vapor plume and plume abatement conditions (p. 60). No information is provided concerning the

operating parameters or meteorological variables used in establishing this plume condition. Tetra Tech also fails to define what it means by a 90th percentile plume, how it arrived at its dimensions, whether it represents a plume-abated or non-plume-abated condition, or why a plume of this magnitude was selected as a study condition. Without this information, conclusions in the Report concerning plume visibility cannot be verified.

Plume Visibility at Distance - The Tetra Tech viewshed analysis (Figure 4-4) illustrates that views of the 90th percentile plume are expected to occur over virtually the entire Hudson River and its immediate shoreline south of the IPEC Site. The Tetra Tech Report establishes a ten- (10-) mile radius study area from the site for the purpose of assessing more distant views of the plume. However, no photo simulations illustrating the visual character of the 90th percentile plume are provided for distances greater than five (5) miles.

The Tetra Tech Report specifically evaluates the High Tor and Hook Mountain State Parks, which are located outside of the five- (5-) mile study area to assess the effects of the NYSDEC Staff Proposal under plume conditions (p. 49). At a minimum, photo simulations should be provided from these locations - but they were not. Without these technical visualizations any conclusion drawn by Tetra Tech concerning the specific impact of plume visibility is speculative.

Tetra Tech states, *"plumes would be difficult to detect in the landscape at distances beyond ten miles"* (p. 39), but no basis is offered for this conclusion. Given the magnitude of the visible vapor plume illustrated for closer vantage points as in Figures VS-1 through VS-24 of the Tetra Tech Report, consideration of plume views beyond ten (10) miles is appropriate, but the Report did not do so.

Figure 4-4 of the Tetra Tech Report illustrates that views of the 90th percentile plume will occur over the entire width of the Hudson River up to the ten- (10-) mile study limit. Because the ten- (10-) mile study limit is arbitrary, plume visibility could occur beyond the ten- (10-) mile limit, potentially affecting on-water and coastal resources for miles to the south. Given the wide area of plume visibility beyond the study limit, visual assessment in the Tetra Tech Report should have considered impact on waterfront resources beyond this distance.

IPEC Site Industrial Lighting and Plume Visibility - Tetra Tech concludes that plumes are expected to occur less than two (2)% of the time and much of the plume formation would occur during the night and thus would be more difficult to see (p. 64). This conclusion is unsupported. For example, no consideration is given or analysis provided relative to the effect of outdoor lighting at IPEC or cumulative lighting of surrounding facilities. IPEC has to maintain a high level of outdoor lighting during the hours of darkness for safety and security purposes. Upward dispersion of light and ground reflectivity can significantly illuminate the visible plume during nighttime hours. This impact would also likely be heightened with winter snow cover when the Tetra Tech Report indicates that the plumes would be more prevalent. Consequently, darkness will not mitigate plume visibility as completely as claimed in the Tetra Tech Report.

3.6.3.2 Photo Simulations

Baseline Photography Quality - Many of the existing condition photographs in the Report used for photo simulations appear to have been taken on an overcast day. Flat lighting and the lack of clear sky contrast minimize the accuracy of the photo simulations. According to Tetra Tech, site visits were conducted on May 8 - 12, 2012 and October 8, 2012. Weather conditions during the May visits were cloudy with intermittent rain from May 8 - 10 and sunny on May 11. Weather conditions on October 8 were partly to mostly cloudy. The existing condition photos found in

Figures VS-1, VS-7, VS-10, VS-13, VS-16, VS-19 and VS-22 all appear generally underexposed and somewhat monochromatic. These figures indicate that the baseline photos were taken on October 8 under mostly cloudy weather conditions.

The lack of color definition, light/shadow contrast and sky definition minimizes the visual distinctiveness of the proposed cooling towers and downplays the contrast of the vapor plume against the background sky. Photographs would have been better taken under clear weather conditions with the sun to the photographer's back to minimize backlighting and maximize photo clarity. Tetra Tech's photo simulations substantially understate potential project visibility.

The Tetra Tech Report baseline photos were taken during leaf-on season when intervening vegetation provides maximum visual screening. It is standard practice to use photos taken during the worst-case leaf-off season to more fully disclose visual impact. Most photographs used in the Tetra Tech Report were taken in early October while leaves were still on the trees. Photo simulations illustrating leaf-off season would likely reveal substantially greater project visibility from a number of scenic resources of statewide significance including Fleischmann Pier (Tetra Tech Figures VS 1-3), Bear Mountain State Park (Tetra Tech Figures VS 13-15), and Jones Point (Tetra Tech Figures VS 16-18). Figure VS-4 appears to have been taken on a clear winter day, not on the May or October dates discussed in the Report.

Representative Photo Simulations for Key Resources - Tetra Tech evaluates visual impact for scenic resources based on computer-generated simulations (p. 61). However, photo simulations were not prepared for the following locations: views on the Hudson River from Haverstraw Bay County Park; Blue Mountain Reservation; High Tor State Park; and, Hook Mountain State Park. Nevertheless, these views are evaluated in Section 4.6.2 of the Report but without any representative photo simulations. Therefore, the impact findings about these key resources by Tetra Tech are speculative.

3.6.3.3 Visual Impact Assessment

Physical Scale of the NYSDEC Staff Proposal - The Tetra Tech Report understates the scale and visual dominance of the NYSDEC Staff Proposal and its cooling towers. The report limits discussion of physical size to just one sentence: *"individual cells are 64 ft x 75.5 ft and rise to 91 feet above grade, for a total tower footprint of 1,400 x 151 ft (approximately 5 acres)"* (p. 13). Of course, this refers to just one set of the two (2) arrays of towers. Figure 3.6-1 illustrates the physical scale of the ClearSky™ tower array in the NYSDEC Staff Proposal (compared to a typical school bus).

The NYSDEC Staff Proposal would be of a scale unprecedented in this region of the Hudson River Valley. Each of the two (2) cooling tower arrays is approximately 151 feet across by 1,408 feet long and 91 feet in height. Ultimate construction of these large structures would effectively triple the industrial profile of IPEC immediately adjacent to the Hudson River, particularly as viewed from the river and opposite shore. At 91 feet tall and 52 feet above river level, the towers would also be substantially taller than surrounding vegetation.

The visual character of a landscape is defined by the patterns composing it, which include the pattern elements of form, line, color, texture and scale/dominance. The qualitative impact of a project is determined by evaluating the compatibility of these visible patterns with the visual character of the surrounding landscape. Tetra Tech discusses these pattern elements in

describing the existing landscape character (Section 4.4.3), but fails to do the same specifically for the NYSDEC Staff Proposal.

Considering the exceptionally large size of the ClearSky™ towers as new structures, it is necessary to evaluate their scale and spatial dominance within the context of the setting to understand their visual compatibility or discordance. The Tetra Tech Report fails to do this.

Visual Absorption - The Tetra Tech Report briefly discusses the visual absorption capability of the landscape and assigns ratings of low, medium or high to different landscape areas (p. 54 - 55). The Report provides no basis or source for this qualitative assessment. Insufficient detail is provided to allow verification of the landscape rating system, and it is not used in any way to characterize the significance of impact or to reach a conclusion.

Views from Regional Trails - Tetra Tech downplays the significance of views from the regional trail system. The Report suggests heavy vegetation will screen views from most of the trails within the project viewshed. Impacts are limited to vantage points along the trail (p. 64). Tetra Tech also fails to point out that many of these locations are recognized overlook points and, for many hikers, an important waypoint or destination. Hikers often choose rugged mountain trails because of the scenic vistas afforded by occasional overlook spots. It is misleading to imply that a trail is minimally affected because views are only found at a limited number of locations, as is done in the Tetra Tech Report.

View from Stony Point Battlefield State Historic Site - The Tetra Tech Report downplays the significance of views from the Stony Point Battlefield State Historic Site. Tetra Tech states that "the most unobstructed view" from the Stony Point Battlefield "is from an approximately 25-foot section of the trail leading to the King's Ferry interpretive sign and from a gazebo/viewing platform near the interpretive sign" (p. 66). The King's Ferry interpretive sign is located in this position to specifically take advantage of a panoramic hillside vista looking northeast toward the Hudson River, Verplanck Point and the Hudson Highlands SASS. The interpretive sign is placed in this location because the unique vista allows clear understanding of the military significance of the Stony Point Battlefield during the American Revolution. The gazebo/viewing platform provides additional northeasterly vistas and appears placed in this location to capitalize on this scenic view. It is misleading to imply that this State Historic Site is minimally affected because unobstructed views are limited to the gazebo and interpretive sign. These are key vantage points that allow the public to understand and appreciate the historic importance of the Stony Point Battlefield Site.

View from the Bear Mountain Bridge Scenic Byway - The Tetra Tech Report notes that the only portion of the Bear Mountain Bridge Scenic Byway affected by the NYSDEC Staff Proposal is a short stretch located on a sharp bend in the road (p. 68). What Tetra Tech fails to mention is that this location is a dramatic road cut into the steep mountainside several hundred feet above the Hudson River. Although cars cannot safely stop here, this is one of the signature viewpoints of the Scenic Byway. Southbound motorists would have a direct view of the ClearSky™ cooling towers from this scenic vantage point.

3.6.4 Mitigation Opportunities

Placement of Cooling Towers and Site Grading - The Tetra Tech Report claims to have placed the southern portion of the northern cooling tower array within "a trench" to reduce its visible height and maintain a vegetated berm between this portion of the tower and the river (p. 78).

This description of the excavated area as a "trench" with a "vegetated berm" is not accurate and overstates the effectiveness of this mitigation measure.

Figure 3-2 of the Tetra Tech Report illustrates that excavation is required in a limited area at the southern portion of the northern array. The central and northern portion of the array would be constructed on fill, elevating the cooling towers above existing grade, increasing visibility. Moreover, only a small portion of the southern land area atop the excavated "trench" is currently vegetated. Much of the vegetation in this area has been previously cleared. The vegetation remaining between the cooling tower and the Hudson River would be at a lower elevation than the building pad, reducing the effectiveness of the remaining vegetation as a visual screen.

Visual Offsets - NYSDEC Visual Policy requires that proposed development projects consider all practicable mitigation techniques. Due to the physical scale and visibility of the Tetra Tech Configuration and its associated plumes, it is unlikely that the NYSDEC Staff Proposal can be mitigated to a meaningful degree using traditional siting and design mitigation techniques. Tetra Tech identifies many of the mitigation approaches listed in the NYSDEC Visual Policy, but discusses them only in a limited manner. To fully respond to NYSDEC requirements, additional detail and analysis of some of these recommended options would need to be provided, particularly in terms of effectiveness and cost.

The NYSDEC Visual Policy states that unavoidable impacts may need to be compensated for, wholly or in part, by offsets (NYSDEC 2000, p. 9). The Tetra Tech Report does not consider this mitigation technique.

3.6.5 Consistency with Coastal Zone Management Act Policy 24 and 25

The NYSDEC Staff Proposal and the Riverkeeper Proposal are located within a designated Coastal Area. As such, SEQRA requires that the Proposals be consistent with the Coastal Zone Management Act ("CZMA"), as implemented through CMP policies. Relative to visual impact, these are:

- Policy #24: Prevent impairment of scenic resources of statewide significance.

- Policy #25: Protect, restore or enhance natural or man-made resources which are not identified as being of statewide significance, but which contribute to the overall scenic beauty of the coastal area.

The Tetra Tech Report evaluates the requirements of the CMP in detail (p. 44), but specifically fails to consider the consistency of the NYSDEC Staff Proposal with Policies #24 and #25 as required by SEQRA. The Powers Report does not address the CMP at all.

Recent projects in the Hudson Valley of comparatively smaller scale and lesser potential visual impact than the NYSDEC Staff Proposal and the Riverkeeper Proposal have been denied for being inconsistent with CMP Policies, based in part on perceived adverse impacts to the aesthetic resources of the region. In 2005, NYSDOS objected to the consistency certification submitted by SLC due, in large part, to the visual impact of the proposed project's waterfront loading terminal and inland manufacturing plant on the scenic cultural and historic resources of the region. The proposed SLC project included construction and operation of a new cement manufacturing plant within an existing limestone quarry two- (2-) miles inland from the Hudson River, and rehabilitation of an existing industrial dock. The manufacturing plant was

predicted to emit a visible vapor plume with an average dimension 1,106 feet long and up to 588 feet high, estimated to be visible approximately 39% of daylight hours.

In ruling that the SLC project was inconsistent with CMP Policy, NYSDOS determined:

- The increased scale of activity and visual impact of the significantly expanded riverfront industrial facilities would present a significant adverse change to the scale, proportions, compositions and enjoyment of nearby historic resources, and would not protect, restore or enhance the scenic riverfront resources (NYSDOS 2005, p. 19-20).

- The proposed cement manufacturing facility, its large plume, and the riverfront industrial facilities and activities would also be visible from and would impact scenic resources of the Hudson River (NYSDOS 2005, p. 19).

- The manufacturing plant would be visible from and incompatible with the Olana [State Historic Site] SASS (NYSDOS 2005, p. 20).

Similarly, in 2000, NYSDOS objected to the consistency of the proposed Athens Generation Plant due, in part, to the potential visual impact of the proposed plant's plume. In that instance, the visible plume from the proposed plant would have existed for approximately 114 hours annually (NYSDOS 2005, p. 18).

Clear parallels can be drawn between the NYSDEC Staff Proposal, the Riverkeeper Proposal and the NYSDOS consistency determinations for St. Lawrence Cement and Athens. Construction of the Proposals would present a large increase in the level of industrial activity at IPEC. The NYSDEC Staff Proposal includes two (2) large-scale industrial structures located within 150 - 300 feet of the water's edge. The cleared and excavated area required for each structure would cover approximately 16 acres and the cooling towers themselves would be approximately nine (9) stories tall and extend more than 1/4 mile in length. These project components are considerably larger in area and scale than the waterfront development proposed by SLC. As in the SLC case, it can be said that the NYSDEC Staff Proposal as presented in the Tetra Tech Report would *"significantly expand[ed] riverfront industrial facilities."* (NYSDOS 2005, p. 19).

Viewed in terms of these precedents and given the scale, extent of project visibility and impact on a large number of scenic resources of statewide significance, including the associated visible vapor plumes, there is no reasonable basis to conclude that the Tetra Tech Configuration at IPEC is capable of satisfying CMP Policy consistency standards with regard to visual impacts.

3.6.6 Determination of Significance

Tetra Tech discusses sensitive resources from which the NYSDEC Staff Proposal would be visible; however, the Report draws no conclusion concerning the potential significance of such visibility.

The NYSDEC Visual Policy provides a definition of aesthetic impact:

> *Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Significant aesthetic impacts are those that may cause a diminishment of the public enjoyment and appreciation of an inventoried resource, or one that impairs the character or quality of such a place.* (NYSDEC 2000, p. 5)

The NYSDEC Visual Policy also states: *"For new permits or significantly modified permits, staff must determine the potential significance of the action pursuant to SEQR"* (NYSDEC 2000, p. 2).

The Tetra Tech Report offers no opinion as to whether or not identified impacts exceed the threshold for a determination of significance. Considering the previously described deficiencies, the Tetra Tech Report does not provide sufficient information necessary for NYSDEC Staff to render an informed decision concerning the potential visual impact of the ClearSky™ cooling towers on the scenic resources of the lower Hudson River Valley region.

The cooling towers of the NYSDEC Staff Proposal would be unprecedented in scale and scope in the Hudson Valley, would affect an unusually large number of visual resources of statewide and national significance, would be incompatible with CMP Policy, and could not be mitigated to a meaningful degree. Under these conditions construction and operation of the visual impact of the NYSDEC Staff Proposal at IPEC can be characterized as LARGE.

3.6.7 Powers Report

The Powers Report that describes the Riverkeeper Proposal provides no SEQRA analysis concerning the potential impact of either the proposed cooling tower structures or associated plume on the scenic resources of the region.

The Powers Report also fails to provide sufficient detail concerning tower dimensions or siting requirements (e.g., clearing and grading parameters) necessary to conduct an independent visual impact assessment. Similarly, no analysis is provided concerning the effectiveness of the Riverkeeper-Proposed technology in minimizing the formation of a visible vapor plume. The Powers Report fails to provide operating parameters identifying the conditions under which the towers would be operated in plume-abated and non-plume abated mode. No analysis or data are provided to determine the frequency, duration or magnitude of potential visible vapor plumes. Without this information, it is not possible to determine if the proposed cooling towers and associated plumes would significantly and adversely impact the scenic resources of the region. The visual analysis of the Riverkeeper Proposal is deficient considering the scale, scope and setting of the Proposal, and its failure to consider regional aesthetics as required by SEQRA.

All variations of the Riverkeeper Proposal would be unprecedented in scale and scope in the Hudson Valley, would affect an unusually large number of visual resources of statewide and national significance, would be incompatible with CMP Policy, and could not be mitigated to a meaningful degree. Under these conditions construction and operation of the visual impact of the Riverkeeper Proposal at IPEC can be characterized as LARGE.

3.7 LAND USE, ZONING AND LOCAL APPROVALS

3.7.1 Introduction

The construction and operation of the closed-cycle cooling configurations proposed by NYSDEC Staff and Riverkeeper will require local land use and zoning approvals from the Village of Buchanan. This chapter summarizes the report prepared by Young/Sommer LLC entitled *Analysis of Municipal and County Permitting for Closed-Cycle Cooling System Retrofit at Indian Point* (Appendix C), which: (1) identifies the local and county permits and approvals potentially required, (2) assesses the likelihood of obtaining those approvals based on the

information provided in the Tetra Tech and Powers Reports, and (3) provides a schedule for obtaining the local and county permits and approvals. The evaluation focuses on the NYSDEC Staff Proposal since the Riverkeeper Proposal as presented in the Powers Report provides inadequate information on multiple closed-cycle cooling configurations to allow for a comparable analysis.

The NYSDEC Staff Proposal faces numerous land use and zoning hurdles with respect to compliance with the Village of Buchanan's Zoning Code ("Village Zoning Code") and other local laws. Among those hurdles are:

- The possibility that the cooling towers are a prohibited use.
- Evidence that closed-cycle cooling will violate Village nuisance prohibitions and performance standards relating to air pollution, noise and other impacts.
- Obtaining an area variance for height and lot coverage in the face of potential significant short and long-term environmental, aesthetic and other impacts.
- Obtaining site plan approval, which requires conformance with nuisance and environmental standards and the Village Zoning Code.
- Lack of consistency of the Proposals with the Village of Buchanan's 2005 Master Plan.
- Obtaining necessary construction-related permits, including those for soil disturbances and excavation, steep slopes and stormwater, among others.
- Obtaining findings from the local involved agencies under SEQRA that the action selected (i.e., cooling towers) is the one that avoids or minimizes adverse environmental impacts to the maximum extent practicable.

3.7.2 Zoning Review and Approval

The Village of Buchanan must assess the Proposals to determine whether they conform to the Village Zoning Code. Although IPEC is located in an M-2 District that authorizes *"the peaceful use of atomic energy,"* it is unclear whether this use extends to cooling towers. Moreover, operation of the cooling towers would likely violate performance standards relating to air pollution and noise, among other impacts. Assuming the Proposals can overcome these prohibitions; they exceed the height and lot coverage restrictions of the Village Zoning Code and so would require an area variance. In addition, the Village Zoning Code requires site plan approval from the Planning Board as well as various construction-related permits. These approvals can be issued only after NYSDEC identifies BTA and issues the final SEIS required under SEQRA.

3.7.2.1 Prohibited Uses under Village Zoning Code

IPEC is located in an M-2 District that allows *"the peaceful use of atomic energy"*. However, after Entergy's predecessor proposed to construct a cooling tower at the facility, the Village of Buchanan revised the Village Zoning Code to prohibit freestanding water towers and water tanks, a term that arguably encompasses cooling towers. The Village also adopted a broader provision prohibiting all uses not specifically authorized under the zoning code. Village Zoning Code § 211-11. This provision could be interpreted to prohibit the extended excavation required

by the Proposals (over two (2) million cubic yards in the case of the NYSDEC Staff Proposal) as illegal quarrying/mining.

In the wake of the earlier cooling tower proposal, the Village of Buchanan also revised the Village Zoning Code to establish stricter prohibitions on nuisances. Among other things, the Village Zoning Code prohibits uses, whether specified or not, that are *"of such a nature as to be detrimental to neighboring properties by reason of emission of odor, dust, refuse matter, garbage, smoke, vibration, gas, radiation, noise or any other factor that is dangerous to the comfort, peace, enjoyment, health or safety of the area or the community."* Village Zoning Code § 211-11. In addition, the Village Zoning Code subjects all non-residential uses to performance standards, including standards relating to air pollution and noise. Village Zoning Code § 211-23. As discussed in Chapters 3.4 and 3.5 of this Response, the NYSDEC Staff Proposal may exceed PM-2.5 air quality standards and does exceed Village noise standards. These impacts render the NYSDEC Staff Proposal a prohibited use under the Village Zoning Code and violate the performance standards contained in the Code. Although the Powers Report lacks the detail necessary to perform a meaningful assessment, evidence suggests that the Riverkeeper Proposal may have similar noise and air quality impacts.

3.7.2.2 Dimensional (i.e., Bulk) Regulations/Area Variance

Like many zoning laws, the Village of Buchanan Zoning Code includes dimensional limitations on structures built in the Village. Village Zoning Code § 211-15 establishes standards regarding acceptable lots and structures, addressing minimum lot size and distances, maximum building height and maximum lot coverage. Where a project does not meet these requirements, the applicant must obtain an area variance from the Village Zoning Board of Appeals ("ZBA"). To grant a variance, the ZBA must make specific findings spelled out in Village Zoning Code § 211-39.B. Among other things, the ZBA must conclude that: (1) the variation requested is not substantial in relation to the requirement; (2) the project will not cause a substantial change in the character of the neighborhood or a substantial detriment to adjoining properties; and (3) the variation will not cause adverse aesthetic, environmental or ecological impacts on the property or surrounding area.

The cooling towers identified in the NYSDEC Staff Proposal will be 91 feet high, and approximately two and a half (2.5) times the maximum building height of 35 feet authorized in M-2 districts under the Village Code. The cooling towers in the Riverkeeper Proposal also will exceed the Village height limits by approximately two and a half (2.5) to three (3) times. Regardless of which cooling tower option is considered, the project will require a height variance from the Village ZBA. In addition, the Tetra Tech Report concludes that construction of the NYSDEC-proposed cooling towers will disturb approximately 20 additional acres of land, causing lot coverage to exceed the 40% limit in the Village Code. Thus, at least one (1), if not both, Proposals also will require a lot coverage variance. As discussed in greater detail in Appendix C, the applicant will likely have difficulty obtaining the required variances. Among other things: (1) the proposed cooling towers are more than two and a half (2.5) times the height authorized in the Village Code making the variation request substantial relative to the requirement; (2) in assessing the height variance, the ZBA will likely consider the exceptional size of the cooling towers – in the case of the NYSDEC Staff Proposal, the cooling towers will be approximately 1,408 feet (or more than four and a half (4.5) football fields) long, dominating the Hudson River landscape; and (3) the cooling towers are likely to have significant adverse environmental impacts on adjoining properties and surrounding communities relating to blasting, excavation, traffic, aesthetics, air pollution and noise.

3.7.2.3 Site Plan Approval

Under § 211-25 of the Village Zoning Code, the Village building inspector may not issue a building permit for the construction or alteration of any structure in the Village until the Planning Board approves a final site development plan, with certain limited exceptions. In considering whether to grant site plan approval, the Planning Board must *"take into consideration the public health, safety and general welfare and the comfort and convenience of the public in general and the residents of the immediate neighborhood in particular."* Village Zoning Code § 211-26. Key factors the Planning Board will consider include the relationship of the structure with the surrounding community, the avoidance or minimization of adverse environmental or aesthetic impacts, and conformance with the Village Master Plan and Zoning Code. As previously noted, both the NYSDEC Staff and Riverkeeper Proposals may result in significant environmental impacts relating to noise, air quality and visual resources (aesthetics), among other potential adverse environmental impacts. Moreover, the NYSDEC Staff Proposal, in particular, is inconsistent with the Village Master Plan, which calls for preserving the remaining area of undeveloped, forested property between Lents Cove Park and IPEC, improving access to the Hudson River, and preserving and protecting important scenic resources and viewsheds, including those along the Hudson River.

3.7.3 Permits and Approvals for Construction

In addition to complying with the Village Zoning Code, the Proposals will require other local permits/approvals from the Village of Buchanan prior to commencing construction. This section summarizes some of the construction-related requirements, permits and approvals potentially applicable to the Proposals under the Village Zoning Code. The summary provides an overview of the Village Code requirements, an assessment of the information contained in the Tetra Tech and Powers Reports concerning these requirements, and an evaluation of whether the Proposals can meet those requirements and obtain the necessary permits/approvals.

3.7.3.1 Soil Disturbance and Excavation Permit

Both the NYSDEC Staff and Riverkeeper Proposals will require a soil disturbance and excavation permit from the Village of Buchanan under Chapter 159 of the Village Code. To obtain the required permit, the applicant must submit detailed project information, a certification that the proposed operation will not interfere with drainage or cause erosion, and a certificate of insurance. The applicant also must meet standards spelled out in the Village Code, including showing that the project will not cause substantial traffic hazards, vibration, noise, dust or sand.

To obtain the required permit, the Proposals must overcome several obstacles. First, the NYSDEC Staff Proposal will require approximately three (3) to four (4) years of excavation. However, the Village Code limits the term of soil disturbance and excavation permits to only two (2) years. Second, the law requires the applicant to obtain a certificate of insurance. Given the scope of the excavation (estimated at two (2) million cubic yards), the possibility of radionuclide contamination, and the proximity of the excavation to an operating nuclear power plant, there is some question whether such insurance can be obtained. Third, construction and operation may have significant noise and other environmental impacts. Also, as discussed in Chapter 3.10, the NYSDEC Staff Proposal could require approximately 110,000 heavy-duty truck trips over the three (3) to four (4)-year excavation period, if blasting spoils cannot be moved by barge. These environmental, traffic and other impacts will weigh against issuing the required permit.

3.7.3.2 Blasting

Chapter 143 of the Village Code sets standards for blasting. Neither the NYSDEC Staff nor Riverkeeper Proposals contain sufficient information to determine whether the blasting required will comply with these standards. In particular, neither the Tetra Tech or Powers Reports contain a blasting feasibility study that would allow for such a determination. In addition, the Village Planning Board must consider the impacts of blasting in deciding whether to grant site plan approval.

3.7.3.3 Steep Slope Permit

Village Code Chapter 165 requires a permit to disturb steep slopes, a term that includes ground areas with a slope steeper than 15%. In deciding whether to issue the permit, the Village must assess many factors, including whether the project is consistent with the Village Master Plan. The Tetra Tech Report states that construction of the NYSDEC Staff Proposal, *"would require excavation of some steep slopes (over 15%)"* (p. 97). However, the report includes no details concerning the extent of steep slope disturbance nor does it address the grade of the disturbed areas – in particular, whether the project will disturb steep slopes of 30% or more, triggering a stricter standard of review. The Tetra Tech Report thus lacks the information necessary to determine whether the Village is likely to issue the required steep slope permit.

3.7.3.4 Stormwater Management and Erosion and Sediment Control

Under the Village Zoning Code, all land development activities that require site plan review must undergo a stormwater review under Article XIV of the Code. To obtain the required approval, the applicant must prepare a stormwater pollution prevention plan and comply with a performance bond and other requirements spelled out in the Code. This permit is necessary to comply with NYSDEC's stormwater permitting program.

The Tetra Tech Report indicates that the NYSDEC Staff Proposal will result in the disturbance of approximately 20 acres of land on the 239-acre IPEC Site (p. 93). It also states that, *"[c]onstruction of the proposed cooling towers will require clearing and blasting a significant area of the IPEC Site, creating the potential for increased stormwater runoff. The exposed surface will be bedrock and is highly impermeable"* (p. 35). While acknowledging these construction-related stormwater impacts, the Report focuses on the stormwater impacts of the completed project and includes no analysis whatsoever of the stormwater permitting implications of construction which entails, among other things, the blasting and removal of approximately two (2) million cubic yards of rock in close proximity to the Hudson River and an active nuclear power plant. The Tetra Tech Report thus lacks sufficient information to assess the construction-related impacts of the NYSDEC Staff Proposal from a stormwater permitting perspective.

3.7.3.5 Building Permit

The Village of Buchanan requires a building permit prior to constructing any building or structure. The rules governing the issuance of building permits are contained in Village Code Chapter 67, Building Construction, and apply to all types of structures regardless of their similarity to buildings. In light of this broad applicability, the Village will likely require building permits for the cooling towers themselves as well as for more conventional structures, such as the new pump houses called for in the NYSDEC Staff Proposal.

As previously noted, building permits for non-residential uses in the Village of Buchanan are subject to performance standards for noise, air pollution and other environmental impacts under Village Zoning Code § 211-23. Also, building permits *"shall be granted only in conformance with regulations. No building permit shall be issued unless the proposed construction or use is in conformance with all of the provisions of this article and other applicable laws, rules and regulations."* Village Code § 67-10.A. As noted in prior sections of this chapter, the NYSDEC Staff Proposal may result in significant adverse impacts related to air quality (Chapter 3.4) and noise (Chapter 3.5), among others. These impacts may prevent the Village from issuing the required building permits.

3.7.4 Schedule for Obtaining Local Permits/Approvals

The Tetra Tech Report contains only a brief discussion of the timing issues associated with obtaining the necessary approvals for constructing and operating the NYSDEC Staff Proposal at IPEC. The Report estimates that the permitting effort for the towers will take three (3) to five (5) years (p. 27). It goes on to note *"IPEC is a high profile facility given its proximity to New York City. Numerous public interest groups (e.g., Riverkeeper, Natural Resources Defense Council, Clearwater) and public officials, including the current governor, have publicly stated their desire to see IPEC cease operation when the operating licenses expire. It is not unreasonable to expect that most, if not all, required permits and approvals would be vigorously contested by IPEC's opponents, up to and including litigation."* (p. 27)

The Tetra Tech Report understates both the obstacles posed and time needed to obtain the required local approvals. The Tetra Tech Report notes the existence of opposition to IPEC from environmental groups and the Governor of New York State. However, the Report fails to mention the Village of Buchanan, which has repeatedly expressed its opposition to cooling towers of any kind. Any attempt to require construction of the cooling towers identified in the NYSDEC Staff Proposal will almost certainly be opposed by the Village, including refusing to grant the required height/lot coverage variance, a determination that cooling towers are a prohibited use, denial of site plan approval, issuance of negative SEQRA findings and refusal to grant key construction-related permits. Since the applicable permitting statute limits NYSDEC's selection of BTA to those technologies that are allowed at this location under local law, the Village will not be inclined to defer to NYSDEC's technology selection if it is clearly barred by law. Because of the nature of the zoning process, each of the denials will likely result in years of litigation-related delays. Even if the Village grants the required approvals, the decision will likely be challenged by Village residents, leading to comparable delays. These delays will arise on top of the time associated with completing the BTA identification process and issuing the required SEIS – a process that can itself be expected to take several years.

In an effort to develop a realistic timeframe for obtaining the local approvals needed to construct and operate the NYSDEC Staff Proposal at IPEC, the following information, documents, and resources were reviewed:

- Applicable laws/regulations
- Published court data
- Special analysis of decisions and the timing thereof related to Article 78 zoning cases.

The Village of Buchanan cannot issue local approvals until NYSDEC issues its final BTA decision and SEQRA findings, and any judicial review of those decisions is complete. Based on the above

consideration, the shortest time period before the applicant, using all due diligence, can expect to complete the local permitting process and begin construction is approximately 85 months (i.e., 7.1 years) after. Given the complexity of the closed-cycle retrofit project at IPEC, the more realistic time frame is approximately 166 months (i.e., 13.8 years). These estimates do not include either the time required to prepare the applications for submission to the Village or the time required to hear the case if the Court of Appeals grants leave to appeal.

3.8 TERRESTRIAL ECOLOGY

3.8.1 Introduction

Terrestrial ecology of the IPEC Site – existing conditions, the status of threatened and endangered terrestrial species, and impacts from construction and operation of the NYSDEC Staff Proposal – is not addressed in the Tetra Tech Report or the Powers Report. This is despite the fact that, for example, the site layout and construction of the NYSDEC Staff Proposal directly impacts and eliminates approximately 16 acres (+/-) of currently forested land and wildlife habitat on the IPEC Site.

To provide some context so that characterizations of potential impact can be made, the following existing conditions information is presented. Natural resources of concern (rare, special concern, listed as threatened, endangered, or candidate) in the vicinity of IPEC have been identified by the New York State Department of State guidance, New York Natural Heritage Program, United States Fish and Wildlife Service ("USFWS"), and County Lists of federally-listed species. A review of readily available sources conducted in 2013 did not indicate any change to the status of any of the previously identified resources by AKRF (2012). The current review did identify another rare species, pending finalization of a listing proposed by USFWS (50 CFR §17).

The proximity of the IPEC Site to two (2) biodiversity areas identified in the Croton-to-Highlands Biodiversity Plan (Miller and Klemens 2004) is important to note as indicative for the site to provide potential high quality habitat for wildlife species.

A number of state-listed ecological communities occur within the vicinity of the IPEC Site. Thirteen state-listed rare ecological communities, not all of which are categorized as Terrestrial, are present in the vicinity of the IPEC Site, as well as the three (3) Hudson River Significant Coastal Fish and Wildlife Habitats ("SCFWHs") (AKRF 2012).

There are also a number of federal and state-listed wildlife species that have been identified as potentially occurring in the vicinity of IPEC. These include the federally- and state-listed endangered Indiana bat (*Myotis sodalis*), the federal candidate New England Cottontail (*Sylvilagus transitionalis*), and the federally-listed threatened and state-listed endangered bog turtle (*Clemmys muhlenbergii*). The bald eagle (*Haliaeetus leucocephalus*) is also found in the vicinity of the site, and is protected by the federal Bald and Golden Eagle Protection Act and is state-listed threatened (AKRF 2012). None of these listed species have been specifically documented to date on the IPEC Site.

On October 2, 2013, the USFWS proposed listing the northern long-eared bat (*Myotis septentrionalis*) as endangered throughout its range under the Endangered Species Act of 1973, as amended (NARA 2013). Westchester County, New York is included by the USFWS as a county where this species is known to or is believed to occur (USFWS 2013).

In addition to these species, there are ten (10) animal species and 24 current records of state-listed plant species that are known to occur in vicinity of the IPEC Site (AKRF 2012).

3.8.2 Construction Impacts

The Tetra Tech Report indicates that the NYSDEC Staff Proposal will result *"in disturbance of an estimated 20 acres of land in addition to disturbed areas associated with the existing facility"* (p.93). However, the area of previously undisturbed forested lands and wildlife habitat area is not specifically estimated in the Tetra Tech Report. TRC has estimated the acreage of forested lands and wildlife habitat at approximately 16 acres (+/-). This disturbed area is part of a contiguous mixed forest stand of approximately 70 acres located north of the developed portion of the IPEC Site. This forested block also has approximately 2,000 feet of undeveloped shoreline and riparian habitat along the Hudson River. The trees found in this area can generally be characterized as mature. A two (2.0) acre freshwater pond is also found within this forested block.

The potential construction-related impacts from the NYSDEC Staff Proposal are not addressed by Tetra Tech. Therefore, the potential for adverse effects from that work on the site are briefly described below.

The disturbance of the approximately 16-acre forested area represents about 23% of the total 70-acre forested block. The 16 acres will not just be disturbed temporarily, but completely altered as it is proposed to blast about two (2) million cubic yards of rock to provide for a level and stable base for the ultimate placement of the northern array of the ClearSky™ cooling towers. All vegetation will be removed and all topsoil as will be removed down to bedrock. The existing vegetation and habitat will be permanently lost (Chapter 3.8.3, below). Moreover, the placement of the northern set of cooling towers will fragment the forested block and isolate much of the shoreline riparian habitat along the Hudson River from the remainder of the more interior forested area. This will reduce the ecological value of the contiguous forested block and the IPEC Site for wildlife habitat.

The blasting of rock for a period of three (3) to four (4) years, as well as the substantial presence and operation of construction equipment for an even longer period of time, will disturb wildlife present in the forested block by that activity and even longer considering the estimated six (6) years of construction per the Tetra Tech Report. The potential effects of noise on wildlife can be far-ranging, and can include: avoidance of local habitat, interference with normal activities such as feeding, breeding and nesting; impaired communication among individuals and groups; long-term physiological damage to the auditory system; physical injury incurred during panicked responses; and, mortality in the most severe of cases (AMEC Americas Limited 2005).

Because of the magnitude and the extended nature of these construction impacts (e.g., noise from blasting and general construction work), and the alteration/elimination of 16 acres of forested habitat, terrestrial ecological impacts can be characterized as SMALL to MODERATE.

3.8.3 Operational Impacts

The presence and operation of the NYSDEC Staff Proposal will permanently displace wildlife and fragment existing habitat on the 70-acre forested block of land. Nearby wildlife will also be subject to the operational noise of the cooling towers. As described in Chapter 3.5.3, long-term operational noise levels in this area of the site near the northern set of cooling towers will be in the range of about 65 to 80 dBA (as modeled by TRC), which represent noise levels typically

associated with the following: noisy urban environment – 75 dBA and a lawnmower at 100 feet – 65 dBA. For comparative purposes, a typical suburban daytime noise level is 50 dBA (Harris 1991). Given the estimated values of noise levels in the forested block, operational noise levels on wildlife, which can be species specific, can be characterized as ranging from NONE to MODERATE.

As noted in Chapter 3.8.1, there are a variety of listed (threatened/endangered) species that potentially occur in the vicinity of the IPEC Site. None of these listed species have been documented to date at the IPEC Site; however, the forested block of land to the north of the developed portion of the site may represent potential suitable habitat for some of these listed species. The Tetra Tech Report does not address the potential suitability of this habitat for federally- and state-listed species. Moreover, the Report does not address the potential presence/occurrence of listed species on the forested block where approximately 16 acres of habitat will be permanently eliminated and increased noise will be continuously present from cooling tower operations.

The listed terrestrial species that could potentially be on the forested block affected by the NYSDEC Staff Proposal are briefly discussed below.

- The bog turtle is generally found in groundwater fed wetlands and clear, slow-moving streams with soft substrates. It is not known if suitable habitat exists on the IPEC Site; however, there is wetland area present within the forested block that could support this species.

- The mature trees of the forested block may provide habitat for Indiana bat and northern long-eared bat summer roosting and maternity colony habitat. Foraging habitat may also found and could include the forested block, the small freshwater pond, and the undeveloped riparian habitat. The NRC FSEIS noted that these forested lands could be used by the Indiana bat as summer habitat given their potential suitability for foraging and the possible presence of suitable roosting trees.

- The bald eagle is found along the Hudson River, and prefers large water bodies and riparian areas with mature trees for roosting and perching. Bald eagles are currently nesting and wintering on the lower Hudson River, and with bald eagle populations increasing, eagle use of the riparian habitat associated with the IPEC Site may increase in the future.

Given the potential presence of listed species in the vicinity of IPEC and the NYSDEC Staff Proposal to disturb and permanently remove 16 acres of forested wildlife habitat, an ecological survey for the presence of habitat and these species is necessary to assess the potential for adverse impacts to listed species. No such ecological survey was proposed or performed by Tetra Tech.

Should there be no listed species habitat or species present, operational impacts to terrestrial ecology would be considered MODERATE.

If the ecological survey finds that listed species or their habitat are, in fact, present on the forested block of land, the potential impact would be considered MODERATE to LARGE. Under these circumstances, it may be necessary to initiate consultation with federal and state agencies (i.e., the USFWS and Natural Heritage Program of NYSDEC) under the requirements of Section 7 of the Endangered Species Act.

3.9 ARCHAEOLOGICAL AND HISTORIC RESOURCES

3.9.1 Introduction

The Tetra Tech Report identifies properties on or eligible for inclusion on the National or State Register of Historic Places (including SASS) that may be affected by construction and operation of the NYSDEC Staff Proposal (archaeological and historical resources are addressed in this chapter of the Response; visual resources are addressed in Chapter 3.6 of the Response.)

The Tetra Tech Report does not disclose the presence of two (2) known archaeological sites on the IPEC Site that would likely be affected by the siting and construction of the NYSDEC Proposal, although it does note the general need for archaeological surveys to be performed. The Powers Report that presents the Riverkeeper Proposal discusses the general cultural resource consultation process and makes indirect reference to the known on-site archaeological resources.

Neither of the Tetra Tech or Powers Reports evaluates the impact (construction or operation) of their respective Proposals on the known archaeological sites at the IPEC Site.

Two (2) previous archaeological and historical studies have been conducted in the vicinity of the proposed ClearSky™ cooling towers of the NYSDEC Staff Proposal at IPEC. The first was a Phase IA study conducted in 2007, followed by a Phase IB identification survey conducted in 2009 by ENERCON. The reports prepared for and reviewed by New York State Historic Preservation Office ("NYSHPO") were:

- *Phase IA Literature Review and Archaeological Sensitivity Assessment of the Indian Point Site, Westchester County, New York, ENERCON March 22, 2007.*

- *Phase IB Archaeological Investigation of Potential Cooling Tower Construction Sites at Indian Point Energy Center Westchester County, New York, ENERCON October 9, 2009.*

As result of the Phase IB identification survey, two (2) archaeological sites were identified: A11967.000106 (precontact and historic) and A11967.000107 (historic). Site A11967.000106 is described as a scatter of prehistoric artifacts (flakes, fire-cracked rocks, and stone tool fragments), historic artifacts (glass, ceramics, and architectural items) and features (concrete foundations, wooden posts). Site A11967.000107 is described as the remnants of historic mining features and stone walls. Based on a review of the NYSDEC Staff Proposal site plan and the locations of the two (2) archaeological sites, one site appears to be located within the area proposed for the northern array of cooling towers; the other site appears to be located within or near the area proposed for the southern set of cooling towers. Verification of their respective locations in the Tetra Tech Report is required to assess the potential for direct impact.

Following review of the ENERCON archaeological reports, in a letter dated December 8, 2009, the NYSHPO recommended that Phase II investigations of the two (2) archaeological sites be completed to provide additional information necessary to evaluate the sites for potential listing on the State Register and the National Register of Historic Places ("NRHP"). In addition to conducting the Phase II study, the NYSHPO recommended that the Area of Potential Effect ("APE") be reassessed (if the then project plans were to change) and that a geomorphological assessment should also be conducted, if warranted (Office of Parks, Recreation and Historic Preservation ("OPRHP") December 8, 2009).

3.9.2 Construction Impacts

Tetra Tech states that the NYSDEC Staff Proposal is not expected to have any direct effects on historic or cultural resources in their designated five- (5-) mile study area. However, the Tetra Tech Report does not identify the presence of the two (2) known archaeological sites (A11967.000106 and A11967.000107) on the IPEC Site within/near the direct impact area of the proposed ClearSky™ cooling tower locations (and ancillary infrastructure). It also does not refer to the documented 2009 determinations by NYSHPO on the need for further study (Phase II) of these resources to determine their NRHP eligibility, if they cannot be avoided because of on-site work. The Tetra Tech Report acknowledges that archaeological surveys would need to be conducted during project construction of the NYSDEC Proposal to determine the presence of archaeological resources, and any necessary mitigation.

A Phase II evaluation will be required prior to construction of the NYSDEC Staff Proposal to comply with the NYSHPO recommendation, which will assure NRHP evaluation of the cultural resources identified as present at the IPEC Site. The overall goal of a Phase II site evaluation is to recover and analyze a sufficient sample of archaeological data that can assist in answering potential research questions about site activities, function, time span, and the regional and local historic context. Fieldwork typically requires hand excavation of closely-spaced interval shovel tests and, if necessary, backhoe trenching to determine if artifact-bearing deposits are stratified (i.e., whether different periods of occupation can be separated in different soil horizons). The field studies are typically complemented by more intensive and site-specific documentary research. Phase II field investigations also serve to retrieve a sufficient artifact sample for laboratory analysis to determine site integrity – or lack thereof – that could support an NRHP Determination of Eligibility ("DOE"), or recommendation of non-eligibility.

Should Phase II evaluations of the archaeological sites be conducted, and the NYSHPO determines the resource(s) eligible for inclusion in the NRHP, construction of the NYSDEC Staff Proposal would result in an ADVERSE EFFECT to NRHP eligible resources. If impacts to the archaeological site(s) cannot be avoided, measures would be required to mitigate project impacts to these resources. Mitigation typically consists of Phase III Data Recovery investigations that follow a research design approved by the NYSHPO.

Phase III investigations require the preparation of a research design approved by NYSHPO, field investigations (typically consisting of block excavations, and an analysis and reporting period). A public outreach component describing the results of the archaeological studies would also be required upon project conclusion. Because impacts to NRHP-eligible resources would result in an ADVERSE EFFECT, a Memorandum of Agreement ("MOA") with NYSHPO and the Advisory Council on Historic Preservation ("ACHP") may be required to assure that mitigative treatment is implemented. The overall consultation process could take approximately 18 months, depending on the results of the Phase II and Phase III work, interagency (and local American Native Tribal) coordination and participation.

3.9.3 Operational Impacts

With the assumption that any potential NRHP-eligible resources would have been fully studied and project effects mitigated as recommended by NYSHPO prior to construction, operation of the NYSDEC Staff Proposal would have no effect (NO IMPACT) on archaeological resources. There are no on-site historic resources that would be affected by operation (NO IMPACT).

Tetra Tech states that the NYSDEC Staff Proposal would not be expected to have any significant, long-term direct effects on cultural/historic resources. However, the viewshed from several off-site historic resources could be affected by project operation due to the visibility of the project components (e.g., the cooling towers) and the plume from the cooling towers. The assessment of visual resources from the presence and operation of the NYSDEC Staff Proposal is presented in Chapter 3.6.

3.9.4 Riverkeeper Proposal

The cultural resources information contained in the Powers Report focuses solely on the possible presence of historic and archeological resources in the area of the proposed closed-cycle cooling tower at Unit 3, advising that further studies and consultation with the NYSHPO and appropriate Native American Tribes would occur under Section 106 of the National Historic Preservation Act ("NHPA"). The Report is presumably referring to the two (2) previously recorded archaeological sites. The Powers Report, however, does not identify or make mention of potential effects to cultural resources outside of that area, particularly given the fact that the proposed multiple configurations on the site and the related ancillary equipment cover considerable other portions of the IPEC Site.

The Powers Report makes reference to prior relevant reports such as the NRC GEIS (2010) and the Entergy Report on closed-cycle cooling (2010). The latter report discussed the Phase II studies and the Powers Report notes that such work would likely be undertaken concurrently with other pre-construction activities.

3.10 TRANSPORTATION AND NAVIGATION

The Tetra Tech Report includes limited information, described below, on road network transportation and barging/navigation impacts relative to construction of the NYSDEC Staff Proposal. Estimates of the possible number of truck trips required and the possible number of barges required are presented; however, Tetra Tech does not include analyses of the impacts to the road network and/or navigation on the lower Hudson River using those estimates.

No existing vehicular volume or movement data on the road network or vessel data on the Hudson River are presented by Tetra Tech.

With respect to NYSDEC Staff Proposal operation, the Tetra Tech Report simply notes that road network traffic levels are not expected to increase (p. 93). The possible need for barges or additional barges to support operations and maintenance of the NYSDEC Staff Proposal (post-construction) is not addressed.

The Powers Report does not address transportation and navigation in any way – there is no background data, no estimate of road and barge trips, and no impact analyses thereof.

3.10.1 Transportation Impacts

3.10.1.1 Construction

According to Tetra Tech, the NYSDEC Staff Proposal requires approximately two (2) million cubic yards of blasting spoils to be removed from the IPEC Site and, if trucks were to be used to remove blasting spoils, an estimated 110,000 trucks trips, or 235 truck trips per day for three (3) to four (4) years would be required, a number that has not been demonstrated to be feasible.

The Tetra Tech Report states that this would constitute *"...a steady stream of heavy equipment traffic along the route between IPEC and Route 9. Noise and dust emission could be notable."* (p. 33). This statement represents the entirety of the characterization of potential construction-related truck traffic impacts by Tetra Tech.

In addition to the truck trips, the Tetra Tech Report notes that approximately 600 construction workers will be needed each day and that regular deliveries of material and heavy equipment will also be made to the IPEC Site. However, there is no estimate of the number of deliveries needed; moreover, there is no assessment that appears to add these considerable numbers of additional vehicular trips (delivery trucks and worker passenger cars) to the estimate of heavy duty truck trips (235 daily).

Despite the lack of analyses, Tetra Tech acknowledged that off-site roadway improvements will be needed to accommodate the increase in construction traffic. A set of improvements at four (4) locations is briefly described; however, there is no data provided on existing or projected traffic volumes and no explanation of how the number of trips was calculated to arrive at the Tetra Tech-recommended roadway improvements. In addition, there are no supporting analyses provided to indicate the Levels of Service ("LOS") on local roadways and at local intersections including during peak hour traffic conditions, or the resultant impacts from construction traffic. Moreover, the feasibility of the proposed improvements is not addressed by Tetra Tech. For example, the proposed addition of dedicated turn lanes may not fit within the existing right-of-way and, therefore, require the acquisition of additional property in order to complete.

Permitting for the proposed improvements and the associated timeframes for doing so are not addressed for the NYSDEC Staff Proposal, nor is the fact that construction of all necessary traffic and roadway improvements will need to be completed before site preparation work and blasting can commence, further potentially delaying commencement of site work and construction.

Tetra Tech states that construction equipment, materials, and employees will utilize the local streets and generally enter the site through the main entrance off of Broadway. The Tetra Tech Report does note that there is available space to construct a new access point along Broadway if necessary, but does not state at what location a new access point would be necessary, and does not provide an illustration of a new access point. Analysis of an alternate access point is not provided by Tetra Tech. Moreover, access to the IPEC Site is heavily secured and an increased security operation would need to accompany any new access point.

Under the NYSDEC Staff Proposal, several existing on-site facilities will need to be relocated to accommodate new structures as well as construction laydown and staging areas. In addition, approximately 800 parking spaces will be lost during construction (there are about 1,000 employees at IPEC). The Tetra Tech Report states that construction of a parking garage could be an option to replace the lost parking. Tetra Tech does not state how much parking would be added and whether this would be adequate to handle the on-site employees and the additional 600 construction employees. Tetra Tech states that the parking garage could be sited on 3.2 acres of an unoccupied area of the IPEC Site, but does not evaluate whether that new parking structure would comply with local permitting requirements (including zoning). Moreover, the number of spaces is not identified and the operation of the garage is not described or evaluated.

Tetra Tech indicates that construction will take seven (7) to nine (9) years (although they do seem to concur in general with the ENERCON estimate of longer duration of 12 to 13 years (p. 3 of the 7/6/10 Memorandum attached to the Tetra Tech Report)). In either case, parking would

also be needed to accommodate the planned outages (about three (3) to four (4) weeks in duration) for each Unit that take place every 24 months, in alternating years. Therefore, parking will be needed for up to approximately 2,400 personnel (1,000 IPEC employees, 600 contractors for the NYSDEC Staff Proposal, and 800 outage contractors). Although Tetra Tech acknowledges outages at IPEC, it has not addressed this overlap in any other way than by proposing that a single deck parking structure be built on 3.2 acres of the IPEC Site. However, a single deck parking structure on 3.2 acres could provide for approximately 650 - 900 spaces as estimated by TRC, not nearly the full complement required.

Should sufficient parking be unavailable at the IPEC Site, a transportation bus system would need to be implemented to transport people from the parking garage and some off-site location to the General Support Building or the Secondary Owner Controlled Area Access Building. Provision would also need to be made for the replacement of handicap spaces at an appropriate location on the site. Finally, initiatives related to Fukushima require the use of a helicopter to be able to fly in critical components. The existing plan uses the parking area in front of the General Support Building for the helicopter pad; however, this area is designated as a construction staging area in Figure 3-2 of the Tetra Tech Report. The Tetra Tech Configuration would need to include this existing operational requirement during construction of the NYSDEC Proposal, but it has not.

Tetra Tech recommends the use of barges to deliver most of the equipment and to remove the blast spoils, if possible (discussed below in Chapter 3.10.2). If barges are to be used, there would still be about 9,000 truck trips over the three (3) to four (4) year period to remove blast spoils (plus all of the other construction vehicles and construction worker trips to and from the site). The Tetra Tech Report does not address the number of additional trucks, aside from the spoils removal, that would be needed for construction, particularly those that could not be offset by the use of barges. Although it is evident that potential road network impacts would be less than the scenario in which no barges are used, there is no impact assessment of this alternative by Tetra Tech.

The characterization of potential construction traffic impacts is incomplete given the lack of information and analysis provided in the Tetra Tech Report. However, the duration of construction and the increased volume of vehicles (heavy duty trucks and others) clearly suggest that potential off-site adverse impacts could occur. Should the use of barges be limited and truck use maximized, construction traffic impacts would likely be MODERATE to LARGE. Under the scenario where truck use is limited and barge use is maximized, construction traffic impacts associated with the NYSDEC Staff Proposal would suggest a range from SMALL to MODERATE.

3.10.1.2 Operation

As noted above, Tetra Tech simply notes that road traffic levels are not expected to increase as a result of the operation of the NYSDEC Staff Proposal; however, no traffic analyses are provided in support of that conclusion. If it were assumed that such was the case, operational traffic impacts would not change considerably compared to current operations, and impacts would likely be NONE to SMALL.

3.10.2 Navigation Impacts

The Tetra Tech Report states that barges on the Hudson River are the preferred method for delivery of heavy equipment and removal of spoils from construction of the NYSDEC Staff

Proposal. The following discussion provides an assessment of the Tetra Tech Report and the potential navigational impacts of using barges.

As noted previously, Tetra Tech does not provide existing conditions information on navigation (e.g., vessel numbers, movements, etc.) in the Hudson River near the IPEC Site, nor does it assess the NYSDEC Staff Proposal's impact on navigation as a result of construction and operation.

3.10.2.1 Construction

The Tetra Tech Report does not provide an estimate of the number of barge transits that will be required for the delivery of supplies and/or equipment. Without this information, the potential impact of barge deliveries on navigation on the Hudson River cannot reasonably be evaluated.

Tetra Tech indicates that the NYSDEC Staff Proposal requires the removal of approximately two (2) million cubic yards of blasting spoils from the IPEC Site. If a combination of barges and heavy trucks is used, blasting spoil barges will likely be moved by tugboats in groups of seven (7), resulting in 1,215 loaded barges (because of limited access to the existing pier during part of the construction schedule, not all of the spoil material can be removed by barge and will require truck hauls). The 1,215 barges will require 174 inbound trips and 174 outbound trips for a total of 348 transits of the Lower Hudson River. Blast spoil removal associated with the NYSDEC Staff Proposal will take place over three (3) to four (4) years, requiring an estimated 87 – 116 transits each year (assuming an even distribution of the barge trips over the entire period).

The number of barge transits required to remove the spoils will represent an increase of about 0.5 to 1.5% over the estimated 8,000 – 16,000 transits that occur in the Hudson River annually (FHWA 2012). Therefore, removal of the spoils by barge under the NYSDEC Staff Proposal likely represents a SMALL navigational impact on the Hudson River.

Tetra Tech does not address navigation in the context of the existing IPEC Safety and Security Zone. Additionally, it does not address where and how barges will be moored or the duration of the mooring while awaiting loading and transport. Moored barges may require additional signage, lighting, or notification to mariners to ensure safety, which is also not addressed in the Tetra Tech Report. Perhaps most importantly, Tetra Tech indicates that the quantity of marble removed from the IPEC Site will significantly exceed the potential market capacity, and it does not identify a disposal location for the remaining spoils (p. 34). Absent a disposal location, for barges loaded with blast spoils it is possible that they could remain on the Hudson River for extended, indefinite periods. If that were to occur, navigation impacts would be greater than spoil removal alone, possibly SMALL to MODERATE in effect.

3.10.2.2 Operation

The Tetra Tech Report does not address the possible need for additional barges and/or vessels for operation of the NYSDEC Staff Proposal compared to existing operations.

3.11 ENVIRONMENTAL JUSTICE

3.11.1 Introduction

The Tetra Tech Report and the Powers Report do not address the potential environmental justice ("EJ") impacts on low-income and minority population communities from construction

and operation of their respective Proposals. Environmental justice concerns are required to be addressed in accordance with applicable NYSDEC EJ Policy. NYSDEC published *Commissioner Policy 29: Environmental Justice and Permitting* ("CP-29") on March 19, 2003 to provide guidance for incorporating EJ concerns into the NYSDEC environmental permit review process and the application of SEQRA. Per CP-29, "*it is the general policy of NYSDEC to promote EJ and incorporate measures for achieving EJ into its programs, policies, regulations, legislative proposals and activities.*"

It is to be noted that applications for NYSDEC permits (excluding SPDES) may require CP-29 review, including a Title V Major Source (air) approval (6 NYCRR § 201), which may be required to implement a closed-cycle cooling alternative at IPEC (TRC March 29, 2013).

In this chapter of the Response an assessment is made on the likelihood of whether construction and operation of the NYSDEC Staff and Riverkeeper Proposals would have any potential adverse and disproportionate impacts on any EJ areas.

The nearest EJ Area as designated by NYSDEC is shown in Figure 3.11-1 and is located just to the north of IPEC and incorporates portions of the city of Peekskill. The EJ community has residences located therein as near as 0.75 miles from the proposed northern array of cooling towers in the NYSDEC Staff Proposal.

3.11.2 Construction Impacts

Neither the Tetra Tech Report nor the Powers Report addresses potential adverse impacts on EJ communities from the construction of their Proposals.

3.11.3 Operational Impacts

Similar to construction, analyses of the potential adverse impacts resulting from operation of NYSDEC Staff Proposal are limited in the Tetra Tech Report and even more so in the Powers Report.

Air Quality

No operational air quality impact analysis of the NYSDEC Staff Proposal was performed by Tetra Tech and none was performed by Powers. No assessment of the potential for adverse air quality impacts from operations was made in either the Tetra Tech or Powers Reports despite the fact that cooling towers are a known source of potential PM emissions and a potential source of water-borne pathogens subject to air dispersal, and the siting of the towers proximate to a NYSDEC-designated EJ community. In addition, prior analyses by TRC for a closed-cycle cooling retrofit at IPEC showed violations of the PM NAAQS for a cooling tower configuration that provides an opportunity for better dispersion of emissions than the NYSDEC Staff Proposal.

The NAAQS were established by USEPA to be protective of human health, and it has been shown that exposure to PM (PM-10 and PM-2.5) can effect breathing and respiratory systems, cause damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, "vulnerable populations" including low-income urban communities, are at increased risk of morbidity and mortality associated with increased exposures to PM pollution (Samet and White 2004). Minority and low-socioeconomic populations consistently have high rates of chronic disease that can increase negative health impacts from poor air quality (Samet and White 2004). Therefore, there could be the potential

for a disproportionate adverse impact from operations of the cooling towers should exceedances of the PM NAAQS result. Again, no analysis of water-borne pathogens has been performed, despite the known risk. The failure to perform a robust EJ analysis, is a material omission, and potential impacts (particularly to the extent they include increased mortality risk) may, upon review, be considered LARGE.

3.12 AQUATIC ECOLOGY

3.12.1 Introduction

Aquatic ecology of the IPEC Site – existing conditions, the status of threatened and endangered aquatic species, and potential impacts from construction and operation of the NYSDEC Staff and Riverkeeper Proposal – are not addressed at all in either the Tetra Tech Report or the Powers Report. This is despite the fact that construction activities would occur in proximity to the Hudson River shoreline and are likely to involve substantially increased barge traffic in the vicinity of habitat utilized by the endangered shortnose sturgeon and Atlantic sturgeon.

As a point of reference, in 2009 NYSDEC issued a Positive Declaration for the proposed United Water Desalination Plant just five (5) miles downstream of IPEC (Haverstraw Water Supply Project 2009). The United Water facility's maximum water withdrawal would be ten (10) million gallons per day ("mgd"). The potential impacts to Plants & Animals identified in the Positive Declaration included:

- *The endangered species Shortnosed Sturgeon and Atlantic Sturgeon utilize Haverstraw Bay. Installation and operation of the intake could impact one or more life stages of these species, or their habitats;*

- *The proposed project proposes to withdraw up to 10 million gallons per day (mgd) average, with a potential maximum withdrawal rate of 20 mgd for 12 hours during the low tide period; this elevated withdrawal rate could result in higher intake velocities which could, in turn, have significant adverse impacts on smaller biota found in the Haverstraw Bay reach of the Hudson River.*

The NYSDEC Staff Proposal (as well as the Riverkeeper Proposal) for IPEC could withdraw more than five (5) times the maximum withdrawal of United Water; however, neither of these issues was addressed in the Tetra Tech or Powers Reports.

3.12.2 Construction Impacts

The Tetra Tech Report indicates that construction will require clearing and blasting of a *"significant area of the IPEC Site"* (p. 35), estimated by TRC as 16 acres. There will also be a need for on-site rock crushing, use of conveyors and trucking. These activities, particularly given the exposed highly impermeable bedrock, will create the potential for increased stormwater runoff as acknowledged by Tetra Tech (p. 35). According to Tetra Tech the increased stormwater would flow within perimeter ditches to an outlet conveyance that terminates at the Hudson River. Bank protection at the outfall location (the Hudson River) was also recommended (p. 36) by Tetra Tech.

A General Permit ("GP") for Construction Stormwater Discharges from Construction Activity would be required as well as the development and implementation of a Stormwater Pollution Prevention Plan ("SWPPP"), which was not addressed by Tetra Tech or Powers. However, any

discharge of potentially contaminated runoff or potentially contaminated dewatering effluent would be subject to a SPDES Permit modification (i.e., coverage would not be granted under the GP for Construction Activity).

Construction of the NYSDEC Staff Proposal will involve blasting and removal of approximately two (2) million cubic yards of rock over a three (3) to four (4) year period. The preferred method of removing this waste rock from the site is by barge (Tetra Tech Report, Section 3.4.2). Approximately 1,215 barge loads will be required to transport this material over this time. Barges will be loaded at IPEC's existing pier adjacent to the Unit 1 intake structure (Tetra Tech Report, Figure 3-2), and then transported to an unspecified off-site location.

None of the potential aquatic impacts that may result from these construction activities – land-based and on the water - are addressed in the Tetra Tech Report. Assuming that the stormwater controls and permit were in place and approved by NYSDEC, land-based construction impacts to aquatic ecology would be considered NONE to SMALL.

The Powers Report also does not address potential aquatic ecology impacts from construction of its Proposal(s).

3.12.3 Operational Impacts

The potential operational impacts to aquatic ecology of the NYSDEC Staff Proposal would include the residual entrainment and impingement that would occur due to the continued withdrawal of service water and makeup flows, and the discharge of blowdown (i.e., the release of water from the closed-cycle system to alleviate high concentrations of dissolved substances).

Neither the Tetra Tech Report nor the Powers Report provides projected water withdrawals during closed–cycle cooling operations. Neither Tetra Tech nor Powers provide an analysis of residual entrainment and impingement with closed-cycle cooling.

As described in Chapter 3.3, an extensive water treatment program for the efficient and effective operation of the proposed cooling towers for the NYSDEC Staff Proposal (a program would be required for the Riverkeeper Proposal as well) would be necessary. The water treatment considerations include the need to manage water quality to prohibit fouling, microbial growth and, with respect to known human health concerns, the demonstrated potential for certain types of cooling towers to harbor, grow and disperse airborne pathogens. These water treatment chemicals are concentrated in the cooling towers prior to blowdown to the Hudson River.

Neither Tetra Tech nor Powers have analyzed the potential aquatic ecology effects of cooling tower blowdown discharges, let alone identifying the need for the water treatment program given the requirements of the cooling towers and the constituents of raw Hudson River water.

For purposes of this Response, and for lack of assessment in the Tetra Tech and Powers Reports, assuming that cooling tower blowdown discharges can be managed and treated in a way to be compliant with applicable effluent limitations and water quality standards, the aquatic ecology impacts would be considered NONE to SMALL.

4.0 SUMMARY AND CONCLUSIONS

Entergy retained ENERCON and BREI to evaluate the NYSDEC Staff and Riverkeeper Proposals. The ENERCON evaluation is presented in its entirety as Appendix A of this Response. The discussion below is a summary of that evaluation, and addresses three (3) major areas of consideration: (1) Whether the TetraTech and Powers Reports are sufficient to establish engineering feasibility; and (2) whether, accounting for any insufficiencies, the TetraTech and Powers Reports fail to establish feasibility or demonstrate infeasibility.

Regarding the first point, the NYSDEC Staff Proposal (defined as conceptual by Tetra Tech) is not sufficient to establish site-specific engineering feasibility at IPEC and in fact includes several acknowledged "potential fatal flaws" (Tetra Tech 2013) that result in Tetra Tech's inability to reach a feasibility conclusion on a site-specific basis for IPEC (underscored by the absence of conclusions). By way of illustration, the Tetra Tech Report does not contain a comparable level of engineering design information presented in the ENERCON 2003 Report on closed-cycle cooling. Further, ENERCON conducted substantial additional engineering design work to determine that various additional design and constructability issues would challenge the feasibility of a closed-cycle cooling retrofit at IPEC (ENERCON 2010). This goes to show that conceptual analysis for a major, untried project of the sort proposed by NYSDEC Staff and Riverkeeper for IPEC on a site-specific basis cannot reasonably be determined feasible. Indeed, it is expected that Tetra Tech would identify additional challenges to feasibility if they performed a more detailed engineering design of the sort required to establish site-specific engineering feasibility. The Powers Report is so inadequate as to allow no reasonable conclusion about engineering feasibility.

Regarding the second point, ENERCON has concluded, based on the information provided by Tetra Tech, that the NYSDEC Staff Proposal cannot be considered feasible at IPEC. There are a variety of reasons for this. As discussed at length in ENERCON's 2010 Report, conversion of existing nuclear stations to a closed-cycle cooling configuration is unprecedented, and at IPEC represents an incredibly complex engineering and construction undertaking, with significant uncertainty about whether it can be performed, as well as the cost and schedule required. As ENERCON describes, large-scale construction activities at nuclear power plants have routinely experienced significant construction schedule overruns, with the result that conversion to closed-cycle cooling at IPEC may consume the entire license renewal period (Yamayee and Anderson 1983). Under these circumstances, cooling towers can provide no reduction in impingement or entrainment, and therefore cannot satisfy applicable law.

Retrofitting to closed-cycle cooling with ClearSky™ cooling towers is even more challenging as a function of the technology selected by NYSDEC Staff, including its defining attributes and the siting configurations that Tetra Tech has proposed for IPEC. ClearSky™ cooling towers employ a novel technology with limited operating experience (and no assurances of its functionality and performance) on only one (1) in-line cooling tower test cell, and no operating experience in the back-to-back configuration proposed by Tetra Tech. This lack of operational history, and the lack of material establishing its functionality and performance, would eliminate ClearSky™ cooling towers from serious consideration at a large baseload nuclear plant, such as IPEC. This is because, in part, large baseload power plants are essential power sources and provide grid stability, and as such, reliable long-term operation is essential and must be an important element of the technology selection process. This is also because nuclear and electric-system reliability consideration is resistant to novel technologies for large-scale facilities, particularly

those that are dedicated, essential power sources for a major metropolitan area, i.e., proven technology is always preferred.

The feasibility issues and operability concerns of the ClearSky™ cooling towers, based on the information provided in the Tetra Tech Report, are summarized below. Briefly. the feasibility issues and operability concerns discussed below are unresolved by Tetra Tech and challenging, with the result that the configuration as presented in the Tetra Tech Report cannot be considered feasible at IPEC. Again, the Powers Report is so inadequate as to allow no reasonable conclusion about engineering feasibility.

4.1 FEASIBILITY ISSUES

1. **Cooling Tower Siting Conflicts:** Using Figure 3-3 in the Tetra Tech Report, the location of the cooling towers would require re-location and/or demolition of a significant number of existing Station structures and equipment, including essential plant components and components containing radionuclides (in the form of spent nuclear fuel and low-level radionuclide material). Tetra Tech did not in some circumstances, even identify and in all circumstances failed to address the adverse impacts to plant structures and equipment, including whether these structures are capable of being moved and relocated on-site. Even if capable of being relocated on-site, Tetra Tech did not account for the cost and schedule impacts of doing so. The number and significance of the siting conflicts unresolved by Tetra Tech would result in a detrimental effect to IPEC, and as such the NYSDEC Staff Proposal cannot be considered an available technology as defined in the Indian Point Interim Decision (NYSDEC 2008). It also represents major unaddressed engineering challenges that undermine a feasibility conclusion.

2. **Algonquin Pipeline Considerations:** Although Tetra Tech acknowledged that the pipelines would have to be relocated, it did not identify how or where to relocate the pipelines. It is not feasible to conduct construction involving blasting directly on top of and around active gas pipelines. Further, Tetra Tech neither acknowledged, nor evaluated the proposed expansion of the pipelines currently planned by the pipeline owner, which may make relocation even more complicated, as well as affect cost and schedule.

3. **Power Transmission Line Impacts:** The proposed cooling tower location directly interferes with the existing overhead 345 kV main transmission lines (and one (1) of the towers) to the power grid and the 138 kV auxiliary power lines from the Buchanan Substation to IPEC. The necessary relocation of these lines (with appropriate clearances) and any underground control cables, including the cost and schedule impacts, are not addressed in the Tetra Tech Report.

4. **Radionuclide Management:** Tetra Tech acknowledged that evaluation and management of the radionuclide conditions is necessary along the riverfront in order to determine feasibility, which has not yet been performed. Tetra Tech states (p. 28), "*If an acceptable method cannot be identified, construction and excavation could not proceed in this area, which is where the CT2 [Unit 2 cooling tower] pipe corridor would be sited. In this case, the proposed Unit 2 retrofit would be infeasible.*"

5. **Closed-Cycle Cooling Retrofit Impact on Condenser:** Tetra Tech did not perform any transient or accident analysis for IPEC subsequent to the closed-cycle cooling retrofit. A review of the transient and accident analysis is necessary for any significant

plant change to ensure that there are no potential impacts to the operation of a nuclear power plant. BREI reviewed one (1) transient condition and they identified that the increased condenser backpressure would be higher than the low vacuum alarm setpoint during a high pressure steam dump at Unit 3, resulting in a trip of Unit 3. The BREI analysis was limited to but one (1) transient condition, which emphasizes the need to identify and resolve any impacts to the transient or accident analysis before concluding the feasibility of such a significant plant modification.

4.2 OPERATIONAL CONCERNS

1. **Site Impact of Cooling Tower Plume:** Although plume-abated cooling towers would produce an invisible plume under defined meteorological conditions, the discharge plume of saturated salt-laden mist still exists. This condition, based on the ClearSky™ configuration proposed by Tetra Tech, is highly localized over the IPEC power blocks and nearby environment. As a result, the Tetra Tech Configuration would lead to increased salt deposition and moisture on existing operating electrical equipment. Specifically, the close proximity of the cooling towers to the power blocks and electrical transmission facilities creates a known risk of electrical arcing (discharge of current through air) in the switchyard. This is a significant workplace safety and operational hazard, and in the latter case may lead to a reactor scram (or shutdown of the nuclear reactor) resulting in forced outages, the implications of which Tetra Tech has not evaluated and may substantially impact electric-system function.

2. **Cooling Tower Recirculation Effects:** As a result of the long rectangular configuration of the ClearSky™ cooling towers, these towers would be subject to significant plume recirculation, which would have an adverse impact on the operational efficiency of the plant. At conditions occurring in June, the combined peak[3] operational and parasitic power losses of the Tetra Tech Configuration would be 137.5 MWe. This is approximately 15% higher than what Tetra Tech lists as the combined peak operational and parasitic power losses, and represents a greater than six (6)% reduction in IPEC power output, which would worsen even more under wind conditions more conducive to recirculation.

3. **Fiberglass Cooling Tower Design Constraints:** The Tetra Tech Report does not address the known structural susceptibility of fiberglass cooling towers to wind damage, tornado-generated missiles and fire. Significant new equipment and larger structures, like the fiberglass SPX ClearSky™ cooling towers proposed by Tetra Tech, have the potential to introduce a new missile case. Since it is not known if this new missile case will exceed the current site design, analysis and potentially configuration changes must be conducted to eliminate this design concern.

Tetra Tech did not identify the type of fill material and/or address fill degradation impact over time for the proposed ClearSky™ cooling towers. As noted above, Tetra Tech did not provide any transient or accident analysis in the report to determine what the proposed closed-cycle cooling retrofit would have on the operation of IPEC, nor did Tetra Tech incorporate the expected cooling tower recirculation effects. Increasing the number of cooling tower cells to address these issues would increase the impacts noted in the feasibility issues and operability concerns above and would result in additional excavation, pipe routing, and likely introduce new feasibility issues or operability concerns.

[3] "Peak" is defined as the maximum operational power loss over a 1-hour period for an increase in wet-bulb temperature due to recirculation at the average site wind speed (as measured from 2004 to 2008).

In summary, the novelty of the ClearSky™ cooling tower, the array of feasibility issues, and various operability concerns described above are unresolved by Tetra Tech. As such, the NYSDEC Staff Proposal as presented in the Tetra Tech Report cannot be considered feasible at IPEC. If the towers are determined to be feasible, the cost and implementation schedule, which would need to be adjusted to account for the feasibility issues and operational concerns identified above, would also likely be impacted by significant schedule overruns associated with Tetra Tech's numerous omissions, particularly accounting for the delays typical of large-scale construction activities at nuclear power plants.

The Powers Report (and supplemental information submitted in September 2013) is not a reasonable engineering review and technology evaluation, insomuch as it lacks essential detail required to establish feasibility. Riverkeeper's selected cooling tower configuration would result in increased circulating water temperature and reduced flow rate, which would impact IPEC's ability to generate electricity and may exceed condenser operational limits during both normal and transient conditions. The Riverkeeper selected closed-cycle cooling configuration would utilize a circulating water flow rate of 600,000 gpm, approximately 29% less than the current IPEC circulating water flow rate of 840,000 gpm. Without sufficient evaluation to conclude that condenser operational limits will not be exceeded, the Riverkeeper selected closed-cycle cooling configuration cannot be considered feasible.

4.3 POTENTIAL SIGNIFICANT ADVERSE ENVIRONMENTAL IMPACTS

As discussed in Chapter 3.0, adverse impacts associated with construction and operation of the NYSDEC Staff Proposal and Riverkeeper Proposal (where feasible) were identified. Impacts were assessed across a range of SEQRA resource issues, including electricity, water treatment/water quality, air quality, noise, visual resources, land use, zoning and local approvals, terrestrial ecology, archaeological and historic resources, transportation and navigation, environmental justice, and aquatic ecology.

The impact analyses (Chapter 3.0) of the NYSDEC Staff Proposal indicate that there would be numerous types of potential adverse impacts. For purposes of this chapter summary, only those resources with potential impacts that have been identified as LARGE and adverse associated with construction and/or operation of the NYSDEC Staff Proposal are presented. The body of this Response (Chapter 3.0) describes the full range of potential impacts (NONE, SMALL, MODERATE and LARGE), as does the Executive Summary.

4.3.1 Potential Significant Adverse Construction Impacts

4.3.1.1 Electricity

Tetra Tech (p. 24) estimates that the NYSDEC Staff Proposal would require construction outages of 30 weeks at Unit 2 and 35 weeks at Unit 3. The outage duration estimates in the Tetra Tech Report reflect a number of unsubstantiated assumptions. These include, for instance, assumptions about the ability to permit and perform blasting in proximity to Indian Point Units over an extended duration during which they continue to operate. The outage duration estimates also include assumptions that the construction period for Unit 2 would overlap partially with a regularly scheduled maintenance outage of five (5) weeks for Unit 2, and that aggressive work schedules would reduce the outage duration by eight (8) weeks for Unit 2 and seven (7) weeks for Unit 3. None of Tetra Tech's assumptions are validated in its Report, and most are not credible. The Tetra Tech Report assumptions are not consistent with the

USEPA 316(b) rule making assumptions that cooling towers and nuclear power plants require seven (7) months of outage.

Even assuming Tetra Tech's analysis is correct, the 30-week construction outage durations (p. 24) imply power losses of 11.2 million megawatt hours ("MWh") for IPEC as a whole (*Benefits and Costs of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (Appendix D)). This potential power loss to the New York State electricity system resulting from construction of the NYSDEC Staff Proposal represents about 65% of total generation at IPEC in 2012 (NYISO 2013) and about 12% of total electricity consumption in southeastern New York State (defined as NYISO Zones G through K) in 2012 (NYISO 2013a). Based on the need to replace these power losses during the outage year, the construction outage associated with the NYSDEC Staff Proposal would likely have a MODERATE to LARGE impact on the electricity system in southeastern New York State (Chapter 3.2.1). In fact, far longer outages should be expected, and will further exacerbate electric-system impacts (Appendix D).

4.3.1.2 Noise

The Tetra Tech Report acknowledges the magnitude of the NYSDEC Staff Proposal, including that approximately two (2) million cubic yards of blasting will need to occur, with blasting spoils required to be excavated, crushed and transported from the IPEC Site. The crushed, transport-ready spoils, if not removed by barge, would be removed by a steady stream of heavy duty trucks. The Report also acknowledges that the transportation process by itself could result in noticeable noise, but does not address potential adverse noise impacts of these activities. Indeed, no quantitative analysis is performed for construction noise, despite the magnitude of the project and its duration (which are long enough that potential impacts will be experienced over multiple years). Tetra Tech further states that, if spoils are removed by barge, then a conveyor system would be used with screens to exclude rock fragments larger than 12 inches in diameter (p. 34). Construction of the NYSDEC Staff Proposal will require daily detonation of blasting charges over a multi-year period and large numbers of on-site construction equipment, such as backhoes, dump trucks, excavators, etc., operating simultaneously.

Considering the scope, extent and duration of the activities necessary to construct the facilities presented in the NYSDEC Staff Proposal, construction would likely have the potential to result in MODERATE to LARGE noise impacts, particularly if the bulk of the blast spoils are moved by truck (Chapter 3.5.2).

4.3.1.3 Visual Resources

The Tetra Tech Report provides no meaningful description of construction activities that may impact the regional viewshed, let alone evaluate the impact of such activates on the scenic resources of the region. To fully evaluate construction-related impacts of the NYSDEC Staff Proposal, consistent with SEQRA requirements, additional information is needed concerning the on-site acreage to be cleared of existing vegetation, excavation area, size and placement of construction cranes, location of site roads, and fugitive dust generation.

The NYSDEC Staff Proposal would be of a scale unprecedented in this region of the Hudson River Valley. Ultimate construction of the proposed cooling towers would effectively triple the industrial profile of IPEC immediately adjacent to the Hudson River, particularly as viewed from the river and opposite shore. Based on the information provided, and considering the anticipated impacts from construction of a project of this scope, magnitude and duration at this

specific location on the Hudson River in the designated coastal zone, the construction-related potential impacts to visual resources would likely be considered LARGE (Chapter 3.6.2).

4.3.1.4 Transportation

Tetra Tech includes limited information on road network transportation relative to construction of the NYSDEC Staff Proposal. Estimates of the number of haul truck trips (and the numbers of barges required) are presented; however, the Tetra Tech does not include analyses of the impacts to the road network (and/or navigation on the river). Should the use of barges be limited and truck use maximized for the removal of blast spoils (i.e., an estimated 110,000 truck trips - or 235 such truck trips per day - over three (3) to four (4) years)), that volume of construction vehicle trips has not been demonstrated to be feasible and would result in potential local traffic impacts ranging from MODERATE to LARGE (Chapter 3.10.1). Under the scenario where truck use is limited and barge use is maximized, construction traffic impacts associated with the NYSDEC Staff Proposal would suggest a range from SMALL to MODERATE (Chapter 3.10.1).

4.3.2 Potential Significant Adverse Operational Impacts

4.3.2.1 Cooling Tower Water Treatment/ Water Quality

Hudson River water exhibits highly variable salinity levels and at times has high concentrations of suspended solids, iron, nutrients, and biological organisms (macro and micro-organisms), as well as the presence of wetting agents/surfactants from upstream discharges of sanitary and industrial wastewater effluents (Puckorius 2013). The performance of the ClearSky™ cooling towers technology at IPEC would be directly affected by the physical and chemical characteristics of the Hudson River raw water supply as well as the water treatments that must be used to control or remove these constituents (Puckorius 2013). Tetra Tech did not address these critical operational issues at all in their Report. By omitting discussion of water treatment, Tetra Tech does not address the impact of water treatment chemicals on air quality, including as a function of the cooling tower drift rate (i.e., the quantity of water, as droplets known as drift, exiting the cooling tower, expressed in gallons per minute). That analysis is essential, and its omission means that operational air quality impacts are also unknown.

SPX (Marley), the vendor for the ClearSky™ technology, is clear that real-world (as opposed to lab) dynamics, such as the use of dispersants, surfactants and microbiocides necessary for tower operation and to control water-borne pathogens subject to air dispersal, negates its cooling tower drift rate "guarantee" of 0.0005% (SPX 2009). This is, for instance, because dispersants, surfactants and microbiocides all exacerbate drift, a fact underscored by SPX's acknowledgement that its drift rate guarantee is based solely on a lab scale model using purified water. Because IPEC would not operate under these circumstances, the actual drift rate using Hudson River (not purified) water and needed water treatment chemicals must be evaluated to comply with air quality requirements, including under SEQRA. Tetra Tech has not done so, constituting a material omission.

However, Puckorius establishes that use of Hudson River water, and necessary treatment chemicals, would result in a substantially greater drift rate (and associated particulate emissions) than asserted by Tetra Tech using the presumed drift rate of 0.0005% (Puckorius 2013). Moreover, the testing protocol to determine compliance with the "guaranteed" drift rate requires that all surfactants and dispersants (that would be used in normal operations at IPEC) be purged from the tower during a three (3) to five (5) day period prior to the test and

throughout the testing period. Because the use of surfactants and dispersants is required, the conditions specified by the "guarantee" simply cannot be satisfied on a site-specific basis for towers operated at IPEC (Chapter 3.3.3), but instead presents a misleading picture of actual drift and therefore, air quality impacts (Chapter 3.3.4).

4.3.2.2 Air Quality

Tetra Tech did not evaluate the air quality impacts associated with the particulate emissions from the cooling towers or address the ability of the NYSDEC Staff Proposal to obtain the necessary air quality permits.

Because the Tetra Tech Report did not assess the operational air quality impacts of the NYSDEC Staff Proposal, there is no basis established that the Proposal could, in fact, operate (including on a full-time, year-round basis) at IPEC. To the contrary, prior analysis by TRC (at lower cycles of concentration and therefore emissions, not to mention an undemonstrated drift rate) concluded that full time, year-round operation of a wet cooling tower could not occur without violating PM-2.5 air quality standards (TRC 2009). Consequently, the NYSDEC Staff Proposal would likely have to operate on an intermittent or limited basis during the year, reflective of the highly variable salinity (and other constituents) of the Hudson River in order to conform to air quality standards. An "intermittent" or "salinity-limited" operation of the NYSDEC Staff Proposal was not evaluated in the Tetra Tech Report.

Tetra Tech also did not address issues relating to cooling tower drift and associated guarantees that the cooling tower vendors would have to achieve. In the absence of these analyses, as well as the inappropriate assumptions of drift rates and fractionalization formulae, which are neither site-specific nor established, there is no assurance that air quality analysis under federal and New York law, including SEQRA, would allow authorization the NYSDEC Staff Proposal. To the contrary, all prior analysis indicates that it would not.

Given the absence of applicable analyses, as well as the inappropriate selection of drift rates and fractionalization formulae which are neither site-specific, nor established, there is no assurance that air quality analysis under federal and New York law, including SEQRA, would authorize the NYSDEC Staff or Riverkeeper Proposals. To the contrary, prior work performed by TRC indicates that no authorizations will result, and that air quality impacts can be characterized as LARGE, even if Westchester County were to be deemed in attainment.

4.3.2.3 Noise

Quantitative noise modeling of the ClearSky™ cooling towers' operation was conducted in this Response for the NYSDEC Staff Proposal based on design data presented in the Tetra Tech Report. The modeled operational noise levels were then compared to the NYSDEC noise impact criterion and the Village Code. Modeled noise levels were shown to exceed the maximum allowable levels under the Village Code by up to 17 dBA at certain locations in selected octave bands, and thus not available on a permitting basis (Appendix C). Increases in noise levels over existing ambient conditions as great as 18 dBA at residential locations were calculated, levels that are well above the NYSDEC noise impact criterion of six (6) dBA over ambient conditions. An increase over ambient conditions of six (6) dBA or more has historically been accepted as resulting in a LARGE noise impact (Chapter 3.5.6).

4.3.2.4 Visual Resources

Operation of the ClearSky™ cooling towers will produce a visible plume, estimated by Tetra Tech (p. 79) to occur less than two (2) percent of the year. Tetra Tech provides no basis to confirm that the towers can, or should be operated in abatement mode at all times, or the basis supporting the conclusion that plume-abatement technology will result in infrequent plume formation largely limited to winter months. Furthermore, Tetra Tech does not consider the potential for nighttime visibility resulting in plume illumination from the high level of outdoor lighting at IPEC for safety and security purposes.

The NYSDEC Staff Proposal would be of a physical scale unprecedented in this region of the Hudson River Valley. Ultimate construction of this project, including the two (2) arrays of cooling towers, would effectively triple the industrial profile of IPEC immediately adjacent to the Hudson River, particularly as viewed from the river and opposite shore; moreover the towers (at 91 feet tall and 52 feet above river elevation) would also be substantially taller than surrounding vegetation.

NYSDEC Visual Policy requires that projects consider all practicable mitigation techniques. Due to the physical scale and high visibility of the ClearSky™ cooling towers and associated plumes, it is unlikely that the NYSDEC Staff Proposal can be mitigated to a meaningful degree using traditional siting and design mitigation techniques. The NYSDEC Visual Policy states that unavoidable impacts may need to be compensated for, wholly or in part, by offsets; however, Tetra Tech does not address this mitigation technique despite the acknowledgement that unavoidable visual impacts would result from operations of the NYSDEC Staff Proposal.

The NYSDEC Staff Proposal would be a project of unprecedented scale and scope in the Hudson Valley. It would affect an unusually large number of visual resources of statewide and national significance, would be incompatible with New York State CMP Policy, and could not be mitigated to a meaningful degree. Viewed in terms of historical visual impact precedents and given the scale, extent of project visibility and impact on a large number of scenic resources of statewide significance, including the associated visible vapor plumes, there is no reasonable basis to conclude that the Tetra Tech Configuration at IPEC is capable of satisfying CMP consistency standards with regard to visual impacts. The presence and operation of the NYSDEC Staff Proposal with ClearSky™ cooling towers would create visual impacts in the Hudson Valley that can be characterized as LARGE (Chapter 3.6.3).

4.3.2.5 Terrestrial Ecology

Tetra Tech did not provide baseline terrestrial data nor present an impact analysis thereof relative to the presence and operation of the NYSDEC Staff Proposal. In fact, natural resources of concern (rare, special concern, threatened, endangered, or candidate species) do exist in the vicinity of IPEC as documented by USFWS and NYSDEC (and not identified by Tetra Tech). Given the potential presence of listed species in the vicinity of IPEC and the NYSDEC Staff Proposal to disturb and permanently remove 16 acres of forested land where habitat for one (1) or more these species of concern (or the species itself) may be present, the potential for adverse terrestrial ecological impacts exists. The Tetra Tech Report did not perform an ecological survey to assess this potential. Should an ecological survey find that listed species or their habitats are, in fact, present on the forested block of land, the potential adverse impacts of the NYSDEC Staff Proposal would be considered LARGE (Chapter 3.8.3). If none are found, the terrestrial ecology impacts would be considered MODERATE (Chapter 3.8.3).

4.3.2.6 Environmental Justice

No operational air quality impact analysis of the NYSDEC Staff Proposal was performed by Tetra Tech despite the fact that cooling towers are a known source of PM emissions and a potential source of water-borne pathogens subject to air dispersal proximate to a NYSDEC-designated EJ community. For example, because prior air quality impact assessment shows potential exceedances of NAAQS from towers configured to provide a better opportunity for dispersion of emissions than the NYSDEC Staff Proposal, including for PM, adverse and disproportionate impact may occur. It has been determined that exposure to PM (PM-10 and PM-2.5) can effect breathing and respiratory systems, cause damage to lung tissue, cancer, and premature death (Chapter 3.11.3). The elderly, children, and people with chronic lung disease, influenza, or asthma, "vulnerable populations" including low-income urban communities, are at increased risk of morbidity and mortality associated with increased exposures to PM pollution (Samet and White 2004). Minority and low-socioeconomic populations consistently have high rates of chronic disease that can increase negative health impacts from poor air quality (Samet and White 2004). No analysis of water-borne pathogens has been performed by Tetra Tech, despite this known risk. The failure to perform a robust EJ analysis is a material omission, and potential impacts (particularly to the extent they include increased mortality risk) may, upon review, be considered potentially LARGE.

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FIGURES

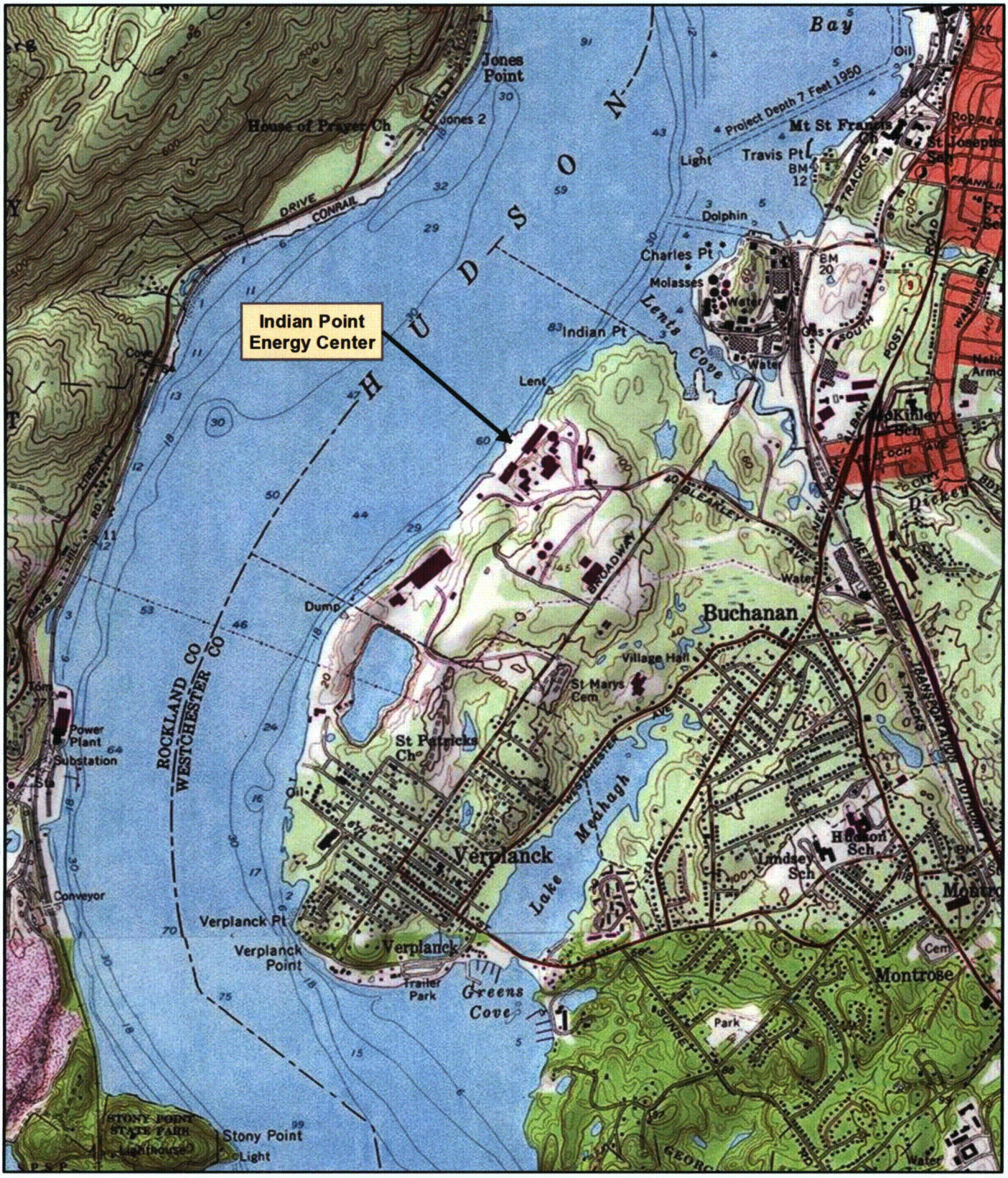

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Figure ES-1
Location Map

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Base Map: National Geographic Society/USGS

TRC

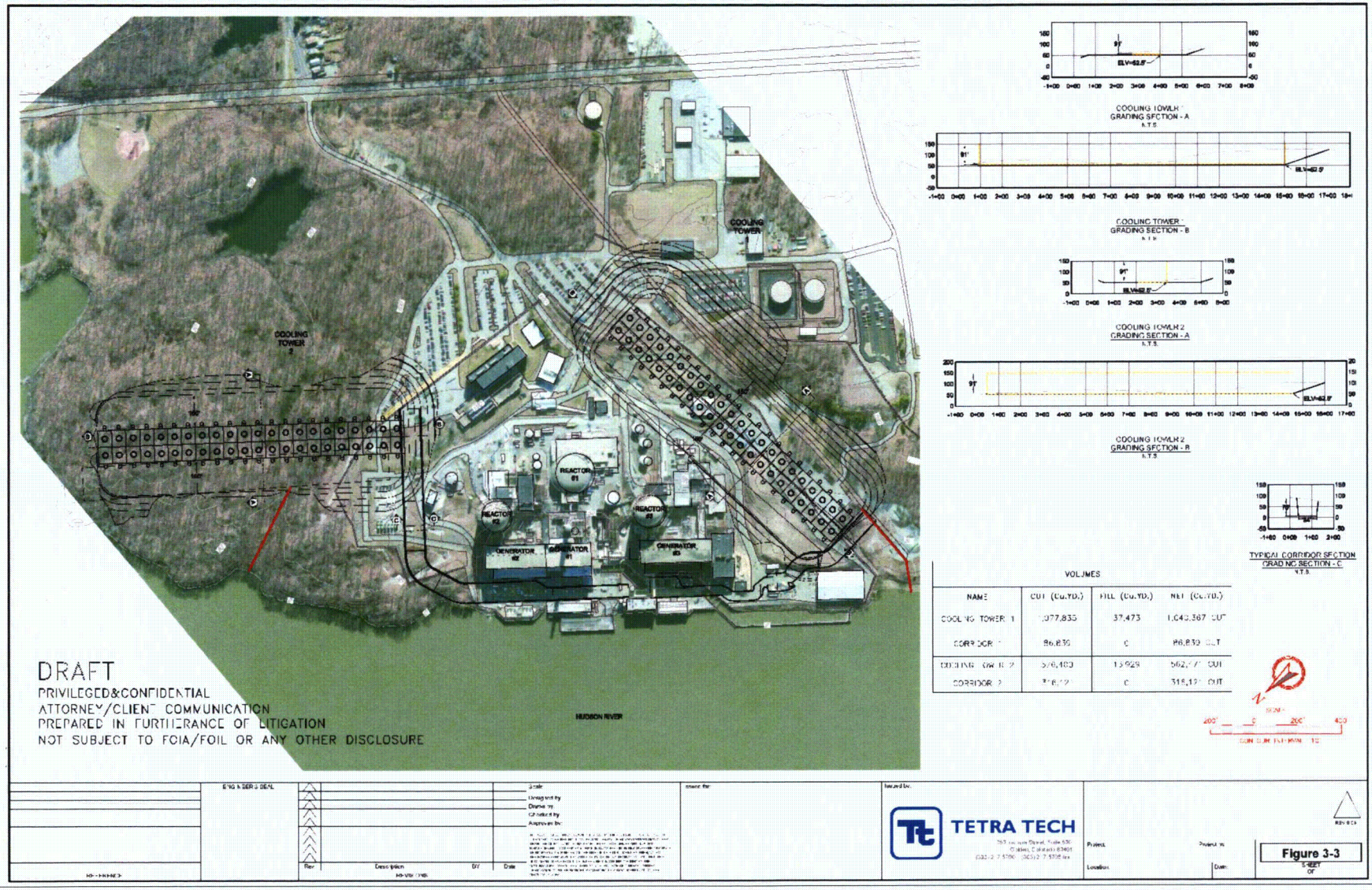

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Figure ES-2

Tetra Tech Configuration
(NYSDEC Staff Proposal)

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Source: Figure 3-3 of the Tetra Tech Report

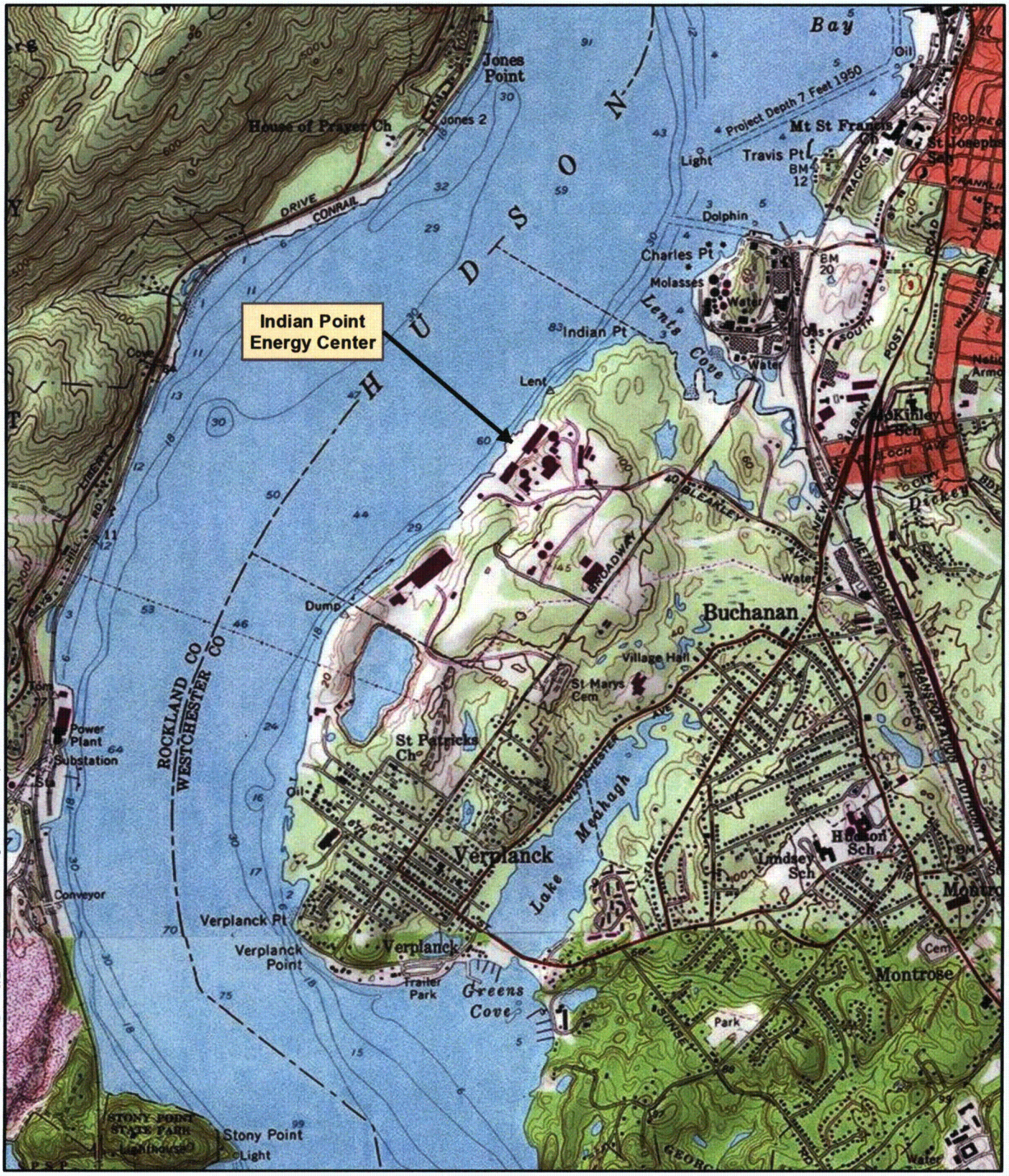

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Figure 1-1
Location Map

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Base Map: National Geographic Society/USGS

TRC

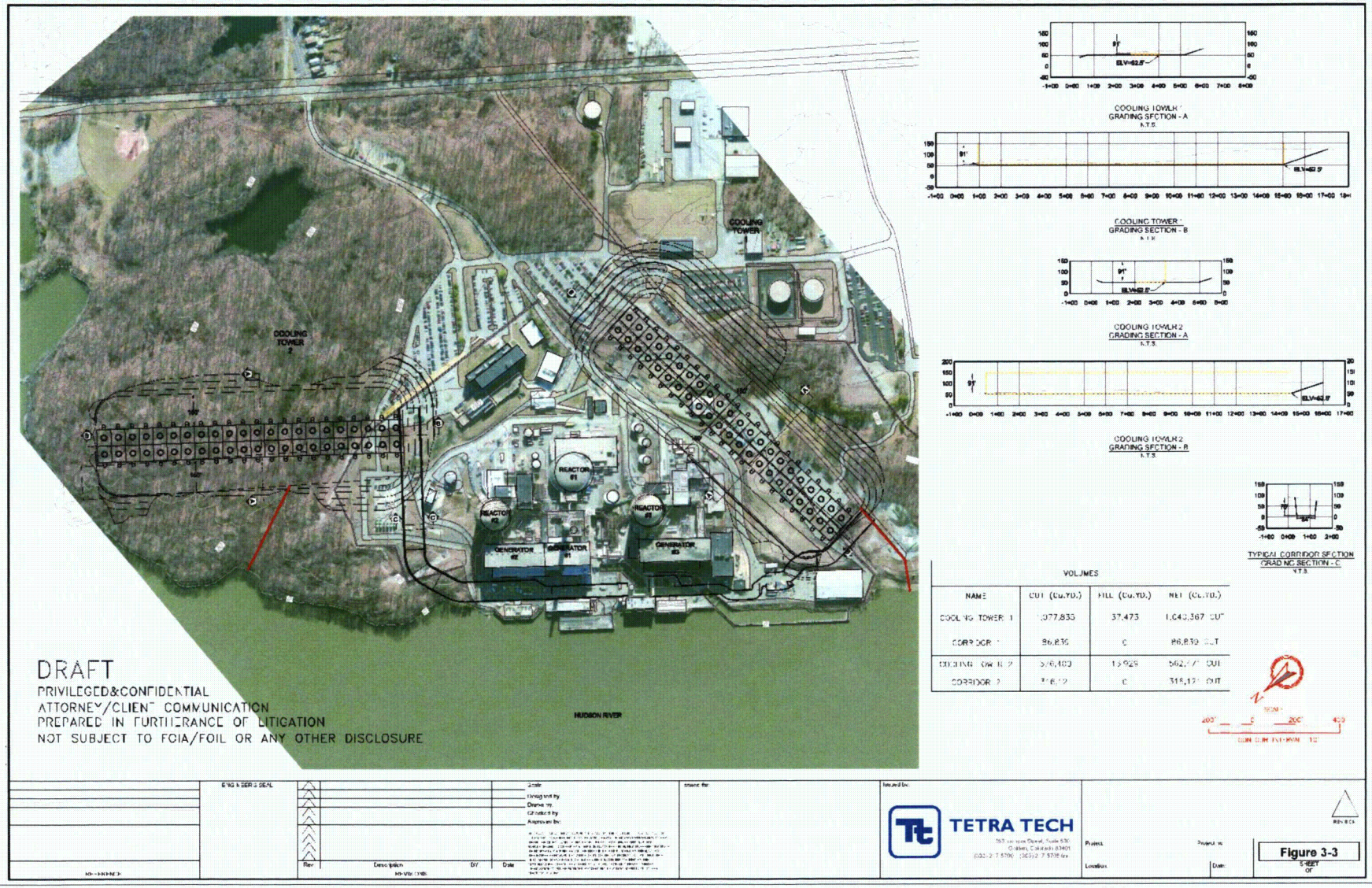

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Figure 2-1

Tetra Tech Configuration
(NYSDEC Staff Proposal)

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Source: Figure 3-3 of the Tetra Tech Report

TRC

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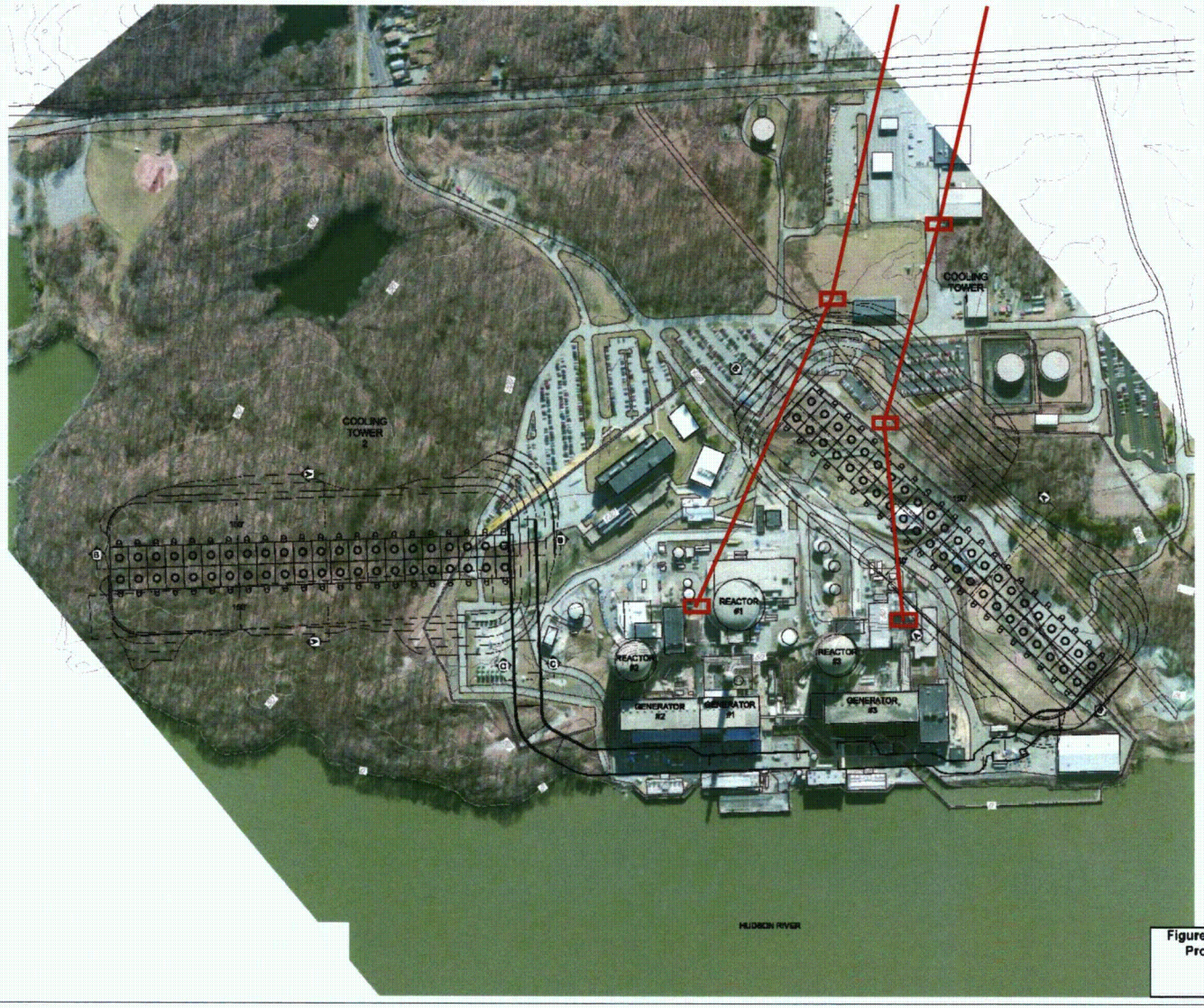


Legend

- Transmission Line
- Transmission Tower

SCALE

200 0 200' 400

CONTOUR INTERVAL 10'

Figure 2 -Transmission Line Overlay on Tetra Tech Proposed Indian Point Closed-Cycle Cooling Configuration

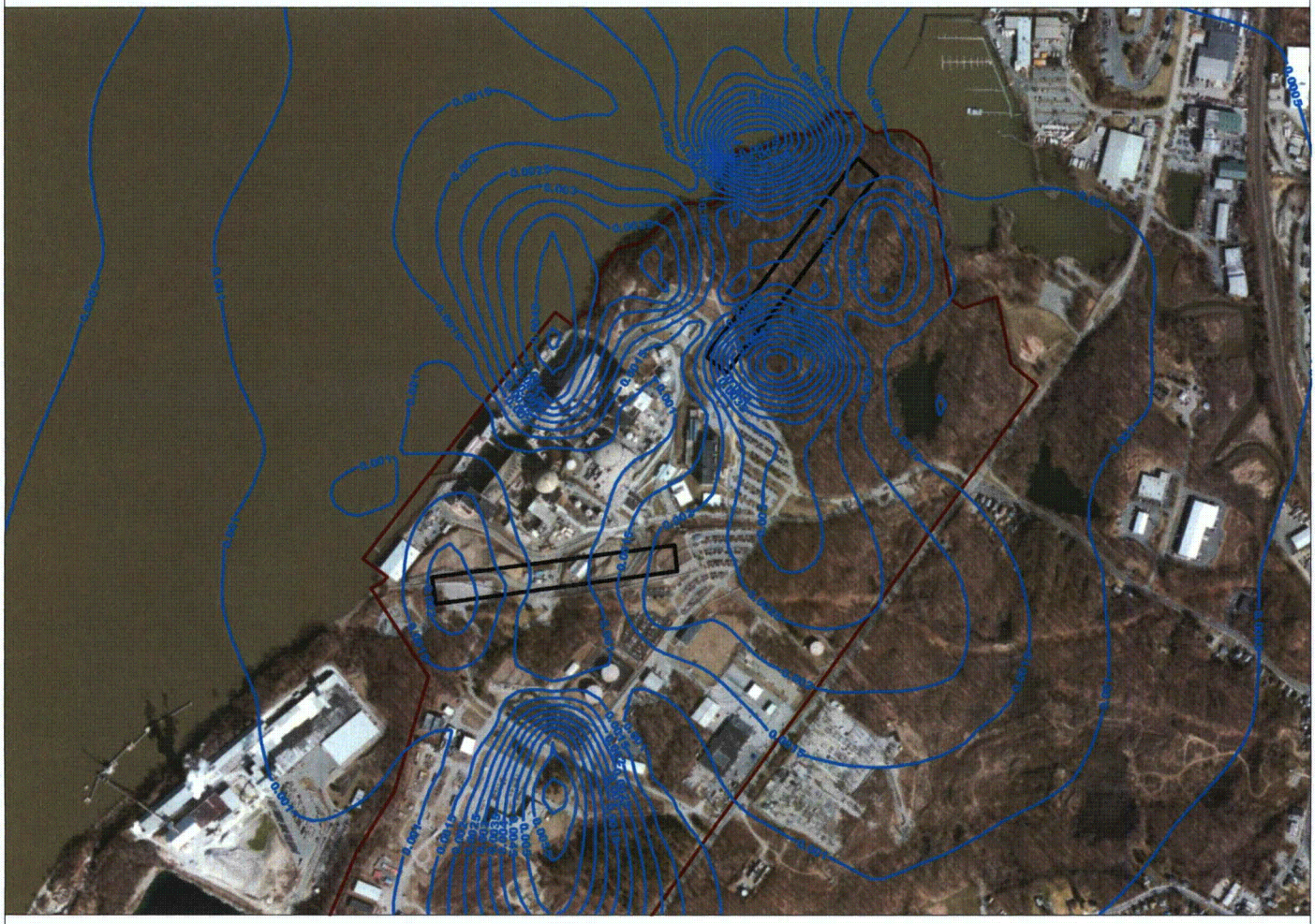
Figure 2-2

Transmission Line Overlay on Tetra Tech Configuration (NYSDEC Staff Proposal)

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Source: Figure 2 of the ENERCON Response, Appendix _

TRC



R:\Projects\GIS_2012\192485_Entergy_IPEC\mxd\CCCFinal\Fig2-3 Salt Deposition Contours 2013-11-26.mxd

Salt Deposition (mg/cm^2/month)
Cooling Towers
Indian Point Boundary

N
W E
S

0 0.25 Miles

Figure 2-3
Salt Deposition at IPEC - Tetra Tech Configuration (NYSDEC Staff Proposal)

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Base Map: Microsoft/Esri, 2011

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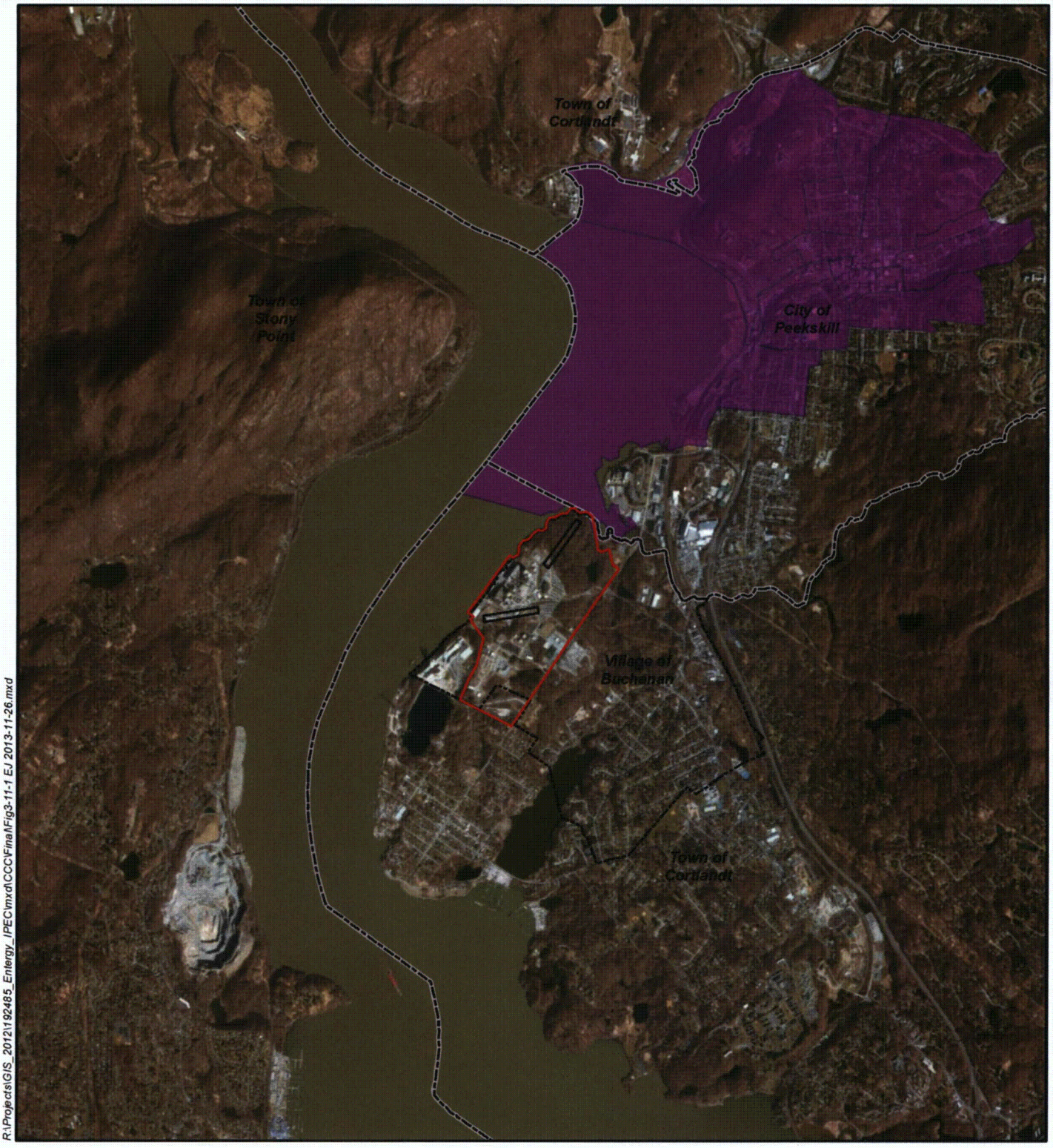

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Cooling Towers
Indian Point Boundary
Potential Environmental Justice Area
Village Boundary
Municipal Boundary

N
W E
S

0 0.25 0.5 Miles

Figure 3.11-1
Environmental Justice Areas

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Source: New York State Department of Environmental Conservation; U.S. Census Bureau, 2000;
Base Map: Esri/Microsoft, 2011

TRC

R:\Projects\GIS_2012\192485_Entergy_IPEC\mxd\CCC\Final\Fig3-5-1 Noise Contours 2013-11-26.mxd

Noise Contours

- 40 dBA
- 45 dBA
- 50 dBA
- 55 dBA
- 60 dBA
- 65 dBA
- 70 dBA
- 75 dBA
- 80 dBA
- Cooling Towers
- Indian Point Boundary
- Village Boundary
- Municipal Boundary

Noise Sensitive Areas (NSAs)

1. St. Patrick's Church
2. Sixteenth Street / Broadway
3. Pheasant's Run
4. Buchanan Town Hall
5. Bleakley Avenue / Broadway
6. Buchanan-Verplanck Elementary School
7. Residence on Broadway
8. China Pier
9. Lents Cove Park

N W E S

0 0.25 0.5 Miles

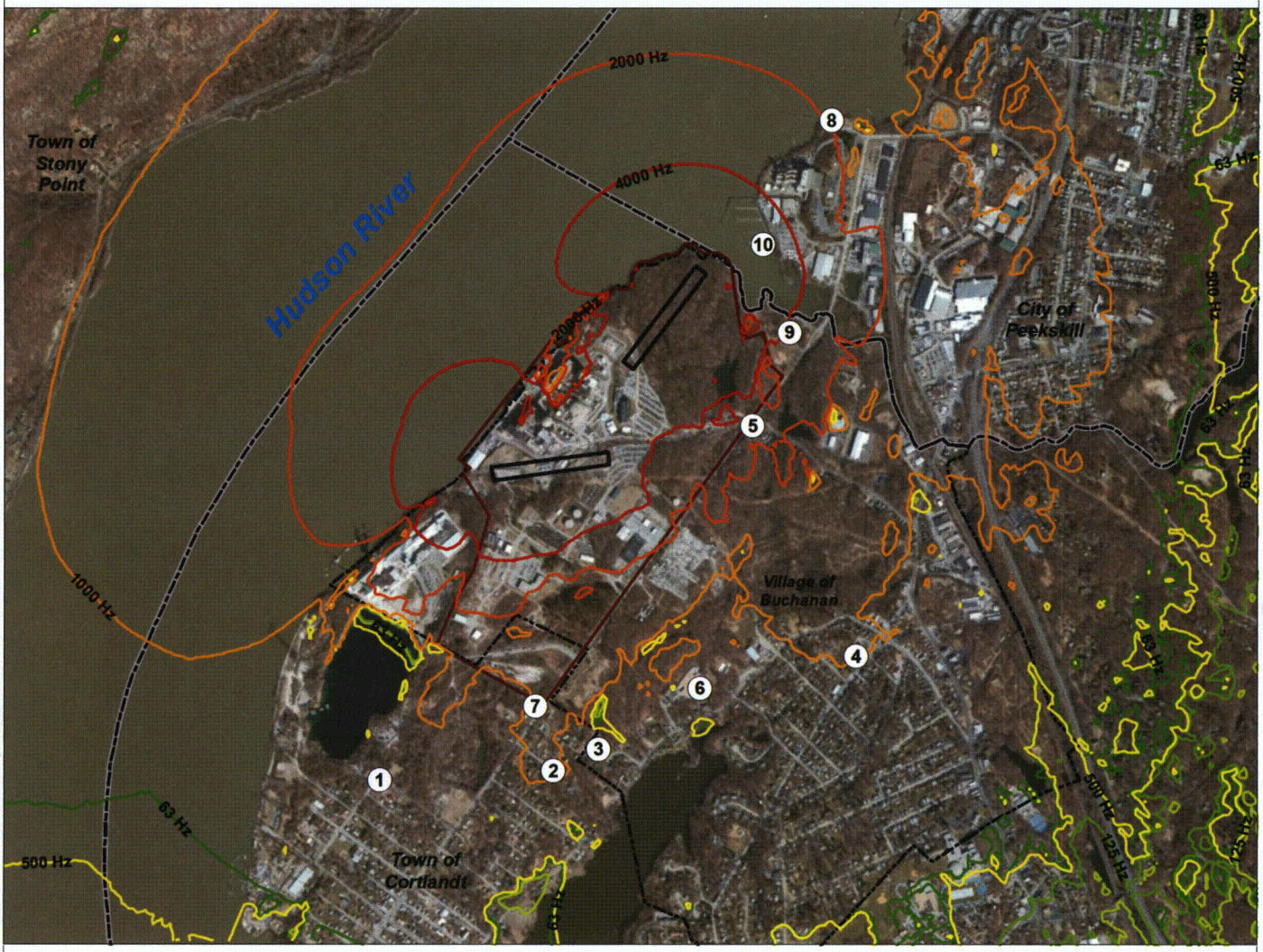
TRC

Figure 3.5-1

Cooling Towers Operational Noise (NYSDEC Staff Proposal)

Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Base Map: Microsoft/Esri, 2011



R:\Projects\GIS_2012\192485_Entergy_IPEC\mxd\CCC\Final\Fig3-5-2 Octave Band Noise 2013-11-26.mxd

Noise Contours

- 63 Hz
- 125 Hz
- 250 Hz
- 500 Hz
- 1000 Hz
- 2000 Hz
- 4000 Hz

- Cooling Towers
- Indian Point Boundary
- Village Boundary
- Municipal Boundary

Noise Sensitive Areas (NSAs)

1. St. Patrick's Church
2. Sixteenth Street / Broadway
3. Pheasant's Run
4. Buchanan Town Hall
5. Bleakley Avenue / Broadway
6. Buchanan-Verplanck Elementary School
7. Residence on Broadway
8. China Pier
9. Lents Cove Park
10. Charles Point Marina

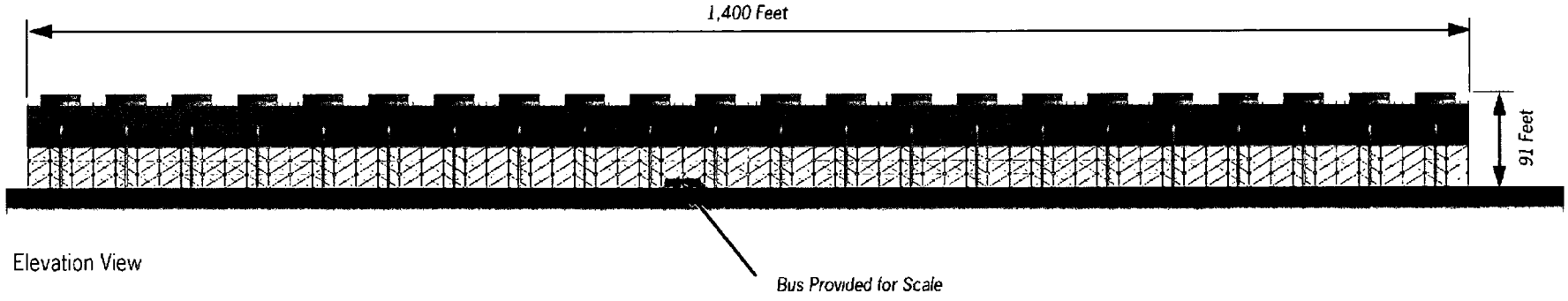
N W E S

0 0.25 0.5 Miles

TRC

Figure 3.5-2
Cooling Towers Operational Noise by Octave Band (NYSDEC Staff Proposal)
Distance Required to Obtain Compliance with Village of Buchanan Noise Ordinance Limits
Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Base Map: Esri/Microsoft, 2011



R:\Projects\GIS_2012\192485_Entergy_IPEC\mxd\CCCVFinal\Fig3-6-1 Cooling Tower Scale 2013-11-26.mxd

Figure 3.6-1
ClearSky™ Cooling Towers Scale Illustration (NYSDEC Staff Proposal)
Indian Point Energy Center
Village of Buchanan, Town of Cortlandt
Westchester County, NY

Source: Saratoga Associates

TRC