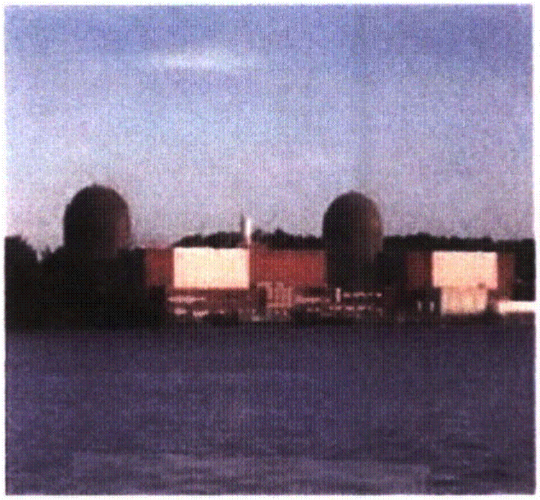
INDIAN POINT UNIT 2 AND UNIT 3



Coastal Zone Management Act Consistency Certification

In support of
Renewal of Indian Point Unit 2 and Unit 3 USNRC Operating Licenses

Submitted by:

Entergy Nuclear Indian Point 2, LLC
Entergy Nuclear Indian Point 3, LLC
Entergy Nuclear Operations, Inc.

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SUPPLEMENTAL INFORMATION REGARDING NYSDEC RECORD

VOL. III OF III

SEPTEMBER 26, 2014

Tab No.	**Description**
Tab 1	Prefiled Direct Testimony of David Harrison, Jr., Ph.D. (February 28, 2014).
Tab 2	**Entergy Ex. 296E**: NERA Economic Consulting, *Impacts to the New York Electric System if Indian Point Energy Center Were Not Available* (December 13, 2013)
Tab 3	**Entergy Ex. 296D**: NERA Economic Consulting, *Benefits and Costs of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (December 13, 2013)
Tab 4	**Entergy Ex. 297**: NERA Economic Consulting, *"Wholly Disproportionate" Assessments of Cylindrical Wedgewire Screens and Cooling Towers at IPEC (December 2013)*
Tab 5	Prefiled Rebuttal Testimony of David Harrison, Jr., Ph.D. (March 28, 2014)
Tab 6	Prefiled Direct Testimony of Christopher J. Russo (February 28, 2014)
Tab 7	**City Ex. 1**: Resume: Christopher J. Russo, Vice President, Charles River Associates
Tab 8	**City Ex. 2**: Charles River Associates, Indian Point Energy Center Retirement Analysis (August 2, 2011
Tab 9	**City Ex. 3**: Charts: Average Yearly LMPs (Local Marginal Prices) of electricity in New York State, 2004-2013 (Accessed February 6, 2014)
Tab 10	**City Ex. 4**: Chart: Average Monthly Natural Gas Prices for Transco Zone 6 Delivery Point, Jan. 2013-Feb. 2014 (Accessed February 6, 2014)
Tab 11	Prefiled Rebuttal Testimony of Christopher J. Russo (March 28, 2014)
Tab 12	Prefiled Direct Testimony of Thomas S. Paynter (February 28, 2014)
Tab 13	**Staff Ex. 222 (TP-1)**: Witness Information for Thomas S. Paynter

Tab 14	**Staff Ex. 223 (TP-2)**: Table: Potential Capacity Market Impacts
Tab 15	Combined Prefiled Direct Testimony of Leka P. Gjonaj and David V. Wheat (February 28, 2014)
Tab 16	**Staff Ex. 221**: Witness Information for Leka P. Gjonaj and David V. Wheat
Tab 17	**Staff Ex. 218**: The Brattle Group, Request for Exemption from FOIL Disclosure (August 28, 2013)
Tab 18	**Staff Ex. 218A**: Indian Point Outage Scenario Definitions for GE-MAPS Simulations
Tab 19	**Staff Ex. 218B**: Year-2022 Forecast Air Emissions and Generation Impacts from Indian Point Outage Scenarios
Tab 20	**Staff Ex. 218C**: Year-2016 Forecast Air Emissions and Generation Impacts from Indian Point Outage Scenarios
Tab 21	**Staff Ex. 218D**: Year-2022 Forecasts of Wholesale Energy Market Impacts from Indian Point Outage Scenarios
Tab 22	**Staff Ex. 218E**: Year-2016 Forecasts of Wholesale Energy Market Impacts from Indian Point Outage Scenarios
Tab 23	Combined Prefiled Rebuttal Testimony of Leka P. Gjonaj and David V. Wheat (March 28, 2014)
Tab 23A	Prefiled Direct Testimony of Ronald Stannard (February 28, 2014)
Tab 24	Prefiled Direct Testimony of Sam Beaver (February 28, 2014)
Tab 25	**Entergy Ex. 296A**: Enercon Services Inc., *ENERCON Response to Tetra Tech's Indian Point Closed-Cycle Cooling System Retrofit Evaluation Report* (December 13, 2013)
Tab 26	**Entergy Ex. 310**: Enercon Services Inc., *Analysis of Closed-Loop Cooling Salinity Levels Indian Point Units 2 & 3* (November 2010)
Tab 27	Prefiled Direct Testimony of John R. Young, Ph.D. (February 28, 2014)
Tab 28	**Entergy Ex. 185B**: ASA, Inc., *Biological Input to Benefits Analysis of the Cylindrical Wedgewire Screen Alternative for Indian Point Energy Center* (March 29, 2013)

Tab 29	Prefiled Direct Testimony of Marc J. Lawlor (February 28, 2014)
Tab 30	**Entergy Ex. 296**: TRC Environmental Corporation, 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) (December 13, 2013)
Tab 31	**Entergy Ex. 296A**: Enercon Services Inc., *ENERCON Response to Tetra Tech's Indian Point Closed-Cycle Cooling System Retrofit Evaluation Report* (December 13, 2013)
Tab 32	**Entergy Ex. 296B**: TRC Environmental Corporation, *Operational Noise Data Inputs – NYSDEC Staff Proposal*
Tab 33	**Entergy Ex. 296C**: Kevin M. Young, Esq. and Elizabeth M. Morss, Esq., Young/Sommer LLC, *Analysis of Municipal and County Permitting for Closed-Cycle Cooling System Retrofit at Indian Point* (December 13, 2013)
Tab 34	**Entergy Ex. 296D**. NERA Economic Consulting, *Benefits and Costs of Cylindrical Wedgewire Screens and Cooling Towers at IPEC* (December 13, 2013)
Tab 35	**Entergy Ex. 296E:** NERA Economic Consulting, *Impacts to the New York Electric System if Indian Point Energy Center Were Not Available* (December 13, 2013)
Tab 36	**Entergy Ex. 296F**: Laura C. Green, Ph.D., D.A.B.T., CDM Smith, *Legionnaire's Disease Risk* (December 13, 2013)
Tab 37	**Entergy Ex. 296G**: Puckorius & Associates, Inc., *Water Treatment for Cooling Towers* (December 13, 2013)
Tab 38	**Entergy Ex. 296H**: TRC Environmental Corporation, *Table C-4: Proposed ClearSkyTM Cooling Tower Operational Noise – CadnaA Model Output* (December 13, 2013)
Tab 39	**Entergy Ex. 296I**: TRC Environmental Corporation, *Table 3.5-5: ClearSkyTM Cooling Towers – Operational Noise Levels and Increases Over Existing Conditions (dBA)* (December 13, 2013)
Tab 40	**Entergy Ex. 311**: TRC Environmental Corporation, *Cooling Tower Impact Analysis for the Indian Point Energy Center* (September 1, 2009)

Tab 41	**Entergy Ex. 370**: AKRF, Inc., *Flora and Terrestrial Fauna Habitat and Communities in the Vicinity of IPEC (Coastal Zone Consistency)* (December 2012)
Tab 42	Prefiled Direct Testimony of Yan Kishinevsky, P.E. (April 30, 2014)
Tab 43	Prefiled Direct Testimony Richard T. Clubb, P.E. (April 30, 2014)
Tab 44	Prefiled Rebuttal Testimony of Sam Beaver (March 28, 2014)
Tab 45	Prefiled Rebuttal Testimony of John R. Young, Ph.D. (March 28, 2014)
Tab 46	Prefiled Rebuttal Testimony of Marc J. Lawlor, Ph.D. (March 28, 2014)
Tab 47	Prefiled Direct Testimony Matthew W. Allen (February 28, 2014)
Tab 48	Prefiled Rebuttal Testimony of Matthew W. Allen (March 28, 2014)
Tab 49.	Prefiled Direct Testimony of Eduardo Ortiz De Zarate (February 28, 2014)
Tab 50	Prefiled Direct Testimony of Tim Havey (February 28, 2104)
Tab 51	**Entergy Ex. 7**: Enercon Services, Inc., *Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-loop Condenser Cooling Water Configuration* (February 12, 2010)
Tab 52	**Entergy Ex. 7A**: Enercon Services, Inc., *Economic and Environmental Impacts Associated With Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration* (2003)
Tab 53	**Entergy Ex. 7B**: Enercon Services, Inc., *Post Modification Site Rendering and Conceptual Drawings*
Tab 54	**Entergy Ex. 7C**: Enercon Services, Inc., *Subsurface Radiological Considerations Related to Construction of Closed-Loop Cooling at Indian Point Energy Center Units 2 and 3*
Tab 55	**Entergy Ex. 7D**: Enercon Services, Inc., *Closed-Loop Performance*
Tab 56	**Entergy Ex. 7E**: Enercon Services, Inc., *Electrical Distribution*

	Model Output Reports
Tab 57	**Entergy Ex. 7F**: Enercon Services, Inc., *Feasibility Evaluation of Relocating the Algonquin Gas Transmission Pipelines*
Tab 58	**Entergy Ex. 7G**: Enercon Services, Inc. Precision Blasting and Rock Removal
Tab 59	**Entergy Ex. 7H**: Enercon Services, Inc., *Cultural/Historic Considerations for Cooling Tower Feasibility*
Tab 60	**Entergy Ex. 7I**: Enercon Services, Inc., *Construction Schedule*
Tab 61	**Entergy Ex. 7J**: Enercon Services, Inc., *Capital Cost Evaluation*
Tab 62	**Entergy Ex. 315**: Cooling Technology Institute, *Legionellosis: Guideline: Best Practices for Control of Legionella* (July 2008)
Tab 63	**Entergy Ex. 321**: Cooling Technology Institute, *Cooling Tower Emissions Quantification using the Cooling Technology Institute Test Code ATC-140* (February 2003)
Tab 64	**Entergy Ex. 328**: Cooling Technology Institute, J. Gill and Y. Lin, *A Synergistic Combination of Advanced Separation and Chemical Scale Inhibitor Technologies for Efficient Use of Impaired Water in Cooling Towers* (2010)
Tab 65	**Entergy Ex. 331**: Cooling Technology Institute, R. Cunningham, *What is the Best Water Treatment Program for my Tower*? (Cooling Technology Institute, February 2010)
Tab 66	**Entergy Ex. 332**: Cooling Technology Institute, K. Mortensen and F. Michell, *Film Fill Fouling: Updated Methods, Results and Predictions* (February 2012)
Tab 67	**Entergy Ex. 346**: June *11, 2010 memorandum from John Shunda and Kelly Meadows, Tetra Tech, to Paul Shriner and Jan Matuszko, USEPA re: cooling tower noise, plume and drift abatement costs*
Tab 68	**Entergy Ex. 348**: *Excerpt: Background, Tetra Tech, Glenwood Main Power Station*
Tab 69	**Entergy Ex. 355**: *Excerpt: Background, Tetra Tech, Northport Generating Station* (March 18, 2010)
Tab 70	**Entergy Ex. 358**: Cooling Technology Institute, *AEP's Experience with Polyester FRP Structure Cooling Towers* (2011)

Tab 71	**Entergy Ex. 360**: Cooling Technology Institute, *A Systematic Review of Biocides used in Cooling Towers for the Prevention and Control of Legionella spp Contamination* (February 2009)
Tab 72	**Entergy Ex. 403**: Cooling Technology Institute, J. Missimer, D. Wheeler, and K. Hennon, *The Relationship Between SP and HGBIK Drift Measurement Results – New Data Creates a Need for Second Look* (1998)
Tab 73	**Entergy Ex. 417**: NYSDEC, 6 NYCRR Parts 242 and 200 Regulatory Impact Statement, http://www.dec.ny.gov/regulations/94833.html (accessed April 2, 2014).
Tab 74	**Entergy Ex. 425:** Regional Greenhouse Gas Initiative Memorandum of Understanding (2005)
Tab 75	**Entergy Ex. 433**: NYSDEC, *Network Plan Part 13 – CO, NOx, Pb, PM, SO2, Ozone*, http://www.dec.ny.gov/chemical/54359.html (accessed April 2, 2014)
Tab 76	**Entergy Ex. 442**: Cooling Technology Institute, *Best Practices for Minimizing Drift Loss in a Cooling Tower* (February 2012)
Tab 77	**Entergy Ex. 444**: Cooling Technology Institute, *Isokinetic Drift Test Code* (July 2011)
Tab 78	**Entergy Ex. 447**: USEPA, *Health Risk and Exposure Assessment for Ozone, Second External Review, Draft Executive Summary* (January 2014)
Tab 79	**Entergy Exhibit 476**: EPA, *Primary National Ambient Air Quality Standards for Nitrogen Dioxide: Final Rule*, 75 Fed. Reg. 26 (February 9, 2010)
Tab 80	**Entergy Ex. 484**: New York City Department of Health and Mental Hygiene, *Air Pollution and the Health of New Yorkers: The Impact of Fine Particles and Ozone*
Tab 81	**Entergy Ex. 483**: NYSDEC, About Ozone, http://www.dec.ny.gov/chemical/8400.htiml (April 6, 2014)
Tab 82	**Entergy Ex. 521**: EIA, *Henry Hub Natural Gas Spot Price*, http://www.eia.gov/dnav/ng!hist/rngwhhdM.htm (April 16, 2014)
Tab 83	**Riverkeeper Ex. 109**: Synapse, *Indian Point Energy Center: Effects*

	of the Implementation of Closed-Cycle Cooling on New York Emissions and Reliability (February 28, 2014)
Tab 84	**Riverkeeper Ex. 165**: New York Energy Highway Taskforce, *New York State Energy Highway Blueprint Update* (April 2013)
Tab 85	**AAEA Ex. 1**: African American Environmentalist Association, *Fish Eggs Versus Asthmatic Children in Harlem* (February 2014)
Tab 86	*Final* Environmental *Impact Statement, New York State Pollutant Discharge Elimination Systems Permits for the Roseton 1 & 2, Bowline 1 & 2, and Indian Point 2 & 3 Steam Electric Generating Stations* (June 25, 2003)
Tab 87	*Matter* of *Entergy Nuclear Indian Point 2, LLC & Entergy Nuclear Indian Point 3, LLC (SPDES)*, Interim Decision (August 13, 2008)
Tab 88	NYSDEC, *Department Staff Offer of Proof on Permanent Forced Outages/Seasonal Protective Outages* (November 12, 2013)
Tab 89	Entergy, *Comments of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. on the DEC Staff Proposal on Scheduled BTA Outages/Seasonal Protective Outages* (July 11, 2014)
Tab 90	*Matter of Entergy Nuclear Indian Point 2, LLC & Entergy Nuclear Indian Point 3, LLC (SPDES)*, Hearing Transcript, pp. 7285-7287, 7291-92, 7317, 7319, 7320-22, 7324-25, 7327-28, 7330, 7343, 7662-7663, 8353, 8410, 8717-18, 8739, 8753, 8788, 8790-8791, 8793-8797, 8827-8828, 8956, 9591-9598, 9615, 9627-28, 9640-42, 9792-94 (April 7, 8, 10, 11, 14, 16, 17, 2014)
Tab 91	Lin et al., *Health Impact in New York City During the Northeastern Blackout of 2003*, Public Health Reports, 126(3):384-393 (2011)
Tab 92	Beatty et al., *Blackout of 2003: Public Health Effects and Emergency Response*, Public Health Reports, 121(1):36-44 (2006)
Tab 93	Email from Mark Lucas, Esq. to the Honorable Maria Villa et al., (February 21, 2014)

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 REBUTTAL 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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March 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 the same Marc Lawlor who provided prefiled direct testimony on February 28, 2014, 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 prefiled rebuttal testimony.

A: The purposes of my prefiled rebuttal testimony are to address certain portions of the prefiled direct testimony of NYSDEC Staff and its consultants, specifically Christopher Hogan ("Hogan Direct"), Tim Havey ("Havey Direct"), Paul Kolakowski ("Kolakowski Direct"), Thomas McMahon ("McMahon Direct"), Susan Corser ("Corser Direct"), and Lawrence Weintraub ("Weintraub Direct"). I have reviewed the prefiled testimony of these individuals and the materials on which each relies (to the extent provided). I have also consulted with my TRC CCC Team and Entergy's additional outside experts (*see* Lawlor Prefiled Direct at p. 4, l.5 to p.9, l. 6), to evaluate these prefiled testimonies and reliance materials, as well as the prefiled direct testimonies and reliance materials of

Sharon Brooks, Leka Gjonaj, and David Wheat, Roy Jacobson, Eduardo Ortiz-Zarete, Charles Nieder, Thomas Paynter, Leo Sedefian, Ronald Stannard, and Margaret Valis.

Q: Please explain how your testimony is organized?

A: My testimony is organized into two sections. First, I address the continued inadequacy of the New York State Department of Environmental Conservation ("NYSDEC") Staff's review, pursuant to the New York State Environmental Quality Review Act ("SEQRA"), of potential significant adverse impacts of: (1) the closed-cycle cooling ("CCC") configuration proposed by Tetra Tech on behalf of NYSDEC Staff (the "Tetra Tech Proposal"), and (2) the CCC configuration assessed in the report entitled *Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration,* dated February 12, 2010, and its attachments (including the 2003 Enercon Report) (Entergy Exs. 7, 7A to 7J) (respectively, the "Enercon Reports" and the "Hybrid Tower Alternative"). Second, I summarize the permitting and feasibility issues (as identified by the TRC CCC Team and Entergy's additional outside experts) that remain unaddressed for both the Tetra Tech Proposal and the Hybrid Tower Alternative. I also explain how these unaddressed permitting and feasibility issues underscore the inadequacy of the SEQRA review.

II. EVALUATION OF THE HYBRID TOWER ALTERNATIVE

Q: NYSDEC Staff and its consultants opined, with caveats, on the feasibility, permitability and potential adverse environmental impacts of the Hybrid Tower Alternative. Have you reviewed the Hybrid Tower Alternative?

A: Yes. In conjunction with the TRC CCC Team and Entergy's additional outside experts, I reviewed the Enercon Reports to address the potential significant adverse environmental impacts of construction and operation of, and to understand the feasibility and permitting issues that remain unaddressed for, the Hybrid Tower Alternative. The potential significant adverse environmental impacts that I have identified, and a summary of the unaddressed feasibility and permitting issues, are presented below.

III. SEQRA REVIEW

A. Purpose of SEQRA Review

Q: What is the purpose of SEQRA review in New York?

A: SEQRA review plays a uniquely important role in New York; it is the mechanism by which decisions of agencies, such as NYSDEC, are reviewed to ensure their actions are not, on balance, deleterious to environmental, human or community resources in New York. *See, e.g.,* ECL §8-0103(7); 6 NYCRR §617.1(a)(d); SEQRA Handbook at 3 (Entergy Ex. 233). Thus, for instance, SEQRA's balancing mandate ensures that NYSDEC Staff focused on SPDES permitting do not view their actions solely through the lens of fish protection, but also consider other environmental and socio-economic ramifications of their proposed (i.e., draft) decision-making. Because SEQRA is the mechanism in New York State to ensure balanced decision-making, the failure to properly implement SEQRA, *e.g.,* by NYSDEC Staff, can result in myopic, poor or unsound decisions. *Id.*

Accordingly, when I discuss SEQRA review in my rebuttal prefiled testimony, I am focused on whether NYSDEC Staff's and its consultants' SEQRA review is adequate–such that the resulting decision will not, on balance, be deleterious to New York environmental, human and community resources.

B. Adequacy of NYSDEC's SEQRA Review

Q: In this Proceeding, who do you understand to be making the final determination regarding whether the information in the record is adequate for purposes of developing a supplemental DEIS?

A: It is my understanding that the administrative law judges in this Proceeding, not NYSDEC Staff, will be acting as lead agency to determine whether the record is adequate for purposes of developing a supplemental DEIS. *See* Interim Decision at 40-41. NYSDEC Staff's obligations are: (1) to provide all necessary information on its BTA proposals; (2) if the ALJ directs as much, to issue a public notice for the complete supplemental DEIS; and (3) to receive public comments to which NYSDEC Staff must respond, forwarding all comments and that response to the ALJs for development of the supplemental FEIS. *Id.* It is therefore not correct to suggest that NYSDEC Staff are fulfilling a lead agency role; instead, NYSDEC Staff's role in this SEQRA Review is equivalent to an applicant's.

Q: How did you determine whether the record evidence in this Proceeding is acceptable for purposes of developing a supplemental draft environmental impact statement ("DEIS"), including for purposes of soliciting public review and comment on the supplemental DEIS?

A: I determined whether the record evidence currently presented by NYSDEC Staff in this Proceeding is sufficient to develop a supplemental DEIS based on the SEQRA statute (*e.g.*, ECL § 8-0109) regulations (*e.g.*, 6 NYCRR §§ 617.9(a)(7), (b)(3)-(5)(7))), and NYSDEC guidance (*e.g.*, the SEQR Handbook., Chapter 5, Sections B-D). I also considered the Interim Decision (*e.g.*, pp. 20-21, p. 23 n.17, 26, 38-41), which Mr. Hogan states is the *de facto* scoping document for the supplemental DEIS. *See* Hogan, pp. 6, 1-18-19. Finally, I brought to bear my professional experience in developing and participating in over 100 Environmental Impact Statements ("EISs") and Environmental Assessments ("EAs") pursuant to SEQRA and the National Environmental Policy Act ("NEPA").

For this Proceeding (and for any SEQRA review), in order to be acceptable the supplemental DEIS must include, at a minimum, the following information:

- A description of the environment and proposed action that is sufficient to understand the potential significant adverse impacts of the proposed action and alternatives (*see* Interim Decision at 39-40; 6 NYCRR §§ 617.9(a)(7)(iii), (b)(5)(i)(ii)).
- An evaluation of all "significant adverse environmental impacts that may be associated with [CCC construction and operation];" NYSDEC Staff, as the proponent of CCC, must present this analysis for both the Tetra Tech Proposal and the Hybrid Tower Alternative (*see* Interim Decision at 39-40; 6 NYCRR §§ 617.9(a)(7)(iii), (b)(5)(iii)). I will refer to this as "Completeness of Review" or "Completeness."
- A level of detail that reflects the complexity of installing CCC at the Indian Point site, and the magnitude and importance of potential significant adverse impacts to the environment (6 NYCRR 617(b)(5)(iii); SEQR Handbook at 131). Summary statements that no impact will occur—especially statements that amount to speculation—are not enough. This requirement is particularly important here, given the scale of the CCC

proposals, which are among the largest in size, duration and range of impacts that I have reviewed in my professional career. I will refer to this requirement as "Sufficiency of Review" or 'Sufficiency."

- Feasible and reasonable mitigation alternatives for all identified significant adverse environmental impacts, consideration of all relevant alternatives for avoiding Isignificant adverse environmental impacts, (*see* Interim Decision at 20-21; 6 NYCRR §§ 617.9(a)(7)(iii), (b)(5)(iv)(v))). I will refer to this requirement as an "Alternatives Analysis."

Q: **Do you believe NYSDEC Staff agrees with your understanding of what information is required for an adequate supplemental DEIS?**

A: In general, yes. Mr. Hogan's explanation of what is required for a supplemental DEIS to be adequate, including for purposes of public review (Hogan Direct at p. 5, l. 25 to p. 7, l. 16), is consistent with my understanding (as set forth above). In particular, I agree that a supplemental DEIS does not need to be a perfect or exhaustive document, nor provide for a final resolution of all issues, but that it "should reflect the complexity of the action and the magnitude and importance of the likely impacts" such that "the public can readily determine the potential impacts of the project, how potential impacts will be minimized to the maximum extent practicable and how impacts that cannot be avoided or minimized will be mitigated." Hogan Direct at p. 6, l. 1, 22-24. Mr. Hogan does not mention that a DEIS must be clearly and concisely written in a manner that can be understood by the public, 6 NYCRR § § 617.9(a)(7), (b)(1,2).

Q: **On p. 5, l. 12-15 of the Hogan Direct, Mr. Hogan states that "[i]f one takes**

the entire record into account, including previously the most recent testimony and reports offered by the Department, it is my opinion that the record is adequate to be considered to serve as the SDEIS and that it is complete for the purposes of soliciting public review and comment" and "that the record ... demonstrates that all potential impacts [of the Department's closed cycle cooling alternative] have been adequately identified and addressed." Do you agree with Mr. Hogan's opinion?

A: No. As an initial matter, as presented in Sections III.C and IV below, NYSDEC Staff and its consultants have failed to adequately describe the proposed project and environment, such that the impacts can be fully evaluated. Further, as discussed in Section III.C and III.D below, the record currently contains multiple Completeness, Sufficiency and Alternatives errors and omissions. The impacts that I identify as requiring further evaluation each have the potential to be significant and adverse on an individual basis; therefore, a full evaluation of each of them (including Completeness, Sufficiency and Alternative Analysis) is required to be included in the supplemental DEIS in accordance with 6 NYCRR § 617.9(b)(5)(iii). Finally, Mr. Hogan's suggestion that the public would need to review the "entire record," including testimony, is out of touch with governing law and guidance requiring a clear, concise document written in plain language that can be read and understood by the public. *See* 6 NYCRR § § 617(a)(7)(iii), (b)(1,2).

Accordingly, based on both Mr. Hogan's and my understanding of what constitutes an adequate DEIS, I conclude that the record advanced by NYSDEC

Staff in this Proceeding for CCC, under either proposal, is inadequate to serve as the supplemental DEIS. To be clear, based upon my experience, there is no chance that an applicant advancing the SEQRA documentation that NYSDEC Staff and its consultants have advanced for CCC would be found to have satisfied its obligations under SEQRA. Rather, in my experience, NYSDEC Staff themselves would reject some of their own submissions as inadequate under SEQRA. Mr. Hogan also concedes, by referring to the evidence in testimony, that the Tetra Tech report was not adequate under SEQRA, as TRC stated. *See* Hogan, p. 4,1.24 – p. 51.15.

Q: Please explain how you present your evaluation of NYSDEC Staff's and its consultants' SEQRA review.

A: Rather than address prefiled testimony separately, my review is organized by SEQRA resource category. For each resource category, I explain whether the prefiled direct testimony of NYSDEC Staff and its consultants has altered the conclusions in the TRC Report or my prefiled direct testimony. My responses also identify omissions or errors in NYSDEC Staff's and its consultants' submissions for the Tetra Tech Proposal.

For each resource category, I also establish my opinion on the potential significant adverse environmental impacts of construction and operation of the Hybrid Tower Alternative, which NYSDEC Staff addressed for the first time in its prefiled direct testimony. My responses will also address the adequacy of NYSDEC Staff and its consultants' submissions for the Hybrid Tower Alternative.

C. Resource Category Evaluation

1. Electricity

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to electricity from operation and construction of the Tetra Tech Proposal.

A: No. Briefly, as presented in the prefiled rebuttal testimony of Dr. Harrison, the testimony of NYSDEC Staff and its consultants testimony is that impacts to the electric system due to constructing the Tetra Tech Proposal will be significant. First, Mr. Hogan concedes "large impacts in ICAP prices in the short term" (Hogan Direct at p. 8, 1.13-14). Further, and despite Mr. Hogan's efforts to suggest otherwise, NYSDEC Staff witnesses' own modeling of long term impacts predicts increased New York capacity price and wholesale electricity costs to consumers of about $1 billion or more, depending upon the year the outage occurs. Harrison Rebuttal at p. 44, ll. 4-10, and p. 45, ll. 1-3. I understand Dr. Harrison to have concluded that these estimates are comparable to NERA's estimates of wholesale electricity and capacity price impacts, which totaled $1.8 billion on average for the years 2016-2019, as presented in the TRC Response Document, as well as the similar estimates of Charles River Associates. *Id.* at p. 44, ll. 1-10, and p. 45, ll. 1-3. There are also unquantified adverse impacts to voltage support and to fuel diversity during the period of any construction outage. *Id.* at p. 50, ll.7-21, and p. 51, l. 17, to p. 52, l. 4. Accordingly, my conclusion that construction of the Tetra Tech Proposal would cause MODERATE to LARGE potential adverse impacts in the short and long term remains unchanged. Finally, Mr. Beaver's identification of various unknowns in and underestimates of the Tetra Tech Proposal performance losses means that continuing electricity system and consumer impacts are unknown.

Q: Have you formed an opinion on the potential adverse impacts to electricity as a result of constructing the Hybrid Tower Alternative?

A: Yes. As the TRC Response Document explains (*see* Section 3.2), the principal source of potential adverse impacts to the electricity system and consumers is the need to replace power losses during construction outages, and the minimum period of outages required by the Hybrid Tower Alternative is even longer than that which the Tetra Tech Proposal contemplates. Accordingly, potential adverse impacts to the electricity system and consumers as a result of the Hybrid Tower Alternative will be at least as large, if not larger, than those expected to result from the Tetra Tech Proposal. Further, the Hybrid Tower Alternative parasitic and efficiency losses are greater than the Tetra Tech Proposal (*see* prefiled rebuttal testimony of Sam Beaver), and therefore also must be addressed by NYSDEC Staff to establish the absence of significant adverse impacts to the electricity system and consumers. The need for this analysis is underscored by Mr. Beaver's testimony that the historic PEPSE modeling has underestimated actual losses.

2. <u>Water Quality</u>

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to water quality from operation and construction of the Tetra Tech Proposal.

A: No. As established in the prefiled rebuttal testimony of Paul Puckorius, system design and water treatment needs will result in releases of various treatment chemicals and sediment to the Hudson River.

Q: Have you formed an opinion on the potential adverse impacts to water quality as a result of operating the Hybrid Tower Alternative?

A: Yes. Given the novelty of the system and the magnitude of its discharge, it is reasonable to conclude that currently unknown impacts may range from SMALL to LARGE. Further, the record is inadequate to dismiss these potential impacts, which are neither understood, nor mitigated (if possible).

3. Air Quality

Q: On p. 11, l. 9-10 of the Hogan Direct, Mr. Hogan concludes that the record in this Proceeding with regard to air quality impacts is sufficient for public review. Do you agree with that conclusion?

A: No. As set forth in the accompanying prefiled rebuttal testimony of Ted Main, the analysis of air quality impacts due to operation of the Tetra Tech Proposal and Hybrid Tower Alternative conducted by NYSDEC Staff and Riverkeeper is flawed and substantially understates PM emissions. As such, it is inadequate for purposes of SEQRA. In particular, Mr. Main discusses NYSDEC Staff's improper selection of a cooling tower drift rate and improper reliance on a drift droplet distribution which substantially underestimate the CCC technologies' "potential to emit" particulate matter.

Further, NYSDEC Staff and its consultants have failed to provide an analysis of the health effects and/or environmental impacts of PM10 and PM2.5 emissions, as required by NYSDEC Policy CP-33, Assessing and Mitigating

Impacts of Fine Particulate Matter Emissions (Entergy Ex. 306). Without this analysis, the Tetra Tech Proposal and Hybrid Tower Alternative are factually inadequate under SEQRA, and potentially LARGE impacts neither understood, nor mitigated (if possible) (*see* TRC Response Document Section 3.4).

Finally, in addition, NYSDEC Staff and its consultants have failed to address the air impacts related to construction of CCC technologies. For a project of the scale and duration of the Tetra Tech Proposalor Hybrid Tower Alternative, the air quality impacts associated with construction are potentially significant. For example, in Table 12 in Appendix A of Ronald Stannard's testimony the NOx emissions associated with construction of the Tappan Zee Bridge (457.0 tons/yr over a five-year project) have been included in the New York State Implementation Plan ("SIP") as they exceed the de minimis threshold. Without a construction analysis, conclusions on the adverse impacts to air quality as a result from construction of the Tetra Tech Proposal and Hybrid Tower Alternative cannot be made conclusively, but are potentially significant in that defined air quality de minimis thresholds (100 tons/yr) could be exceeded.

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to air quality from operation of the Tetra Tech Proposal.

A: No. As explained above, NYSDEC Staff and its consultants have failed to provide an adequate analysis of air quality impacts that would change my conclusions on the impacts to air quality from operation of the Tetra Tech Proposal.

Q: Have you formed an opinion on the potential adverse impacts to air quality

as a result of operating the Hybrid Tower Alternative?

A: Yes. As discussed in the accompanying prefiled rebuttal testimony of Ted Main, TRC performed an analysis of the air quality impacts of the Hybrid Tower Alternative (*see Cooling Tower Impact Analysis for the Indian Point Energy Center* (Sept. 2009), Entergy Ex. 311). That analysis concluded that operation of the Hybrid Tower Alternative would violate National Ambient Air Quality Standards ("NAAQS") and, where applicable, the Significant Impact Levels ("SIL") for particulate matter. Therefore, it is my opinion that the operation of the Hybrid Circular Tower Alternative will result in LARGE significant adverse impacts to air quality.

4. <u>Noise</u>

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to noise from construction and operation of the Tetra Tech Proposal.

A: No. Both construction and operation of the Tetra Tech Proposal result in significant adverse noise impacts. The scale of the construction work in terms of the general on-site activity and equipment operations, the blasting for 3 – 4 years, the need for on-site rock crushing, and the potential off-site transport of blast spoils via heavy-duty truck all speak to the real potential for noise impacts over the 7 – 9 year construction schedule. Operational noise from the cooling tower arrays has been modeled by TRC and shown to exceed both the Village of Buchanan standards and NYSDEC Noise Policy at off-site sensitive receptors.

Q: Please explain why your conclusion on the impacts to noise from *operation* of

the Tetra Tech Proposal has not changed.

A: As an initial matter, NYSDEC Staff's noise expert, Mr. McMahon, does not dispute any of the noise analysis or findings that were provided in the TRC Response Document relative to CCC operation. Rather, Mr. McMahon's report, entitled Acoustic Assessment of the Proposed Cooling Towers for Closed Cycle Cooling (Hoover & Keith, Inc., February 2014, Staff Ex. 250), acknowledges that the operational noise analysis provided in the TRC Response Document was conducted consistent with good industry practice (Staff 250 at p. 5). NYSDEC Staff, Mr. Hogan, reiterates this acknowledgement (Hogan Direct at 28, 32).

Mr. McMahon next acknowledges, consistent with the TRC Response Document, that year-round, continuous noise levels from operation of the Tetra Tech Proposal will exceed the Village of Buchanan noise ordinance by up to 19 dB, and further would exceed existing nighttime conditions by 5 dBA to 18 dBA. These increases exceed NYSDEC's impact criteria of 6 dBA (as set forth in NYSDEC Policy DEP-001, Entergy Ex. 308), as a level that is "intrusive" and "may cause complaints." Indeed, NYSDEC classifies increases of 15 to 20 dBA as "objectionable" (*see* NYSDEC Policy DEP-001). Tetra Tech's identified sound levels within 50 and 100 meters of each tower also consistently exceed the NYSDEC Policy "upper end" of 65 dBA that "allows for undisturbed speech at a distance of approximately three feet." In other words, NYSDEC Staff offers no basis for concluding that on-site communications among Entergy personnel – and therefore existing operations - will not be fundamentally altered. Given this dynamic, it is not surprising that Mr. McMahon acknowledges the potential for adverse noise impacts within the 100 foot setback area identified in Figure 3-1 on p. 32 of the Tetra Tech Report and including the heart of the plant (Staff Ex. 250 at p.6) due to these increases over existing conditions, and that Mr. Weintraub acknowledges that noise is arguably a significant impact (*see* Weintraub, *Indian Point Energy Center Unit 2 and Unit 3 Cooling System Retrofit Alternatives: An Analysis of Municipal Land Use Approval Requirements for the Retrofit of Indian Point Units 2 and 3 with a Closed-Cycle Cooling System* at p.20 (Feb. 28, 2014), Staff Ex. 265).

While Mr. McMahon suggests that noise abatement for the Tetra Tech Proposal is possible (Staff Ex. 250 at 6), he fails to mention that the design already incorporates the noise abatement measures he suggests, specifically low noise fans and splash attenuation (Tetra Tech Report at 31). As McMahon also acknowledges, any further noise abatement could require a total redesign of the Tetra Tech Proposal (Staff Ex. 250 at 7). NYSDEC Staff and its consultants do not propose any other operational-based noise mitigation options, which suggests that none exist.

Accordingly, it is my opinion that NYSDEC Staff and its consultant's testimony underscore my previous finding of unevaluated LARGE potential significant adverse noise impacts due to operation of the Tetra Tech Proposal.

Q: **On p. 31, l. 23-24 of the Hogan Direct, Mr. Hogan states that "it is [his] opinion that noise or air blasts as an issue related to construction have been adequately addressed in the record." Do you agree?**

A: No. Mr. Hogan's conclusions rely on the discussion of air blast impacts in a

NYSDEC fact sheet and adopting a sample "MLR Blasting Condition" into the SPDES permit. First, the sample MLR Blasting Condition has significant information missing from it that would be necessary to determine whether NYSDEC Staff has limited blasting impacts to the "maximum extent practicable," as Mr. Hogan claims (p.31, l. 24-26). This includes the (1) "maximum allowable charge weight/delay" and "minimum initiation sequence;" (2) the number of times blasting may occur per calendar year; and (3) the hours that blasting may occur. Second, attaching a fact sheet that generically discusses the recognized noise impacts of air blasting, and how "atmospheric conditions that either attenuate or exacerbate the impacts," is not an analysis of the potential noise impacts of blasting at the Indian Point site. For example, there is no discussion of whether topographic and atmospheric conditions at Indian Point will attenuate or exacerbate the blasting impacts. This information is necessary to provide the public with the necessary information to submit informed comments on the supplemental DEIS and to assist the ALJs in making an informed decision.

Further, while I agree that NYSDEC Staff does not typically require modeling of blasting noise for hard rock mines, I believe that modelling is warranted here, due to Indian Point being located, as Tetra Tech asserts, in a "primarily residential" surrounding area. (Staff Exhibit 214, p. 1)

Finally, in order to meet the estimated construction schedule, it is likely that general construction work on the site, outside of the blast area for the northern cooling tower, would be necessary (although a project phasing or Gantt chart has not been provided such that this can be confirmed). Consequently, blasting noise and general construction noise would be occurring simultaneously and increase noise levels, to an unknown degree. Without a legitimate sound analysis, the combined, site-wide, construction noise impacts for NYSDEC Staff's proposals remain unknown, in contravention of SEQRA.

Q: Please explain why your conclusion on the impacts to noise from *construction* of the Tetra Tech Proposal has not changed.

A: Mr. Hogan acknowledges that that NYSDEC Staff did not request that Tetra Tech conduct a construction noise analysis (Hogan Direct at 28), and Mr. McMahon acknowledges that no study was conducted for construction noise (Staff Ex. 250 at 7). No one suggests that large scale construction does not produce noise. For instance, Mr. McMahon acknowledges that one aspect of the construction - blasting spoils removal by truck - could cause a significant increase in sound levels by itself (Staff Ex. 250 at 7).

As provided in the TRC Response Document (Entergy Ex. 296 at 30-31), quantification of construction noise levels and their potential impacts are routinely conducted, and even required, for projects of a smaller scale and shorter duration than the Tetra Tech Proposal. It is therefore highly unusual that NYSDEC Staff would notperform a construction noise analysis for a project the scale and duration of the Tetra Tech Proposal. In fact, the NYSDEC Noise Policy, which is the operative statewide guidance and relied on extensively for evaluating potential noise impacts under SEQRA, clearly states that all facets of construction and operation that produce noise should be included (*see* Entergy Ex. 308 at 16). The NYSDEC Noise Policy further provides an extensive listing of noise emissions data for a variety of construction equipment, such that potential construction-related noise impacts can be evaluated for a specific construction project.

Despite this, rather than conduct a construction noise analysis for the Tetra Tech Proposal, Mr. Hogan attempts to rely on a construction noise analysis conducted for a non-related peaking facility project on the Indian Point site (the "Peaking Facility Noise Analysis"). Mr. Hogan's reliance on the Peaking Facility Noise Analysis is inappropriate when one considers the substantial difference in the magnitude, intensity and duration of the two construction projects. Mr. Hogan fails to acknowledge that construction of the peaking facility would have occurred over a much shorter time period (1 year) and on a much smaller parcel (5 acre) than the Tetra Tech Proposal (*see* Peaking Facility Noise Analysis at 1-1, 1-5) (Entergy Ex. 371). For comparison, the Tetra Tech Proposal requires approximately 4 years of blasting, with spoils crushing and removal continuing afterward, and will affect over 46 acres of land in total, as estimated by TRC (*see* Tetra Tech Report at Figure 3-2).

Further, the Tetra Tech Proposal would require much greater use of noise generating equipment than that proposed for the peaking project. By way of example, the peaking facility involved no blasting and consequently none of the noise-generating equipment that comes with it, whereas the Tetra Tech Proposal requires the blasting of approximately two (2) million cubic yards of rock for a period of approximately three to four years. In addition, the peaking facility did not require rock crushing operations, which are likely required for the Tetra Tech Proposal in order to reduce the size of larger rock that cannot be efficiently trucked or barged offsite due to the void spaces between large pieces of rock (*see, e.g.*, TRC Response Document at 3-31). If rock crushing were not used, then the amount of truck/and or barge traffic would increase even more than estimated for the Tetra Tech Proposal because of the larger pieces of blasted rock and associated voids when in transit. Finally, the Peeking Facility review process ws never completed. For these reasons, reliance on the Peaking Facility Noise Analysis to determine construction noise impacts of the Tetra Tech Proposal is inappropriate.

In addition, as explained above in discussing whether blasting noise has been adequately addressed, NYSDEC Staff's discussion of construction noise is too fragmented to be made meaningful, because it separately considers impacts of noise to be generated during blasting as opposed to other construction activities. This is inconsistent with SEQRA' mandates.

Accordingly, it is my opinion that NYSDEC Staff and its consultant's evaluations underscore my previous finding of inadequate analysis and LARGE potential significant adverse impacts to noise due to construction of the Tetra Tech Proposal. The absence of information necessary to allow informed public comment and to assist the ALJs in making an informed decision under SEQRA.

Q: **On p. 30, l. 5-10 of the Hogan Direct, Mr. Hogan states that mitigation of construction noise can be accomplished by use of mufflers on construction equipment. Do you agree that mufflers alone can mitigate construction noise for the Tetra Tech Proposal?**

A: No. In order to mitigate the potential construction impacts of a project the scale, magnitude and duration of the Tetra Tech Proposal, it is first necessary to determine impacts themselves, which has not been done. Further, the possible mitigation measures available to minimize the range of impacts that will arise during construction are far more diverse than mufflers. Examples of mitigation that could be considered, *assuming impacts and their significance were known*, include: Maintenance of Traffic Plan (MTP) for off-site traffic impacts; avoiding materials delivery or removal during peak traffic hours along major arterials, when possible; on-site construction crew parking; construction of a temporary concrete batch plant to avoid concrete truck trips; locate stationary construction equipment away from sensitive receptors, where possible (portable noise barriers could be used where this is not possible); substituting hydraulic or electric models for impact tools (*e.g.*, jack hammers, pavement breakers, etc.). If there are significant construction noise impacts based on a quantitative project-specific analysis, these measures could potentially mitigate the impacts below regulatory criteria or significance thresholds; however, the availability of the mitigation measures and their ability to be successfully implemented has not been established. Further, some measures also have the potential to increase the construction time frame (*e.g.*, if the MTP results in limiting the number of trips per day).

Q: Have you formed an opinion on the potential adverse impacts to noise quality as a result of *operating* the Hybrid Tower Alternative?

A: Yes. Based on NYSDEC Staff's consultants' analysis, the Hybrid Tower Alternative will result in LARGE potential significant adverse noise impacts. Mr.

McMahon obtained noise level data for a Hybrid Tower Alternative directly from SPX, which shows that the operational noise levels from that tower would be approximately 3 dBA lower than the Tetra Tech Proposal (Staff ex. 250 at 5-6). While marginally lower, the noise increases from the Hybrid Tower Alternative still result in exceedances of the Village noise ordinance and still result in significant increases (greater than NYSDEC impact criteria of 6 dBA) over ambient conditions.

While McMahon asserts that noise abatement for the Hybrid Tower Alternative is possible (Staff Ex. 250 at 6), he also acknowledges that adding any noise abatement could require either "a complete re-evaluation of the cooling tower design to ensure thermal performance is achieved," or "detailed engineering study" (*Id.* at 7), neither of which have been performed by NYSDEC Staff or its consultants.

Accordingly, my opinion that there will be LARGE potential significant adverse impacts to noise due to operation of the Hybrid Tower Alternative is underscored by NYSDEC Staff's prefiled direct testimony.

Q: Have you formed an opinion on the potential adverse impacts to noise as a result of *constructing* the Hybrid Tower Alternative?

Yes. The construction-related impacts of the Hybrid Tower Alternative and Tetra Tech Proposal are generally comparable. Accordingly, it is my opinion that there will be LARGE potential significant adverse noise impacts due to construction of the Hybrid Tower Alternative. Notably, NYSDEC Staff's consultant stated that site preparation and debris removal, including blasting, "will have the greatest acoustic emissions," but "no comment is made regarding the potential noise from blasting." Obviously, failing to address the admitted greatest noise source is not consistent with SEQRA.

5. Visual Resources

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to visual resources from operation and construction of the Tetra Tech Proposal.

A: No. It is my opinion that impacts to visual resources due to construction of the Tetra Tech Proposal are expected to be LARGE, based on the expected construction impacts from a project of this magnitude. The Tetra Tech 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 significance that would be impacted. My conclusions are based on the accompanying prefiled rebuttal testimony of Matthew Allen of Saratoga Associates, which evaluates and responds to NYSDEC Staff's and its consultant's testimony on visual resource impacts.

Q: Have you formed an opinion on the potential adverse impacts to visual resources as a result of constructing and operating the Hybrid Tower Alternative?

A: Yes. It is my opinion that impacts to visual resources due to construction of the Hybrid Tower Alternative are expected to be LARGE based on the expected construction impacts from a project of this magnitude. The Hybrid Tower

Alternative'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. My conclusions are based on the accompanying prefiled rebuttal testimony of Matthew Allen of Saratoga Associates, which evaluates and responds to NYSDEC Staff's and its consultant's testimony on visual resource impacts.

6. *Consistency with the New York State Coastal Management Plan ("NYCMP")*

Q: Have you formed an opinion on the consistency of the Tetra Tech Proposal with the NYCMP?

A: Yes. It is my opinion that the Tetra Tech Proposal is not consistent with the NYCMP due to its impacts to visual resources, as set forth more fully in the prefiled direct and rebuttal testimony of Matthew Allen.

Q: Have you formed an opinion on the consistency of the Hybrid Tower Alternative with the NYCMP?

A: Yes. Based on my review of the Saratoga Associates visual impact assessment of the Hybrid Tower Alternative and the accompanying prefiled rebuttal testimony of Matthew Allen, it is my opinion that the siting and operation of the Hybrid Tower Alternative would be inconsistent with the NYCMP. The presence and scale of the cooling towers along the Hudson River, as well as the visible plume that would result from operations, would each cause a potential LARGE significant adverse effect on visual resources and would be inconsistent with the

NYCMP and its applicable policies.

7. *Terrestrial Ecology*

Q: On p. 11, l.1 30 of the Hogan Direct, Mr. Hogan states that the Tetra Tech Proposal "will remove approximately 10 acres of potential upland habitat (less any previously developed/disturbed areas)." Do you agree with this statement?

A: No. TRC has estimated the forested area affected (eliminated) by construction for the northern cooling tower array (by itself) to be 16 acres. Entergy Ex. 296 at 3-52.

Q: Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to terrestrial ecology from operation and construction of the Tetra Tech Proposal?

A: No. As discussed below, it is my opinion that the record is inadequate for purposes of determining impacts to terrestrial ecology, but that the available information indicates there is the potential for MODERATE to LARGE significant adverse impacts due to construction and operation of both the Tetra Tech Proposal and the Hybrid Tower Alternative.

Q: On p. 11, l. 22-23 of the Hogan Direct, Mr. Hogan states that the area proposed for construction and/or operation of the proposed CCC technologies has not been identified as being of unique or significant value. Do you agree with that conclusion?

A: No. Based on information in the record, the area proposed for construction and/or affected by operation of the CCC technologies may be of unique or significant value for terrestrial ecology. The area proposed for construction of the CCC technologies consists of 16 and 9 acres (for the Tetra Tech Proposal and Hybrid Tower Alternative, respectively) within a 70 acre tract of undisturbed land that consists of a mature forested block, wetlands, a freshwater pond, and undeveloped riparian habitat. The National Wetlands Inventory ("NWI") shows a small unmapped pond and part of a headwater/tributary stream in the forested block on the Indian Point site (*see* NWI, Indian Point Woodlands, Entergy Ex. 342). Based on a review of aerial photography and topographic maps, the stream appears to be hydrologically connected to a larger 2.5-acre pond to the east/southeast, which is mapped as a palustrine, unconsolidated bottom, permanently flooded [PUBH] wetland (*see* Bing Map, Entergy Ex. 343). Overlaying the construction footprint of the northern tower array of the Tetra Tech Proposal with the NWI data shows that the small pond and some of the associated connection to the larger pond would be within the limits of the Tetra Tech Proposal construction (*see* NWI, Indian Point Woodlands, Entergy Ex. 342) and would be completely eliminated.

The forested block is also in the vicinity of two (2) biodiversity areas as identified in the Croton-to-Highlands Biodiversity Plan, thirteen (13) state-listed rare ecological communities, and three (3) Hudson River Significant Coastal Fish and Wildlife Habitats. The presence of these surrounding unique habitats combined with on-site wetlands and the undisturbed nature of the area proposed for construction indicates that the area itself also may be of unique or significant value. As explained below, the uniqueness or significant value of this area cannot be ruled out by reference only to the National Heritage Program database, because that database is not conclusive, and there are reasons to believe the database to be insufficient in categorizing species present at the Indian Point site. Rather, a survey is necessary to document the terrestrial ecology characteristics of the area before determining that it is not unique or of significant value. This is particularly true considering that there are 24 records of state-listed plant species that are known to occur in the vicinity of Indian Point (Coastal Zone Management Act Consistency Certification, Appendix C, Flora and Terrestrial Fauna Habitat and Communities in the Vicinity of IPEC (AKRF 2012). (Entergy Ex. 370).

Further, based on a review of available aerial photography, the pond in the area proposed for construction of the Tetra Tech Proposal appears to be hydrologically connected to a larger pond within the forested block that is mapped by USFWS as a National Wetland Inventory (NWI) wetland (PUBH). And this larger pond itself appears to be hydrologically connected to the Hudson River, which would make the set of interconnected ponds likely federal jurisdictional wetlands. No wetland survey has been performed on the forested block where the northern cooling tower array of the Tetra Tech Proposal is to be constructed. A survey is necessary to confirm the presence and characteristics of these features and their hydrologic connections (to one another and to the Hudson River), and their jurisdictional status. If these are established as federal jurisdictional wetlands, the Tetra Tech Proposal would require an Army Corp of Engineers permit and possible compensatory mitigation of the potential unavoidable adverse loss of the resource and potential loss of its wetland function. NYSDEC Staff has not identified the potential adverse impacts to this resource.

Q: On p. 14, l. 5-6 of the Hogan Direct, Mr. Hogan states that "there is no reason to believe that [the northern long-eared bat] is present on the Indian Point property." Do you agree with this conclusion?

A: No. Mr. Hogan acknowledges that the northern long-eared bat has been sighted in the Town of Cortland (Hogan Direct at p. 14, l. 3-4). On October 2, 2013, the northern long-eared bat was proposed for listing as endangered under the Federal Endangered Species Act (*see* 78 Fed. Reg. 61046, Entergy Ex. 337).

I disagree with NYSDEC Staff's conclusion that there is no reason to believe this species is present on the Indian Point property (see Hogan Direct at p. 14, l. 5-6). The species is known to opportunistically roost either singly or in colonies underneath bark or in cavities or crevices of both live trees and snags without preference to tree species, though the structural complexity of the habitat may be important (*see* 78 Fed. Reg. 61046, 61054-55). The areas proposed for construction of the CCC technologies—70 acres of undisturbed land that includes mature forest and is surrounded by a diverse number of unique habitats—therefore, has the potential to provide roosting habitat for the northern long-eared bat.

Q: On p. 14, l. 20 to p. 15, l. 2 of the Hogan Direct, Mr. Hogan states that the potential impacts to terrestrial endangered and threatened species from activities conducted at the Indian Point site have been adequately identified and assessed. Do you agree with Mr. Hogan's conclusion?

A: No. Although Mr. Hogan states that DMFWR Staff was consulted on the potential presence of rare, threatened and endangered, that consultation was based solely on a review of existing records. As I noted earlier in my testimony, no ecological survey of the 70-acres of forested land has ever been performed by NYSDEC, Entergy or any of its consultants. Given the potential impact to that contiguous block of forested land with 2,000 feet of riparian shoreline along the Hudson River and the presence of freshwater ponds, a field survey of the terrestrial ecology is necessary to meet the SEQRA "hard look" standard, to support Mr. Hogan's conclusion and/or provide evidence of potential mitigation that may be required.

As Mr. Hogan also acknowledges (Hogan Direct at p. 12, l. 20 to p. 13, l. 17), there are twelve species of federal- and/or state-listed endangered or threatened species within Westchester County, three of which may occur within six miles of Indian Point. These species could potentially inhabit the 70 acres of undisturbed land on the Indian Point site, in particular—the eastern small-footed bat (*Myotis leibii*), and the osprey (*Pandion halieaetus,* a New York "species of concern" that is also protected from taking under the federal Migratory Bird Treaty Act). In addition, the New England cottontail rabbit (*Sylvilagus transitionalis*) and the northern long-eared bat (*Myotis septentrionalis*)—federal "candidate" and "proposed" species, respectively—may also be present on the Indian Point site, and should be considered under SEQRA.

As Mr. Hogan further acknowledges (Hogan Direct at p. 11, l. 19-28), no survey of the area for purposes of documenting terrestrial species has been performed. Therefore, their presence is unknown.

Finally, Mr. Hogan's reliance on the records in Natural Heritage Program

("NHP") database (*see* Hogan Direct at p. 14, l. 13-18) to confirm that federal- and state-listed species are not present at the unstudied Indian Point site is neither credible, nor reasonable. A negative response from the NHP database is not an affirmation that federal- and state-listed species are not present on the Indian Point site. NYSDEC has not provided the NHP response that is relied on, but in my experience the NHP typically includes the following caveat in its responses:

> For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement as to the presence or absence of all rare or state- listed species or significant natural communities. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.

(*See* Correspondence from to Jean Pietrusiak, NYSDEC to Marc Lawlor, TRC (Oct. 6 ,2011), Entergy Ex. 344)

Contrary to Mr. Hogan's and Weintruab's assertions (*see* Hogan Direct at p. 11, l. 25-28, Weintraub Direct at 38), a portion of Indian Point property is not within the perimeter fence. I confirmed the lack of a fence in the areas described with Mr. Charlie Caputo of Entergy. Mr. Caputo also noted that deer, turkeys and other larger animals regularly enter the fenced areas of the site, including within the "owner controlled area," perhaps through the gates. This and common sense suggests that the smaller federal- and state-listed species may be present in the fenced block, particularly such species as birds, bats, snakes, turtles, rabbits – the types of species that are identified as threatened and endangered in the vicinity of Indian Point – and reasonably could be expected to pass over, through or under fencing.

Considering these factors, and based on my experience, the information currently present in the record about terrestrial ecology and potential impacts is inadequate for purposes of drafting the supplemental DEIS. Available information indicates that there is a likelihood that federal- and state-listed species may be present at the Indian Point site and NYSDEC Staff does not have adequate information to conclude otherwise. If these species frequent or use the site, mitigation that has not been discussed will be required (*see e.g.*, Hogan Direct at p. 14, l. 6-9). Accordingly, in order to provide the public and the ALJs with necessary information, a field survey is necessary to confirm the presence of these species and/or their habitat at the Indian Point site. Without this information, a discussion of available mitigation cannot be included in the DEIS, as required.

Q: Is the information on terrestrial ecology provided in the record consistent with the level of information typically required by NYSDEC in a DEIS?

A: No. I share TRC's work in developing the DEIS for the CPV Valley Energy Project ("CPV Project") to demonstrate the level of detail on terrestrial ecology the NYSDEC would typically require in a DEIS for a project of this scope, magnitude and scale. The CPV Project is a proposed 630 megawatt natural gas-fired electric generating facility that is to be located on 30 acres of an undeveloped 112 acre tract in Orange County, NY. The tract had previously been used for agricultural purposes, including the growing of hay and corn crops, and wooded areas. The tract also contained wetlands where the bog turtle could be found. Acting as lead agency, the Wawayanda Planning Board scoped the DEIS to require the following field surveys:

- Ecological Communities per Ecological Communities of New York State (2002);
- Invasive Species;
- State and Federal Jurisdictional Wetlands and Waters;
- Aquatic Ecology;
- Riparian and Wetland Buffers;
- Wildlife Habitat (General, Reptiles and Amphibians, Breeding and Nesting Birds, Mammals, Species of Greatest Conservation Need; Insects);
- Rare, Threatened and Endangered Species; and
- Site Biodiversity.

(*see, CPV Valley Energy Center Final Scoping Document For SEQR Environmental Impact Statement* (Oct. 14, 2008), Entergy Ex. 340). The U.S. Fish and Wildlife Service also required a survey for summer roosting trees, because the Indiana bat was known to occur at a distance of about two miles from the site; and a Phase I survey was required to evaluate the presence of the bog turtle due to the presence of wetlands (*see* DEIS, CPV Valley Energy Center, Prepared by TRC for CPV Valley, LLC at 14-37, 14-38, 14-52, 14-59 to 14-60 (Feb. 2009), Entergy Ex. 341, full document available at: http://www.cpvvalley.com/impact_study.html).

The Indian Point site is comparable to the CPV Project site in that it involves a large tract of undeveloped land with potentially unique habitat that could support endangered species known to occur in close proximity to the site.

Accordingly, the type of information required in the CPV Valley DEIS should also be required for the supplemental DEIS in this Proceeding in order to allow the ALJs to draw conclusions about potential significant adverse impacts to terrestrial ecology.

Q: Have you formed an opinion on the potential adverse impacts to terrestrial ecology as a result of constructing the Hybrid Tower Alternative?

A: Yes. Construction impacts to terrestrial ecology of the Hybrid Tower Alternative would be similar to those of the Tetra Tech Proposal. There would be a permanent loss of an estimated 9 acres of the forested block of land, although the location of the cooling tower would appear to avoid the pond and potential jurisdictional wetlands. Construction noise on wildlife and threatened and endangered species, including blasting, would last for at least 3 - 4 years, an extended period of time. The potential effects of construction noise on wildlife are far-ranging, and could 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, Entergy Ex. 338).

Q: Have you formed an opinion on the potential adverse impacts to terrestrial ecology as a result of operating the Hybrid Tower Alternative?

A: Yes. TRC modeled the Hybrid Tower Alternative operational noise levels, based on data provided by NYSDEC Staff consultant Mr. McMahon (*see* Staff Ex. 250 at 4), and found levels would be approximately 80 - 50 decibels across most of the forest block on the Indian Point site; Entergy Ex. 296 at 3-53 to 3-54. These levels, in particular the highest values, are comparable to the Tetra Tech Proposal's operational noise levels of approximately 80 - 65 decibels across most of the forested block. These continuous, long-term operational noise levels have not been assessed for impacts to terrestrial wildlife and threatened and endangered species. Accordingly, there could be substantial adverse impacts to terrestrial wildlife and threatened and endangered species.

8. Archaeological Resources

Q: **Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to archaeological resources from operation and construction of the Tetra Tech Proposal.**

A: No. The presence of potential archaeological resources exists and the area of potential effect for the NYSDEC Staff Proposal would differ from that area previously studied, as acknowledged by Mr. Hogan (Hogan Direct at 17). Therefore, based on prior guidance from the New York State Historic Preservation Officer ("NY SHPO"), a geomorphological assessment and a Phase II investigation should be conducted.

It is not made clear how these new studies would be integrated into the estimated project schedule and what effects they could have on the estimated project schedule. Given the known sensitivity of the area, per NY SHPO, uncovering of resources that could require data recovery with an approved data retrieval plan is reasonably foreseeable. As explained in my prefiled direct testimony and the TRC Response Document, it is my opinion that the potential for adversely impacting known and currently unknown resources in areas acknowledged to be archaeologically sensitive is real and material; therefore, the studies recommended by NY SHPO should be conducted prior to construction. The potential implications to the construction schedule for the Tetra Tech Proposal also should be addressed.

Q: **Have you formed an opinion on the potential adverse impacts to archaeological resources as a result of constructing the Hybrid Tower Alternative?**

A: Yes. As acknowledged by Mr. Hogan, the Hybrid Tower Alternative was studied by Enercon, the presence of potential archaeological resources was documented, and NY SHPO recommended Phase II studies and a geomorphological assessment be conducted (Hogan Direct at p. 17). Accordingly, it is my opinion that construction of the Hybrid Tower Alternative has the potential for adversely impacting known and currently unknown resources in areas acknowledged to be archaeologically sensitive, and that the studies recommended by NY SHPO must be conducted prior to construction and directly addressed in NYSDEC Staff's construction schedule estimates.

9. Transportation

Q: **Do the prefiled direct testimony of NYSDEC Staff and its consultants alter your conclusion on the impacts to transportation from operation and construction of the Tetra Tech Proposal.**

A: No. It is my opinion that the record contains inadequate information on the construction-related transportation impacts. In their prefiled testimony, NYSDEC

Staff and its consultants do not provide necessary substantive information regarding transportation impacts associated with the Tetra Tech Proposal, nor do they respond to many of the issues identified in the Response Document, and my prefiled direct testimony.

In fact, while the record is still incomplete, it is my opinion that the potential for significant adverse impacts to transportation due to the Tetra Tech Proposal has only increased, based on NYSDEC Staff's testimony. Specifically, in his prefiled direct testimony, Mr. Havey increased Tetra Tech's estimated number of construction truck trips for the Tetra Tech Proposal by 20% for both the overburden and the blasting spoils (*compare* Tetra Tech Report at 33 *to* Havey Direct at p. 32, l. 13 and Tetra Tech Supplement, Section 2). The total number of trucks for the spoils would be increased by more than 16,000 trucks, to a total of 126,000 trucks, if barges are not used (or a daily increase of trucks from 235 to 282). NYSDEC Staff appears to be uninformed on this 20% increase, as Mr. Hogan states in his testimony that there would be 110,000 truck trips during the estimated 3 to 4 year period for blasting and excavation work (Hogan Direct at p. 25, l. 14-15). Although Tetra Tech utilized a 20% contingency on the number of trucks, the actual number could be even greater depending upon the size of the blasted rock to be placed in the haul trucks (*i.e.*, larger pieces result in more numerous voids in the truck hopper). In addition, these estimates are based on the trucks being filled to the State's gross vehicle weight limit of 80,000 pounds. Trucks at this weight will place additional stress on the area roadways and bridges on which they travel.

In regard to missing information, the issues that I identified in my prefiled direct testimony remain unaddressed (*see* Lawlor Direct at Section III.B.8). There is no specific analysis of the impacts of the entire construction phase of the project; for example, the trips of construction workers, although their number was identified, were never added to the estimated number of trucks needed for blast rock transport; nor was there an identification and assessment of other vehicle movements such as delivery trucks for material and equipment supply. In addition to the current employees at the site, Mr. Havey acknowledges the presence of a *"sizable workforce"* of as many as 600 laborers daily during the construction of the proposed cooling towers (Havey Direct at p. 17, l. 6 (emphasis added)). He also agrees that there potentially would be *"a steady stream of heavy duty trucks entering and exiting the site"* (Havey Direct at p. 17, l. 9-10 (emphasis added)). NYSDEC Staff and its consultants have not established how the site driveways (ingress/egress) at an operating nuclear facility would operate (*i.e.*, the potential for delay and back up for security purposes) nor provided details or analyses of the operation of the local intersections through which vehicles would traverse.

While NYSDEC Staff and its consultants have included estimates of the number of haul truck trips (and the numbers of barges required), they do not include analyses of the impacts to the road network. No vehicle volume or movement data on the roadway network are provided. No trip generation table had been developed. No assessment of the impacts on the road network at any time of day, including peak hours, was performed.

The current record lacks adequate information on vehicle movements and fails to include an adequate traffic analysis. Without that information, the record for the supplemental DEIS does not conform to SEQRA. Given the scale of the construction and its duration, the potential for SMALL to LARGE transportation impacts, and SMALL to MODERATE navigation impacts is reasonable.

Q: On p. 18, l. 21 of the Havey Direct, Mr. Havey characterizes the Tetra Tech Proposal as having "primary short-term construction-related effects" on land-use. Do you agree with that characterization?

A: No. The timeframe and effects for construction of the Tetra Tech Proposal, as developed by Tetra Tech and including consideration of the number of trucks, cannot reasonably be considered "*short term.*" The 126,000 truck trips associated with blasting spoils alone would have an impact for an estimated three to four years. Blasting is estimated to take 3-4 years with removal activities presumptively continuing afterward (according to Tetra Tech), and Mr. Havey acknowledges in his testimony that the ENERCON timeline for the Hybrid Tower Alternative "*of 12to 13 years was not unreasonable...*" (Havey Direct at p. 9, l. 18 – 19) (emphasis added). Projects of this duration are not "short-term" under SEQRA. For example, environmental review guidance presented in the New York City Environmental Quality Review ("CEQR") Technical Manual, which provides guidance on New York City's implementation of SEQRA, states that *"[c]onstruction activities, although temporary in nature, can sometimes result in significant adverse impacts;"* it then defines "short term" as less than two years, and "long term" as more than two years. (CEQR Technical Manual Chapter 22, at 22-1, Entergy Ex. 339, full document available at http://www.nyc.gov/html/oec/html/ceqr/technical_manual_2014.shtml). (Emphasis added).

Q: Is the information on transportation provided in the record consistent with the level of information typically required by NYSDEC in a DEIS?

A: No. A SEQRA transportation analysis of construction activities is predicated on the duration, intensity, complexity and/or location of the activity (*see, e.g.*, CEQR Technical Manual Chapter 22, at 22-1). None of these factors were considered in the Tetra Tech Report or in any of the subsequent NYSDEC Staff and consultant submittals or testimony provided.

On projects much smaller in size and scope, TRC has been required to analyze in detail the potential construction-related traffic impacts. For example, these types of projects include:

- Bowline Generating Station, Haverstraw, NY – As part of an Article X procedure, this project had a projected two-year construction period with a peak construction timeframe of 3 - 4 months and a peak of 350 construction workers.
- CPV Project, Wawayanda, NY – Under SEQRA, this project had a projected 2 - 2.5 year construction schedule with a peak construction period of 6 months and a peak workforce of 420 contractors.
- TransGas Energy Facility, Brooklyn, NY – As part of an Article X procedure, this project had a projected 3-year construction schedule with a peak construction period of 3 - 4 months, and a peak construction

workforce of 310 construction workers during the day and 120 workers at night.

Each of these projects was considerably smaller in scale and shorter in duration than the Tetra Tech Proposal. However, current traffic counts were required, along with detailed traffic analysis and levels of service analysis to characterize existing conditions as well as to assess potential construction and operational traffic impacts. Accordingly, the level of information on traffic impacts currently in the record is not consistent with SEQRA.

Q: Have you formed an opinion on the potential adverse impacts to transportation as a result of constructing the Hybrid Tower Alternative?

A: Yes. . Although no estimates of the construction workforce were done, Enercon did estimate that blasting operations alone would result in between 364 – 518 truckloads per day for up to four years; these numbers are slightly larger, but not significantly different than those estimated for the Tetra Tech Proposal. Therefore, the potential for adverse transportation impacts exists for the Hybrid Tower Alternative, as it does for the Tetra Tech Proposal. An assessment of these trucks (and other vehicle trips) has not been evaluated by any traffic studies to provide such measures as trip generation by construction project phase, level of service impacts, service delays, etc. Accordingly, the potential transportation impacts due to construction of the Hybrid Tower Alternative are SMALL to LARGE and require further assessment.

10. Environmental Justice

Q: Does the prefiled direct testimony of NYSDEC Staff and its consultants alter

your conclusion on the impacts to environmental justice from operation and construction of the Tetra Tech Proposal?

A: No. As discussed below, it is my opinion that operation of the Tetra Tech Proposal, based on the assessment by TRC's air quality expert (*see* prefiled direct and rebuttal testimony of Ted Main and TRC Response Document), would exceed NAAQS and cause significant adverse impacts to air quality, encompassing a geographic area that includes the NYSDEC-identified EJ Community in the city of Peekskill. Therefore, a significant adverse air quality impact would result that could cause a disproportionate adverse impact in the EJ Community.

Q: Have you formed an opinion on the potential adverse impacts to environmental justice as a result of operating the Hybrid Tower Alternative?

A: Yes. Briefly, the air quality impact analyses of the Hybrid Tower Alternative by TRC (*see* prefiled direct and rebuttal testimony of Ted Main and TRC Response Document at 3-21 to 3-29) indicated the exceedance of the NAAQS and significant adverse air quality impacts, including to the designated EJ Community in the city of Peekskill. Therefore, a significant adverse air quality impact would result that could cause a disproportionate adverse impact in the EJ Community.

Q: On p. 35, l. 15-16 of the Hogan Direct, Mr. Hogan suggests NYSDEC's 2003 EJ Policy does not apply to the BTA determination, because NYSDEC Staff issued the draft SPDES permit prior to the effective date of the 2003 Policy. Do you agree?

No. First, Mr. Hogan ignores the Water Quality Certification application, which postdates the policy and is likewise subject to SEQRA. Insomuch as

NYSDEC Staff addresses BTA in that Proceeding and I understand the proceedings have been consolidated, I can see no credible basis for ignoring the EJ Policy in the SPDES Proceeding. Further, NYSDEC Staff's revised BTA proposals, which alter the underlying permit, postdate the EJ Policy cut-off. More importantly, Mr. Hogan's exemption argument ignores the fact that, in my experience, current DEISs are not approved by NYSDEC without considering EJ issues, particularly when relevant. Indeed, the potential for adverse and disproportionate air quality impacts on EJ Communities has also been addressed by the African American Environmentalist Association in its most recent submittal entitled *Fish eggs versus asthmatic children in Harlem*, AAEA Ex. 1.

11. Aquatic Resources

Q: On p. p. 17, l. 1-2 of the Hogan Direct, Mr. Hogan states that, for purposes of SEQRA review of aquatic impacts, "NYSDEC [S]taff will defer to the BTA portion of the [P]roceeding pursuant to CP-52." Do you believe this deference to CP-52 for evaluation of CWIS impacts is appropriate under SEQRA.

A: No. Per CP-52, the "adverse environmental impact" that must be minimized by the BTA standard of 6 NYCRR §704.5 relates only to the individual "fish and shellfish killed or injured through entrainment and impingement by the operation of cooling water intake structures" and based on the Interim Decision does not allow for a more holistic consideration of how the individual fish and shellfish killed impact aquatic resources (*see* Interim Decision at 17 ("[T]he loss of aquatic organisms, by itself, constitutes an adverse environmental impact.")). In contrast, SEQRA review is broader in scope and requires evaluation of the potential adverse impacts, if any, of individual fish and shellfish mortality on the aquatic ecosystem and/or species stocks. As such, a BTA determination of impact may not equate to a SEQRA finding of significant adverse environmental impact.

D. Mitigation and Alternatives

Q: In your opinion, have NYSDEC Staff and its consultants appropriately considered the mitigation alternatives and performed an alternatives analysis pursuant to SEQRA?

A: No. As an initial matter, NYSDEC Staff and its consultants have failed to consider Entergy's proposed CWWS as an alternative, although selection of CWWS as BTA may occur and therefore is a reasonable alternative that should be considered. Further, the potential significant adverse impacts of CWW screens were evaluated by all parties and presented to the Tribunal in July 2013; therefore, NYSDEC Staff have sufficient information on CWWS to perform an alternatives analysis.

Second, depending on the resource category being reviewed, NYSDEC Staff and its consultants variously have asserted that the Tetra Tech Proposal is a mitigating alternative to the Hybrid Tower Alternative, or vice versa (*see, e.g.*, Corser Direct at p. 7, l. 5-7 (concluding Tetra Tech Proposal mitigates visual resource impacts as compared to Hybrid Tower Alternative); Hogan Direct at p. 32, l. 7-11 (concluding Hybrid Tower Alternative has less significant noise impacts as compared to the Tetra Tech Proposal)). This particular form of ping pong does not advance a SEQRA resolution, without consideration of CWWS, and amount to limiting the alternatives in a manner inconsistent with SEQRA.

A:

IV. PERMITTING AND FEASIBILITY ISSUES

A. Overview

Q: **On pages 23-27 of your February 28, 2014, prefiled direct testimony, you outlined the permitting and feasibility issues identified by the TRC CCC Team in the TRC Response Document. Has NYSDEC Staff or its consultants addressed these permitting and feasibility issues in their February 28, 2014 direct prefiled testimony?**

A: No. As outlined below and discussed more fully in the accompanying testimony of Entergy's additional outside experts, the significant permitting and feasibility issues identified in the TRC Response Document remain unaddressed by NYSDEC Staff.

B. Engineering

Q: **What engineering feasibility issues remain unaddressed by NYSDEC Staff and its consultants?**

A: As presented in detail in the accompanying prefiled rebuttal testimony of Sam Beaver, NYSDEC Staff and its consultants have failed to address numerous engineering feasibility issues for both the Tetra Tech Proposal and the Hybrid Tower Alternative, including: (1) the uncertainty associated with Tetra Tech's proposal to use novel and commercially unproven ClearSky cooling towers; (2) the numerous siting conflicts of essential plant structures; (3) the relocation of the Algonquin pipeline; (4) the management of radiologically contaminated areas; (5) the relocation of IPEC's Independent Spent Storage Installation ("ISFSI"); (6) the potential impacts associated with the cooling tower emissions on the facility, such as salt deposition and icing; and (7) the considerable impact on IPEC's ability to generate power efficiently.

C. Land Use

Q: Do land use permitting issues remain unaddressed by NYSDEC Staff and its consultants?

A: Briefly, as presented in detail in the accompanying prefiled rebuttal testimony of Kevin Young, NYSDEC Staff and its consultants have failed to address numerous local land use issues for both the Tetra Tech Proposal and the Hybrid Tower Alternative, including: a soil disturbance and excavation permit, a steep slopes permit, stormwater-related approvals, and building permits. NYSDEC Staff and its consultants, including Mr. Weintraub, do not discuss these approvals and, based on the testimony of Kevin Young, it is unlikely that these permits can be obtained for either the Tetra Tech Proposal or the Hybrid Tower Alternative.

D. Cooling Water Treatment Management

Q: On pp. 23, l. 22 to 24, l. 3 the Havey Direct, Mr. Havey says he could not comment on the appropriateness of the TSS levels relied on in the TRC Response Document because the reference was not available for review. What source was relied on for the TSS levels cited in TRC Response Document and its Appendix G?

A: The TSS levels cited on p. 3-15 of the TRC Response Document and in Appendix G were based on levels presented in the Hudson River Estuary by Levinton and Waldman (2006), which I understand was provided to counsel in July 2013 as Entergy Ex. 287 and is otherwise available. Based on that source, the average concentration of TSS along the axis of the estuary is 35mg/L, but can range over a factor of 3 to 4 depending on tidal cycle variations; that source also documents observed estuary turbidity maxima ("ETM") occurring at the leading edge of the salt wedge above and below the Indian Point region (*see* Entergy Ex. 287 at 47-48, Figures 4.5 and 4.6 (providing TSS contour maps for Hudson River in which Indian Point is located at approximately river kilometer 98)), which will result in elevated TSS levels at that point.

Q: **Do you consider the Levinton and Waldman source a reliable estimate of TSS concentrations in surfacewater in the Indian Point region?**

A: Yes. TSS concentrations presented in Levinton and Waldman are consistent with other long-term TSS data for the Hudson River. For example, based on measurements taken every 15 minutes from 2002 through 2006, Wall et al. (2008) documented a TSS range of approximately 5 to 100 ppm at a location 3.7 km south of Poughkeepsie, NY (*see* Wall et al. (2008) at 545 Entergy Ex. 345). The frequency of sampling makes this dataset particularly valuable, as it serves to demonstrate how TSS concentrations typically vary throughout the day, month, year, and year-to year in the Hudson River. It also demonstrates that, while the average TSS concentrations may be approximately 20 mg/L in summer and 40 mg/L in winter, there are periods of the year where TSS levels will be increased by a factor of 2 or 3 for sustained periods of time with episodes near, at, or over 100 mg/L. While the study area in the Wall et al. (2008) paper is located north of Indian Point, it is consistent with the Levinton and Waldman paper and the ranges presented in the United Water DEIS.

Q: **Are you comfortable relying solely on the TSS levels presented in the United**

Water DEIS and cited by Mr. Havey?

A: No. Sediment load to the Hudson River can vary from year to year, season to season, episodically and even daily (*See* Entergy Ex. 287 at 39-40; Wall et al. (2008) at Figure 4). The information presented in Entergy Ex. 287 on average TSS levels and levels in the vicinity of Indian Point is based on more than one year of data and is consistent with long-term data available from other sources (see Wall et al (2008)). In contrast, the United Water DEIS sampling took placed over one (1) calendar year, from April 2007 through April 2008 in Haverstraw Bay, and therefore, may not capture the full range of potential TSS levels. This is particularly true because Indian Point is located in an area of the Hudson River where the location and characteristics of the leading edge of the salt wedge fluctuates—depending on the year and season, the leading edge of the salt wedge may be below, above or adjacent to Indian Point. As discussed above, TSS concentrations will be higher at the leading edge of a salt wedge. Of course, as our scrubbers, CTs also entrain airborne particles, with the result that TSS levels in the cooling water system will be even higher, perhaps substantially so.

Q: **What cooling water treatment management issues remain unaddressed by NYSDEC Staff and its consultants?**

A: As discussed in the accompanying testimony of Mr. Beaver and Mr. Puckorius, NYSDEC Staff and its consultants have failed to address whether the level of chlorine, water treatment chemicals and TSS discharged from the Tetra Tech Proposal and Hybrid Tower Alternative can be permitted, as designed. I understand that both the Tetra Tech and Hybrid Tower Alternative calls for the discharge of circulating water for both Units and service water for both Units into hot water reservoirs where the current discharge canal exists. When the Unit 2 reservoir reaches capacity, the water in the reservoir will overflow a weir into the Unit 3 reservoir. When the Unit 3 reservoir reaches capacity, it will overflow a second weir into the unmodified portion of the discharge canal that will return the excess water to the river. The overflow of the Unit 3 weir represents an uncontrolled discharge, which have the water quality characteristics of the hot water reservoir. Concentration levels will be variable, but I am unaware of comparable authorizations.

Q: **On p. 5, l. 12 to p. 6, l. 10 of the Kolakowski Direct, Mr. Kolakowski acknowledges and presents the minimum requirement for blowdown discharges from cooling towers. Do these requirements demonstrate that a dechlorination or other water quality treatment system will not be required at Indian Point if the Tetra Tech or Hybrid Tower Alternatives are selected as BTA?**

A: No. According to the minimum requirements for blowdown discharge cited by Mr. Kolakowski, the concentration of free available chlorine shall not exceed a maximum of 0.5 ppm or an average of 0.2 ppm. I understand from Mr. Puckorius that in order to control for *Legionella*, a continuous level of free residual chlorine of 0.5 – 1.0 ppm must be maintained, which clearly exceeds the requirements set forth by Mr. Kolakowski. In addition to the weir system described above, the Tetra Tech Alternative also calls for separately blowdown releases past the Unit 3 weir into the discharge canal. This discharge will also share the water quality characteristics, including the 0.5 – 1.0 ppm of free residual chlorine that is required to treat the cooling tower basins.

E. Air Emissions

Q: Do air permitting issues remain unaddressed by NYSDEC Staff and its consultants?

A: Yes. As set forth in the accompanying prefiled rebuttal testimony of Ted Main, the analysis of air emissions due to operation of CCC technologies conducted by NYSDEC Staff and its consultants is flawed, and as such, inadequate for purposes of evaluating the permitability of the Tetra Tech Proposal and Hybrid Tower Alternative; NYSDEC Staff and it consultants have failed to establish that these CCC technologies could be permitted for air emissions or satisfy SEQRA.

F. Visual Resources

Q: What visual resource permitting issues remain unaddressed by NYSDEC Staff and its consultants?

A: Briefly, as presented in detail in the accompanying testimony of Matthew Allen, NYSDEC Staff and its consultants have failed to establish that either the Tetra Tech Proposal or the Hybrid Tower Alternative are consistent with the NYCMP. Neither project may be constructed until consistency has been established pursuant to SEQRA. In addition, a consistency determination may be separately required by the New York State Department of State if a federal permit is required. As discussed below, a federal Clean Water Act section 404 permit may be required if the wetland located on the forested block of the Indian Point site is determined to be a water of the United States.

G. 404 Permit

Q: Are there other permitting issues that you identified in reading NYSDEC Staff's and its consultant's prefiled testimony and supporting documents?

A: Yes. As discussed above in the terrestrial ecology discussion, the forested block of the Indian Point site contains wetland water resources that may be regulated as waters of the United States. NYSDEC Staff has not addressed this issue.

H. Conclusion

Q: Is the consequence under SEQRA of not addressing the issues presented in Sections IV.A through IV.G significant?

A: Yes. Absent resolution of these significant issues, an adequate SEQRA evaluation has not been performed. Further, resolution of these issues could lead to significant changes to the Proposals or to their rejection by the ALJs. Timeline and cost implications of these issues are also real and may be substantial.

END OF TESTIMONY

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 MATTHEW W. ALLEN
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 Matthew W. Allen. I am a principal at Landscape Architects, Architects, Engineers and Planners, P.C. ("Saratoga Associates"). My office is located at Four Congress Park Centre, 21 Congress Street, Suite 201, Saratoga Springs, NY 12866.

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 the 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 to minimize adverse environmental impacts consistent with the "best technology available" ("BTA") 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 BTA 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) contains sufficient analyses of visual resources to determine compliance of its CCC proposal with New York State law, and (2) provide my opinion as to whether the Tetra Tech Report provides sufficient analyses of the significant adverse impacts to visual resources to satisfy the requirements of SEQRA.

In particular, this testimony describes the review and evaluation that I conducted in conjunction TRC Environmental Corporation ("TRC") as presented in a report 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 assesses, *inter alia*, the potential significant adverse environmental impacts to visual resources as a result of the construction and operation of the CCC configuration 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]

This testimony and the TRC Response Document are intended to assist

[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.

this Tribunal in making findings necessary or appropriate pursuant to 6 NYCRR § 704.5 and the State Environmental Quality Review Act ("SEQRA"), as prescribed in the August 8, 2010 Interim Decision and applicable orders of this Tribunal.

II. QUALIFICATIONS

Q: Please describe your academic background.

A: I earned my B.S. degree in Landscape Architecture from the SUNY College of Environmental Science and Forestry, and a M.S. in Urban and Environmental Studies from Rensselaer Polytechnic Institute. My most recent professional resume, including professional affiliations and work experience, is attached as Entergy Ex. 302.

Q: What is Saratoga Associates?

A: Saratoga Associates is a multi-disciplinary professional firm that provides landscape architectural, architectural, planning, and engineering services throughout the Northeast. Saratoga Associates' Visual Assessment and Scenic Resource Management studio is a national leader in the specialized discipline of visual impact assessment and scenic resource management. Our services are provided to both developers and agencies, including NYSDEC, and include assisting in compliance with the National Environmental Protection Act ("NEPA"), SEQRA, NYSDEC Program Policy, and local planning and zoning.

Q: Please summarize your relevant work experience.

A: I am a Registered Landscape Architect with over 25 years of experience in regional, community, and environmental planning, and regulatory permitting. As the head of Saratoga Associates' Visual Assessment and Scenic Resource

Management studio, I have particular experience in visual impact assessment, aesthetic mitigation and the application of advanced computer-generated visual simulation, animation and viewshed development technology. My experience in visual assessment spans a broad range of project types, many of which are located in coastal or riverine settings, including a waterfront residential and commercial development, a waterfront cement manufacturing facility, numerous coastal-area liquefied natural gas facilities, and numerous coastal-area on- and off-shore wind turbines.

Q: Please summarize your experience with visual assessments under New York law.

A: I served on the peer review team for the landmark 2000 NYSDEC Program Policy concerning visual impact assessment and mitigation, and therefore have a comprehensive understanding of that policy. In addition, I have served as a third-party advisor to NYSDEC, helping state regulators understand and minimize aesthetic impacts associated with large and often controversial development projects. As a third-party advisor to NYSDEC, I conduct visual assessments pursuant to SEQRA of proposed projects on behalf of NYSDEC. My reviews on behalf of NYSDEC have included assessment of visual impacts of proposed projects in the Hudson River Valley, including assessment of visual impacts of the U.S. Generating Company's proposed combined-cycle power plant in Athens, New York (the "Athens Generating Plant"), and Sour Mountain Realty's proposed quarry in Fishkill, New York.

III. TRC RESPONSE DOCUMENT VISUAL ASSESSMENT

A. Overview

Q: Please provide an overview of your work on the TRC Response Document.

A: I consulted with TRC to review the Proposal for potential adverse impacts to visual resources pursuant to SEQRA and for consistency with the New York State Coastal Zone Management Plan ("CMP"). My assessment is provided in Section 3.6 of the TRC Response Document.

Q: What standards did you rely on to determine the potential adverse impacts to visual resources of the Proposal pursuant to SEQRA?

A: I relied on the standards set forth in the SEQRA statute, regulations, SEQR Handbook, and the NYSDEC Program Policy on Assessing and Mitigating Visual Impacts (2000) (the "NYSDEC Visual Policy") (Entergy Ex. 304).

SEQRA requires that a visual impact assessment be conducted when a proposed facility is within the viewshed of a designated aesthetic resource to identify potential significant impacts. (*See* NYSDEC Visual Policy at 2). If significant impacts are identified, SEQRA requires that reasonable and necessary measures be employed to eliminate, mitigate or compensate for the adverse effects. *Id.*

In addition, SEQRA requires review of proposed projects located in the coastal area for consistency with the state's coastal policies. (*See* 6 NYCRR § 617.9 (b)(5)(vi)). Final agency actions may not be undertaken until the agency has determined that the action is consistent with New York's coastal policies. (*See* 6 NYCRR § 617.11 (e)).

For purposes of a visual assessment, the relevant coastal polices that must be considered are:

- Prevent impairment of scenic resources of statewide significance
- 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 coast.

(*See* 19 NYCRR § 600.5(d); 6 NYCRR § 617.9 (b)(5)(vi)). While the lead SEQRA agency will evaluate consistency with these state coastal policies for purposes of SEQRA review, the New York State Department of State ("NYSDOS") is the agency charged with advising state agencies on consistency with coastal policies. (*See* Exec. Law § 913 (1), (4)). My evaluation also considered whether the Proposal is consistent with these coastal policies as interpreted by NYSDOS. NYSDOS considers past consistency determinations as precedent; accordingly, I also considered past NYSDOS consistency determinations when evaluating consistency with the coastal policies. (*See, e.g.*, Correspondence from Randy A. Daniels, NYSDOS to Mr. David Loomes, St. Lawrence Cement Company, LLC, re: Objection to Consistency, p. 18 (Apr. 19, 2005)) (hereinafter "St. Lawrence Objection") ("Previous consistency decisions are often useful to inform subsequent decisions") (Entergy Ex. 305).

Q: Why did you determine whether the Proposal is consistent with the CMP?

A: Unless otherwise exempted, consistency with the CMP is required separate and apart from SEQRA for projects that require federal approvals. It is my understanding that the Proposal may require federal approvals, and therefore, must separately demonstrate consistency with the CMP.

Q: What standards did you rely on to determine whether the Proposal is consistent with the CMP?

A: The two coastal polices identified above are identical to CMP polices #24 and #25 and NYSDOS is the agency charged with determining consistency with the CMP for projects requiring federal approvals. Therefore, my review of the Proposal for consistency with coastal policies under SEQRA is applicable to whether the Proposal is consistent with the CMP.

B. Assessment And Conclusions

Q: Please describe the visual resources that are potentially impacted by construction and operation of the Proposal.

A: The Proposal is located in the lower Hudson Valley, a region of exceptional scenic, historic, and recreational importance. The area includes numerous sites and areas that are protected through regulatory designations such as Scenic Areas of Statewide Significance ("SASS"), State Parks, National Register of Historic Places, Scenic Byways, American Heritage River, and National Heritage Area.

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

The Proposal does not sufficiently evaluate potential impacts to visual resources during the construction period. The Tetra Tech Report acknowledges that construction of its proposed CCC technology will take seven (7) to nine (9) years to complete (see Tetra Tech Report at 27), though a longer timeframe of twelve (12) to thirteen (13) years is more likely (*see* TRC Response Document at 3-30). Even assuming that the Tetra Tech estimates are correct, the protracted duration of construction makes visual impacts during construction effectively permanent.

The following construction activities have the potential to impact visual resources: site excavation; vegetation removal; development of access roads, contractor parking and lay down areas; dust emissions; heavy-duty truck traffic, and crane usage. For example, cranes of 200-300 feet are required to build the Proposal and will be present on the site for four to six years. Based on the information provided in the Tetra Tech Report and typical impacts from construction of a project of this scope and magnitude, the potential impacts to visual resources from construction will be LARGE.

Q: Does the Proposal provide sufficient analysis of impacts to visual resources as a result of operating the Proposal?

A: No. While, the Tetra Tech Report provides a visual impact assessment, that assessment fails to provide substantial information necessary to fully evaluate potential visual impacts. As a result, the Tetra Tech Report's conclusions on impacts to visual resources are unsupported (*i.e.*, fail to provide factual information to back-stop its assumptions) and/or deficient (*i.e.*, fail to provide necessary analysis in accordance with New York law). Further, the Tetra Tech Report's conclusions on visual assessment go against established New York precedent.

Q: How is the Tetra Tech Report's visual assessment unsupported?

A: As detailed in Section 3.6 of the TRC Response Document, the Tetra Tech Report assumes that its proposed cooling towers will be run in plume-abated mode at all times when meteorological conditions are conducive to plume formation, but it provides no basis for this assumption and fails to acknowledge that plume-abated mode may not be possible under all circumstances due to the substantial energy penalty associate with such operation. The Tetra Tech Report fails to provide an operating plan establishing the parameters under which the cooling towers would be operated in plume-abated and non-abated modes, and fails to acknowledge that there is a significant energy penalty for continuously operating the towers in plume-abatement mode. Full consideration of proposed operating parameters and the effect of extended plume-abated operation on operational efficiency and cost is necessary to thoroughly evaluate the effectiveness and feasibility of the proposed technology. By assuming, without support, that the technology will be operated in plume-abated mode at all possible times, the Tetra Tech Report fails to evaluate the full potential for adverse impacts to visual resources.

The Report also states, without support, that the visible plume will be difficult to detect beyond ten miles away. This unsupported conclusion leads to a failure to fully evaluate potential adverse impacts to visual resources beyond the ten-mile range. Considering the magnitude of the Proposal and the abundance of designated aesthetic resources in the area, the Tetra Tech Report must support its assumptions with line-of-sight profiles, computer simulations, comparative studies, or worst-case projections. (*See* NYSDEC Visual Policy at 5).

Q: How is the Tetra Tech Report's visual assessment deficient?

A: The Tetra Tech Report's visual assessment has numerous deficiencies. First, in evaluating impacts from the visual plume it chooses to evaluate the 90th percentile visible plume, but failed to define what that plume represents or the operating parameters and meteorological variables that would lead to that plume. As a result the Report's conclusions cannot be verified.

Second, the Tetra Tech Report fails to provide photo simulations for the full range of the visible plume on designated resources in accordance with the NYSDEC Visual Policy (pp. 4-5). Photo simulations are limited to locations within a five-mile radius when the Report acknowledges that the plume will be visible up to and beyond locations ten miles away. The full scope of potential impacts cannot be evaluated without an assessment of the full range of visual resources that may be affected.

Third, the Report's conclusions are based on poorly rendered photo simulations of the visible plume. These simulations are based on underexposed photographs taken on overcast days with a monochromatic effect. As a result, the photo simulations understate the potential visibility of vapor plumes on the scenic resources of the region.

Fourth, the Tetra Tech Report fails to provide photo simulations for key visual resources areas along the Hudson River, including the Haverstraw Bay County Park, Blue Mountain Reservation, High Tor State Park, and Hook Mountain State Park. Without photo simulations impacts to these visual resources from both the visible plume and cooling tower structures cannot be fully evaluated.

Fifth, the Report underestimates potential impacts to visual resources by failing to account for the interaction of industrial lighting on nighttime visible plumes.

Sixth, the Report understates the scale and visual dominance of the proposed cooling towers, which are of an unprecedented size and scale for the region. The proposed cooling tower array is approximately 151 feet across by 1,408 feet long and 91 feet high. At 52 feet above the river level the towers would be substantially taller than surrounding vegetation.

Finally, as explained in Section 3.6 of the TRC Response Document, the Tetra Tech Report analysis of mitigation is deficient because it overestimates the mitigation provided by existing vegetation and fails to consider visual offsets that are required by the NYSDEC Visual Policy.

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

A: The Proposal does not provide information sufficient to understand the full scope of potential visual impacts of its chosen technology. Even the underestimated impacts to visual resources described in the Tetra Tech Report are of unprecedented size and scope and would affect an unusually large number of visual resources of statewide and national significance in a manner that could not be effectively mitigated.

For example, the Tetra Tech Report concludes (without support) that a visible plume will occur approximately two percent (2%) of the year, with over half of occurrences at night. Accordingly, the plume would be visible for approximately 175 hours per year with somewhat more than half these hours estimated to occur at night when industrial lighting would light up the plume. In addition, the cooling tower structures themselves are of unprecedented size and scale, rising 143 feet above river level and clearly visible to surrounding resources.

Accordingly, despite the lack of information I can conclude that the potential for adverse impacts to visual resources from the Proposal is LARGE. This conclusion is consistent with NYSDOS precedent, as described below. While unsupported and deficient for the reasons set forth above, Tetra Tech's evaluation of impacts to visual resources does not establish that its proposed technology is consistent with New York's coastal policies.

Q: Is the Proposal consistent with the CMP?

A: No. The Proposal is not consistent with the following coastal policies:

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

As discussed above the size and scope of these projects will adversely affect an unusually large number of visual resources of statewide and national significance. NYSDOS has objected to consistency determinations for projects of smaller scale and with lesser potential visual impact.

In 2000, NYSDOS objected to the Athens Generating Plant consistency certification due to the visual impacts of the proposed plant's visible plume, projected to exist for approximately 114 hours annually, upon scenic and historic resources of the Hudson River Valley. (*See* Athens Generating Project, Federal Consistency Statement, February 2000 (Entergy Ex. 303); St. Lawrence Objection at 18).

Similarly, in 2005, NYSDOS objected to the consistency of the St. Lawrence Cement, LLC's proposed Greenport Project. (*See* St. Lawrence Objection at 18). The St. Lawrence Objection was based on impacts to visual resources from the large-scale nature of the facility being proposed:

- 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.
- 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.
- The manufacturing plant would be visible from and incompatible with the Olana [State Historic Site] SASS.

(*See* St. Lawrence Objection at 18-20).

Based on these precedents and the scale of the Proposal, the Proposal is not reasonably likely to be found consistent with CMP coastal policies #24 or #25.

END OF TESTIMONY

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 REBUTTAL TESTIMONY OF MATTHEW W. ALLEN 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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March 28, 2014

TABLE OF CONTENTS

I. INTRODUCTION

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

A: My name is Matthew W. Allen. I am a principal at Saratoga Associates Landscape Architects, Architects, Engineers and Planners, P.C. ("Saratoga Associates"). My office is located at Four Congress Park Centre, 21 Congress Street, Suite 201, Saratoga Springs, NY 12866.

Q: Are you the same Matthew Allen who provided prefiled direct testimony on February 28, 2014, 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 prefiled rebuttal testimony.

A: The purpose of my prefiled rebuttal testimony is to address certain portions of the prefiled direct testimony of Department of Environmental Conservation Staff ("DEC Staff") and its consultants, specifically Christopher Hogan ("Hogan Direct"), Tim Havey ("Havey Direct"), and Susan Corser ("Corser Direct") related to visual resource impacts. For purposes of my response I reviewed these three testimonies as well as documents referenced in and/or attached to those testimonies.

Q: Please explain how your testimony is organized.

A: My testimony is organized into three sections. First, I respond to address the continued inadequacy of the DEC Staff's review, pursuant to the New York State

Environmental Quality Review Act ("SEQRA") of potential significant adverse visual resource impacts for both the closed-cycle cooling ("CCC") configurations: (1) proposed by Tetra Tech on behalf of DEC Staff (the "Tetra Tech Proposal") as presented in the report entitled *Indian Point Closed-Cycle System Retrofit Evaluation* (Tetra Tech June 2013) (the "Tetra Tech Report") and (2) preliminarily assessed at the direction of DEC Staff in the report entitled *Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration* and dated February 12, 2010 (Entergy Exs. 7, 7A to 7J) (the "Hybrid Tower Alternative"). Second, I respond to address the inadequacy of DEC Staff's evaluation of consistency with the New York State Coastal Management Plant ("NYCMP") Third, I respond to specific statements regarding visual resources made in the Corser Direct, Hogan Direct and Havey Direct.

II. DEC STAFF'S REVIEW OF VISUAL RESOURCE IMPACTS REMAINS INAEDEQUATE

A. Tetra Tech Proposal

Q: Please remind the Tribunal of the visual assessment review that you conducted for the Tetra Tech Proposal.

A: I consulted with TRC to review the Tetra Tech Proposal for potential adverse impacts to visual resources pursuant to SEQRA and for consistency with the NYCMP. My assessment is provided in Section 3.6 of the December 2013 reported 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"), and summarized in my February 28, 2014 prefiled direct testimony. Based on my review, I concluded that the Tetra Tech Report failed to provide sufficient analysis of impacts to visual resources as a result of constructing and operating the Tetra Tech Proposal.

Q: Has DEC Staff addressed the visual resources issues that you identified as unaddressed?

A: No. In the TRC Response Document I identified the key visual resources issues that required further review and evaluation pursuant to SEQRA and the NYCMP. These included:

- An operating plan establishing the parameters under which the cooling towers would be operated in plume-abated and non-abated modes, in light of the significant energy penalty for continuously operating the towers in plume-abated mode;
- Potential impacts to visual resources during the 4-6 year construction period. Construction activities which require more detailed evaluation include site excavation; vegetation removal; development of access roads, contractor parking and lay down areas; dust emissions; heavy-duty truck traffic; and crane usage;
- Quality of base photograph use to develop simulations;
- The impact of industrial lighting for the expanded footprint on scenic resources;
- The impact of industrial lighting on visibility of plumes at night;
- Inconsistency of the Tetra Tech Proposal with New York state

precedent on visual resource impacts; and

- Mitigation of visual resource impacts.

Based on my review of the Corser Direct, Havey Direct, and Hogan Direct testimony, as well as the references cited in and attachments to those testimonies, these issues remain unaddressed by DEC Staff. In fact, DEC Staff and its consultants acknowledge that many of these issues were not addressed in their review (*see* Appendix A).

Q: Did DEC Staff agree with your conclusion that Tetra Tech Proposal will have adverse visual impacts?

A: Yes. DEC Staff and its consultants acknowledged that the Tetra Tech Proposal "would result in visual impacts" (Corser Direct at p. 7, l. 7), although neither Staff nor its consultants developed their analysis sufficiently to establish the level of significance of those impacts. The same acknowledgment is implicitly made for the Hybrid Tower Alternative (*see* Corser Direct at p. 7, ll. 3-10). In addition, DEC Staff and its consultants acknowledge that the following conclusions presented in the TRC Response Document and regarding the Tetra Tech Report were correct:

- The calculation and use of the 90th percentile plume is appropriate (Corser Direct at p. 9, ll. 9-11);
- It is not possible to predict the frequency or duration of plume formation without an operating plan (*see generally* Corser Direct at pp. 8-9);
- Evaluation of construction impacts is necessary (*see* Corser, p. 8,

ll. 4-11);

- Plume impacts at night may be heightened by industrial lighting and require mitigation (*see* Corser p. 10, ll. 4-6);
- The project is subject to the NYSDEC Visual Policy under SEQRA which requires that significant visual impacts be mitigated to the maximum extent practicable. (Tetra Tech Report at 78);
- The Hudson River and Hudson River Valley are recognized by numerous agencies for their important contributions to the scenic, cultural, historical, recreational, and economic resources of the State of New York and our Nation as a whole (Tetra Tech Report at 62)
- Major areas of concern with the Tetra Tech Proposal's impact on visual resources include:
  - Views from resources located due west of the project, including NY Route 9W, the east facing slopes of the Dunderburg Mountain, and the Jones Point and Bear Mountain subunits of the Hudson Highlands Scenic Areas of Statewide Significance;
  - Views from the north, including Annsville Creek and Paddlesports Center (part of the Hudson Highlands State Park), the Amtrak corridor, the lower portion of Route 6/202, Peekskills Riverfront Green Park, Fleishmann Pier and Lents Cove; and

- Views from the Hudson River, much of which lies within the Jones Point Subunit of the Hudson Highlands Scenic Area of Statewide Significance (Tetra Tech Report, p. 61)

Q: **Having reviewed the Corser Direct, Havey Direct and Hogan Direct testimonies, including the referenced reports and attachments, has your conclusion on the visual resource impacts of the Tetra Tech Proposal changed?**

A: No. It is still my opinion that DEC Staff's visual resource assessment is insufficient to understand the full scope of potential visual resource impacts of the Tetra Tech Proposal, and that based on the information available there is the potential for LARGE impacts.

Q: **Please explain.**

A: First, DEC Staff's conclusions are inappropriately based on continuously running CCC in plume abatement mode (*see, e.g.*, Corser Direct at p. 7, ll. 12-14, p. 8, ll. 12-22, p. 13, ll. 12-14; Havey Direct at p. 30, ll. 12-21; Hogan Direct at p. 19, ll. 17-32). Second, DEC Staff's visual assessment failed to explain how its visual simulations for the Tetra Tech Proposal were developed rendering those simulations meaningless. Third, five of the eight issues that Tetra Tech identified in a October 2009 memorandum as unaddressed in my visual assessment of the Hybrid Tower Alternative remain unaddressed for the Tetra Tech Proposal as well, and are required for an adequate visual resource assessment under SEQRA. Fourth, DEC Staff failed to follow through on 15 of Tetra Tech's recommendation for visual assessments—recommendations that I agree should be completed to develop an adequate visual assessment. Essentially, DEC Staff's and its consultants' current visual assessment is missing everything that Tetra Tech identified as missing (but required) in the report by Saratoga Associates entitled *Indian Point Energy Center Closed Cycle Cooling Conversion Feasibility Study Visual Assessment*, and dated June 1, 2009 (Staff Ex. 246) (the "Saratoga Report"), and also fails to follow 15 of the 20 recommendations that Tetra Tech made for gathering visual assessment information and conducting the visual assessment analysis.

Finally, DEC Staff and its consultants have articulated their conclusions regarding the visual resource impacts of the Tetra Tech Proposal as a comparison not to the existing conditions, but to the impacts of the Hybrid Tower Alternative. For example, in response to the TRC Response Document's criticism that the Tetra Tech Report fails to make a determination of significance for the Tetra Tech Proposal, Ms. Corser explains that "at the outset [] the purpose of the Tetra Tech ClearSkyTM cooling tower proposal was to present an alternative to or otherwise mitigate the impacts from the cooling towers proposed by Enercon" (Corser Direct at p. 15, ll. 3-18). This type of comparative analysis is insufficient for purposes of SEQRA and the NYCMP consistency review.

Overall, the visual assessment of the Tetra Tech Proposal conducted by DEC Staff and its consultants consists of conclusory statements that the alternative will have less visual impacts as compared to the Hybrid Tower Alternative. It fails to provide enough information concerning all necessary topics to make a complete determination of significance in comparison to existing conditions, but still provides enough information to support a conclusion that the potential for significant adverse impacts is LARGE.

Q: You state that "DEC Staff's conclusions are inappropriately based on continuously running CCC in plume abatement mode." Why is it inappropriate to assume the Tetra Tech Proposal will be continuously run in plume abatement mode?

A. DEC Staff's consultants acknowledge that no operating plan has been established for the Tetra Tech Proposal (*see, e.g.*, Corser Direct at p. 8, ll. 19-20; Havey Direct at p. 30, ll. 21-23, p. 31, ll. 1-4). As the party proposing CCC and a regulatory agency with experience overseeing assessments of visible plumes, the development of a proposed operating plan and/or predicting the operating plan was well within DEC Staff and its consultants' capability; I understand that all parties have been testifying as to reasonably likely operational and regulatory outcomes.

In the absence of an operating plan that establishes when the visible plume will occur, an appropriate visual assessment must include assessments for the worst case plume conditions (*see, e.g.*, NYSDEC, Program Policy DEP-00-2, Assessing and Mitigating Visual Impacts at 5 (requiring worst-case scenarios for control points). Worst-case plume analysis means identifying the frequency, duration and dimension of visible plumes under all potential operating conditions.

The assumption of the Tetra Tech Report is that the Tetra Tech Proposal will be operated in plume abated mode at all times when weather conditions are conducive to plume formation. This assumption represents the "best-case" scenario. This is an acceptable method of evaluation only if the information derived leads to the conclusion that even under the best case operating conditions, the resulting visual plume represents an unacceptable visual impact. This was how the hybrid tower was evaluated by in the *Athens Generation* coastal consistency review, leading to a determination that the visible plume produced by the hybrid cooling tower alternative operating in a best-case scenario was inconsistent with NYCMP visual resource policies. If, however, the plume generated while operating in full-time plume abatement mode (best case operation) is acceptable, then consideration of potential tower operation in non-plume abated mode (worst-case) must be provided to determine whether that is also acceptable.

Because DEC Staff and its consultants assumed plume-abatement conditions in their visual assessment and went no further, their review fails to provide the public with information on the worst-case scenario conditions. For example, the assessment does not include nighttime plume conditions (Corser Direct at p. 10, ll. 1-4), and excluded visual simulations for daytime plume for resources in the plume viewshed—Haverstraw Bay County Park, Blue Mountain Reservation, and High Tor and Hook Mountain Statement Parks (Corser Direct at p. 10, l. 22 to p. 11, l. 2). Without information on these worst-case conditions, DEC Staff's visual assessment is inadequate.

Q: You also stated that "DEC Staff's visual assessment failed to explain how its visual simulations for the Tetra Tech Proposal were developed." What do you mean by that?

A. Typically, a plume assessment will develop simulations of the plume that provide the public with information on how frequently a plume of the simulated size will occur. Without operating plans establishing plume abatement mode, the simulations should be based on operation in non-abatement mode. For example, the Saratoga Report recognizes that operating parameters can range from full-time plume abatement mode operation (at a significant energy efficiency penalty) to full time wet mode operation (with significant plume visibility), or a balance of both wet and abatement mode operation. Since specific operating parameters have not been defined for the Tetra Tech Proposal, it is not possible to predict the frequency or duration of visible plume formation under plume abatement and non-abatement mode operation. Accordingly, the Saratoga Report properly addressed a worst-case plume visibility assessment considering plume frequency, duration and dimension assuming wet-mode operation. To simplify the analysis for purposes of visual assessment, visible plume predictions were ranked from shortest to longest and predicted frequencies were summed to identify the 90th percentile ("reasonably anticipated worst-case") and 50th percentile ("average case") in terms of potential plume size. These predictions show the average and worst-case plume dimensions that the public can expect to see if the hybrid cooling towers were operated in non-abated mode during weather conditions conducive to plume formation.

The basis for DEC Staff's simulations is not as clear. The Tetra Tech Report purports to simulate the 90th percentile plume for the Tetra Tech Proposal, but Ms. Corser states that "the intent of the 90th percentile simulations in the Tetra

Tech [R]eport was to show the effects of a plume of the same dimensions as that generated by the Enercon proposal under non-plume abatement operation" (Corser Direct at p. 9, ll. 5-7). Therefore, it appears that the Tetra Tech Report simulations are merely showing a plume that is about the same size as the 90th percentile plume expected for the Hybrid Tower Alternative without providing any meaningful information to the public as to how frequently a plume of this dimension could be expected in non-abatement mode. Ms. Corser asserts that "the plumes shown in Tetra Tech's 90 percentile simulations would have a substantially lower frequency than the same dimension plume generated without plume abatement" (Corser Direct at p. 9, ll. 7-9) but provides no support for this statement, nor could she because DEC Staff and its consultants provide no method for modeling plumes in plume abatement mode (*see* Havey Direct at p. 30, ll. 2-3).

Q: You stated that in 2009 Tetra Tech identified certain issues in the Saratoga Report as requiring additional assessment, but that these same issues are not addressed with respect to the Tetra Tech Proposal. To which issues are you referring?

A. The following five issues were identified by Tetra as unaddressed in my assessment of the Hybrid Tower Alternative, but also remain unaddressed for the Tetra Tech Proposal, and are required for an adequate visual resource assessment under SEQRA:

1. Provide a clear, objective description of the project that it intends to evaluate, including all of the operating parameters and conditions.

2. Assess the frequency or duration of visual plumes.

6. Cite examples as precedent with a thorough discussion.

7. Determine impact significance with a robust basis.

8. Thoroughly analyze mitigation measures and offsets.

(*see* Tetra Tech Report at Appendix D, p. 2-3).

Q: You also mentioned 15 Tetra Tech recommendations that DEC Staff failed to complete; which issues?

A. Attached as Appendix B is a list of the 15 Tetra Tech recommendations that were not followed by DEC Staff and its consultants. Of these unaddressed issues, I find particularly significant DEC Staff's failure to: develop operating plan clearly stating how often plume-abated mode would be operated and develop plume estimates accordingly; clearly state the methodology used to conduct the visual analysis (such as how visual simulations were developed); clearly state the objective criteria for determining impact significance; compare the project to established precedent; develop mitigation options that would include potential offsets and decommissioning plans; and provide information and an analysis of construction impacts.

Q: Why is it inappropriate, as you mentioned, for DEC Staff to articulate its conclusions on the Tetra Tech Proposal as a comparison to the Hybrid Tower Alternative?

A. SEQRA and the NYCMP require an evaluation of each alternative's potential for significant adverse environmental impacts and for consistency with the State's coastal policies (*see, e.g.*, NYSDEC Visual Policy at 9 ("However, the residual impact after all such [mitigation] strategies have been employed may still be significant. Offsets should then be considered to help achieve the balancing required of SEQRA."); 6 NYCRR §617.11(e)). It is not enough to say that alternative B will have fewer impacts than alternative A when alternative B itself has the potential for significant adverse environmental impacts; rather, DEC Staff must make significance determinations for each alternative and then evaluate available mitigation including potential offsets. DEC Staff has yet to make a significance determination for the Tetra Tech Proposal, contributing to the inadequacy of its visual assessment, and does not dispute my LARGE finding.

B. Hybrid Tower Alternative

Q: Have you conducted a visual assessment of the Hybrid Tower Alternative?

A: Yes. In 2009, I conducted a review of the Hybrid Tower Alternative for potential adverse impacts to visual resources pursuant to SEQRA and for consistency with the NYCMP. That review is set forth in the Saratoga Report. I understand that the Hybrid Tower Alternative was refined in a 2010 Enercon report (Entergy Ex. 7); I have reviewed that report and determined that the Hybrid Tower Alternative was not altered in any manner that would affect the Saratoga Report's conclusions. The standards for visual assessment that I applied in the Saratoga Report are consistent with the standards I applied in the TRC Response Document and set forth in my February 28, 2014 prefiled testimony.

Q: What did the Saratoga Report conclude?

A: The Saratoga Report concluded that the Hybrid Tower Alternative would be of a scale unprecedented in the Lower Hudson River Valley—a region of exceptional scenic, historic, and recreational importance which includes numerous sites and areas that are recognized for their high scenic quality and aesthetic value. The Saratoga Report's conclusion on the unprecedented scale of the Hybrid Tower Alternative is based on the size of the hybrid towers, which would be highly visible to the surrounding area. It was also based on the required excavation of approximately nine acres (a minimum 700-foot grading diameter) and disturbance of approximately 22 acres of riverfront land required to construct the towers. Finally, it was based on a finding that large and highly visible vapor plumes will form at times when the cooling towers are operating in wet (non-plume abated) mode. Since an operating plan was not available for the Hybrid Tower Alternative, my conclusions on the impacts from visible vapor plumes were based on the reasonable assumption that the 50th percentile visible plumes would form some of the time.

The Saratoga Report also found there is no reasonable basis to find that this alternative is capable of satisfying NYCMP consistency standards with regard to the visual resource policies. This conclusion was based on the precedent set by recent proposed projects in the Hudson River Valley of comparatively smaller scale and lesser potential visual impact that were denied as inconsistent with the NYCMP visual resource policies, based in part on perceived adverse impacts to the aesthetic resources of the region.

The Saratoga Report also evaluated the Hybrid Tower Alternative for significance impacts to visual resources in accordance with the NYSDEC Visual Policy. It concluded that it is likely that the Hybrid Tower Alternative would be deemed a significant visual impact due to its close proximity to, and direct effect on, numerous valuable and highly visited scenic resources of statewide significance. It also concluded that due to the physical scale and high visibility of the Hybrid Tower Alternative, it is unlikely that the project could be mitigated to a meaningful degree using traditional siting and design mitigation techniques. The Saratoga Report also found it unlikely that an acceptable degree of offset mitigation can be incorporated to satisfactorily compensate for the project's impact on scenic resources of statewide significance.

Q: What is your opinion on the adequacy of DEC Staff's review of potential aesthetic impacts of the Hybrid Tower Alternative?

A. It is my opinion that DEC Staff has failed to adequately review and evaluate the potential impacts to visual resources of the Hybrid Tower Alternative. As an initial matter, DEC Staff never provides its own conclusions on the Hybrid Tower Alternative. Instead, they criticize my report but offer no affirmative conclusions themselves. Moreover, in an October 14, 2009 memorandum Tetra Tech concluded that the Saratoga Report was "insufficient to draw any conclusions regarding the potential visual impacts associated with hybrid cooling towers at Indian Point," and proceeded to identify eight issues that it concluded required further information (*see* Tetra Tech Report at Appendix D, pp. 2-3; *see also* Havey Direct at p. 6, ll. 14-18). In fact, Ms. Corser reiterated the need to obtain additional information on the Hybrid Tower Alternative in order to have "[a] full understanding of the visual effects," specifically "further definition of the plume abatement operations and plume frequency" (*see* Corser Direct at p. 6, ll. 10-12). While I do not necessarily agree that all eight of these issues requires further information, I do note that DEC Staff has failed to follow its own consultant's advice and has provided no visual impact analysis for this proposal that it is now apparently advancing.

Of the eight issues identified by Tetra Tech, I agree that the following require further information for purposes of SEQRA:

1. Provide a clear, objective description of the project that it intends to evaluate, including all of the operating parameters and conditions.

2. Assess the frequency or duration of visual plumes.

6. Cite examples as precedent with a thorough discussion.

7. Determine impact significance with a robust basis.

8. Thoroughly analyze mitigation measures and offsets.

In addition to these issues, I conclude that the following visual resource issues related to the Hybrid Tower Alternative remain to be addressed:

- Construction impacts;
- Industrial lighting impacts; and
- Nighttime plume visibility based on industrial lighting.

Q: **Has your opinion on the visual resource impacts of the Hybrid Tower Alternative changed since drafting the Saratoga Report?**

A: No. It is my opinion that there is a LARGE potential for visual impacts from the Hybrid Tower Alternative. DEC Staff and its consultants have not come forth with any information on the Hybrid Tower Alternative that would alter the conclusions set forth in the Saratoga Report.

C. Comparison of Alternatives

Q: In your opinion does DEC Staff appropriately compare the Tetra Tech Proposal and Hybrid Tower Alternative pursuant to SEQRA?

A: No. A more appropriate comparison of alternatives would include a comparison of impacts to visual resources for all proposed alternative technologies, including Entergy's proposed cylindrical wedgewire screens ("CWWS") alternative. TRC evaluated Entergy's proposed CWWS' potential impacts to visual resources and concluded that the technology would result in NONE to SMALL impacts on visual resources (*see* Entergy Ex. 184 at Table ES-1). It is my understanding that this analysis was presented in the July 2013 hearings for this Proceeding. In failing to compare Entergy's proposed CWWS alternative DEC Staff fails to acknowledge that Entergy's alternative provides for mitigation of visual resource impacts as compared to the Tetra Tech Proposal and Hybrid Tower Alternative.

III. RESPONSE TO MR. HOGAN'S CMP REPORT

Q: Have you reviewed the report by Mr. Hogan entitled *Indian Point Energy Center Unit 2 and Unit 3 Cooling System Retrofit Alternative: State Environmental Quality Review Act Preliminary Assessment of Consistency with Applicable State Coastal Policies* and dated February 28, 2014 (the "Hogan CMP Report")?

A: Yes. I reviewed the report to evaluate its statements regarding consistency of the Tetra Tech Proposal and Hybrid Tower Alternative with NYCMP policies on visual resources.

Q: **On pp. 4-5 of the Hogan CMP Report the ClearSky Technology is described. Is it your opinion that the description of the ClearSky technology on pp. 4-5 is accurate?**

A: No. Mr. Hogan understates the scale and visual dominance of the Tetra Tech Proposal. The Tetra Tech Proposal would be of a scale unprecedented in this region of the Hudson River Valley. Each of the two 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 Indian Point immediately adjacent to the Hudson River, particularly as viewed from the river and opposite shore. At 91 feet tall, the towers would be substantially taller than surrounding vegetation.

Q: **On p. 13 of Hogan CMP Report it states that "[t]he cooling towers and associated structures would be constructed wholly within IPEC's existing property boundary and thus would not require the irreversible modification of geologic forms destruction or removal of vegetation or structures which are significant to the scenic quality of an identified statewide scenic resource. As such, the coastal policy contained in 19 NYCRR 600.5(d)(1)(i) is not relevant to this assessment." Do you agree with this statement?**

A: No. Mr. Hogan is mistaken in his assumption that the project is not governed by NYCMP Policy 24 simply because the project site itself is not an identified scenic resource. The stated intent of Policy 24 to "prevent impairment of scenic resources of statewide significance." The policy includes, but is not limited to physical impairment of a designated scenic resource. It also includes impairment of portions of the regional landscape that are visible from a scenic resource. Because the Indian Point property is within the viewshed of multiple scenic resources of statewide significance and designated Scenic Areas of Statewide Significance (SASS), clearing, excavation and substantial construction on the property, particularly the undeveloped eastern portion of the site, is clearly relevant to NYCMP Policy 24. This is self-evident given the precedent of projects that have been deemed inconsistent with NYCMP Policy 24 because of impacts on views from designated scenic areas (*e.g.*, St. Lawrence Cement and Athens Generation projects).

Q: **You mention St. Lawrence Cement and Athens Generation projects as examples of projects which have been deemed inconsistent with the NYCMP, in part, due to impacts on scenic resources. Does the Hogan CMP Report consider precedent of similar projects as part of its consistency opinion?**

A: No. Although the Secretary of State stated in the St. Lawrence Cement Consistency Determination that "[p]revious consistency decisions are often useful to inform subsequent decisions," the Hogan CMP Report does not consider how the NYSDOS interpreted or applied Policies 24 and 25 in similar cases. Ms. Corser testified that ECA's scope of work did not include research on precedents within the Hudson Valley (Corser Direct p. 14, ll. 19-20). And Mr. Havey opined in the 2009 Tetra Tech Report (Staff Ex. 214 at Appendix D, p. 9) that "a thorough accounting of all projects in the Hudson Valley – approved and denied – would provide a better understanding of the operating guidelines used by the applicable resource agencies." Without considering how NYSDOS applied

NYCMP policy in the past, DEC Staff's opinion concerning NYCMP compliance is without basis.

Q: In your opinion does the Hogan CMP Report establish that the Tetra Tech Proposal is consistent with the State Scenic Quality Policies contained in 19 NYCRR § 600.5(d)?

A: No. The Hogan CMP Report discusses at great length the visibility of the Tetra Tech Proposal from resources of statewide significance, but fails to discuss how the project is consistent with NYCMP Policy 24 (Prevent impairment of scenic resources of statewide significance) or Policy 25 (Protect, restore or enhance natural and man-made resources which are not identified as being of statewide significance, but which contribute to the scenic quality of the coastal area).

Q: On p. 30 of the Hogan CMP Report, it states that "Tetra Tech's Report addresses the deficiencies and includes sufficient information for the Department to assess the consistency of ENERCON's round hybrid cooling towers with the State Scenic Quality Policies contained in 19 NYCRR § 600.5(d)." Do you agree with that statement?

A: No. The Tetra Tech Report provides little or no information concerning the irreversible modification of geologic forms and the destruction or removal of vegetation, nor any significant evaluation of how the proposed structures will affect the scenic quality of an identified resource accounting for their siting and scale (NYCMP Policy 24). The Tetra Tech Report also fails to provide adequate information concerning long-term construction impacts, visible plume, industrial lighting and night illumination of visible plume, as necessary for the Department of State to determine project consistency with the NYCMP.

Moreover, the suggestion that the Tetra Tech Report supplements the record is odd considering the 2013 Tetra Tech Report incorporates none of the recommendations made by Mr. Havey in his 2009 memorandum concerning the perceived deficiencies of the 2009 Saratoga Report (*see* Tetra Tech Report Appendix D, pp. 2-3 and 10-12).

Q: **In your opinion, does the Hogan CMP Report establish that the Hybrid Tower Alternative is consistent with the State Scenic Quality Policies contained in 19 NYCRR § 600.5(d)?**

A: No. The Hogan CMP Report includes none of the assessment required by is mistaken in his assumption that the project is not governed by the NYCMP to demonstrate consistency with NYCMP Policies 24 and 25. Consistency with NYCMP Policy 24 requires that simply because the project site itself is not an identified scenic resource. The stated intent of Policy 24 to will "[p]revent impairment of scenic resources of statewide significance." Consistency with Policy 25 requires that the project "[p]rotect, restore or enhance natural and man-made resources which are not identified as being of statewide significance, but which still contribute to the scenic quality of the coastal area": "When considering a proposed action which would not affect a scenic resource of statewide significance, agencies shall ensure that the action will be undertaken so as to protect, restore or enhance the overall scenic quality of the coastal area." The policy includes, but is not limited to, physical impairment of a designated scenic resource. It also includes impairment of portions of the regional landscape that are visible from a scenic resource. Because the Indian Point property is within the viewshed of multiple scenic resources of statewide significance and designated Scenic Areas of Statewide Significance (SASS), clearing, excavation and substantial construction on the property, particularly the undeveloped eastern portion of the site, is clearly relevant to NYCMP Policy 24. This is self-evident given the precedent of projects that have been deemed inconsistent with NYCMP Policy 24 because of impacts on views from designated scenic areas (*e.g.*, the St. Lawrence Cement and Athens Generation projects).

For both policies impairment is defined as: (i) the irreversible modification of geologic forms, the destruction or removal of vegetation, the modification, destruction, or removal of structures, whenever the geologic forms, vegetation or structures are significant to the scenic quality of an identified resource; and (ii) the addition of structures which because of siting or scale will reduce identified views or which because of scale, form, or materials will diminish the scenic quality of an identified resource.

The following siting and facility-related guidelines are to be used to achieve these policies, recognizing that each development situation is unique and that the guidelines will have to be applied accordingly. Guidelines include, as relevant to the cooling tower proposals:

1. Siting structures and other development such as highways, power lines, and signs, back from shorelines or in other inconspicuous locations to maintain the attractive quality of the shoreline and to retain views to and from the shore;

2. Clustering or orienting structures to retain views, save open space and provide visual organization to a development;

5. Maintaining or restoring the original land form, except when changes screen unattractive elements and/or add appropriate interest; and

8. Using appropriate scales, forms and materials to ensure that buildings and other structures are compatible with and add interest to the landscape.

The Hogan CMP Report does not evaluate the Tetra Tech Proposal in accordance with the NYCMP guidance (see NYCMP, Appendix B, setting forth guidance) or explain why the guidance is not applicable to the Hybrid Tower Alternative.

IV. RESPONSE TO DEC STAFF'S STATEMENT ON VISUAL RESOURCES

A. Corser

Q: **On p. 6, ll. 4-8 of the Corser Direct, Ms. Corser states that the Saratoga Report was based on "an incomplete and inconsistent resource characterization" and that "ECA conducted considerable research and fieldwork regarding the study area's scenic resources, including the duration of views from each resource, [and] user information." Do you agree with this statement?**

A: No. While ECA did conduct considerable research and field work as part of the 2013 Tetra Tech Report, it was virtually identical to the work provided in the 2009 Saratoga Report. Additional information provided by ECA concerning the duration of views from each resource and user information was limited in scope and added little to the overall understanding of the visual impact.

Q: On p. 7, ll. 1-5 of the Corser Direct, Ms. Corser states that the Tetra Tech Proposal "represents the application of design and siting mitigation measures" as compared to the Hybrid Tower Alternative. Do you agree with this statement?

A: No. There is no basis for concluding that the Tetra Tech Proposal represents a siting mitigation measure as compared to the Hybrid Tower Alternative because both CCC configurations are located at the same site.

There is also no basis for concluding that the Tetra Tech Proposal represents a design mitigation measure because neither CCC proposal includes an operating plan to define the scope of plume abatement operations and plume frequency, which Ms. Corser acknowledges is necessary for a full understanding of the visual effects (*see* Corser Direct at p. 6, ll. 10-12). Further, Ms. Corser's mitigation conclusion is based on her belief that the viewshed for the Tetra Tech Proposal is significantly reduced as compared to the Hybrid Tower Alternative, which is incorrect as explained below.

Q: On p. 7, ll. 7-10 of the Corser Direct, Ms. Corser states that the Tetra Tech Proposal "would significantly reduce the viewshed" as compared to the Hybrid Tower Alternative. Do you agree with this statement?

A: No. As an initial matter, I would note that the Tetra Tech Report (p. 61) and the Hogan CMP Report (p. 16) reach the opposite conclusion—those two reports indicate that these CCC configurations will have similar viewsheds.

For purposes of a visual assessment a viewshed is defined as "[a] map that shows the geographic area from which a proposed action may be seen" (*see*

NYSDEC Visual Policy at 10). The viewshed for the Hybrid Tower Alternative was presented in figures 12-17 of the Saratoga Report, while the viewshed for the Tetra Tech Proposal was presented in figure 4-2 through 4-4 of the Tetra Tech Report. Comparing these figures it is readily apparent that the viewshed for the two CCC configurations are similar, such that the Tetra Tech Proposal does not represent a "significantly reduced viewshed."

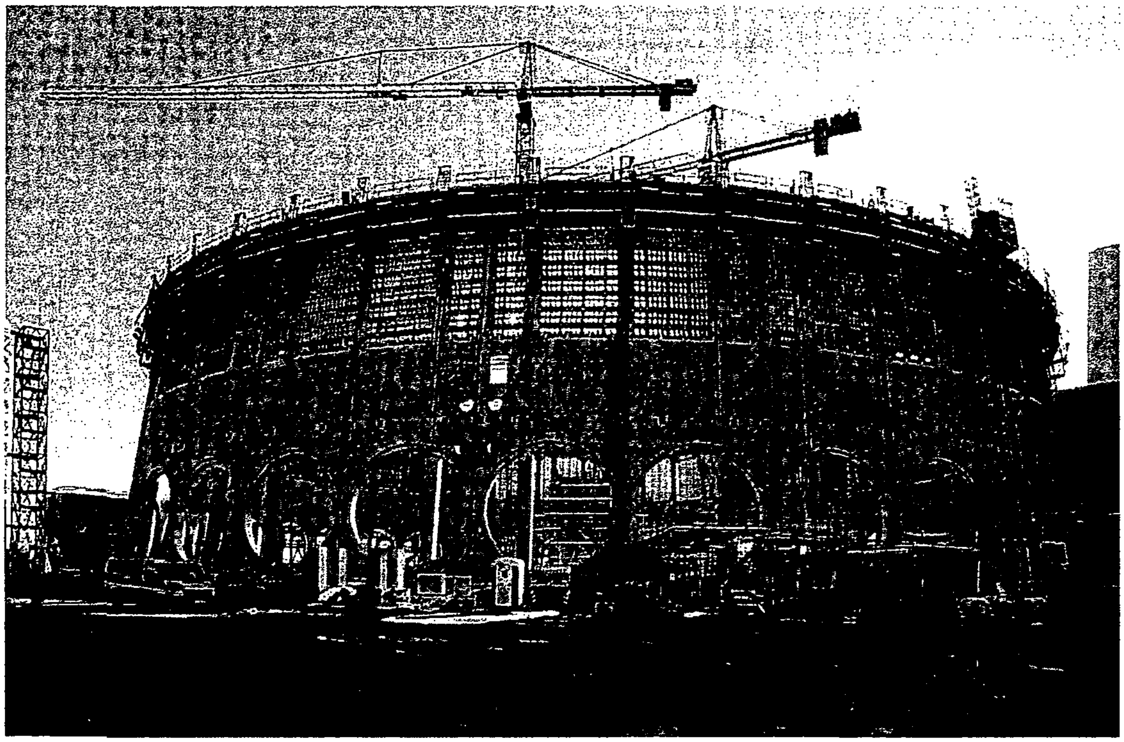
Q: On p. 8, ll. 1-11 of the Corser Direct, Ms. Corser states that a "visual assessment of construction impacts of the Tetra Tech Proposal was not possible due to lack of information on the extent and location of individual construction activities such as vegetation removal acreage, lay down areas configuration, size of cranes, etc." Is this a valid reason for not evaluating construction impacts?

A: No. Construction impacts for any project are temporary in duration, but have the potential to cause visual impacts and are typically assessed in a SEQRA review (*see, e.g.*, CEQR Technical Manual at 22-3 to 22-4, Entergy Ex. 339 (requiring assessment of cultural resources, land use and public policy, and neighborhood character when construction will take place for more than two years)). As an expert in visual assessment, Ms. Corser should have explained that a complete visual assessment required this information and obtained the information from DEC Staff, and DEC Staff should have developed it. In my experience, DEC Staff would not excuse a project applicant from conducting an analysis of construction impacts because it lacked information, but instead would have directed the applicant to develop the information necessary for the evaluation.

Q: On p. 8, ll. 7-11, Ms. Corser states that a visual assessment of construction impacts "would not likely change the Tetra Tech report's overall conclusions due to the temporary duration of the impacts." Do you agree with this conclusion?

A: No. The record does not support Ms. Corser's conclusion. Ms. Corser is essentially acknowledging that the Tetra Tech Report's conclusions regarding visual impacts could change after a review of the construction impacts. Based on this acknowledgment, there is no excuse for Tetra Tech and DEC Staff's failure to conduct an analysis of construction impacts. Considering that Ms. Corser claims to lack any information on the construction activities necessary for the Tetra Tech Proposal, I find the statement that her conclusion would not change due to the "temporary duration of the impacts" to be necessarily unsupported. I also fail to understand how she can conclude on p. 8, ll. 3-4 that "many of the individual construction activities would occur over a shorter period of time" when she acknowledges on p. 8, ll. 7-9 that she lacks information on the "detailed plans and schedules." Her conclusion is inconsistent with her claimed lack of knowledge and wholly unsupported.

The construction period of 4-6 years estimated by Tetra Tech is a significant period of time over which impacts to visual resources must be evaluated. By way of example, the level of excavation necessary for the Tetra Tech Proposal is not trivial but equivalent to the operation of a small quarry—a project that requires its own SEQRA visual assessment. Construction activities taking place during the 4-6 year period that may have visual impacts and therefore would need to be included in the visual assessment include: clearing and removal of vegetation for the project and construction lay down areas, excavation, dust, heavy duty truck traffic, and use of cranes that will likely be 200 to 300 feet—far taller than the 91-foot height of the Tetra Tech Proposal. For illustrative purpose, the photo below shows the cranes used to construct the Hybrid Tower Alternative in Moorburg, Germany (*see* Peter Tetzlaff, Vattenfall, *Power plant Moorburg Hybrid cooling tower Specification and civil engineering requirements* (Mar. 28, 2012), Entergy Ex. 363).



Moreover, once the renewed operating licenses expire in 2033 and 2035, mitigation of visual impacts may require dismantling of the towers, which itself might take years. Consequently, the visual impacts from construction and dismantling could last many years with a short intervening period between.

Q: On p. 10, ll. 1-6 of the Corser Direct, Ms. Corser stated that "plumes during

nighttime hours ... would be a relatively infrequent occurrence (assuming operation in plume abatement mode at all times) and thus quantification or simulation of the plume visibility during night time was not within ECA's scope of work." Do you agree with this statement?

A: No. Without an operating plan there is no basis to assume that the Tetra Tech Proposal will run in plume abatement mode at all times. As discussed above, without an operating plan the worst-case plume conditions must be assessed. Accordingly, an assessment of the visual plume at night should have been included in ECA's scope of work. Although not definitive, it is likely that high site lighting levels necessary for safety and security, combined with existing outdoor lighting at Indian Point, will illuminate any visible plume generated by the cooling towers. Such impact has the potential to be significant.

Q: Do you agree with Ms. Corser's statement on p. 10, ll. 4-6 that "[i]f the State ultimately allows operation under non-plume abatement mode as part of the project approval, it may want to consider evaluating nighttime effects of plumes and potential mitigation measures?"

A: I agree that the State must evaluate nighttime effects of plumes, but the appropriate time to provide this analysis is now. Without an operating plan, the worst-case plume conditions must be assessed and provided to the public for comment. The public must be informed of these potential effects in order for it to provide informed comments to DEC Staff. This is particularly true because DEC Staff has not established that mitigation for nighttime plume effects will be available, especially considering that Indian Point has stringent security measures that require adequate site lighting.

Q: **On p. 10, ll. 11-17 of the Corser Direct, Ms. Corser acknowledges that "not all of the baseline photos were ideal" due to the weather and location of the sun when the pictures were taken, but finds them "acceptable for evaluation" and concludes that "the simulations portray the scale of the cooling towers relative to other structures in the vicinity and the relative line, form color and texture." Do you agree with this statement?**

A: No. While these photographs may be acceptable for preliminary "in-office" evaluation, they are not acceptable for public presentation or interpretation. They do not represent the worst-case visual condition of high contrast background landscape and sky and thus result in a significant understatement of visual contrast and may be misleading for the purpose of public review. Under these circumstances it would have been reasonable to ECA to plan another visit to the project area at a time when the weather forecast is conducive to quality outdoor photography, or to hire a local professional photographer who can duplicate the preliminary photos on a clear day and at the optimum time of day. For a proposed project of this scale and magnitude, estimated to cost between $1.6 and $2 billion, a reasonable visual assessor would follow through to obtain adequate photos for visual simulations.

Q: **Can you provide an example of how the less than ideal photos are misleading?**

A: Yes. To illustrate how misleading the photos used for the visual simulations in the Tetra Tech Proposal are I have taken the base photographs and altered the background sky to diminish the dominant cloud cover present in ECA's photos. Unfortunately, ECA's decision to go forward with photos that are "not ideal" and to provide no photos with a clear sky leaves no other option for considering a worst-case scenario plume. These examples are found in Entergy Exs. 364-369.

Q: **On p. 10, ll. 19-21 of the Corser Direct, Ms. Corser states that "the photos in the Tetra Tech Report were intentionally taken during leaf-on conditions because the scenic resources around the project site are primarily recreational sites and the majority of activities take place during leaf-on conditions." Do you agree that it is appropriate to develop photo simulations based on the leaf-on condition?**

A: It is widely considered standard practice to take photos used for the purpose of visual impact assessment during leaf-off season to present a worst-case visual condition. While it is true that a larger number of users visit recreational sites during the warmer months, the shoulder seasons of Spring and Fall are popular times for outdoor recreation, particularly along the waterfront. In taking photos for the Saratoga Report during leaf-off season I noticed a good number of visitors at the scenic resources I visited.

Q: **On p. 11, ll. 6-9 of the Corser Direct, Ms. Corser states that "plumes of the size shown in the Saratoga Associates' simulations would have a much lower frequency under the Tetra Tech ClearSky cooling tower proposal due to the plume abatement operations." Do you agree with this statement?**

A: I cannot agree or disagree with this statement because Ms. Corser has provided no support for her statement that I can evaluate. While I understand that operating in plume abatement mode will decrease the frequency of the plume in general, I cannot say whether there will be a "much lower frequency" without an assessment.

Q: **On p. 11, ll. 16-19 of the Corser Direct, Ms. Corser states that "the cooling towers' absolute size is less relevant to visual impacts as is its size relative to other facilities and the project context as a whole, as viewed from sensitive resources." Do you agree with this statement?**

A: Yes. But evaluating the proposals' relative size, I still conclude that the potential for adverse impacts to visual resources from the Tetra Tech Proposal and the Hybrid Tower Alternative is LARGE. This opinion is reinforced when considering NYCMP Policies 24 and 25 which, in part, define impairment of scenic resources as the addition of structures which because of siting or scale will reduce identified views or which because of scale, form, or materials will diminish the scenic quality of an identified resource (NYCMP Policy 24).

Q: **On p. 12, ll. 1-2 of the Corser Direct, Ms. Corser describes the absorption capability of the site as "medium to high" due to its location in an "urbanized coastal plain." Do you agree with this statement?**

A: No. First, I would note that she has not defined what it means for a site to have medium or high absorption capability, nor has she defined "urbanized coastal plain." Regardless of her definitions I would not classify the site as having "high" absorption capacity.

I also would not classify the site as an urbanized coastal plain. That is an illustrative term that is open to individual interpretation and misleading when applied to this riverfront landscape. This description ignores the significant shoreline woodland and undisturbed slopes of the Hudson Highlands.

Q: **On p. 12, ll. 10-18 of the Corser Direct, Ms. Corser acknowledges that "those using [the Dunderberg trail] likely have a high degree of concern for scenery and that high vista points are often the culmination and thus important part of the hiking experience," but concludes that this fact "would not have contradicted her discussion on the duration of the view nor changed the report's conclusions." Do you agree with Ms. Corser's response?**

A: The NYSDEC Visual Policy defines a significant adverse visual impact as a change in the visual landscape which will adversely affect a viewer's appreciation of a designated resource. Summit views or trailside overlooks are often the primary objective of a mountain hike. Ms. Corser's response does not address the test for significance provided in the NYSDEC Visual Policy.

Q: **On p. 13, ll. 1-4 of the Corser Direct, Ms. Corser states that she concluded that the Tetra Tech Proposal "is not expected to significantly impair public enjoyment of [Stony Point Battlefield State Historic Site's lighthouse area] based primarily on the simulation, which shows that only the top corner of the cooling tower on Unit 3 would be visible from the viewpoint." Do you agree with her conclusion based on the simulation?**

A: No. The simulation only accounts for the Tetra Tech Proposal's physical structure and not the potential visible plumes that may form. Accordingly, I find the conclusions unsupported.

Q: **On p. 13, l. 5 to p. 14, l. 2 of the Corser Direct, Ms. Corser discusses the Tetra**

Tech Report's review of the Bear Mountain Scenic Byway. Do you agree with the manner in which Tetra Tech evaluated the impacts to the Bear Mountain Scenic Road?

A: No. The Bear Mountain Scenic Road is so designated for good reason. Although the winding character of the roadway through the woods along the mountainside is visually interesting, the spectacular views from narrow and precipitous cliff side vistas are unique and scenic.

The speed limit along this precipitous section of road is only 25 MPH. We estimate the open view area to be approximately 600 feet in length. View duration is therefore 16 seconds. As a New York State designated Scenic Road, the Bear Mountain Bridge Scenic Road is a visual resource of statewide significance by definition (NYSDEC Visual Policy at 4).

Q: **On p. 15, ll. 14-17 of the Corser Direct, Ms. Corser states that "additional mitigation measures and/or offsets could be applied to the Tetra Tech [] Proposal once the final BTA is selected and more detailed design is initiated which would further refine the project's visual impacts." Do you agree with this statement?**

A: No. The NYSDEC Visual Policy requires that mitigation be evaluated for all alternatives that have the potential for significant adverse impacts. As discussed in my prefiled direct testimony, it is my opinion that the Tetra Tech Proposal and Hybrid Tower Alternative both have the potential for LARGE adverse environmental impacts in both plume abatement and non-abatement mode. Therefore, mitigation options must be included in the visual assessment and presented to the public. There is no reason to wait for a more "detailed design" of either alternative; in fact, alterations in design are a form of mitigation that requires evaluation under the NYSDEC Visual Policy (*see* NYSDEC Visual Policy at 6-7) and should be presented to the public to the extent that they are available. If a more detailed design cannot minimize the adverse environmental impacts to the maximum extent practicable, then the visual assessment must explain this to the public and provide a discussion of the additional mitigation options available, such as decommissioning and offsets. This is particularly true in the context of this Proceeding, as I understand that the April 2014 hearings will simultaneously consider whether CCC is BTA and evaluate CCC pursuant to SEQRA, and as a result CCC SEQRA impacts cannot be assessed after this Tribunal determines whether CCC is BTA.

Q: **On p. 14, ll. 3-18 of the Corser Direct, Ms. Corser states that "[e]stimating the cost of mitigation techniques is not within my area of expertise and, as such was not included in ECA's scope of work" but that "the State may want to consider offsets as a potential means to further mitigate visual impacts." Can you estimate the costs of mitigation?**

A: As an initial matter, while Ms. Corser does not have the expertise to estimate mitigation costs, I note that there are plenty of visual assessors within New York state that do have this experience, whom DEC Staff could have hired.

The cost of mitigation can vary depending on the type of mitigation chosen. The NYSDEC Visual Policy sets forth three broad types of mitigation: (1) professional design and siting (*i.e.*, screening, relocation, camouflage/disguise, low profile, downsizing, alternate technologies, non-specular materials, and lighting), (2) maintenance (*i.e.*, decommissioning), and 3) offsets. Because both the Tetra Tech Proposal and the Hybrid Tower Alternative have a LARGE potential for significant adverse impacts to visual resource, mitigation must be considered for either proposal. Without an evaluation of available mitigation it is impossible to estimate the costs, but NYSDEC has concluded that costs which are less than 10% of the total project cost are insignificant (*see* NYSDEC Visual Policy at 8). Presumably then (and based on the reasonable assumption that additional mitigation is available in the form of offsets, decommissioning or additional design and siting), NYSDEC will require the visual impacts of either proposal to be mitigated at a costs of at least 10% of the total project cost, or approximately $161 million to $207 million (*see* Tetra Tech Report at 22).

Q: **On p 16, ll. 7-17 of the Corser Direct, Ms. Corser criticizes your statement that the "proposed cooling towers would effectively triple the industrial profile of IPEC" as inaccurate depending on the viewpoint. What was the purpose of your comment?**

A: The purpose of my comment was to highlight the scale and dominance of the Tetra Tech Proposal on the waterfront landscape. As stated in the TRC response the Tetra Tech Proposal would effectively triple the industrial profile of Indian Point immediately adjacent to the Hudson River, "particularly as viewed from the river and opposite shore" (TRC Response Document at p. 3-42). Based on the visual simulations presented in the Tetra Tech Report, my statement is an accurate description of proposal from multiple viewpoints (*see* Tetra Tech Report Figures

VS-1/VS-2, VS-8/VS-9, VS-13/VS-14, VS-16/VS-17).

Q: On p. 16, l. 21 of the Corser Direct, Ms. Corser criticizes your use of the word "unprecedented" in the TRC Response Document as unsupported? On what basis do you classify the Tetra Tech Proposal and Hybrid Tower Alternative as unprecedented?

A: My use of the word "unprecedented" is based on my experience in visual assessment in the Lower Hudson River Valley. I have worked on visual assessments in the Lower Hudson River Valley for nearly 25 years. My work has covered over 100 projects ranging from communication towers to large scale industrial facilities. Outside of my personal experience, my firm has experience in conducting visual assessment of the projects in this area as well, and I am generally familiar with the proposed projects and their outcomes. As part of my work I keep abreast of projects that are being proposed and evaluated in the Lower Hudson River Valley so that I am aware of precedent. To date, I have never seen a project of the scope and magnitude as the Tetra Tech Proposal and the Hybrid Tower Alternative approved as consistent with the NYCMP, or determined to have non-significant impacts under SEQRA. Accordingly, I find these two proposals to be unprecedented in the Lower Hudson River Valley. Based on her CV, I understand that Ms. Corser has no experience in conducting visual assessments in the Lower Hudson River Valley such that she would be able to evaluate my conclusions on the unprecedented scale of these proposals.

B. Havey

On p. 30, ll. 21-23 of the Havey Direct, Mr. Havey states that "Tetra Tech did not develop an operating plan because conditions that would govern plume

abatement operation will be based, in part, on future determinations as to what would constitute an unacceptable plume." Do you agree that development of an operation plan should be based on future determinations?

A: No. First, as Mr. Havey acknowledges on p. 14 of the Tetra Tech Report, "[n]umerous 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 scenic resources." Tetra Tech therefore already has concluded that a visible plume is not acceptable.

Second, in order to determine what would constitute an acceptable plume in the absence of an operating plan, the visual simulations in the Tetra Tech Report should have included worst-case conditions such that the public could determine whether those conditions were acceptable or whether plume abatement would be required. Without presenting the public with the worst-case conditions any future determination on what would constitute an unacceptable plume would be made without necessary information.

Q: **On p. 30 ll. 12-14 of the Havey Direct, Mr. Havey states that operation of the Tetra Tech Proposal in plume abatement mode would mitigate the plume for approximately 94% of the daylight hours. Do you agree with this statement?**

A: As an initial matter, without an operating plan Mr. Havey has not established that the Tetra Tech Proposal will be run in plume abatement mode 100% of the time, and therefore, he cannot establish how frequently the plume will in fact occur. Further, I cannot reconcile this statement with the Tetra Tech Report's conclusion that a visual plume would "occur less than 2 percent of the year, and over one-half of these occurrence would be during the nighttime hours" (Tetra Tech Report at 79). Clearly, DEC Staff's witnesses do not know how often there will be a visible plume, which is unsurprising given the lack of an operation plan.

Based on Mr. Havey's best-case prediction that plume abatement mode would mitigate the plume approximately 94% of the daylight hours, a visible plume would form approximately 263 daylight hours per year (12 hrs/day x 365 days x 6%). This conflicts with what Ms. Corser estimates when she provides a best-case estimate that complete plume mitigation will occur approximately 98% of the year (Corser Direct at p. 8, ll. 20-22). Using Ms. Corser's best-case estimate a visible plume would form approximately 175 hours per year (24hrs/day x 365 days x 2%), or approximately 88 daylight hours per year. I am unable to verify which of these two estimates, if either of them, is correct without an operating plan, which highlights the problem of estimating the amount of time a visible plume would form without an operating plan. In either case, both are unacceptable plumes under the *Athens Generating* project precedent.

C. Hogan

Q: On p. 18-19 of the Hogan Direct, Mr. Hogan discusses the CCC technology that was proposed by the NRC in the 1970s. Do you find that discussion relevant to conducting a visual assessment of the Tetra Tech Proposal or Hybrid Tower Alternative?

A: No. The technology proposed in the 1970s is not being proposed today. The relevant evaluation in a visual assessment under SEQRA (which was not even in force at the time NRC proposed CCC) is the determination of significance for each proposed technology and alternative, and an evaluation of mitigation for those technologies and alternatives that are found to have potentially significant adverse impacts to visual resources. Mr. Hogan's discussion also ignores NYCMP Policy 25

END OF TESTIMONY

Appendix A

List of issues that DEC Staff and its consultants acknowledge were not addressed in their visual assessment

- "Decisions as to whether or not to operate in plume abatement mode at all times would be made by relevant regulatory agencies and likely memorialized as permit conditions, but are unknown at this time and thus cannot be fully evaluated" (Corser Direct p. 8, ll. 16-19).
- "[M]odeling plume frequency and size under plume abatement was not included within Tetra Tech's scope of work" (Corser Direct p. 9, ll. 1-2).
- "Tetra Tech did not develop an operating plan because the conditions that would govern plume abatement operations will be based, in part, on future determinations as to what would constitute an unacceptable plume" (Havey Direct, p. 30, ll. 21-23).
- "A detailed assessment of construction impacts was not possible due to a lack of information on extent and location of individual construction activities ..." (Corser Direct p. 8, ll. 4-9).
- "[P]lume visibility at night was not within ECA's scope of work" (Corser Direct at p. 10, ll. 3-4).
- "The photos that were used for simulations in the Tetra tech Report were taken by tetra Tech staff, who were limited to taking photos during the site visits on October 8, 2012 and December 28, 2012 ... I concur that not all of the baseline photos were ideal" (Corser Direct at p. 10, ll. 7-10, 15-16).
- "Evaluation of the mitigation measures' effectiveness would have required more information on site clearing and revegetation plans and possibly visual simulations of

the project with mitigation techniques in place, which was also not within the scope of the Tetra Tech Report" (Corser Direct at p. 14, ll. 12-15).

- "[I]f the Tetra tech cooling tower proposal is accepted by DEC as BTA for the Indian Point facilities, the State may want to consider offsets as a potential means to further mitigate visual impacts" (Corser Direct at p. 14, ll. 15-18).
- "ECA's scope of work did not include research on precedents within the Hudson Valley" (Corser Direct at p. 14, ll. 19-20).

Appendix B

List of 15 Unaddressed Tetra Tech Recommendations

1. Redefine the proposed project description to accurately reflect the specific technology, including all potential operating parameters and explanations as to why they would be used.

2. Clearly state how plume-abated towers would be operated at Indian Point and revise the potential plume estimates accordingly.

3. Redefine the project alternatives to explicitly state whether the single tower options were analyzed in detail.

4. Revise visual simulations to accurately reflect all project alternatives (e.g., single tower option).

5. Clearly state the methodology used to conduct the visual analysis, including any applicable federal, state, or local policies or guidance documents. Include justifications for all study assumptions, such as why the 10-mile radius was selected as the study's upper bound.

6. Clearly state the objective criteria that can be used to determine an impact's significance.

7. Define the roles of other resource agencies that may need to be consulted and verify whether they have policies or guidance documents that should be used to inform the analysis.

10. Revise the impacts analysis to specifically account for expected impacts under each project alternative and clearly state how the impacts affect the individual resource

considering its relative importance to other resources.

11. Revise the impacts analysis into discrete categories for each alternative: construction, operation, reclamation, decommissioning (if applicable), and direct vs. indirect impacts. Include a discussion of cumulative impacts as well.

12. Provide more thorough explanations of examples that might be used as precedent, why they are appropriate to use as references, and how they may differ from the proposed project.

13. Conduct a more comprehensive evaluation of projects—approved and denied—in the local area to provide a more accurate context for the proposed project.

14. Expand the mitigation discussion to more fully explain whether the mitigation options would be effective and how they might reduce visual impacts.

18. Provide descriptions and/or plans of potential offsets, decommissioning plans, lighting, materials, or other potential mitigation options.

19. Provide any available cost estimates of mitigation options.

20. Provide any data available on the construction process: length, worker numbers, special accommodations such as parking, etc.

(*see* Tetra Tech Report at Appendix D, p. 10-12).

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Appendix C

NYCMP Guidelines For Establishing Consistency With NYCMP Policy 25

1. Siting structures and other development such as highways, power lines, and signs, back from shorelines or in other inconspicuous locations to maintain the attractive quality of the shoreline and to retain views to and from the shore;

2. Clustering or orienting structures to retain views, save open space and provide visual organization to a development;

3. Incorporating sound, existing structures (especially historic buildings) into the overall development scheme;

4. Removing deteriorated and/or degrading elements;

5. Maintaining or restoring the original land form, except when changes screen unattractive elements and/or add appropriate interest;

6. Maintaining or adding vegetation to provide interest, encourage the presence of wildlife, blend structures into the site, and obscure unattractive elements, except when selective clearing removes unsightly, diseased or hazardous vegetation and when selective clearing creates views of coastal waters;

7. Using appropriate materials, in addition to vegetation, to screen unattractive elements; and

8. Using appropriate scales, forms and materials to ensure that buildings and other structures are compatible with and add interest to the landscape.

See NYCMP at II-6, p. 74 (2006), Entergy Ex. 362.

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of a Renewal and Modification of a State Pollutant Discharge Elimination System ("SPDES") permit pursuant to Environmental Conservation Law ("ECL") Article 17 and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR") Parts 704 and 750, et seq.

DEC No.: 3-5522-00011/00004
SPDES No.: NY-0004472

- by -

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

Permittee.

In the Matter of the Application of

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

DEC Application Nos.:
3-5522-00011/00030 and
3-5522-00105/0031

for a Water Quality Certificate pursuant to Section 401 of the Federal Clean Water Act and Section 608.9 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

DIRECT TESTIMONY OF EDUARDO ORTIZ DE ZARATE

Principal Consultant – Piping Specialist & Supervisor

Hatch
5 Place Ville Marie, Bureau 1400
Montréal, Canada 80401
H3B 2G2 Canada
Tel. (514) 861-0583

February 28, 2014

Name: Eduardo Ortiz de Zarate

Q. Please state your name, employer, title, and business address.

A. My name is Eduardo Ortiz. I am employed as a piping specialist and supervisor by Hatch, in its Montréal hub located at 5 Place Ville Marie, Bureau 1400, Montréal, Canada.

Q. What is Hatch?

A. Hatch is a multidisciplinary professional services firm that supplies engineering, project and construction management services, process and business consulting and operational services to the mining, metallurgical, energy and infrastructure industries. Hatch has served clients for over 59 years and has project experience in more than 150 countries around the world, with more than 10,000 employees in over 65 offices worldwide.

Q. Please describe your educational background, professional experience, any licenses held, and responsibilities at Hatch.

A. I have attached a copy of my professional resumé/curriculum vitae to the end of my prefiled direct testimony for this purpose.

Q. Does the resumé/curriculum vitae attached to this testimony accurately reflect your background and experience?

A. Yes, it does.

Q. Please describe the purpose of your current testimony.

A. All direct testimony is based on my personal observations and interpretations of the project files, reports, and conversations with former members of this project. I have no firsthand knowledge of this project and varying interpretations of the services may exist, However, based on my research the direct testimony being provided is a reasonable interpretation of Hatch's methods and findings. This direct testimony will provide a technical interpretation of the services that Hatch perform, as a technical consultant to Tetra Tech, to analyze potential closed cycle cooling alternatives for the Indian Point Energy Center ("IPEC") and which culminated in a written report entitled "Engineering Feasibility Study for the Implementation of Closed-loop Cooling Using Plume Abatement Cooling Towers at Indian Point Units 2 and 3" dated December 18, 2012 ("Hatch 2012 Report"). My testimony will also provide a technical interpretation of the services Hatch was contracted by Tetra Tech to perform, as a technical consultant, to comment on: (i) Enercon's 2003 report entitled "Economic and Environmental Impacts Associated with Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration" ("Enercon 2003 Report"); and (ii) Enercon's 2010 report entitled "Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration" ("Enercon 2010 Report").

Q. What was Hatch`s role in or involvement with Tetra Tech's technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. Hatch provided technical comments to Tetra Tech for the Enercon 2003 Report (Entergy Ex. 7A).

Q. Can you please describe what was involved in Hatch's technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. As I understand it, in October 2008, the Department of Environmental Conservation ("DEC") requested Tetra Tech to provide a review of Enercon's 2003 Report, with a primary emphasis upon the engineering assumptions, methodology, and conclusions made in the report. Tetra Tech, in turn, requested Hatch to utilize its professional judgment gained from performing similar analyses, to read and comment on the Enercon

2003 Report. The review focused on the engineering assumptions (siting, electrical, piping, pumps, etc.) and identifying any errors, significant deficiencies, and/or omissions that should be investigated further (i.e., “fatal flaws analysis”).

Q. Did Hatch prepare a review of its technical analysis of the Enercon 2003 Report (Entergy Ex. 7A)?

A. No, Hatch was engaged only to read the report and comment to Tim Havey (Project Manager at TetraTech). No detailed analysis was carried out and the effort was concentrated on the technical feasibility of transferring from a once-through cooling system to a closed loop cooling system.

Q. Were there any limitations with Hatch’s 2009 technical review of the Enercon 2003 Report?

A. Yes. Hatch was engaged only to read the report and comment on the engineering assumptions and identify potential errors, significant deficiencies, and/or omissions that might need to be investigated further.

Q. Can you please summarize Hatch’s 2009 technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. Yes. Hatch performed a limited review of Enercon 2003 Report (Enterby Ex. 7A) challenging certain assumptions on the prevailing winds, soil conditions, some contradictions on the wet bulb temperatures used, and identified minor discrepancies.

Q. What was Hatch`s role in or involvement with Tetra Tech’s technical review of the Enercon 2010 Report (Entergy Ex. 7)?

A. Hatch provided technical advice to Tetra Tech to assist them in their 2010 written technical review of the Enercon 2010 Report.

Q. Can you please describe what was involved in Hatch's technical review of the Enercon 2010 Report (Entergy Ex. 7)?

A. Yes. The review focused on the engineering assumptions (siting, electrical, piping, pumps, etc.) and identifying any errors, significant deficiencies, and/or omissions that should be investigated further (i.e., "fatal flaws analysis").

Q. Did Hatch prepare a review of its technical analysis of the Enercon 2010 Report?

A. Hatch provided input to Tetra Tech by means of comments to Tim Havey (Project Manager at TetraTech).

Q. Were there any limitations with Hatch's 2010 technical review of the Enercon 2010 Report?

A. Yes. Hatch performed a limited analysis of the Enercon 2010 Report, reading the report and commenting to Tim Havey.

Q. Can you please summarize Hatch's 2010 technical review of the Enercon 2010 Report?

A. Yes. Subject to the limitations outlined above of reading the report and commenting, no major issues or deficiencies were identified by Hatch with respect to the technical feasibility of transferring from a once-through cooling system to a closed loop cooling system.

Q. In your professional opinion, based upon Hatch's involvement with Tetra Tech's 2009 and 2010 technical evaluations of Enercon's 2003 and 2010 Reports and your best professional judgment, is Enercon's circular hybrid cooling tower proposal available and generally feasible for the IPEC facilities?

A. Based on the limited scope and analysis of the study it may be feasible, but a more in depth study would be necessary to obtain a final conclusion.

Q. What was Hatch`s role in or involvement with Tetra Tech's evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC?

A. Hatch provided technical analysis, review, and input to Tetra Tech on the ClearSky™ cooling tower alternative at Indian Point. Hatch also provided a written report (Hatch 2012 Report) to Tetra Tech that was included in Tetra Tech's June 2013 closed-cycle cooling system retrofit evaluation ("Tetra Tech 2013 Report") for the DEC.

Q. Can you please describe what was involved in Hatch's evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC?

A. Yes. Based on a review of the report presented to me, Hatch, at Tetra Tech`s request, provided a limited evaluation of the ClearSky plume abatement cooling towers as a potential cooling system alternative for IPEC based upon Hatch's professional judgment. Hatch`s evaluation was a feasibility-level study that assessed the technical soundness of a proposed alternative with the development of a conceptual design that could be used to estimate initial capital and operating costs. Most of the information used by Hatch to develop a conceptual design and cost estimates for the proposed cooling system alternative was obtained from the previous reports prepared by Enercon Services (Enercon) on behalf of Entergy for IPEC in 2003 and 2010 (Enercon 2003 Report and Enercon 2010 Report).

Q. Did Hatch prepare a written report or review of its evaluation of a potential closed cycle cooling alternative at IPEC for Tetra Tech and DEC?

A. Yes. Hatch provided Tetra Tech with a written engineering review entitled "Engineering Feasibility Study for the Implementation of Closed-loop Cooling Using Plume Abatement Cooling Towers at Indian Point Units 2 and 3" dated December 18, 2012 ("Hatch 2012 Report").

Q. Were there any limitations with Hatch's 2012 Report?

A. Yes. Hatch did not analyze the Algonquin pipeline feasibility assessment, nor did it review issues related to potential groundwater radiological contamination, nor any visual assessment, blasting, building or equipment relocations, the modification or addition of site services, and air quality. Moreover, Hatch did not have access to models or the underlying data used in the Enercon Reports. Conclusions in the Enercon 2003 Report and Enercon 2010 Report based on model results were accepted at face value for purposes of the Hatch 2012 Report.

Q. Can you please briefly summarize the Hatch 2012 Report?

A. Yes. Based on my interpretation of the documents I have reviewed, Hatch was requested by Tetra Tech Inc. to assess the feasibility of converting the condenser cooling water system at Indian Point Units 2 to a closed-looped system using ClearSky™ plume-abated cooling towers and to produce a capital cost estimate. Based on a preliminary review, and subject to the limitations previously stated, the installation of a closed loop system was determined to be technically feasible. The Hatch 2012 Report determined that the ClearSky™ plume-abated cooling tower technology developed by SPX/Marley could be a practical alternative for a closed-cycle cooling retrofit at IPEC instead of the circular hybrid cooling towers proposed by Enercon in 2003 and 2010. *See* Hatch 2012 Report at Appendix A of the Tetra Tech 2013 Report. Accordingly, the Hatch 2012 Report consists of a preliminary engineering assessment of a closed-cycle cooling retrofit at IPEC using ClearSky™ cooling towers in a back-to-back configuration in order to minimize the adverse environmental impact from the facilities' cooling water intake structures. The data used in the Hatch 2012 Report is the same used to develop the circular hybrid cooling tower design described and evaluated in the Enercon 2003 Report and Enercon 2010 Report. As noted, the Hatch 2012 Report was limited to an evaluation of hybrid, plume-abated mechanical draft cooling towers arranged in a back-to-back configuration and did not include a detailed comparison between the circular hybrid cooling towers proposed by Enercon and the ClearSky™ cooling towers evaluated by Hatch. With input and assistance from Tetra Tech, Hatch evaluated individual ClearSky™ cooling towers for each generating unit (Unit 2 and Unit 3) and, to the extent practicable, the conceptual design used existing systems (intakes, condensers, discharge) to minimize on-site disruptions and installation costs. The design selected for IPEC consists of two independently operated, mechanical draft cooling towers to service Unit 2 and Unit 3, complete with dedicated pumps, piping, and electrical systems. Each ClearSky™ cooling tower is designed to operate in a saltwater (high TDS – total dissolved solids) environment. A conceptual design of the proposed cooling towers is provided in the Hatch 2012 Report. Hatch's proposed conceptual design assumed that general operating parameters for both IPEC generating units, such as condenser flow rate and thermal load, would remain unchanged in a closed-cycle configuration.

Q. Were there any key considerations that Hatch took into account in order to assess whether the ClearSky™ cooling tower retrofit proposed in the Tetra Tech 2013 Report could be implemented?

A. Yes. Based on information in the reports I have reviewed, the key considerations involved in implementing the ClearSky™ cooling tower proposal at IPEC are whether: (i) the design of the towers were feasible, and (ii) construction of the towers were feasible. The design and construction of the cooling system was based, for the most part, on Enercon`s design as detailed in their 2010 report, the major exception being the installation of back to back plume abatement cooling towers instead of Enercon's circular hybrid cooling tower proposal.

Q. Did Hatch consider or evaluate any other factors associated with its ClearSky™ cooling tower alternative?

A. Yes. From the documents I have reviewed, Hatch also considered or evaluated at a very limited level (vendor information only): (i) baseline noise (sound pressure) levels of each cooling tower during operation at distances of 50 meters and 100 meters [Appendix C of Hatch 2012 Report]; (ii) total height of the proposed cooling towers; (iii) piping for the ClearSky™ cooling tower alternative [Appendix D of Hatch 2012 Report]; and (iv) prestressed concrete pipe and vertical column pumps [Appendix E of Hatch 2012 Report].

Q. In your professional opinion, based upon your involvement with the Hatch 2012 Report and Tetra Tech 2013 Report and best professional judgment, is the ClearSky™ cooling tower proposal available and generally feasible for the IPEC facilities?

A. Based on the conclusions of the Hatch 2012 Report and subject to the limitations previously outlined, no major issues or deficiencies were identified by Hatch with respect to the technical feasibility of transferring from a once-through cooling system to a closed loop cooling system using the ClearSky™ cooling tower system.

Q. Have you reviewed a document entitled *Entergy Response Document To the Tetra Tech Report and the Powers Engineering Report* prepared by TRC Environmental Corporation dated December 13, 2013 ("Entergy Response Document')?

A. Yes, I have.

Q. Do you have any comments on Entergy's Response Document?

A. Yes, I do. My comments are directed to specific sections of Entergy's Response Document as noted below:

2.1 Feasibility Issues and 2.2 Operational Concerns:

This is a general comment concerning section 2.1 Feasibility Issues and 2.2 Operational Concerns that are outlined In the Entergy Document and go into detail in Appendix A and that relate to the work Hatch prepared its assessment based on the information provided and the scope of work as directed by TetraTech. The evaluation is based on a conceptual design that is used to evaluate feasibility and determine if there are identifiable obstacles that would objectively prevent that design from being implemented. It is not intended to enumerate all potential items that would be addressed in a final engineering and construction plan. Their exclusion from the Hatch 2012 report does not imply they are immaterial or irrelevant for final design and cost estimates.

Appendix A: 3.2 Cooling Tower Siting Conflicts:

Hatch made some reasonable assumptions that were taken in the feasibility phase in order to estimate a cost for the project, the siting conflicts outlined in section 3.2.1 of Appendix A (High voltage cables, Cable trenches, Security Towers & Fencing, Fuel Storage installation, Roadways, Water Storage Tank, Substations, Utility Tunneling & Monitoring house, and City Water access) cannot be studied in detail during the limited scope of a feasibility report. A reasonable cost of these site issues was calculated, that could be estimated during the limited mandate of this phase of the project, and this cost can be found in Appendix A in the Hatch report, under Code C17, described as *allowance for additional costs related to existing installations potentially interfering with this project that could involve, relocations, repairs or rebuilds (retaining walls, fences, roads, underground drainage, parking lots, fuel lines, steam lines, conduits from screenwells, ductbanks, direct buried cables, aerial electrical or communication lines, landscaping..etc).* This includes all the structure and components outlined in the Entergy report section 3.2.1 of Appendix A with regards to the siting conflicts.

Appendix A: 5.0 Power Transmission Lines Impacts:

The relocation of both Unit 2 and Unit 3 345/138 kV high voltage transmission lines and any towers are included in the cost of the project under the Code C17 in Appendix A of the Hatch report. The actual relocation of this equipment would be studied in more detail during the engineering phase of the project.

Appendix A: 6.0 Closed-cycle Retrofit Impact on Condenser:

As was stated in the Hatch 2012 report, Specification sheets detailing the thermal design of the condensers with once through cooling (existing design) were not provided. Therefore, it was impossible to accurately assess the impact on condenser thermal performance with a higher inlet cooling water temperature resulting from the use of the cooling towers.

As stated earlier in the report, Hatch's proposed conceptual design reasonably assumed that general operating parameters for both IPEC generating units, such as condenser flow rate and thermal load, would remain unchanged in a closed-cycle configuration.

Appendix A: 7 Site impacts from Plume (Salt related issues):

The issue of drift and salt deposition on electrical equipment was not studied in the Hatch feasibility report. The results of the Enercon 2003 and 2010 Reports on the salt deposition and drift were taken at face value. Moreover, the drift value for the ClearSky cooling towers was estimated by the vendor (SPX/Marley) to be one half (0.0005%) the rate of Enercon's circular hybrid cooling tower proposal which had a drift value of 0.001% .

Appendix A: 8 Operational Concerns, Cooling Tower Recirculation Effects:

While recirculation effects can reduce the efficiencies of cooling towers, both cooling towers were sized for a proper allowance for recirculation as determined by the vendor (SPX/Marley). In order to better simulate the recirculation effects created by different wind conditions a more detailed analysis is required. This analysis would normally be performed during the engineering phase of the project and adjustments, if required, can be implemented at this time. This does not presume that the cooling towers lack capacity when air recirculation conditions occur, but rather, that a proper allowance was made by the vendor to take these operating conditions into account.

Appendix A: 10.2.3 Fire Damage to Cooling Tower FRP Design:

Fire protection suppression systems were not included in the cost estimate for the cooling towers and was excluded from the scope of the report as it was not considered a major factor in determining the feasibility of the ClearSky™ cooling towers. Fiberglass cooling towers that have been installed at other nuclear power plants without fire protection suppression systems and it is not certain that they would be required for the IPEC site. Locations that have fiberglass towers but no fire suppression systems are Southern Nuclear Plant Farley (6 counterflow towers, 104 cells), Southern Nuclear Plant Hatch (3 counterflow towers, 32 cells), Entergy Grand Gulf (1 counterflow tower, 28 cells), and Entergy Palisades (1 crossflow tower, 16 cells). It would be the decision of the Nuclear Regulatory Commission or other authority having jurisdiction for IPEC whether a fire suppression system is required, this would only be concluded after a proper risk assessment analysis was performed. This is not an item that would be addressed during a feasibility report but rather it would be addressed once the engineering phase of the project began. The cost of the fire suppression system for the cooling towers, if required, are included in the 30% contingency cost.

Q. Please summarize the information that you relied upon or considered for your prefiled direct testimony.

A. In addition to my education, experience, training, professional judgment, and the references set forth in my testimony, my testimony is based on the following information:

- Enercon Services, Inc. 2003. Economic and Environmental Impacts Associated with Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration. 2003 (with references set forth therein).
- Enercon Services, Inc. 2010. Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration. February 12, 2010 (with references set forth therein).

• Hatch, Ltd. 2012. Indian Point Engineering Review: Engineering Feasibility Study for the Implementation of Closed-Loop Cooling Using Plume Abatement Cooling Towers at Indian Point Units 2 and 3. December 18, 2012 (with references set forth therein).

• Tetra Tech. 2013. Indian Point Closed-Cycle Cooling System Retrofit Evaluation. June 2013 (with references set forth therein).

Q. Does this conclude your direct testimony on these topics?

A. Yes, it does.

EDMS#496464v1

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of a Renewal and Modification of a State Pollutant Discharge Elimination System ("SPDES") permit pursuant to Environmental Conservation Law ("ECL") Article 17 and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR") Parts 704 and 750, et seq.

- by -

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

Permittee.

DEC No.: 3-5522-00011/00004
SPDES No.: NY-0004472

In the Matter of the Application of

Entergy Indian Point Unit 2, LLC, and
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for a Water Quality Certificate pursuant to Section 401 of the Federal Clean Water Act and Section 608.9 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

DEC Application Nos.:
3-5522-00011/00030 and
3-5522-00105/0031

DIRECT TESTIMONY OF TIM HAVEY

Senior Environmental Scientist

Tetra Tech
350 Indiana Street
Golden, Colorado 80401
Tel. (303) 217-5700

February 28, 2014

Name: Tim Havey

Q. Please state your name, employer, title, and business address.

A. My name is Tim Havey. I am employed as a senior environmental scientist by Tetra Tech, 350 Indiana Street, Golden, Colorado.

Q. What is Tetra Tech?

A. Tetra Tech is a provider of consulting, engineering, program management, construction management and technical services worldwide. Tetra Tech offers solutions for water, environment, energy, infrastructure, and natural resources. Tetra Tech has approximately 13,000 employees located in more than 330 offices worldwide.

Q. Please describe your educational background, professional experience, any licenses held, and responsibilities at Tetra Tech.

A. I have attached a copy of my professional resumé/curriculum vitae to the end of my prefiled direct testimony for this purpose.

Q. Does the resumé/curriculum vitae attached to this testimony accurately reflect your background and experience?

A. Yes, it does.

Q. Please describe the purpose of your current testimony.

A. The purpose of my direct testimony is to provide a review and description of the work that Tetra Tech performed for or on behalf of the New York State Department of Environmental Conservation ("DEC" or "Department") to evaluate potential closed cycle cooling alternatives for the Indian Point Energy Center ("IPEC") which culminated in a June 2013 written report entitled "Indian Point Closed-Cycle Cooling System Retrofit Evaluation" ("June 2013 Tetra Tech Report"). My testimony will also provide a review and description of the work Tetra Tech performed for or on behalf of DEC to give technical reviews of: (i) Enercon's 2003 report entitled "Economic and Environmental Impacts Associated with Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration" ("Enercon 2003 Report"); (ii) Saratoga Associates 2009 report entitled "Visual Assessment Report" based upon information in the Enercon 2003 report; and (iii) Enercon's 2010 report entitled "Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration" ("Enercon 2010 Report"). It is my understanding that the Enercon 2003 Report was previously identified and received as Entergy Ex. 7A in this proceeding, and that the Enercon 2010 Report was previously identified and received as Entergy Ex. 7 (and included Entergy Exs. 7A through 7J) in this proceeding.

Q. What was your role in or involvement with Tetra Tech's technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. I acted as the project manager or leader on Tetra Tech's technical review of the Enercon 2003 Report (Entergy Ex. 7A), responsible for assigning any necessary Tetra Tech staff or arranging for appropriate subcontractors to provide assistance and input with reviewing the Enercon 2003 Report. I also acted as the principal reviewer and primary editor of Tetra Tech's 2009 written technical review of the Enercon 2003 Report.

Q. Can you please describe what was involved in Tetra Tech's technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. Yes. In October 2008, the DEC requested Tetra Tech to provide a review of Enercon's 2003 Report, with a primary emphasis upon the engineering assumptions, methodology, and conclusions made in the report. Tetra Tech's review of the Enercon 2003 Report was based upon best professional judgment from in-house expertise gained from performing similar reviews, as well as from a subcontractor, Hatch, Ltd., that previously partnered with Tetra Tech on similar projects.

Q. Did Tetra Tech prepare a written review of its technical analysis of the Enercon 2003 Report (Entergy Ex. 7A)?

A. Yes. Tetra Tech's initial written review, dated October 14, 2009, was revised in a subsequent review dated November 18, 2009. A copy of Tetra Tech's November 18, 2009 review of the Enercon 2003 Report was provided to DEC and is included as Appendix B in the June 2013 Tetra Tech Report.

Q. Were there any limitations with Tetra Tech's 2009 technical review of the Enercon 2003 Report?

A. Yes. As noted in its 2009 review, Tetra Tech did not have access to models or their underlying data used in the Enercon 2003 Report. *See* Tetra Tech's November 18, 2009 review of the Enercon 2003 Report included as Appendix B in the June 2013 Tetra Tech Report. Conclusions in the Enercon 2003 Report based on model results were accepted as face value for purposes of Tetra Tech's 2009 review. *Id.*

Q. Can you please summarize Tetra Tech's 2009 technical review of the Enercon 2003 Report (Entergy Ex. 7A)?

A. Yes. Subject to the limitations outlined above, and with input and assistance from its subcontractor, Hatch, Ltd., Tetra Tech's 2009 technical review determined that Enercon's preferred cooling tower design – circular hybrid cooling towers – could be constructed, installed, and operated at the Indian Point nuclear facilities. *See* Tetra Tech's November 18, 2009 review of the Enercon 2003 Report included as Appendix B in the June 2013 Tetra Tech Report.

The Tetra Tech 2009 technical review found that the Enercon 2003 Report provided design assumptions and methodologies which conformed to accepted industry practices and were similar to initial engineering cost estimates developed for projects at other facilities, including nuclear power plants. _Id._ The Tetra Tech 2009 technical review found that the Enercon 2003 Report also provided a detailed estimate of the costs for initial capital, installation, operations and maintenance, and energy impacts associated with the construction and operation of circular hybrid cooling towers at IPEC, as well as a qualitative assessment of certain identified environmental impacts resulting from a cooling tower retrofit. _Id._; *see also* Entergy Ex. 7A, Section 3.0 (including sections 3.1 through 3.6).

In addition to economic/cost estimates associated with the design and use of round hybrid cooling towers at IPEC, the Enercon 2003 Report also provided a description and analysis of the environmental impacts raised by the cooling tower proposal such as: cooling tower plumes, cooling tower noise, visual/aesthetic concerns, construction activities (site clearing, blasting, traffic, etc.), and IPEC's reduced intake flow. *See* Entergy Ex. 7A, Section 4.0 (including sections 4.1 through 4.5).

Tetra Tech's 2009 technical review identified certain concerns and deficiencies with the Enercon 2003 Report which are described in the 2009 technical review. *See* Tetra Tech's November 18, 2009 review of the Enercon 2003 Report at 2-8. None of the deficiencies noted in Tetra Tech's 2009 technical review of the Enercon 2003 Report were determined to be "fatal flaws" or technical limitations which would make Enercon's selection and use of circular hybrid cooling towers infeasible at IPEC. _Id._ As reflected in Tetra Tech's 2009 technical review, "[t]he main obstacles discussed in the Enercon [2003] report are logistical in nature (e.g., space requirements) or reflect permitting and approval concerns that are entirely unrelated to the technology's performance." *Id.* at 5.

Q. What was your role in or involvement with Tetra Tech's technical review of the Saratoga Associates' 2009 "Visual Assessment Report"?

A. I acted as the project manager or leader on Tetra Tech's technical review of the Saratoga Associates' 2009 "Visual Assessment Report," responsible for assigning any necessary Tetra Tech staff or arranging for appropriate subcontractors to provide assistance and input with reviewing the Saratoga Associates' 2009 "Visual Assessment Report."

Q. Can you please describe what was involved in Tetra Tech's technical review of the Saratoga Associates' 2009 "Visual Assessment Report"?

A. Yes. DEC requested Tetra Tech to provide a review of a June 2009 "Visual Assessment Report" prepared by Saratoga Associates, with a primary emphasis upon whether the Visual Assessment Report was adequate for the purpose of analyzing impacts from the closed-cycle cooling configurations evaluated in the Enercon 2003 Report on visual resources in the study area. Tetra Tech's review of Saratoga Associates' June 2009 "Visual Assessment Report" was based upon New York State policies and guidance documents that address visual impacts, as well as a handbook published by the U.S. Forest Service, with input and assistance from a subcontractor, Ernst Corser Associates, that previously partnered with Tetra Tech on similar projects.

Q. Did Tetra Tech prepare a written review of its technical analysis of the Saratoga Associates' 2009 "Visual Assessment Report"?

A. Yes. Tetra Tech provided DEC with an initial written review dated October 14, 2009. A copy of Tetra Tech's October 14, 2009 review of Saratoga Associates' 2009 Visual Assessment Report is included as Appendix D in the June 2013 Tetra Tech Report.

Q. Can you please summarize Tetra Tech's technical review of the Saratoga Associates' 2009 "Visual Assessment Report"?

A. Yes. With assistance from its subcontractor, Ernst Corser Associates (Susan Corser), Tetra Tech's 2009 technical review determined that the Saratoga Associates' 2009 "Visual Assessment Report" provided extensive documentation of the cultural, recreational, and transportation resources within the area studied and the visibility of the circular hybrid cooling towers propounded in the Enercon 2003 Report from some of these areas as required by DEC's visual impact assessment policy (DEP-00-2). *See* Tetra Tech's October 14, 2009 review of Saratoga Associates' 2009 "Visual Assessment Report" included as Appendix D in the June 2013 Tetra Tech Report.

Nevertheless, Tetra Tech's technical review found that Saratoga Associates' 2009 "Visual Assessment Report" could not be considered adequate if it was intended, at that time, to serve as the basis for determining whether the circular hybrid cooling towers evaluated in the Enercon 2003 Report would constitute a significant visual impact on the area surrounding IPEC. *Id.* at 2.

Tetra Tech's 2009 technical review identified various deficiencies and limitations with the Saratoga Associates' 2009 "Visual Assessment Report" which are more fully described and detailed in the 2009 technical review. *Id.* at 2-12. As reflected in Tetra Tech's 2009 technical review, the Saratoga Associates' 2009 Visual Assessment Report "contains several flawed assumptions that provide the basis for much of the subsequent analysis and results in poorly supported conclusions." *Id.* at 2. Tetra Tech's 2009 technical review concluded that the level of detail in Saratoga Associates' 2009 Visual Assessment Report was "insufficient to draw any conclusions regarding the potential visual impact associated with hybrid cooling towers at Indian Point." *Id.* Finally, Tetra Tech's 2009 technical review provided recommendations that could be used to support discovery requests by DEC as they related to visual impacts analysis at Indian Point. *Id.* at 10-12.

Q. What was your role in or involvement with Tetra Tech's technical review of the Enercon 2010 Report (Entergy Ex. 7)?

A. I acted as the project manager or leader on Tetra Tech's technical review of the Enercon 2010 Report (Entergy Ex. 7), responsible for assigning any necessary Tetra Tech staff or arranging for appropriate subcontractors to provide assistance and input with reviewing the Enercon 2010 Report. I also acted as the principal reviewer and primary editor of Tetra Tech's 2010 written technical review of the Enercon 2010 Report.

Q. Can you please describe what was involved in Tetra Tech's technical review of the Enercon 2010 Report (Entergy Ex. 7)?

A. Yes. In 2010, the DEC requested Tetra Tech to provide a review of Enercon's 2010 Report, with a primary emphasis upon the engineering assumptions, methodology, and conclusions made in the report. Tetra Tech's review of the Enercon 2010 Report was based upon best professional judgment from in-house expertise gained from performing similar reviews, as well as additional technical expertise from a subcontractor, SAIC, that previously partnered with Tetra Tech on similar projects and was, at that time, providing support to U.S. EPA on the development of national regulations for once-through cooling systems (CWA §316[b]).

Q. Did Tetra Tech prepare a written review of its technical analysis of the Enercon 2010 Report?

A. Yes. Tetra Tech provided DEC with an initial written review dated July 6, 2010. A copy of Tetra Tech's July 6, 2010 review of the Enercon 2010 Report is included as Appendix B in the June 2013 Tetra Tech Report.

Q. Were there any limitations with Tetra Tech's 2010 technical review of the Enercon 2010 Report?

A. Yes. As noted in its 2010 review, Tetra Tech did not review the Algonquin pipeline feasibility assessment in the Enercon 2010 Report, nor did it review issues related to potential groundwater radiological contamination. *See* Tetra Tech's July 6, 2010 review of the Enercon 2010 Report included as Appendix B in the June 2013 Tetra Tech Report. Similar to its previous review of the Enercon 2003 Report, Tetra Tech did not have access to models or their underlying data used in the Enercon 2010 Report. *Id.* Conclusions in the Enercon 2010 Report based on model results were accepted as face value for purposes of Tetra Tech's 2010 review. *Id.*

Q. Can you please summarize Tetra Tech's 2010 technical review of the Enercon 2010 Report?

A. Yes. Subject to the limitations outlined above, and with input and assistance from its subcontractor, SAIC, Tetra Tech's 2010 technical review determined that the Enercon 2010 Report expanded upon the earlier Enercon 2003 Report by providing greater detail concerning critical elements such as initial capital and long term costs, construction timeframes and implementation schedules, and site configuration and logistical considerations. *See* Tetra Tech's July 6, 2010 review of the Enercon 2010 Report included as Appendix B in the June 2013 Tetra Tech Report.

Tetra Tech determined that certain components of the Enercon 2003 Report were essentially unchanged in the Enercon 2010 Report including cooling tower design, PEPSE model (minor updates), air emission conclusions, and cooling tower plume/salt deposition analysis. *Id.* at 2. Consequently, Tetra Tech's 2010 technical review confirmed its previous findings following its review of the Enercon 2003 Report that round hybrid cooling towers were a reasonable conceptual design for the facilities given the constraints at IPEC. *Id.* at 4.

Tetra Tech's 2010 technical review also identified certain concerns, inconsistencies, and deficiencies with the Enercon 2010 Report which are described in the 2010 technical review. *Id.* at 2-16. Given the level of detail presented by Enercon up to that time, Tetra Tech's 2010 technical review found, among other things, that: (i) estimates for direct capital costs and ongoing operation and maintenance of round hybrid cooling towers were within the range of comparable project estimates developed for other nuclear facilities when adjusted for the unique considerations at IPEC (*e.g.*, transmission pipeline relocation); (ii) the overall time to completion estimate of 12 to 13 years was 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; (iii) the construction downtime estimate of both IPEC units being offline for up to 42 weeks was reasonable and acceptable; and (iv) the estimated thermal efficiency losses were reasonable when compared to other similar projects, although

Tetra Tech did not have access to the PEPSE model (and could not recreate the estimates in the Enercon 2010 Report) and additional information describing each unit's thermal cycle would enable Tetra Tech to provide a more detailed review. Id. at 3. Additional details and discussion on specific elements associated with Tetra Tech's technical review of the Enercon 2010 Report are provided in its 2010 review. Id. at 3-16. Ultimately, Tetra Tech concluded, based upon its evaluation and review of both the Enercon 2003 Report and Enercon 2010 Report that, while certain elements in those Reports required clarification or correction, Enercon's circular hybrid cooling tower proposal was available and generally feasible for the IPEC facilities in order to satisfy the BTA requirement of 6 NYCRR §704.5. Tetra Tech's 2010 technical review of the Enercon 2003 and 2010 Reports confirmed the Department's preliminary determination that conversion of IPEC from a once-through cooling system to a closed-cycle cooling system, while expensive and involving a potentially lengthy construction process, was nevertheless an available and feasible technology for Units 2 and 3 to satisfy the BTA requirement of 6 NYCRR §704.5.

Q. In your professional opinion, based upon your involvement with Tetra Tech's 2009 and 2010 technical evaluations of Enercon's 2003 and 2010 Reports, as well as Tetra Tech's review of Saratoga Associates' Visual Assessment Report, and your best professional judgment, did the Enercon Reports identify all significant construction and operational considerations, including economic and environmental impacts, associated with converting Indian Point Units 2 and 3 to a closed-cycle cooling system with round hybrid cooling towers?

A. Yes.

Q. In your professional opinion, based upon your involvement with Tetra Tech's 2009 and 2010 technical evaluations of Enercon's 2003 and 2010 Reports and best professional judgment, is Enercon's circular hybrid cooling tower proposal available and generally feasible for the IPEC facilities?

A. Yes.

Q. In your professional opinion, based upon your involvement with Tetra Tech's 2009 and 2010 technical evaluations of Enercon's 2003 and 2010 Reports and best professional judgment, will Enercon's circular hybrid cooling tower proposal minimize adverse environmental impact from the IPEC facilities in accordance with 6 NYCRR §704.5?

A. Yes.

Q. What was your role in or involvement with Tetra Tech's evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC?

A. I acted as the project manager or leader for Tetra Tech's evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC, responsible for assigning any necessary Tetra Tech staff or arranging for appropriate subcontractors to provide assistance and input with preparing an alternative to Enercon's round hybrid cooling tower proposal. I also acted as the principal preparer, reviewer and primary editor of Tetra Tech's 2013 written evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC.

Q. Can you please describe what was involved in Tetra Tech's evaluation of an alternative closed-cycle cooling system retrofit at IPEC for the DEC?

A. Yes. DEC retained Tetra Tech to evaluate potential cooling system alternatives for IPEC, including an examination and analysis of various impacts and considerations associated with implementing such alternatives. Tetra Tech's evaluation of potential cooling system alternatives for IPEC was based upon best professional judgment from in-house expertise gained from performing similar reviews, as well as additional technical expertise from subcontractors, Hatch, Ltd. and Ernst Corser Associates, that previously partnered with Tetra Tech on similar projects, including previous Tetra Tech reviews related to IPEC. Tetra Tech's evaluation was intended to be a feasibility-level study that assessed the technical soundness of a proposed alternative with the development of a conceptual design that could be used to estimate initial capital and operating costs. Most of the information used by Tetra Tech to develop the conceptual design and cost estimates for the proposed cooling system alternative was obtained from the previous reports prepared by Enercon Services (Enercon) on behalf of Entergy for IPEC in 2003 and 2010 (Enercon 2003 Report and Enercon 2010 Report).

Q. Did Tetra Tech prepare a written report on its evaluation of potential closed cycle cooling alternatives at IPEC for DEC?

A. Yes. Tetra Tech provided DEC with a written review dated June 2013. It is my understanding that DEC provided hard copies of Tetra Tech's June 2013 closed-cycle cooling system retrofit evaluation ("Tetra Tech 2013 Report") to the Administrative Law Judges on or about June 6, 2013 and copies of the Tetra Tech 2013 Report contained on compact discs to the parties to these proceedings on or about June 10, 2013.

Q. Were there any limitations with Tetra Tech's 2013 Report?

A. Yes. As noted in its previous reviews of the Enercon 2003 Report and Enercon 2010 Report, Tetra Tech did not analyze the Algonquin pipeline feasibility assessment, nor did it review issues related to potential groundwater radiological contamination. Moreover, similar to its previous reviews of the Enercon 2003 Report and Enercon 2010 Report, Tetra Tech did not have access to models or their underlying data used in the Enercon Reports. Conclusions in the Enercon 2003 Report and Enercon 2010 Report based on model results were accepted at face value for purposes of Tetra Tech's 2013 Report.

Q. Can you please briefly summarize the Tetra Tech 2013 Report?

A. Yes. Subject to the limitations outlined above, and with input and assistance from its subcontractors, Hatch, Ltd. and Ernst Corser Associates, the Tetra Tech 2013 Report determined that the ClearSky™ plume-abated cooling tower technology developed by SPX/Marley is a practical alternative for a closed-cycle cooling retrofit at IPEC apart from the circular hybrid cooling towers initially proposed by Enercon. *See* Tetra Tech 2013 Report at 10-11. Accordingly, the Tetra Tech 2013 Report consists of a preliminary engineering assessment of a closed-cycle cooling retrofit at IPEC using ClearSky™ cooling towers in order to minimize the adverse environmental impact from the facilities' cooling water intake structures.

The conceptual design established the basis of estimate for the feasibility-level review that evaluated logistical and siting constraints, and technical specifications associated with the proposed retrofit. *Id.* at 12. The Tetra Tech 2013 Report included a budgetary cost estimate that reflects the major conceptual design elements as they were understood at the time of the report. The capital cost estimate developed for the ClearSky™ cooling tower proposal can be found in the Tetra Tech 2013 Report at pages 22 to 23.

The data used in the Tetra Tech 2013 Report are the same used to develop the circular hybrid cooling tower design described and evaluated in the Enercon 2003 Report and Enercon 2010 Report. _Id._ The Tetra Tech 2013 Report was limited to an evaluation of hybrid, plume-abated mechanical draft cooling towers arranged in a back-to-back configuration and did not include a detailed comparison between the circular hybrid cooling towers proposed by Enercon and the ClearSky™ cooling towers evaluated by Tetra Tech.

With input and assistance from Hatch, Ltd., Tetra Tech selected individual ClearSky™ cooling towers for each generating unit (Unit 2 and Unit 3) and, to the extent practicable, Tetra Tech's conceptual design used existing systems (intakes, condensers, discharge) to minimize on-site disruptions and installation costs. _Id._ The design selected for IPEC consists of two independently operated, mechanical draft cooling towers to service Unit 2 and Unit 3, complete with dedicated pumps, piping, and electrical systems. Each ClearSky™ cooling tower is designed to operate in a saltwater (high TDS – total dissolved solids) environment, with an expected maximum circulating TDS concentration of approximately 24,000 parts per million (ppm). _Id._ Parasitic load estimates for the proposed cooling towers are provided in Table 2-3 on page 19 of the Tetra Tech 2013 Report. A conceptual design of the proposed cooling towers is provided in Figure 02 on page 21 of the Tetra Tech 2013 Report.

Tetra Tech's proposed conceptual design assumed that general operating parameters for both IPEC generating units, such as condenser flow rate and thermal load, would remain unchanged in a closed-cycle configuration. Tetra Tech, with input and assistance from its subcontractor, Hatch, Ltd., provided estimates of thermal efficiency losses resulting from the conversion of IPEC from once-through cooling to cooling towers based on modeled output curves from the Enercon 2003 Report. The annual maintenance cost estimate associated with operation of the ClearSky™ cooling towers is based on information provided by SPX/Marley. *See* Tables 2-6 and 2-7, respectively, on pages 25 and 26 of the Tetra Tech 2013 Report. Tetra Tech also provided a summary comparison of costs of its ClearSky™ cooling tower proposal and Enercon's round hybrid cooling towers. Id. at 26.

Tetra Tech estimated that the total time required to complete the cooling tower retrofit evaluated in its 2013 Report ranged from seven to nine years. Id. at 27. While the proposed cooling tower alternative evaluated in the Tetra Tech 2013 Report considered the retrofit of both IPEC Units 2 and 3 as a single project, nothing that was examined in the Report would prevent the proposed retrofit from being applied to either IPEC operating unit separately or alone. Id. at 12.

With input and assistance from Ernst Corser Associates (*see* Appendix D of the Tetra Tech Report), Tetra Tech prepared visual simulations of the ClearSky™ cooling tower alternative. *See* Appendix C of the Tetra Tech 2013 Report.

Q. **Were there any key considerations that Tetra Tech took into account in order to assess whether the ClearSky™ cooling tower retrofit proposed in the Tetra Tech 2013 Report could be implemented?**

A. Yes. As one might expect, given the overall scope and complexity of building cooling towers at IPEC, combined with the inherent obstacles of working in and around an active nuclear power facility, many challenges are presented by both the Tetra Tech proposal, although none of them are insurmountable. The key considerations involved in implementing Tetra Tech's cooling tower proposal at IPEC are: (i) design and permitting of the towers; and (ii) construction of the towers. *See* Tetra Tech 2013 Report at 27.

Q. Can you please briefly discuss these considerations?

A. Yes. Design and Permitting: as noted in the Tetra Tech 2013 Report, the permitting process for any closed-cycle retrofit proposal is likely to be contentious and involve a multitude of local, state, and federal agencies. *See* Tetra Tech 2013 Report at 27. While the design process for the proposal could run concurrently with the permitting effort, Tetra Tech assumed the permitting effort could take three to five years, while a final design effort to produce construction-level plans and drawings could lag behind final permit approval by one year or more. *Id.* Key elements that Tetra Tech identified and factored into its design and permitting completion estimate include: (i) public involvement; (ii) on-site contamination and radiological plume; (iii) site complexity and additional site investigations; (iv) NEPA/SEQRA compliance; and (v) air emission impacts. *Id.* Based upon available data, similar projects, and professional experience, Tetra Tech did not identify any clear "fatal flaws" related to the permits required for or design elements associated with its cooling tower proposal. *Id.* at 28. The only "critical path" identified by Tetra Tech in the 2013 Report is radionuclide management which, due to the plume's location along the waterfront at IPEC, has a high likelihood of impacting both the schedule and design of the proposed retrofit due to unresolved permitting issues (relative to proposed treatment and disposal options). *Id.* at 29. Additional details and discussion of specific permits and approvals, including local restrictions, associated with Tetra Tech's cooling tower alternative are provided in its 2013 Report. *Id.* at 28-33.

Site Construction: as noted in the Tetra Tech 2013 Report, notable disruptions to the IPEC site will begin several years into the cooling tower project when field work commences and will include relocating several existing facilities in order to accommodate new, permanent structures as well as laydown and staging areas which will remain until construction ends. *See* Tetra Tech 2013 Report at 33. Tetra Tech estimated that a sizable workforce, as many as 600 laborers, will require daily access to the IPEC site during construction of the proposed cooling towers. *Id.* An extremely large volume of blasting spoils, estimated at approximately two million cubic yards, will need to be removed from the IPEC site, potentially requiring a steady stream of heavy duty trucks entering and exiting the site or, the preferred alternative, use of barges from IPEC's existing heavy duty pier along the Hudson River. Tetra Tech estimated that barge use would replace approximately 100,000 truck haul trips to and from the site, thereby significantly reducing street noise and fugitive dust emissions along the truck route (estimated to include Broadway, John Walsh Boulevard, and Louisa Street in Buchanan). *Id.* at 34. Additional details and discussion of other construction related considerations associated with Tetra Tech's cooling tower alternative are provided in its 2013 Report. *Id.* at 33-38.

Q. Did Tetra Tech consider or evaluate any other factors associated with its ClearSky™ cooling tower alternative?

A. Yes. In addition to the items already discussed, the Tetra Tech 2013 Report also considered or evaluated: (i) baseline noise (sound pressure) levels of each cooling tower during operation at distances of 50 meters and 100 meters [*see* Table 3-3 on page 31 of Tetra Tech 2013 Report]; (ii) total height of the proposed cooling towers [*see* page 33 of

Tetra Tech 2013 Report]; (iii) truck access to/from the IPEC site during construction [*see* pages 33-34 of Tetra Tech 2013 Report]; (iv) stormwater controls resulting from potential for increased stormwater runoff as a result of construction at the IPEC site [*see* pages 35-36 of Tetra Tech 2013 Report]; (v) visual resource impact assessment, including conformity with State and local visual resource management programs [*see* pages 39-80 of Tetra Tech 2013 Report]; and (vi) compatibility with land use, neighborhood character, recreation, and cultural resources, including Federal, State, and local management programs [*see* pages 81-97 of Tetra Tech 2013 Report].

Q. As a result of its evaluation, was Tetra Tech able to draw any conclusions about any potential effects the proposed ClearSky™ cooling tower proposal could have on land use or cultural/historic resources in the study area around IPEC?

A. Yes. The ClearSky™ cooling tower proposal is not expected to have any significant, long-term direct effects on land use or cultural/historic resources in the study area around IPEC. *See* Tetra Tech 2013 Report at 97. The project would not displace any recreational facilities or other land use, except for wildlife habitat; it would not cause long-term increases in employees or traffic levels; and is buffered from most of the Village of Buchanan's neighborhoods by existing undeveloped lands owned by Entergy or Consolidated Edison of New York ("ConEd"). *Id.* The proposed project's primary long-term effect would be the indirect visual effects of one cooling tower on the Lents Cove area, as well as the occasional views of a plume from the Village of Buchanan. *Id.* The primary short-term construction-related effects from the proposed project on land use and recreation would be the increased traffic on Broadway, John Walsh Boulevard, and

Louis Street, which would create additional noise and congestion near adjacent industrial activities and recreational uses. *Id.*

Q. In your professional opinion, based upon your involvement with the Tetra Tech 2013 Report and best professional judgment, is Tetra Tech's ClearSky™ cooling tower proposal available and generally feasible for the IPEC facilities?

A. Yes.

Q. In your professional opinion, based upon your involvement with the Tetra Tech 2013 Report and best professional judgment, will Tetra Tech's ClearSky™ cooling tower proposal minimize adverse environmental impact from the IPEC facilities in accordance with 6 NYCRR §704.5?

A. Yes.

Q. Have you had the opportunity to review a document entitled *Entergy Response Document To the Tetra Tech Report and the Powers Engineering Report* prepared by TRC Environmental Corporation dated December 13, 2013 ("Entergy Response Document").

A. Yes, I have.

Q. Do you have any comments to make about the Entergy Response Document?

A. Yes, I do. My comments are directed to specific sections of the Entergy Response Document as noted below:

2.1 Feasibility Issues – Cooling Tower Siting Conflicts: Tetra Tech prepared its assessment and evaluation based upon a conceptual design that is used to evaluate feasibility and determine if there are identifiable obstacles that would objectively prevent that design from being implemented. It is not intended to enumerate all potential items that would be addressed in a final engineering and construction plan. Their exclusion from the Tetra Tech 2013 report does not imply they are immaterial or irrelevant for final design and cost estimates.

2.2 Operational Concerns – Fiberglass Cooling Tower Design Constraints: Fiberglass, or fiber reinforced polymer (FRP), is a structurally sound material that has been used successfully in cooling tower components for decades. Pultruded FRP has a tensile strength that approximates that of steel, offers high impact resistance, and is highly resistant to corrosion and scaling that can affect steel or wood cooling towers. Marley uses pultruded FRP in the F400 series cooling tower. Since 1992, Marley has installed over 400 F400 cooling towers consisting of more than 1700 individual cells in fresh, brackish, and sea water environments with a strong record of long-term operational success (CTI 2013). The ClearSky™ cooling towers used in the conceptual design is an F400 series tower with an added plume abatement system. In addition to the inherent strength of pultruded FRP, the F400 tower is constructed with a factory-drilled, through-bolt system for all structural joints instead of adhesives. Structural deformation (e.g., warping, splitting, twisting) is not typically a concern with pultruded FRP (Marley 2013). In the conceptual design, bolts and fittings are designed for a salt water application (e.g., silicon bronze). The wind load specification discussed by Enercon (Entergy 2012, Appendix A) is for a base case cooling tower. Additional structural reinforcements can be added to the tower to meet higher wind load requirements.

3.1.2 SEQRA Impact Analyses in the Tetra Tech Report: Tetra Tech was not tasked to qualify impacts by their impact level categories as described by Entergy or TRC.

3.2.2 Operation: Tetra Tech did not specifically propose removing the existing traveling screens from service at the intake as described by NYSDEC and did not include any related cost savings in its 2013 report. However, I agree with Enercon's proposal (2003 and 2010) that several intake bays and their associated screens can be retired from service in a closed cycle configuration.

3.3 Cooling Water Tower Treatment and Water Quality: Section 3.3.1 (Introduction) of the Entergy Response Document summarizes various comments made regarding water treatment and quality during construction and operation. My comments address the arguments raised in this section but are presented below according to the subsection and/or appendix upon which the Introduction is based.

3.3.2 Construction Impacts: Tetra Tech generally accepted, and took at face value, the conclusions of Entergy's consultant, GZA GeoEnvironmental, Inc. (Enercon 2010, Attachment 3) with regard to potential soil and groundwater contamination from tritium and strontium migration at the site. Tetra Tech was not tasked to conduct any additional investigation of the radiological plume for its 2013 report, including treatment or disposal options. During Tetra Tech's review, we reviewed other options for a Unit 2 pipe alignment that would avoid disturbing the plume area, including an above ground configuration, an offshore route, and an alignment around the main power block to the south. All of these options were rejected as impractical given the space constraints and operations at IPEC. I would agree that the retrofit project for Unit 2 is heavily dependent on finding an acceptable solution for dewatering the area during excavation and construction. It is my opinion that the plume area will likely require sampling to determine what disposal and/or treatment methods, if any, are most appropriate to manage dewatered groundwater and excavated material (Tetra Tech 2013 at 28). These issues apply to the Unit 2 cooling tower retrofit only; the Unit 3 retrofit would not be affected by groundwater contamination. Apart from dewatering the plume area, storm water management during construction is largely an erosion and sediment control effort associated with blasting and land clearing. Best management practices and design/control technologies are well established for land disturbing activities and should not pose significant obstacles except as described above. At this stage of design it would be premature to prepare a construction storm water plan.

3.3.3 Operational Impacts: The comments presented by Entergy in this section and Puckorius & Associates (Entergy 2013, Appendix G) do not accurately reflect the conceptual design proposed by Tetra Tech and incorrectly interpret information provided by the cooling tower vendor (SPX/Marley). The introduction presented in Section 3.3.3 summarizes points that are further detailed in subsections. My comments are presented accordingly.

3.3.3.1 Hudson River Water Chemistry/Biology: In the conceptual design, cooling tower makeup water would be withdrawn from the service water discharge. The annualized service water pump flow rate is 49,000 gpm (Entergy 2013 at 3-14) while the required makeup water withdrawal rate would be approximately 19,000 gpm for each tower, or 38,000 gpm in total (Tetra Tech 2013 at 13). As part of the closed-cycle cooling retrofit, the existing discharge canal will be modified with an overflow weir to manage the difference between the service water discharge and makeup demand (Tetra Tech 2013 at 17). This modification is identical to the one presented by Enercon (Enercon 2010 Section 2.1.2.1). Tetra Tech assumed that the overall quality of the service water discharge would be substantially similar to the Hudson River intake water. The conceptual design is based, in part, on an initial TDS concentration in the makeup water of 7,200 ppm. At three cycles of concentration, plus an additional allowance for source water fluctuation, the peak circulating water TDS concentration would be 24,000 ppm, which places the resulting cooling towers in the "salt water" category according to Marley (Tetra Tech 2013, Appendix A). Consequently, all design elements, including sizing, thermal efficiency, and construction materials assume a salt water application. Entergy 2013 and Puckorius 2013 cite a Marley-provided document (Marley 2009) where Marley recommends a limit of 5,000 ppm as the circulating water TDS concentration (Entergy 2013 at 3-14; Puckorius 2013 at 3). Entergy suggests further suggests that the 24,000 TDS exceeds the manufacturer's specification and would have operational ramifications that were not addressed in the Tetra Tech report. Entergy's citation, however, is inappropriate for the Tetra Tech conceptual design. Marley 2009 does not state the 5,000 ppm value as a limit, but rather notes that TDS concentrations over 5,000 ppm "may require thermal performance derate" because high TDS levels have a slight negative impact on a cooling tower's ability to dissipate heat. To compensate for this diminished thermal efficiency, salt water cooling towers are designed to be slightly larger, on a per-gpm basis, than a comparable "fresh water" cooling tower. The high TDS concentration in the circulating water would not have operational ramifications because it has already been factored into the initial design. I would further note that there are numerous "salt water" cooling towers currently operating in the United States with circulating water TDS concentrations that far exceed 5,000 ppm. Entergy 2013 cites TSS concentrations ranging from 17 mg/L to over 800 mg/L over a tidal cycle with levels of

35 mg/L "routinely experienced" near IPEC (Entergy at 3-15). I cannot comment on the appropriateness of these values because the reference cited, Hudson River Estuary (Levinton and Waldman 2006), was not available to review. Likewise, Puckorius states TSS levels will approach 420 ppm (~420 mg/L) at three cycles of concentration (raw water concentration of 140 mg/L), but does not provide a reference. Recent water quality sampling conducted for the proposed United Water project in Haverstraw, New York, showed a TSS range of 4.4 to 100 mg/L, with a mean of 26.1 mg/L from over 200 samples collected from five Hudson River locations within four miles of IPEC (United Water 2012). At the mean, TSS levels would approach 80 mg/L. While this level exceeds Marley's base design specification of 50 ppm, Marley further notes that "Except for those unusual operating situations where the circulating water may be so laden with suspended solids, algae, fatty acids...that plugging of the cooling tower fill is a *probability*, [emphasis added] reasonable attention to the hardware materials and/or their coatings is all that is normally required" (Marley 2010 at 5). TSS levels in the circulating water flow, and any potential deleterious effects, are typically addressed by a well-implemented maintenance strategy according to the manufacturer's recommendations. I would further add that if TSS levels at 3 cycles of concentration would present long-term maintenance issues, a more viable treatment option would be to increase the blowdown rate, thus reducing the TSS concentration in the circulating water, rather than implementing an aggressive chemical treatment regime. As noted above, additional makeup water could be withdrawn from the service water discharge surplus without any net increase to the total withdrawal rate from the Hudson River. Entergy 2013 and Puckorius 2013 state that iron levels in the circulating water could reach 15 ppm at 3

cycles of concentration. At this level, iron would exceed the recommended maximum of 3 ppm as prescribed in Marley's Preferred Cooling Tower Water Condition Limits (Marley 2009). The citation is incorrect, however, in that the water condition limits do not apply to the conceptual design in the Tetra Tech report. Rather, the water limits cited are applicable to either wood or steel cooling tower installations. As previously indicated, the Tetra Tech conceptual design incorporates fiberglass (FRP) as the primary construction material. The "normal" water conditions for the F400 series FRP cooling towers do not list iron as a constituent of concern (Marley 2010 at 5).

3.3.3.2 Cooling Tower Chemical Conditioning Program: The primary reason for the chemical conditioning program described by Entergy and Puckorius is to control suspended solids and scaling/corrosion. For the reasons described in the previous section, I do not believe this chemical conditioning program is necessary for TSS. Likewise, scaling/corrosion concerns are significantly reduced in the Tetra Tech conceptual design because the cooling tower materials (FRP, silicon bronze fittings) are highly resistant to scaling, corrosion, splitting, and cracking. The use of surfactants and dispersants as proposed by Entergy and Puckorius do not appear to be necessary. As noted above, FRP towers, through their ability to resist scaling and corrosion, offer fewer rough surfaces that can promote microbiological growth. However, I would agree that water treatment with biocides, most likely chlorine, will still be necessary to manage any potential *Legionella* and to control general biofouling that may occur in the FRP towers.

3.3.3.3 Effect of Water Treatment Chemicals on Cooling Tower Drift: The drift rate quoted by SPX/Marley (0.0005%) for the conceptual design is based on a salt water configuration using high efficiency drift eliminators, and is appropriate for a budgetary estimate (Tetra Tech 2013 Report, Appendix A). Numerous water quality-related factors will contribute to a cooling tower's actual drift rate, but at this stage of the process it is speculative to state that the drift rate would be "substantially higher" than the quoted design rate (Entergy Response Document at p. 3-18), particularly when the rationale for increased drift emissions (high use of surfactants and dispersants) is not supported by the operating conditions and design materials. In later stages of the design process, the circulating water's chemical and physical properties would be modeled using air quality measurements and source water samples that accurately reflect operating conditions. The results would be used to determine what chemicals are necessary to control circulating water quality, and further refine the effect on drift rate.

On February 13, 2014, I spoke with John Arnston of SPX/Marley and specifically asked about the basis for the 0.0005% drift emission rate and how chemical treatment may affect that rate. He responded that the 0.0005% rate is the current "state-of-the-art" standard for drift emissions and has been validated by in-field verification tests conducted by SPX for various clients, including those with saltwater applications. He further noted that chemical addition for suspended solids control, particularly at high levels which would significantly impact the drift emission rate, is more common in applications that use recycled/reclaimed wastewater as the makeup water source.

3.3.4 SPDES Permit Considerations: I agree, generally, with the argument that the presence of nutrients in the intake water will contribute to microbiological growth in the cooling towers and require some means of chemical control. Puckorius states that the level of chemical addition will be 2 to 3 times that required for clean water due to "decaying vegetation, aquatic life based materials, phosphates and ammonia from surface runoff of fertilizer treated soil and discharge of wastewater treatment plants upstream" (Puckorius 2013 at p. 3). I cannot comment on the accuracy of this statement since the rationale for high nutrient contribution from surface runoff and wastewater discharge is not supported and somewhat speculative. I would note, however, that water quality data collected for the proposed United Water project in Haverstraw do not indicate high nutrient levels. Observed values for total nitrogen ranged from 1 to 4.9 mg/L (1.35 mg/L average) while total phosphorus ranged from 0.1 to 0.24 mg/L (0.13 mg/L average). In both cases, more than half of the samples were non-detect (United Water 2012).

3.3.4.1 Stormwater: Post construction storm water management focuses the additional volumes of storm water generated by the expansion of impervious surfaces at the site. Once land disturbances have stabilized, there is no reason to expect that the storm water generated from the cooling tower areas would require atypical treatment technologies since there would be no potential contributors to stormwater contamination from the new towers and their associated equipment. Energy dissipation to prevent embankment erosion is the primary concern for stormwater discharges (Tetra Tech 2013, Section 3.5). Moreover, the DEC has indicated that it can accommodate, via SPDES, stormwater management concerns.

3.3.5 Risk of Legionnaires' Disease: As noted by the Entergy Response Document and CDM Smith 2013 (Appendix F of Entergy Response Document), control of *Legionella* is a concern for any evaporative cooling tower operator due to its potentially lethal impacts when inhaled. The risk, however, is well understood within the cooling tower industry and can be effectively managed through proper maintenance and disinfection (CTI 2008).

CDM Smith 2013 describes numerous cases where Legionnaire's outbreaks were traced back to aerosols emitted from a cooling tower or towers. It is important to note, however that the term "cooling tower" is poorly defined and is very often applied to a wide range of evaporative cooling units from small, rooftop units used for air conditioning up to and including hyberbolic natural draft towers more than 500 feet tall. The distinction is key when implicating a "cooling tower" as the source of an outbreak, as is a detailed description of the operating conditions and maintenance history associated with the tower. A cursory review of some of the Legionnaire's outbreaks cited in CDM Smith 2013 reveals that the offending cooling tower is more likely to be of the smaller, rooftop variety (poorly maintained) rather than the large, continuous use towers proposed for IPEC. For instance, in Christchurch, New Zealand, the likely source was an unmonitored cooling tower (Fairfax 2008). The Melbourne outbreak was definitively linked to a poorly disinfected cooling tower at the Melbourne Aquarium (Greig 2004). The 2005 outbreak at an assisted living facility in Toronto was blamed on an improperly maintained cooling tower (Walker 2005). Lastly, the Murcia, Spain outbreak – the largest cited – was caused by a poorly maintained cooling tower at a hospital (Garcia-Fulgueiras 2003). Cooling towers that are allowed to stand idle without proper cleaning can retain stagnant water in which *Legionella* may flourish. If restarted without disinfection, the bacteria may be emitted from the towers. CDM Smith does not relate how the information it provided is instructive for the cooling towers under consideration for IPEC, since the towers would be actively monitored, maintained, and disinfected as necessary. Furthermore, it is not clear why attributes of the ClearSky towers "may exacerbate the risks associated with water-borne pathogens" (CDM Smith p. 1) or what those attributes might be. The ClearSky™ cooling towers can readily be maintained and monitored to effectively control *Legionella.*

3.4.3 Drift Rate: My comments on this section are the same as in Section 3.3.3.3, above.

3.4.4 Preferred Cooling Tower Water Condition Limits: As noted above, the preferred cooling tower water condition limits cited by Entergy are not applicable to the Marley F400-series ClearSky™ FRP cooling tower.

3.4.5 Hudson River Salinity: Tetra Tech did not address the seasonal variability in Hudson River salinity levels because the conceptual design is based on the peak operating conditions that would reasonably be expected during the year, not the average. Thus, the ClearSky™ cooling towers are designed to reject the maximum thermal load (7000 MMBTU per tower) under the most stringent conditions (highest salinity, highest wet bulb). As the Entergy Response Document notes, salinity levels vary widely during the year. Any operating conditions that are less than the peak design criteria will allow the cooling towers to operate more efficiently and may contribute to reduced maintenance requirements and air emissions. I have noted previously that while the conceptual design is based on 3 cycles of concentration, there is nothing that would prevent the towers from being operated at fewer cycles during periods of elevated salinity in the source water. This would maintain thermal efficiency within an acceptable range and, in most cases, could be accomplished without any net increase in water withdrawal from the Hudson River.

3.6.3.1 Visible Plumes: The scale, frequency, and duration of a visible plume are dependent on several factors, particularly the ambient dry bulb temperature, relative humidity (or humidity ratio), and wind speed and direction. Accurate predictions can only be made using detailed models like SACTI that can analyze the interaction of numerous variables and inputs. I would note that the SACTI model, unless modified, is not typically used to model a visible plume under plume-abated operations. However, it is possible to estimate when plume-forming conditions would occur using meteorological data and the plume-free design point for the ClearSky™ cooling towers – 27° F (dry bulb) at 90% relative humidity. Tetra Tech reviewed three years (2010-2012) of meteorological data for Westchester County Airport in White Plains as reported by NOAA. These data include hourly observations for dry bulb temperature and relative humidity. Values were then plotted against the plume-free design point to estimate the number of hourly observations that would be considered "plume-forming" (plots for January and July are included in Tetra Tech Supplement, Figures 1A and 1B). Conditions in January are representative of winter months when plumes are more likely to form. When operated in plume-abatement mode, the ClearSky™ towers would effectively mitigate the plume approximately 94% of the daylight hours. In July, plume-forming conditions (in plume-abatement mode) would occur approximately 1% of daylight hours. I would add that "plume-forming conditions" is an inclusive phrase that does not indicate the size or duration of the potential plume. In some cases the plume may be small and barely perceptible above the tower, while larger, more persistent plumes would occur less frequently. Operating the ClearSky™ cooling towers in plume-abatement mode is only necessary when plume-forming conditions would be expected; it is not required on a continual basis. Tetra Tech did not develop an operating plan because the conditions that would govern plume abatement operation will be based, in part, on future determinations as to what would constitute an unacceptable plume. As Entergy notes "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" (Entergy 2013 at 3-40).

3.8 Terrestrial Ecology: Potential habitat disturbances associated with the conceptual design are largely limited to the footprint area for the cooling tower on Unit 2; other areas on-site have largely been disturbed previously. Tetra Tech compiled a list of terrestrial wildlife species classified as Threatened, Endangered, or of Special Concern, which have the potential to occur within a 5-mile radius of IPEC. Three listed animal species were identified as occurring within Westchester County, New York. These include the Indiana Bat (*Myotis sodalist*), Bog Turtle (*Clemmys muhlenbergii*), and New England Cottontail (*Sylvilagus transitionalis*).

Indiana Bat: The Indiana Bat is listed as endangered by New York and USFWS. Winter hibernation sites have not been documented in Westchester County. During warmer months, female bats disperse to forested areas to raise young under loose bark or hollows in dead trees. Suitable summer habitat for Indiana bats includes forest with cover of at least 15 percent, permanent access to water, and potential roost trees. The IPEC project area does not contain suitable habitat for hibernation, and only limited opportunities for roosting areas due to the small size of the forested area. The potential to be impacted by the proposed retrofit of Unit 2 is minimal.

Bog Turtle: The Bog Turtle is listed as endangered by New York and threatened by USFWS. The bog turtle is a semiaquatic reptile whose habitat includes shallow, cool and slow moving water, soft and deep muck soils, and tussock-forming herbaceous vegetation. These turtles are often found in the open and require access to sunlit areas. No Bog Turtles have been documented at IPEC and their potential presence is limited. The potential to be impacted by the proposed retrofit of Unit 2 is minimal.

New England Cottontail: The New England Cottontail is federally listed as a species of special concern within the state of New York. Although this species in not yet on either the threatened or endangered species lists, the rapid decrease in population due to habitat loss has drawn attention to preventing future reduction of cottontail habitat. These cottontails typically occupy young forests, thickets, brushy fields and other locations with similar coverage of brush, shrubs, and densely growing young trees. The forested area where the Unit 2 cooling tower would be sited could potentially impact habitat for the New England Cottontail, although no observations have been documented to date. A more detailed field survey would be required prior to construction.

3.10 Transportation and Navigation: See Tetra Tech Supplement, Section 2.

Q. Please summarize the information that you relied upon or considered for your prefiled direct testimony.

A. In addition to my education, experience, training, best professional judgment, and the references set forth in my testimony, my testimony is based on the following information:

- CTI. 2008. Legionellosis. Guideline: Best Practices for Control of Legionella. July 2008.
- CTI. 2009. Cooling Technology Manual, Chapter 9. Materials of Construction for Cooling Towers. October 2009.

- ECA Community Planning. 2012. Memorandum to Tetra Tech – Indian Point Visual Assessment Review, Site Visit Summary. June 19, 2012 (with references set forth therein).
- Enercon Services, Inc. 2003. Economic and Environmental Impacts Associated with Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration. 2003 (with references set forth therein).
- Enercon Services, Inc. 2010. Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration. February 12, 2010 (with references set forth therein).
- Fairfax NZ News. 2008. Christchurch cooling tower linked to legionella. May 1, 2008.
- Garcia-Fulgueiras, Ana et. al. 2003. Legionnaire's Disease Outbreak in Murcia, Spain. Emerging Infectious Diseases. Vol. 9, No. 8. August 2003.
- Greig, Jane. Ph.D. 2004. An outbreak of Legionnaire's Disease at the Melbourne Aquarium, April 200: investigation and case-control studies. Medical Journal of Australia. Vol. 180, p. 566-572. June 7, 2004.
- Hatch, Ltd. 2012. Indian Point Engineering Review: Engineering Feasibility Study for the Implementation of Closed-Loop Cooling Using Plume Abatement Cooling Towers at Indian Point Units 2 and 3. December 18, 2012 (with references set forth therein).
- Marley. (SPX Cooling Technologies). 2009. Preferred Cooling Tower Water Condition Limits. September 4, 2009.
- Marley. (SPX Cooling Technologies). 2010. Marley Class F400 Cooling Tower: Product Specifications. 2010.

- Marley (SPX Cooling Technologies). 2012. F400 ClearSky Cooling Tower Operation and Maintenance User Manual. June 2012.
- NYSDEC. 2011. CP-52: Best Technology Available (BTA) for Cooling Water Intake Structures. July 10, 2011 (with references set forth therein).
- Saratoga Associates. Indian Point Energy Center Closed Cycle Cooling Conversion Feasibility Study: Visual Assessment. June 1, 2009 (with references set forth therein).
- TRC. 2009. Cooling Tower Impact Analysis for the Entergy Indian Point Energy Center. September 1, 2009 (with references set forth therein).
- TRC. 2013. Entergy Response Document To the Tetra Tech Report and the Powers Engineering Report. December 13, 2013 (with references and appendices therein).
- Tetra Tech. 2009. Memorandum to NYSDEC – 2003 Enercon Report Review (Revised). November 18, 2009 (with references set forth therein).
- Tetra Tech. 2009. Memorandum to NYSDEC – Visual Assessment for Proposed Indian Point Cooling Towers. October 14, 2009 (with references set forth therein).
- Tetra Tech. 2010. Memorandum to NYSDEC – 2010 Indian Point Engineering Feasibility Review. July 6, 2010 (with references set forth therein).
- Tetra Tech. 2013. Indian Point Closed-Cycle Cooling System Retrofit Evaluation. June 2013 (with references set forth therein).
- United Water. 2012. United Water New York, Inc. Haverstraw Water Supply Project, Draft EIS, Chapter 2. January 13, 2012.
- Walker, David, Ph.D., James Young, Ph.D and Bonnie Henry, Ph.D. 2005. Report of the Expert Panel on the Legionnaire's Disease Outbreak in the City of Toronto- September/October 2005. December 2005.

Q. Does this conclude your direct testimony on these topics?

A. Yes, it does.

EDMS#489018v1

TIM HAVEY

Environmental: Senior Environmental Scientist

EDUCATION

BS, Environmental Science and Public Policy, Fordham University, 1994

REGISTRATIONS/CERTIFICATIONS

Certified Lead Auditor: ISO 14001:2004

EXPERIENCE SUMMARY

Mr. Havey is an accomplished project manager and permitting compliance specialist with 15 years of experience supporting clients on a broad range of regulatory requirements, with a particular focus on the National Pollutant Discharge Elimination System (NPDES) program. Through this experience, he has developed an understanding of how to develop and maintain productive working relationships with key state and federal agency staff throughout the permitting process. In Alaska, Mr. Havey has worked closely with ADEQ, ADNR and EPA Region 10 staff to secure a new source APDES permit for the Rock Creek Mine and led the effort to adopt a revised closure and reclamation plan on an accelerated schedule. Mr. Havey has written numerous NPDES permits for industrial facilities and is currently supporting similar permitting efforts for large mining clients in Arizona, Colorado, and Idaho.

Mr. Havey also has a strong background managing and analyzing large data sets used to support various water quality analyses and modeling efforts. He has developed numerous databases and user-friendly tools in MS Access, Excel, SQL Server, and SharePoint, and is proficient in VBA and SQL.

PROJECT EXPERIENCE

Permitting and Compliance

- ***Rock Creek Mine Permitting and Compliance Support.*** Developed APDES permit application materials, including draft permit and fact sheet language. Conducted reasonable potential analyses on water quality data to develop effluent limitations and routinely met with ADEQ and EPA staff to secure a final permit. Developed revised stormwater pollution prevention plan and oversaw general compliance reporting to ADEQ and ADNR. Led effort to draft a revised closure and reclamation plan and reclamation bond calculation, working closely with ADNR staff to meet client's aggressive schedule requirements. Implemented environmental management system to track compliance reporting. Developed MS Access database to manage 100,000+ compliance data points and efficiently standardize data from multiple laboratories.

- ***American West Potash, Arizona.*** Environmental discipline lead overseeing applications for aquifer protection, air quality, storm water, and mineral development permits for new underground potash mine in eastern Arizona. Developed permitting strategy to avoid all federal permitting requirements, allowing the project to proceed on an accelerated schedule.

- ***Usibelli Coal Mine.*** Assisted in developing land application permit materials for non-domestic wastewater disposal system using a series of small infiltration ponds near New Jumbo Creek and Marguerite Creek in northern Alaska.

- ***Sunshine Mine Permitting and Compliance Support.*** Currently developing NPDES application for large silver mine in northern Idaho and revising stormwater pollution prevention plan for re-opened mine. Project will involve mixing zone analyses for existing facility discharging to impaired waters.

- ***Climax Mine Permitting, Freeport McMoran.*** Assisted in finalizing the NPDES permit application with CDPHE for the Climax Mine near Leadville, Colorado. Conducted water quality analyses to determine compliance potential at proposed outfalls.

- ***NPDES Permit Development for POTW and Industrial Dischargers, California State Water Board.*** Provided technical support to California State Water Board in developing and standardizing NPDES permits for POTW and industrial dischargers, with a particular focus on steam electric power plants. Responsible for drafting Waste Discharge Requirements and supporting documents as part of the permitting process. Evaluated existing 316(b) Demonstration Studies, determined their suitability to continue to serve as a basis for BTA determinations, and made recommendations for changes in study requirements. Evaluated technological and operational options available to existing dischargers for minimization of entrainment and impingement impacts.

- ***NPDES-Permitted Facilities Compliance Evaluation Inspection.*** Conducted more than 200 compliance evaluation inspections (CEI) for NPDES-permitted facilities in California. Inspections assess current levels of compliance as well as collect additional data for reissuance of NPDES permits. Compiled data to provide region- and state-wide trends in compliance and identified target areas for compliance assistance.

- ***Clean Water Act National Standards Development Technical Support, Environmental Protection Agency.*** Provided technical support to EPA in the development and implementation of national standards under the CWA Section 316(b). Developed intake flow estimates using existing industry data to establish intake limitations for riverine, lacustrine, estuarine, and marine facilities. Evaluated different technology-based solutions and developed performance estimates for various technologies.

- ***Biological Benefits Estimates.*** Compiled case study assessments of more than 200 individual facilities to assist in the development of biological benefits estimates associated with the 316(b) Phase I and Phase II rules. Compiled and analyzed academic evaluations of more than two dozen technological and operational configurations designed to minimize impacts associated with cooling water intake structures. Developed database to manage documents and allow comparative analyses.

- ***Storm Water Sampling Data Analysis, Pennsylvania.*** Developed detailed analysis of storm water sampling data submitted by industrial facilities under the Pennsylvania general permit (PAG-3). Data for over 10,000 samples at more than 200 facilities were compiled to characterize the impact of industrial facility runoff on the health of state waters and to assess the overall effectiveness of the current PAG-3 requirements. Proposed water-quality pollutant sampling recommendations for the re-issued permit using sampling data.

- ***Municipal Storm Water Phase II Program Development.*** Assisted EPA in the development of the municipal storm water Phase II program. Collected and analyzed construction start data from 14 municipalities and extrapolated development patterns to characterize national construction start averages. Used averages to justify lowering the construction threshold to one disturbed acre and to estimate the fiscal and administrative burden to the regulated community as well as the permitting agency. Provided EPA with assessments of Best Management Practices and developed implementation fact sheets to assist municipalities in implementing the new program.

- ***Multi-sector General Permit, Environmental Protection Agency.*** Assisted EPA in re-issuing the 2000 Multi-sector General Permit for industrial activities (MSGP). Provided sampling analysis for each of the industrial sectors required to monitor for water-quality pollutants and made recommendations for continuation/discontinuation of monitoring requirements. Provided technical review of revised permit language and modified the permit comply with standard language permit requirements.

- ***NPDES Construction General Permit.*** Supported the re-issuance of the NPDES Construction General Permit (CGP) for non-authorized states, territories, and tribes. Specifically, collected examples of Storm Water Pollution Prevention Plans (SWPPP) and sampling data to support proposed revisions to the previous CGP. Made final recommendations to streamline application procedure and clear up inconsistencies between CGP and stated NPDES goals.

- ***Power Plant Once-Through Cooling System Policy Development, California State Water Resources Control Board.*** Developed a statewide policy applicable to existing power plants with once-through cooling systems. Support includes analyzing costs and benefits of proposed compliance options as well as conformity with accepted engineering practices for cooling system and power plant operation.

- ***Storm Water Best Management Practices Review, Pennsylvania.*** Reviewed storm water Best Management Practices (BMP) employed at industrial facilities in Pennsylvania under that state's industrial general permit. Responsible for reviewing site plans and existing state BMP criteria with a final goal of assessing the effectiveness of the inclusion of BMPs in the industrial storm water program. Final report characterized specific BMPs and their relative effectiveness for the various sectors of industrial activity.

Engineering Evaluation / Cost Analysis

- ***Wet Cooling Tower Retrofit Technical Proposal Review, New York State Department of Environmental Conservation, New York.*** Reviewed technical proposals for a wet cooling tower retrofit at the Indian Point Nuclear Power Plant. The review consists of an engineering analysis to determine the suitability of the proposed retrofit as well as an investigation into the scope and scale of secondary impacts such as noise, aesthetics, grid reliability, and energy efficiency losses.

- ***Closed-Cycle Wet Cooling System Cost and Engineering Feasibility Analysis, State of California, California.*** Conducted detailed cost and engineering feasibility analysis for retrofitting 15 once-through cooled power plants to closed-cycle wet cooling systems for State of California. Developed project-level BPJ determinations of technical and logistical feasibility, initial capital and life cycle cost estimates, and estimates of long-term secondary environmental impacts such as efficiency losses and air emission increases.

PRESENTATIONS

Wet Cooling System Retrofit Impacts: A Technical and Economic Perspective., (Presenter), California State Water Board WISER Once-through Cooling Symposium., Davis, CA, 2008.

Technology Evaluation and Assessment Criteria for Impingement and Entrainment Controls., (Presenter), California State Water Board Cooling Water Seminar., Monterey, CA, 2006.

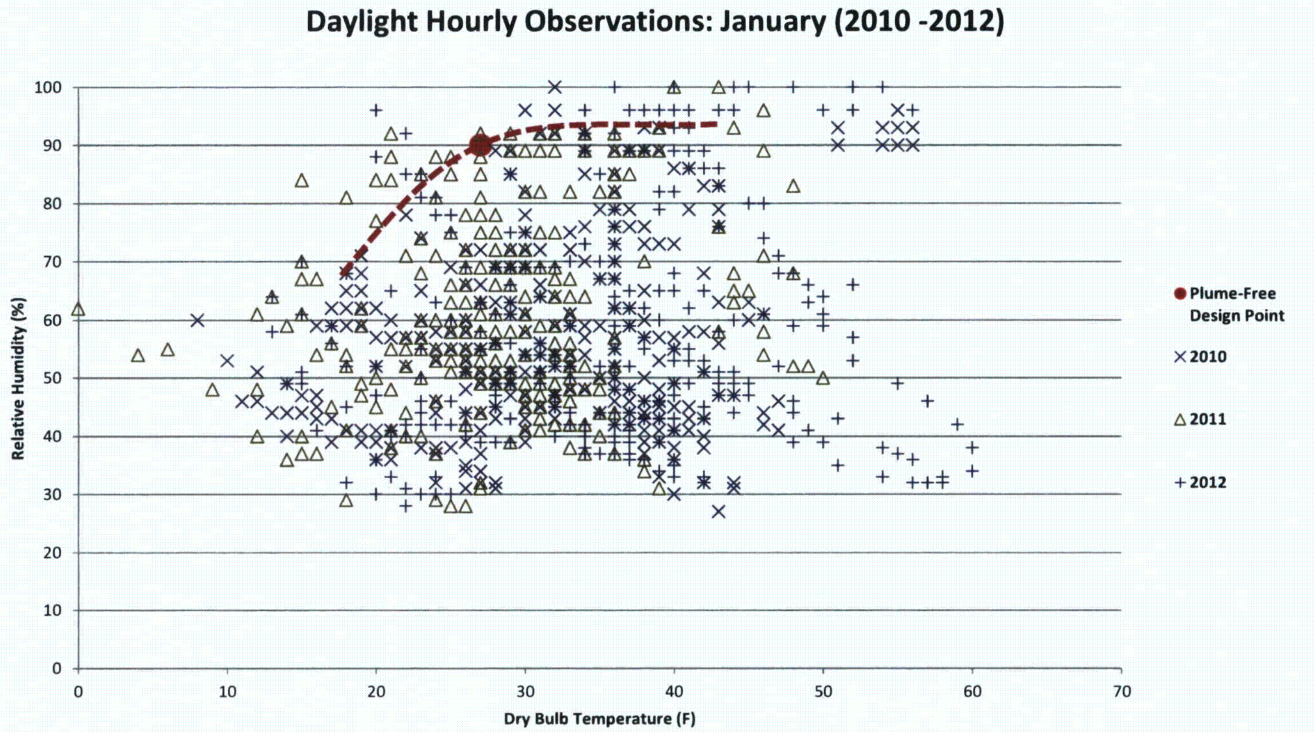
Federal Regulatory Impacts on California Steam Electric Facilities., (Presenter), California State Water Board Workshop on Implementation of CWA 316(b) Regulations., Laguna Beach, CA, 2005.

PROFESSIONAL EMPLOYMENT HISTORY

Senior Environmental Scientist, Tetra Tech, 1999 to Present
Environmental Scientist, SAIC, 1998 to 1999

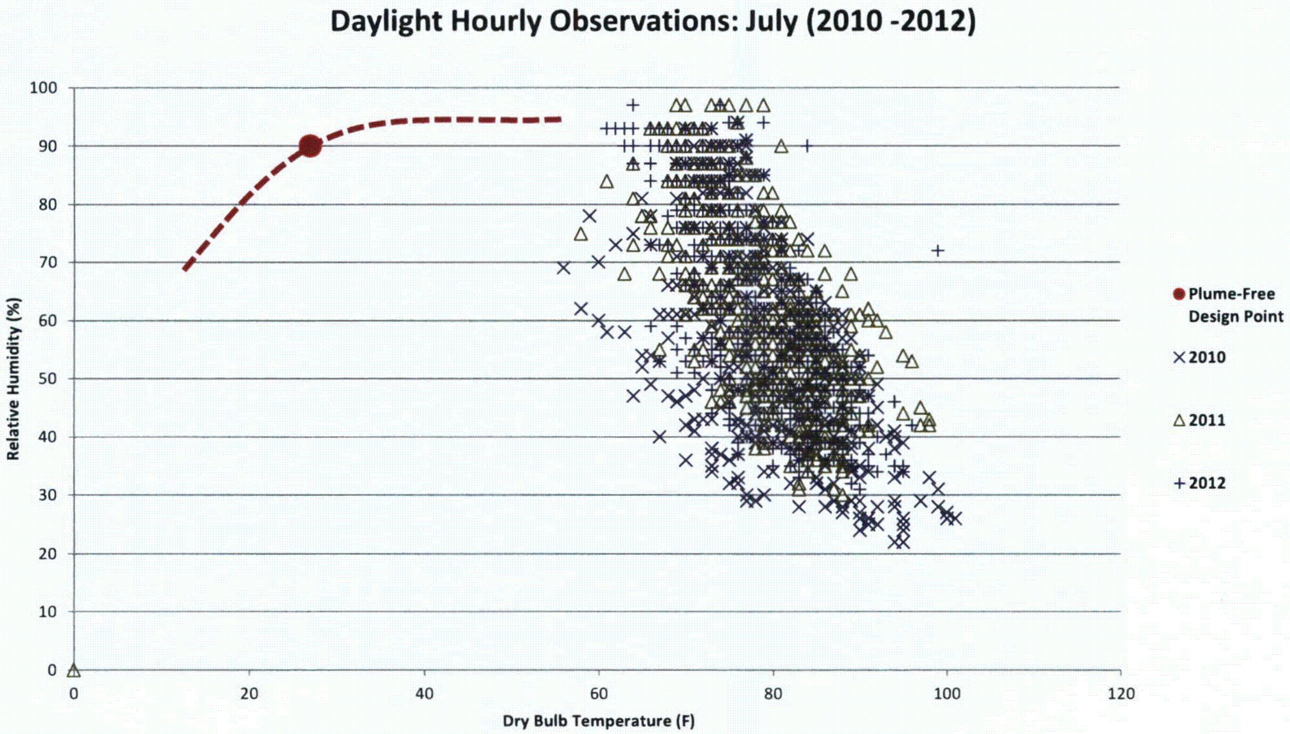
Section 1: Plume Abatement

Figure 1A: Estimated Plume-Free Conditions (January)



Daylight hours bounded by civil twilight (6 degrees below horizon)
Source: NOAA, Hourly Observations for Westchester County Airport, White Plains, NY
Plume-free conditions are estimated only; does not factor wind speed, wind direction, or duration.
Total observations plotted = 1023

Figure 1B: Estimated Plume-Free Conditions (July)



Daylight hours bounded by civil twilight (6 degrees below horizon)
Source: NOAA, Hourly Observations for Westchester County Airport, White Plains, NY
Plume-free conditions are estimated only; does not factor wind speed, wind direction, or duration.
Total observations plotted = 1581

Section 2: Transportation and Navigation Estimates

Truck Haul

While the preferred construction option relies heavily on barges to remove most spoil materials, some portion will still be removed by surface trucks. Tetra Tech assumed that all overburden material, consisting of organic and inorganic soils as well as plant material, will be removed by truck. An additional volume of blast spoils would be removed by truck when access to the pier was interrupted.

New York Vehicle and Traffic Law §385 limits the gross vehicle weight to 80,000 lbs. An empty side dump truck with a haul capacity of 30 cubic yards weighs approximately 31,000 lbs. Therefore, the material weight cannot exceed 49,000 lbs. Assuming a soil weight of 2,430 lbs/cubic yard, each truck could haul no more than 20 cubic yards without exceeding weight limits.

Tetra Tech estimated the total overburden volume to be approximately 150,000 cubic yards. This volume is based on an assumed overburden depth of 2 feet across the footprint areas. At a minimum, overburden removal would require 7,500 truck trips. Including a contingency of 20 percent raises this number to 9,000.

If trucks were to be used to remove all blasting spoils in addition to the overburden, the number of truck trips would increase significantly. Roughly 1.9 million cubic yards of blast spoils will be produced during the excavation period. These spoils will consist almost entirely of marble, which weighs approximately 2,700 lbs/cubic yard. At this weight, individual truck loads would be limited to 18 cubic yards. This translates to approximately 106,000 truck trips, increased to 126,000 to include a 20 percent contingency.

Barge Haul

Blast spoils removal by barge is the preferred construction alternative for materials removal. While barges will not eliminate truck traffic, they will significantly reduce the truck frequency and volume on local streets. Grouped barges consisting of 6 or 7 individual barges can be anchored offshore in the Hudson River and brought to the pier at Indian Point for loading. Each barge has 2,000 ton capacity, which is the equivalent of 1,500 cubic yards of marble, or approximately 82 truckloads. Over the course of the project, this translates to more than 1,200 individual barge loads.

100% Recycled 30% PCW

ENGINEERING FEASIBILITY AND COSTS OF CONVERSION OF INDIAN POINT UNITS 2 AND 3 TO A CLOSED-LOOP CONDENSER COOLING WATER CONFIGURATION

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

Prepared by:

Enercon Services, Inc.
500 TownPark Lane, Suite 275
Kennesaw, GA 30144

February 12, 2010

TABLE OF CONTENTS

Attachments

Executive Summary

Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC (collectively, Entergy), have submitted a timely and complete renewal application for a State Pollutant Discharge Elimination System (SPDES) permit (SPDES Permit NY0004472) for Indian Point Energy Center (IPEC) nuclear powered electric generating stations 2 and 3 (collectively, the Stations, individually Unit 2 and Unit 3). The New York State Department of Environmental Conservation (NYSDEC) staff has proposed modifications in IPEC's draft SPDES permit, including possible construction and operation of cooling towers in a closed-loop cooling configuration (NYSDEC Proposed Project). Consideration of the NYSDEC Proposed Project is subject to certain feasibility and alternative technologies assessments, as directed by the NYSDEC Assistant Commissioner's August 13, 2008 Interim Decision. Accordingly, NYSDEC may revisit its proposed modifications to the draft SPDES permit for IPEC and change them pursuant to Entergy's closed-loop cooling feasibility and alternative technologies reports.

The Interim Decision provides that Entergy must submit an engineering report that addresses significant construction and operational considerations, associated with conversion of the Stations' existing cooling water systems to closed-loop cooling, taking into account site constraints, including, but not limited to, existing physical features and the relocation of the Algonquin Gas Transmission pipelines. As part of this feasibility analysis of the NYSDEC Proposed Project, this Report supplements and amends the preliminary 2003 Economic and Environmental Impacts Associated with Conversion of IPEC Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration Report (2003 Report), prepared by Enercon Services, Inc. (ENERCON).

ENERCON was retained to further evaluate the potential conversion to closed-loop cooling. While different types of cooling towers exist, with varying levels of cost, performance, and impacts, the cooling tower configurations that could reasonably be considered for Unit 2 and Unit 3 are limited to a single 100% capacity round hybrid cooling tower for each Unit.

Even with this configuration, several site-specific conditions have been identified at IPEC that would challenge the feasibility of the NYSDEC Proposed Project. Such challenges include, but are not limited to, the following:

- As TRC Environmental Corporation concluded, air emissions resulting from operation of the cooling towers would exceed the National Ambient Air Quality Standards for PM_{10} and $PM_{2.5}$. Saltwater cooling towers of the scale proposed at IPEC would typically be expected to produce plume emissions exceeding National Ambient Air Quality Standards in non-attainment areas (see discussion of San Onofre Nuclear Generating Station in Section 7.2).
- As Saratoga Associates, Landscape Architects, Architects, Engineers and Planners, P.C. concluded, construction of cooling towers at IPEC may be incompatible with New York law and policy relating to scenic resources and aesthetic impacts.
- Archeological concerns have been identified that could affect the excavation schedule and, potentially, tower placement.

- The required tower configurations do not conform to municipal law, and Village of Buchanan officials are on record in opposition to the construction of cooling towers at IPEC. As such, required local zoning approvals may be difficult to obtain.
- The topography of the IPEC site and general space constraints, in conjunction with the fact that the elevation of the tower basins must be sufficiently low to prevent damage to the condenser tubes, limit the potential locations for cooling towers. Where located, approximately 2 million cubic yards of soil and inwood marble bedrock would need to be excavated in conjunction with tower construction. This exceeds 50% of the total crushed marble sold or used in the U.S. in 2007. Blast removal would be required to excavate large quantities of bedrock at the cooling tower locations and in the piping trenches outside of the Riverfront area. To avoid prolonged forced outages, blasting operations are proposed to occur while both Units are online. For reference, blasting operations would produce quantities of broken rock equivalent to between 364 and 518 truck loads (20-cubic yard capacity) each day.
- Excavation in the Riverfront area would intersect groundwater contamination plumes containing tritium and strontium, with potential for soil contamination, requiring sampling, analysis, handling, and disposal protocols. Additional construction delays beyond those identified in this Report may result from these conditions.
- Algonquin Gas Transmission pipelines currently exist where the Unit 3 tower would be constructed, requiring relocation of those facilities within the IPEC site. The Algonquin Gas Transmission pipelines supply approximately 50% of the natural gas demand in New England, and the pipelines' owner has emphasized that this supply cannot be interrupted, requiring accommodations that may cause further construction delay. This relocation also would require Federal Energy Regulatory Commission (FERC) approval.
- Conversion of the Stations to closed-loop cooling would be an unprecedented undertaking that would likely encounter unforeseen challenges during design and implementation that are not anticipated or addressed here.

The total duration of the NYSDEC Proposed Project is expected to extend almost 13 years. This schedule includes an 18-month design period before NYSDEC approval, a 36-month permitting and licensing period between NYSDEC approval of the project and the start of construction, and the expected construction duration of more than eight years, which includes an estimated 42 weeks of continuous forced outage, conducted simultaneously, at both units. Of the eight-year construction schedule, approximately four years would be required for drilling, blasting, and spoils removal. This construction timeframe reflects conditions that have arisen since the initial 2003 conceptual construction schedule, as well as additional analysis of the conditions described at that time, including the following:

- Excavation for the conversion to closed-loop cooling would overlap with areas of known radiological groundwater contamination, the remediation of which is currently subject to NRC oversight. Development and employment of protocols for sampling, analysis, handling and disposal of contaminated soil and water may result in substantial construction delays.
- The relocation of the on-site Algonquin pipelines must be undertaken and completed prior to any blasting work performed at the Unit 3 cooling tower location.

Considering the conceptual nature of the current design parameters, the lack of comparable retrofits, and typical unknown conditions that arise in major construction projects, this schedule represents a reasonably aggressive scenario. Significantly longer durations than currently estimated could result.

The anticipated direct overnight capital cost for the conversion for both Unit 2 and Unit 3 is collectively estimated at a minimum of $1.19 billion. The estimated cost includes relocation of the Algonquin Gas Transmission pipelines. As Unit 2 and Unit 3 have net capacities of 1078 MWe and 1080 MWe, respectively, a 42 week forced outage at both Units 2 and 3, accounting for a coincident maintenance outage at one Unit, would result in approximately 14,502,000 MWhr of lost electrical generation, significantly increasing the overall costs of conversion and adverse environmental impacts. A subsequent report will address forced outage costs specifically, as well as related impacts.[1]

As a result of conversion, the Stations would also incur ongoing operational and parasitic electrical generation losses. Averaged across the entire year, the combined operational and parasitic losses would be approximately 88.2 MWe; however, operational power losses would increase to approximately 157.8 MWe during the peak summer power generation season. Again, this report does not directly calculate the impacts of lost electrical generation. In addition to ongoing operational and parasitic losses, the Stations would also incur annual operations and maintenance costs due to the NYSDEC Proposed Project. Annual operations and maintenance costs associated with closed-loop cooling at the Stations would be more than $4 million for the first five years, with increasing costs in the subsequent years due to the need for increased equipment replacement and repair.

No nuclear stations designed solely for once-through cooling have been converted to closed-loop cooling. Conversion of the condenser cooling system of an existing plant presents fundamental design problems that result in plant performance impacts or require redesign of the condenser. At the Stations, the expected performance impacts could not be mitigated by condenser modifications without the complete reconstruction of the turbine building. Moreover, absent any practical history of closed-loop cooling retrofits at nuclear facilities, engineering observations and conclusions regarding any such conversion must be made on a purely speculative basis and are inherently subject to unforeseen challenges during the detailed design phase and the subsequent implementation. As such, the cost and schedule estimates presented herein are likely understated, representing a lower bound for the cost and durations for the actual project. In addition, due to the untried nature of this type of conversion and the intrusive plant modifications that would be required, the feasibility of a closed-loop cooling retrofit at a nuclear facility cannot be guaranteed at any point in the design stage. Only upon successful operation of a completed closed-loop cooling retrofit could this type of conversion be conclusively considered feasible.

[1] Entergy's legal counsel has directed that forced outage costs be considered, consistent with the Interim Decision, under New York's State Environmental Quality Review Act ("SEQRA") and/or an economic test not currently defined by NYSDEC in a separate assessment, and accordingly need not be addressed now.

1 Background and Introductions

1.1 History

Unit 2 and Unit 3 were each approved for service by the New York Public Service Commission in the mid-1970s to meet a demonstrated need for electric power. Both Units are pressurized water reactors (PWRs) with net capacities of 1078 MWe and 1080 MWe for Unit 2 and Unit 3, respectively. Located on the east side of the Hudson River in the Village of Buchanan, each Unit utilizes a once-through type condenser cooling water system (i.e., circulating water (CW) system), with the intakes from and a shared discharge canal to the Hudson River. The design flow rate of the CW system (i.e., CW system capacity) for each unit is 840,000 gpm.

1.1.1 PWR System Operation

Unit 2 and Unit 3 are Westinghouse four-loop PWRs. PWRs consist of two separate systems: a closed, pressurized reactor coolant system (primary system), and a power conversion system (secondary system) for the generation of electricity. The basic configuration of a typical PWR is shown in Figure 1.1. In the primary system, reactor coolant is heated by nuclear fission in the reactor. The primary system operates at high pressure to prevent the production of steam in the reactor. The heated reactor coolant is used in the steam generators to produce steam in the secondary system. The steam formed in the steam generator is transferred by the secondary system to the main turbine generator, where it is converted into electricity. After passing through the low pressure turbine, the steam is routed to the main condenser, which is operated at a vacuum to allow for the greatest removal of energy by the low pressure turbines. The steam is condensed into water in the condenser by the flow of circulating water through the condenser tubes. The water is then pumped back to the steam generator for reuse. The primary and secondary systems are physically separated in the steam generator, minimizing radioisotope transfer to the secondary system.

The power output of the reactor, and the outlet temperature of the reactor coolant, are controlled by adjusting several factors which affect the core's reactivity. The reactor control system is designed to avoid nuclear plant transients for prescribed design load perturbations. Long-term regulation of the core reactivity is accomplished by adjusting the concentration of boric acid in the reactor coolant, while short term reactivity control for power changes or reactor trip is accomplished by the movement of control rod clusters [Ref. 12.7].

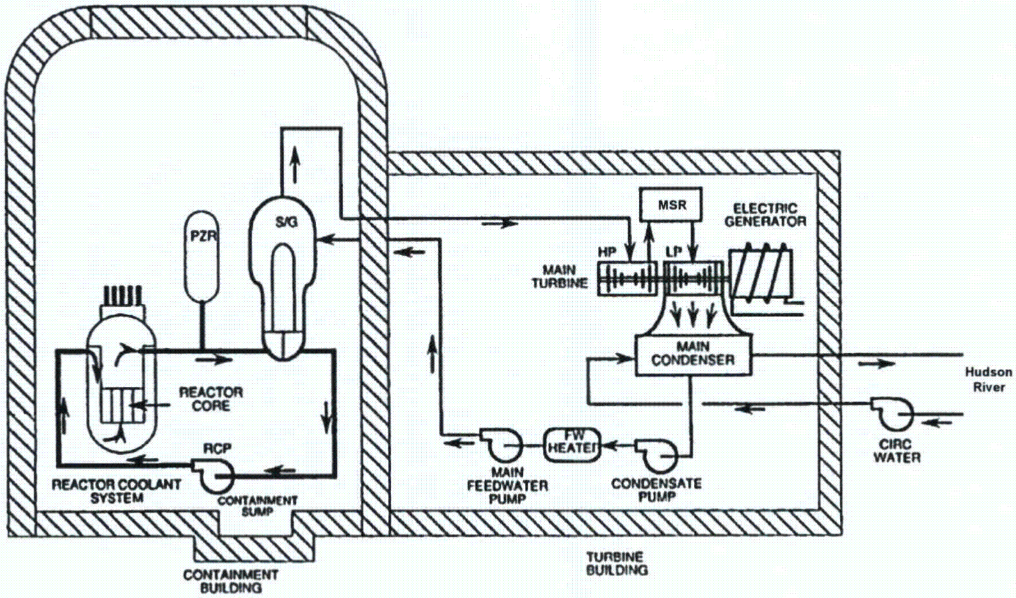


Figure 1.1 Basic Arrangement of a PWR

1.1.2 Circulating Water System Background

The circulating water systems for Unit 2 and Unit 3 each consist of six circulating water pumps that draw water from the Hudson River and discharge into the inlet water boxes of their respective condensers. Each circulating water pump has a design intake flow capacity of 140,000 gpm and is housed in an individual well within each unit's consolidated cooling water intake structure (CWIS). Unit 2 and Unit 3 have separate CWISs, each configured with central service water intake channels located between three circulating water channels on each side. The CWISs contain bar racks that filter debris, and coarse mesh traveling water screens that filter fish and residual debris from the intake water prior to the circulating water pumps suction. Unit 2 contains six Allis Chalmers dual speed circulating water pumps rated at 140,000 gpm at 21 feet total dynamic head (TDH) when running at 254 rpm, and 84,000 gpm and 15 feet of total dynamic head when running at 187 rpm. Unit 3 contains six Allis Chalmers variable speed pumps that are rated for 140,000 gpm at 29 ft TDH when running at 360 rpm and 84,000 gpm at 19.5 ft TDH when running at 250 rpm. The circulating water pumps discharge through 84 inch headers to the inlet water boxes and the circulating water subsequently passes through the condenser tubes condensing steam admitted from the turbines. Flow from the condenser outlet waterboxes of Unit 2 and Unit 3 is discharged through 96 inch piping, and combines in the discharge tunnel prior to being returned to the Hudson River via the discharge canal.

1.1.3 Novelty of Closed-Loop Cooling Retrofits

No nuclear power plant designed for once-through cooling has ever been retrofitted to closed-loop condenser cooling. One nuclear power plant, Palisades Nuclear Generating Station (PNGS), although initially designed for once-through cooling, was redesigned for closed-loop cooling during construction; consequently, the circulating water system components, particularly the condensers, were sized to accommodate the expected heat rejection capability provided by cooling towers.

Absent any practical history of closed-loop cooling retrofits at nuclear facilities, engineering observations and conclusions regarding any such conversion must be made on a purely speculative basis and are inherently subject to unforeseen challenges, with a corresponding, potentially large, degree of uncertainty. Thus, conclusions about feasibility, while based on best professional judgment, do not have the benefit of either available technology or past efforts at comparable facilities. Due to the untried nature of this type of conversion and the intrusive plant modifications that would be required, the feasibility of a closed-loop cooling retrofit at a nuclear facility cannot be guaranteed at any point in the design stage. Only upon successful operation of a completed closed-loop cooling retrofit could this type of conversion be conclusively considered feasible. Likewise, only direct comparison to a successful closed-loop cooling retrofit could provide reliable basis for cost estimates. For this assessment, cost estimates were done in such a way as to minimize the necessary assumptions, and relied instead on well-developed, detailed conceptual designs. However, given the absence of any practical applications, costs are likely to be understated.

1.1.4 Conclusions from the 2003 Report

In 2003, ENERCON performed a preliminary evaluation of the feasibility of converting IPEC Units 2 and 3 to closed-loop cooling, and an assessment of the associated economic and environmental impacts (see Attachment 1). The 2003 Report concluded that conversion of IPEC to closed-loop cooling would be theoretically feasible; however, with appreciable elevation changes, a general lack of available space, a subsurface primarily composed of solid rock, the location of a major interstate gas pipeline, local air quality, archeological and aesthetic considerations, etc., significant site-specific challenges existed. This Report further investigates these and other challenges to a closed-loop conversion of IPEC.

There are various methods for heat rejection from a closed-loop cooling system, including cooling ponds, canals, and towers. However, the 2003 Report concluded that cooling towers would be the only heat rejection method not rendered infeasible by space constraints at IPEC. Several cooling tower types were evaluated: natural-draft towers, mechanical-draft towers, and hybrid towers.

Conversion of the condenser cooling system of an existing plant presents fundamental design problems. The design of the condenser and turbine is based on the anticipated temperature of the condenser cooling water. If the condenser cooling water were not as cold as the original once-through design requires for optimal performance, then the condenser heat rejection would be reduced and the backpressure on the turbine increased. With an increase of backpressure on the turbine, performance is significantly affected, and ultimately generator output is reduced. The 2003 Report determined that cooling towers, through evaporative cooling, could not match the low temperature of the River intake. In the winter months the impact would be lessened, but during the summer performance would suffer appreciably.

Due to IPEC-specific zoning and permitting constraints, a tower with visible plume abatement and noise abatement was deemed necessary. Additionally, due to the rocky terrain and rapid elevation changes, a tower with a minimum footprint was selected to reduce overall excavation and clearing. A single round hybrid cooling tower for each Unit was found to most closely meet each Unit's performance needs.

A hybrid, also referred to as a "wet/dry" or "plume abated" cooling tower, addresses many of the shortcomings of other types of cooling tower, particularly as applies to the IPEC site. Basically, a hybrid tower is the combination of the wet tower, with its inherent cooling efficiency, and a dry heat exchanger section used to reduce or eliminate visible plumes in the majority of atmospheric conditions. After the plume leaves the lower "wet" section of the tower, it travels upward through a "dry" section where heated, relatively dry air is mixed with the plume in the proportions required to achieve a non-visible plume in most circumstances.

Figure 1.2 illustrates the air flow path through a cell of a parallel path hybrid tower, and the applicable simplified psychrometric chart.

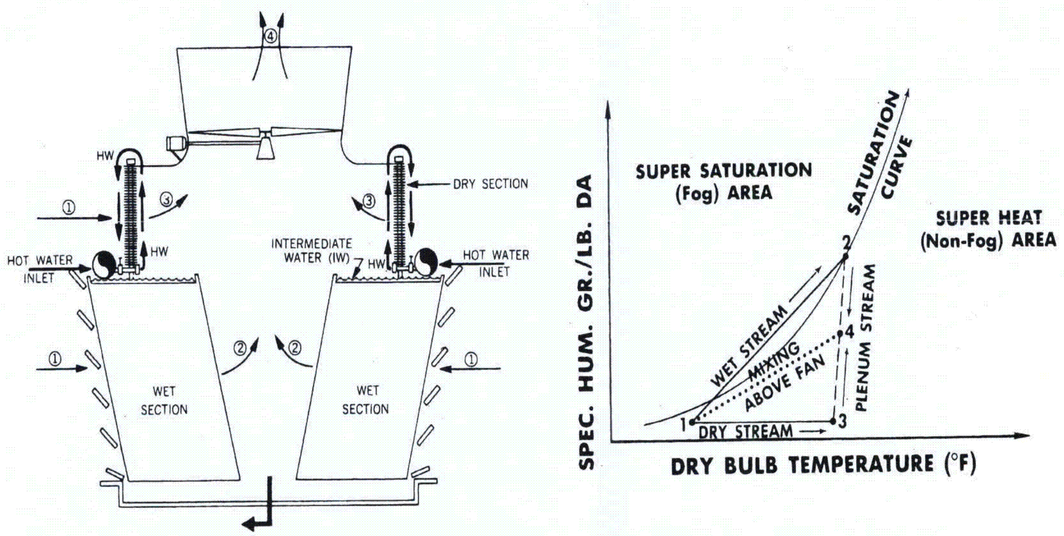


Figure 1.2 Partial Desaturation of Air in a Parallel Path Hybrid Tower

A hybrid cooling tower is designed to significantly reduce both the apparent density and the persistency of the plume. Incoming hot water flows first through the dry heat exchanger (finned coil) sections, then through the wet (evaporative cooling) fill section. Parallel streams of air flow across the coil sections and through the fill sections, leaving the coil sections at dry condition 3, and leaving the fill sections at saturated condition 2. These two separate streams of air then mix together going through the fans, along the lines 3-4 and 2-4 respectively, exiting the fan cylinder at sub-saturated condition 4. This exit air then returns to ambient conditions along line 4-1, avoiding the region of super-saturation (visible plume) in most cases.

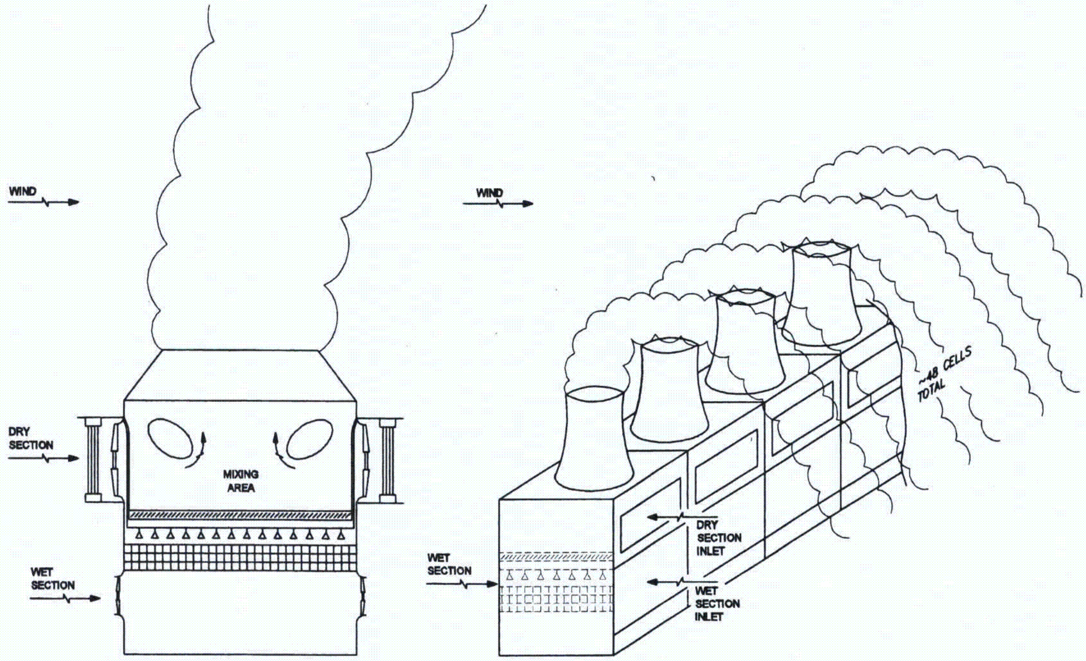


Figure 1.3 Round Hybrid Tower versus Linear Cell-Type Hybrid Tower

As detailed in the 2003 Report, the round hybrid tower has the following attributes and features (see Figure 1.3):

- The concentrated center plume is not susceptible to recirculation to the tower inlets, improving tower performance. Additionally, the center plume is discharged at a higher elevation, approximately 165 feet, and reaches significantly greater heights due to the flow velocity and thermal concentration created by the central discharge shroud. This feature promotes distribution of entrained salts over a much larger area, thus lowering local concentrations, and reducing ground level plumes that could compromise Station systems, including plant security.
- The round tower has an appreciably smaller size footprint than an equal capacity linear tower. With the high excavation costs at IPEC, the smaller footprint would facilitate construction. The round design, at approximately 500 feet in diameter for the required capacity for each Unit, compares favorably to a linear tower that could approach 1500 feet in length, running parallel to the River shore.
- Less piping, in a simpler configuration, is required for a round tower. Supply and return piping is required for each cooling tower. To provide cooling for either Unit 2 or 3, a single round tower or a pair of linear towers would be required. In addition to the requirement for more towers, linear towers are also subject to more restrictive siting requirements. Siting restrictions can significantly increase piping requirements due to the need for adequate spacing between towers and also between towers and other buildings.
- Dedicated fans for the dry and wet sections of the round hybrid allows efficient tower usage, with the dry section fans operating at reduced capacity when ambient

conditions don't dictate their usage for plume control. Linear, cell-type hybrid towers have a single fan per cell, inducing flow through both sections, hence operate at full fan power at all times.

The conceptual design provided in the 2003 Report balanced the siting of each cooling tower against the site terrain and proximity to each Turbine Building to minimize the excavation required. Siting was also constrained by the maximum cooling tower basin elevation, which was fixed by the maximum pressure allowable through the condenser. The cooling tower supply and return piping was also concentrated into two 122-inch and two 144-inch concrete lined steel pipes for each cooling tower to minimize the excavation required and reduce capital costs.

Because any changes to the condenser cooling systems would involve the very heart of the plant, construction in the Riverfront area and tie-in with the condenser cooling systems would have to be completed with both Units in a forced outage. Although much of the excavation work and cooling tower erection could be done pre-outage, new circulating water pumping stations and changes to the common discharge canal force a major outage.

1.2 Purpose and Scope of this Report

Although the existing once-through circulating water scheme provides both the lowest cost method of condenser cooling and supports the highest level of Station capacity, IPEC has been required by the NYSDEC to further evaluate possible conversion of the existing system to a closed-loop circulating water system configuration. The overall purpose and scope of this Report is to determine feasibility of the NYSDEC Proposed Project and, also, update the 2003 Report in order to achieve a higher measure of certainty, with appropriate defined ranges, for the costs of retrofitting with closed-loop cooling and the schedule for doing so. This includes further development of the initial conceptual design to a level of detail commensurate with more accurate subsequent cost estimates, updating the previously estimated construction and procurement costs to the current dollar value, addressing additional impacts and new site conditions identified since the 2003 Report, and updating construction costs and outage schedules to account for additional analysis performed since the original report submittal.

2 Conceptual Design

As discussed in Section 1.1.3, there have been no conversions of existing operating nuclear stations from once-through to closed-loop cooling. Due to this uncertainty, an investigative analysis on the impact of closed-loop cooling on plant systems, operation, and electrical output must be considered. Conversion to closed-loop cooling would represent a massive and difficult engineering and construction undertaking.

Three design alternatives are considered for closed-loop cooling at IPEC: (1) retrofit both Units to closed-loop cooling, (2) retrofit only Unit 2 to closed-loop cooling, or (3) retrofit only Unit 3 to closed-loop cooling. Conceptual designs, including major plant modifications, have been developed for all three alternatives consistent with the conclusions of the 2003 Report (Section 1.1.4). The conceptual designs are based on summary level scope intended to identify challenges and predict budgetary costs.

2.1 Conversion of Unit 2 and Unit 3

The conversion of both Units 2 and 3 to closed-loop cooling would require the installation of two 100% capacity round hybrid cooling towers and the associated piping and equipment (Attachment 1). The cooling towers would need to be placed to the northeast and southwest of the Stations, as shown in Attachment 2, Sketch ENTGNU011-SK-001. Construction of the Unit 3 cooling tower would require relocation of the Algonquin Gas Transmission pipelines, as discussed in Section 4. Each cooling tower would be approximately 165 feet tall and 525 feet in diameter (Attachment 1).

2.1.1 Circulating Water System Piping

The new circulating water piping would need to be routed from new circulating water pumps to the cooling towers and back to the condenser. The cooling tower supply piping would need to be two 120-inch (10 feet) diameter concrete-lined steel pipes (AWWA Specification C200 and C205) per Unit. Gravity-driven flow from the cooling tower basin to the condenser would need to be via two 144-inch (12 feet) diameter concrete-lined steel pipes (AWWA Specification C200 and C205) per Unit.

Retrofitting a nuclear power plant from a once-through cooling design to closed-loop cooling has not occurred; therefore, there is a large degree of uncertainty in the operation of any closed-loop cooling retrofit. The startup, steady-state operation, and shutdown of the closed-loop cooling system would require balancing the circulating water flow between the cooling tower basin and the discharge canal reservoir. The control scheme would require a programmable logic control system and redundant instrumentation, and be capable of balancing the closed-loop cooling equipment to meet ambient environmental conditions, plant operational requirements, and maintain adequate inventory each basin.

2.1.1.1 Pipe Routing / Interferences

The new Unit 2 circulating water pump house would need to be located on the existing discharge canal between the Unit 1 and Unit 3 turbine-generator buildings, as shown in Attachment 2, Sketch ENTGNU011-SK-001. Also shown in Attachment 2, Sketch

ENTGNU011-SK-001, the cooling tower supply piping would need to be routed from the new pump house to the Unit 2 cooling tower through the "Riverfront", the space between the intake structures and turbine-generator buildings of each Unit. There are several underground utilities present in the Riverfront area, the most significant of which is the Unit 2 service water and existing circulating water supply piping and electrical duct banks. Furthermore, this area is commonly used for vehicular traffic and is part of the heavy load path (i.e., the road must withstand loads up to 300 tons). Therefore, the supply and return piping would need to be buried to sufficient depth beneath the road elevation and backfilled to support the current traffic patterns and the resultant structural loads. Outside the protected area (i.e., outside the graded and paved Riverfront area), the piping would need to be routed to the cooling towers following approximately the same gradient as the surface elevation, providing a minimum of 10 feet depth of cover (see Attachment 2, Sketch ENTGNU011-SK-002).

Routing the piping from the Riverfront area to the Unit 2 cooling tower basin presents significant challenges. The piping elevation would rise approximately 15 feet between the Riverfront area and the Unit 2 cooling tower basin, following the gradient of the surface elevation, and excavation of the bedrock would be required. The drainage areas created by the construction of the Independent Spent Fuel Storage Installation (ISFSI) would also create challenges for the Unit 2 pipe routing. These areas would either need to be avoided or moved to appropriate locations consistent with the drainage requirements of the ISFSI.

The new Unit 3 circulating water pump house would need to be located on the existing discharge canal near the end, as shown in Attachment 2, Sketch ENTGNU011-SK-001. The cooling tower supply piping would need to be routed almost directly southeast to the Unit 3 cooling tower. Both the cooling tower supply and return pipes would need to be routed to the cooling towers following approximately the same gradient as the surface elevation, providing a minimum of 10 feet depth of cover (see Attachment 2, Sketch ENTGNU011-SK-003). Inside the protected area, the cooling tower return piping would need to be routed to the Unit 3 condenser through the Riverfront area between the Unit 3 turbine-generator building and intake structure. Similar to the Unit 2 routing, the Unit 3 pipes would need to be buried to accommodate current traffic and access patterns and to avoid many underground utilities, including the existing Unit 3 service water piping.

Installation of the new circulating water piping in the Riverfront area would require an outage of both Units. Several safety-related systems would still require offline cooling (e.g., Spent Fuel Pool, Emergency Diesel Generators); however, the existing service water supply would be interrupted by excavation under and around the service water piping. Each safety-related system requiring offline cooling would need to be reviewed and provided with secondary cooling. Additional security would also be required during construction within the protected area.

2.1.1.2 Tie-In Locations

The Unit 2 cooling tower return piping would tie-in to the existing Unit 2 CW piping in the Riverfront area prior to flowing through the condensers, as shown in Attachment 2, Sketch ENTGNU011-SK-004. Each cooling tower return pipe would supply three existing CW pipes. One cooling tower return pipe would be routed at centerline elevation 1'-0" above MSL through the Riverfront to tie-in to the three northernmost existing CW pipes. The 1'-0" centerline elevation would allow a 7.5' depth of cover. The other cooling tower return pipe would be routed at centerline elevation (-) 11'-0" below MSL through the Riverfront to pass underneath the exiting service water piping at centerline elevation 1'-0" above MSL, with 5' of clearance between pipes. After clearing the existing service water piping, the cooling tower return line rises to centerline elevation 1'-0" above MSL to connect to the three southernmost existing CW pipes. A header would be required at the end of each cooling tower return line to connect to the existing CW pipes at centerline elevation 6'-6" above MSL. A throttling valve would be required after the tie-in on each existing CW pipe to regulate flow to each condenser waterbox and allow for condenser maintenance.

The Unit 3 cooling tower return pipes would tie-in to the existing Unit 3 CW pipes in the Riverfront area prior to flowing through the condensers, as shown in Attachment 2, Sketch ENTGNU011-SK-007. Each cooling tower return pipe would supply three existing CW pipes. One cooling tower return pipe would be routed at elevation 1'-0" above MSL through the Riverfront to tie-in to the three southernmost existing CW pipes. The 1'-0" elevation would allow a 7.5' depth of cover. The other cooling tower return pipe would be routed at centerline elevation (-) 11'-0" below MSL through the Riverfront to pass underneath the exiting service water piping at centerline elevation 1'-0" above MSL, with 5' of clearance between pipes. After clearing the existing service water piping, the cooling tower return line would rise to centerline elevation 1'-0" above MSL to connect to the three northernmost existing CW pipes. A header would be required at the end of each cooling tower return line to connect to the existing CW pipes at centerline elevation 6'-6" above MSL. A throttling valve would be required after the tie-in on each existing CW pipe to regulate flow to each condenser waterbox and allow for condenser maintenance.

The new circulating water pumps for each Unit would draw suction from the modified discharge canal to supply water to the cooling tower supply pipelines. In its modified configuration, the discharge canal would no longer serve its once-through cooling function to return circulation water to the Hudson River and would become the new circulating water pump pit. The new Unit 2 pump house would be located on the discharge canal between the Unit 1 and Unit 3 turbine generator buildings. The new Unit 3 pump house would be located on the discharge canal along the Hudson River bank. Additional details on how closed-loop cooling would require reconfiguration of the discharge canal are provided in Section 2.1.3.

2.1.2 Intake Structure

Although the existing circulating water pumps and screens would no longer be required for closed-loop operation, service water flow would still be maintained through the existing intake structures. The discharge from the service water systems would be used after a conversion to closed-loop cooling for makeup water to the cooling towers.

2.1.2.1 Closed-Loop Operation

The makeup water flow rate required to support closed-loop cooling would vary based on Hudson River water quality and meteorological conditions as further discussed in Section 7.1. In addition, the closed-loop cooling start-up sequence would require a large amount of makeup water to charge the system. All makeup and start-up flow would be supplied to the discharge canal to provide adequate flow to the new circulating water pumps.

Under typical operation, the makeup water flow would be provided to the Unit 2 and Unit 3 reservoirs by the service water discharge. An ancillary makeup pump (shown in Attachment 2, Sketch ENTGNU011-SK-007) would provide additional makeup flow directly to the Unit 2 reservoir under conditions when the total required makeup flow exceeds the service flow discharged by both Units. The additional flow from the makeup pump would flow over the weir between the Unit 2 and 3 pump reservoirs to provide flow to the Unit 3 pump reservoir. The ancillary pump would also likely be used during the closed-loop start-up sequence. The blowdown flow plus any excess service water flow would be discharged through the Unit 2 and Unit 3 reservoir weirs.

Additional operational procedures would be required to ensure flow balance throughout the closed-loop cooling system. As a result, conversion of IPEC to closed-loop cooling would increase the complexity of plant operations and require additional operations personnel.

2.1.2.2 Current Equipment to Remain Under Closed-Loop Operation

The current intake structures are divided into separate channels for each of the six circulating water pumps with a center channel shared by the six service water pumps as shown in Figure 2.1. Each of the circulating water pump channels is served by a Ristroph-type traveling water screen and the service water pump channels have two Ristroph-type traveling water screens.[2]

[2] A full description of the Ristroph-type traveling water screens is included in Section 2.3.1.1 of the Evaluation of Alternative Intake Technologies at Indian Point Units 2 & 3 [Ref. 12.8], submitted with this Report.

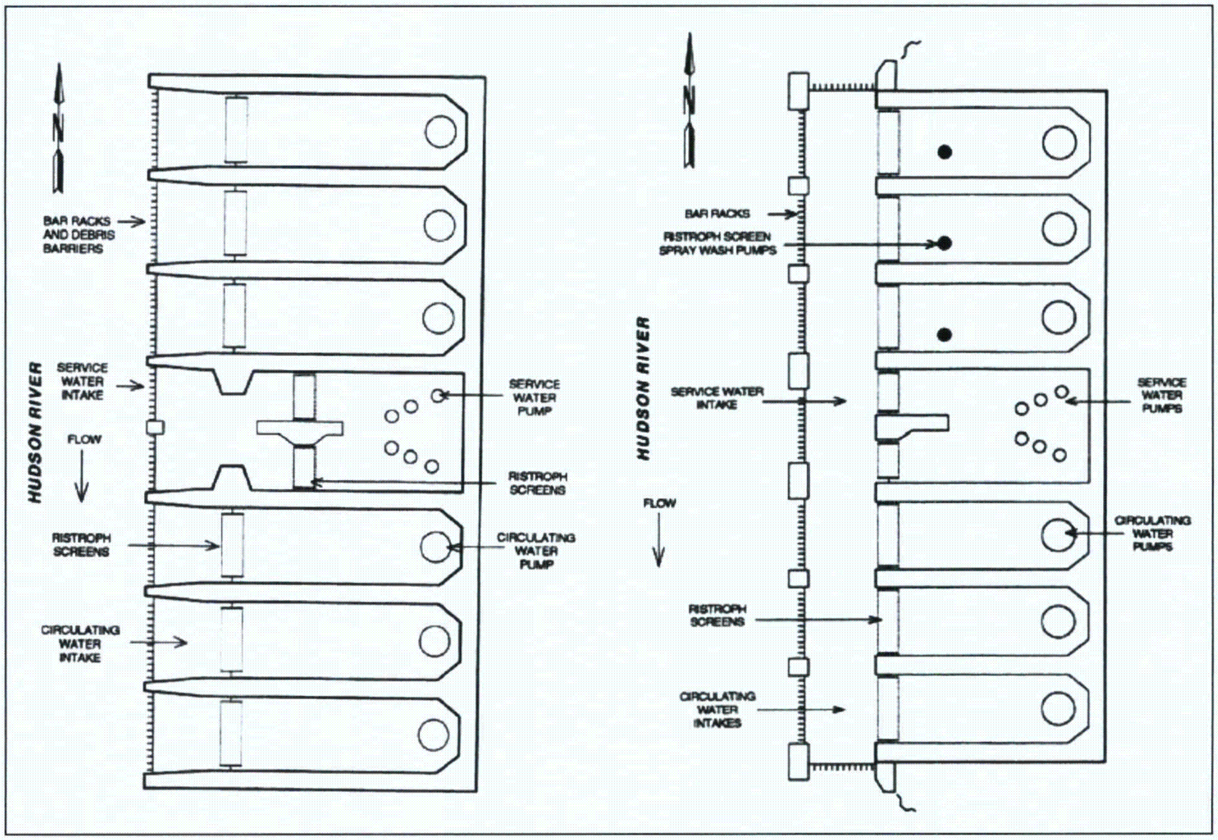


Figure 2.1 Plan View of the Unit 2 (Left) and the Unit 3 (Right) CWISs

Due to the need to maintain the existing safety-related service water systems, four traveling water screens, two at each Unit, would need to be retained.

2.1.3 Discharge Canal

In order to convert Units 2 and 3 to closed-loop cooling, multiple modifications to the discharge canal would be required, as discussed in Sections 2.1.3.2 through 2.1.3.6. The existing discharge canal would need to be modified to serve as a reservoir/pump pit for the twelve new circulating water pumps that would supply the cooling towers. A weir would be installed to separate the Unit 2 and Unit 3 pump reservoirs, as shown in Attachment 2, Sketch ENTGNU011-SK-007. The new reservoirs would provide some operational flexibility, whereby the reserve volume in each reservoir acts as a buffer against flow disruptions and equipment failure. The technical and logistical challenges associated with this design are discussed in the following sections.

2.1.3.1 New York State Energy Research and Development Authority Discharge Canal Ownership

Entergy's counsel has advised that conversion of IPEC to closed-loop cooling may increase the appraised value of the area of the discharge canal leased from the New York State Energy Research and Development Authority (NYSERDA) and thus increase the discharge canal rent obligations upon renewal of the lease in March 2017 above the current annual cost of approximately $1.0 million.

2.1.3.2 Pump Submergence Modification

New Unit 2 and Unit 3 pump houses would need to be constructed on the existing discharge canal, near the Unit 3 turbine-generator building and along the Hudson River bank, respectively. The conceptual pump house locations are shown on Sketch ENTGNU011-SK-001 in Attachment 2.

In order to provide the necessary flow to the cooling towers, the new circulating pumps would need to be approximately 45 ft long. Providing the correct submergence of the pump is necessary for continuous closed-loop operation, whereby inadequate submergence would cause damage to the pumps, render the circulating water system inoperable, and cause the plant to trip offline. The required submergence value of these pumps would necessitate excavation to increase the depth of the existing discharge canal in the locations of the new pump houses. The new depth at elevation (-) 32'-5" under the Unit 2 pump house would slope up gradually to meet the existing canal depth at elevation (-) 17'-0" below mean sea level (MSL). The existing canal depth in the Unit 3 pump house location at elevation (-) 20'-0" would require less excavation. This design maximizes the water inventory margin available above the minimum required submergence level of the pumps (Attachment 1). The minimum required submergence would be reached when the water level dropped from the nominal elevation of (+) 1'-0" above MSL to (-) 14'-0" below MSL. This level would need to be reached in the Unit 2 and Unit 3 reservoirs after approximately 4 to 6 minutes if supply to the reservoirs was suddenly cut off. Once the water level has dropped below the minimum required submergence, the circulating water pumps would no longer be capable of pumping water from the reservoirs to the cooling towers. A weir would need to be installed in the existing discharge canal prior to converging with the Unit 3 discharge tunnel outlet, as shown in Attachment 2 Sketch ENTGNU011-SK-007, to separate the reservoirs for each Unit and prevent an inventory drop in one reservoir from affecting the other.

2.1.3.3 Reservoir Capacity

Modifications would be required to convert the existing discharge canal to serve as the Unit 2 and Unit 3 pump reservoirs. These modifications would include increasing the depth of the canal beneath the new pump houses to accommodate new circulating water pumps, adding a weir prior to converging with the Unit 3 discharge tunnel outlet, as shown in Attachment 2 Sketch ENTGNU011-SK-007, to separate the Unit 2 and Unit 3 pump reservoirs. After modifications, the Unit 2 and Unit 3 reservoirs would hold over 4.2 million and 6.5 million gallons, respectively.

2.1.3.4 Offline Effluent Flow

Flow from each Unit's discharge tunnel would need to be rerouted directly to the Hudson River, using temporary piping, to maintain dry construction conditions in the existing discharge canal for modification to new pump reservoirs. Routing of temporary piping would be difficult due to the fact that the discharge tunnel is rectangular in shape, with the outlet piping into the discharge tunnel prior to flowing into the discharge canal.

Even though construction in the Riverfront area would require an outage of both Units, several safety-related systems would still require offline cooling (e.g., Spent Fuel Pool, Emergency Diesel Generators). Each of these systems would need to be reviewed and secondary cooling provided. Discharge from these secondary cooling systems would need to be returned directly to the Hudson River via temporary piping.

2.1.3.5 Groundwater Contamination

As discussed in Attachment 3, groundwater, currently subject to NRC regulatory oversight because of the presence of radiological contamination (primarily tritium (H-3) and strontium (Sr-90)), migrates through a portion of the expected cooling tower excavation area. GZA GeoEnvironmental, Inc. (GZA), an environmental and geotechnical consulting firm, developed groundwater contamination plume models for tritium and strontium based on quarterly groundwater sampling and elevation measurements taken at various monitoring points, as well as the analyses summarized in previous Quarterly Reports and the Conceptual Site Model presented in the final Hydrogeologic Site Report [Ref. 12.14]. According to GZA, sampling and analysis protocols for groundwater and excavated material would be developed and employed to manage site work and determine appropriate handling and disposal requirements (see Attachment 3).

Further, during the excavation process discussed in Section 6, excavation would be required at depths well below the groundwater table in the contaminated areas. To maintain dry conditions required for pipe construction and backfilling, contaminated groundwater would need to be continually pumped from the excavation area below the groundwater table (i.e., dewatering). As described in Attachment 3, absent careful management, dewatering could cause the groundwater to migrate from contaminated areas to clean areas, altering the existing radionuclide plume. To control spreading, dewatering from within contaminated groundwater areas would have to begin prior to excavation in the contaminated area, but coincident with excavation and dewatering in the adjacent clean areas. This dewatering would also have to be continued until completion of the excavation.

As discussed in Attachment 3, groundwater may contain tritium, strontium, and potentially smaller concentrations of other radionuclides, including cesium, that would have to be disposed of. GZA analyzed several disposal options and concluded that the only feasible method of disposal would be discharge directly to the Hudson River (Attachment 3). GZA has been advised by Entergy's legal counsel that NYSDEC appears to believe they have jurisdiction of discharge to the Hudson River. GZA concluded, therefore, that disposal options are limited.

2.1.3.6 Low Volume Waste Effluents

Conversion to closed-loop cooling would have engineering and operational impacts on the liquid waste disposal system regulated by NRC. With respect to radiological materials, discharge streams are managed consistent with 10 CFR 20 dose limits and to ensure consistency with 10 CFR 50 design objectives for keeping potential exposure levels as low as is reasonably achievable (ALARA). Likewise, discharge of non-radioactive material (i.e., boron, chlorine, etc.) is authorized and governed by the SPDES permit [Ref. 12.20]. Both are managed in the existing liquid waste disposal system.

Conversion to closed-loop cooling would require significant changes to the existing liquid waste disposal system, any of which would require reconsideration and/or revision of plant operating procedures and the operating margins to current regulatory limits. Therefore, a thorough review of the final design under 10 CFR 50.59 would be required to ensure compliance with 10 CFR 50 ALARA practices and 10 CFR 20 dose and release rate limits, as well as environmental reviews of SPDES permit limitations for non-radioactive releases.

2.2 Conversion of Only Unit 2

Conversion of Unit 2 to closed-loop cooling would require the installation of one 100% capacity round hybrid cooling tower and the associated piping and equipment as described in the 2003 Report (Attachment 1). The cooling tower would need to be placed to the northeast of the Unit Containment Building, as shown in Attachment 2, Sketch ENTGNU011-SK-002. The closed-loop cooling design of only Unit 2 would be identical to that discussed in Section 2.1 without the modifications to Unit 3.

2.3 Conversion of Only Unit 3

Conversion of Unit 3 to closed-loop cooling would require the installation of one round hybrid cooling tower and the associated piping and equipment as described in the 2003 Report (Attachment 1). The cooling tower would need to be placed to the southwest of the Unit 3 Containment Building, as shown in Attachment 2, Sketch ENTGNU011-SK-003. Construction of the Unit 3 cooling tower would require relocation of the Algonquin Gas Transmission pipelines, as discussed in Section 4. The closed-loop cooling design of only Unit 3 would be identical to that discussed in Section 2.1, whereby the only modification to Unit 2 would be additional piping to transport Unit 2 low level effluents to the Unit 3 discharge point.

3 Station Operational Parameters

Unit 2 and Unit 3 are water-dependent – meaning both that they require a specific quantity and temperature of water. The Stations were designed for and currently utilize the consistently cold brackish water from the Hudson River for operation. Specifically, the main steam condensers at both Units were designed to operate over the fixed range of circulating water inlet temperatures provided by the Hudson River. Deviation beyond this range impacts plant performance. Conversion of IPEC to closed-loop cooling would reduce access to the relatively cold Hudson River water and increase the circulating water inlet temperature to the main condensers. Therefore, the impact of this increase to circulating water temperature on plant systems, operation, and output must be evaluated.

Conversion of a nuclear power plant designed for once-through cooling to closed-loop cooling has never occurred (Section 1.1.3). As such, the following analysis is theoretical, and while benchmarked against actual plant data, is not reflective of any history of operation of a nuclear power plant converted to closed-loop cooling. Subject to these limitations, the theoretical impacts on Units 2 and 3 due to conversion from once-through to closed-loop cooling are evaluated herein.

This evaluation of closed-loop cooling is performed using a state-of-the-art site performance evaluation of power system efficiency (PEPSE) model that accurately predicts and provides plant operational parameters and power reductions associated with conversion of IPEC to closed-loop cooling. PEPSE is used across the nuclear power industry, as well as the power industry as a whole, and is the standard analytical tool to model "what if" scenarios to determine system impacts of altering power plant operation. The PEPSE model is designed for each Unit's actual configuration and performance, and used to benchmark theoretical plant performance against measured data to provide an accurate summary of the expected results of conversion to closed-loop cooling. Similar to the methodology employed in the 2003 Report, an analysis was done over the range of expected circulating water inlet temperatures to determine plant performance; however, the current analysis utilizes an updated PEPSE model to account for modifications to each Unit and was performed using a much larger set of discrete input parameters to increase precision.

3.1 Administrative/Operating Limits

The Stations' equipment operation is governed by a set of administrative limits[3] used to ensure safe and reliable operation of each Unit. Specifically, PWRs are subject to nuclear safety constraints on operations of various Station equipment, including pump net positive suction head requirements, overall plant control characteristics, core thermal power limits, and core thermal-hydraulic stability. The Stations' equipment operation must be thoroughly analyzed in regard to the modifications likely required to convert Unit 2 and 3 from once-through to closed-loop cooling, in order to ensure these administrative limits are not exceeded.

[3] Administrative limits are limits used to prevent encroachment of NRC licensed limitations (e.g., technical specification limitations, FSAR limitations, etc.) and equipment operational limits. They represent practical limits for safe and reliable plant operation.

Changes to the Stations' cooling water equipment to offset the losses associated with conversion to closed-loop cooling are restricted by the size and configuration of the equipment within the Turbine Building, particularly the condenser and the surrounding components. The main condensers were sized to reflect the use of a stable and cold inlet water source (i.e., water drawn from the Hudson River). In order to maintain current operational efficiencies, a drastic modification of the condenser (through a size increase) would be required; however, due to the physical constraints of the Turbine Building, a significant size increase of the condensers is not possible without the complete reconstruction of the turbine building. A condenser / turbine building modification of this magnitude would be unprecedented (i.e., implementation of a condenser redesign of this magnitude has never occurred at an operational nuclear power plant). Due to the magnitude of this redesign, the lack of any history of a nuclear plant undertaking such a modification, and the physical constraints of the Unit 2 and Unit 3 Turbine Buildings, it is concluded that modification of the current cooling water equipment to compensate for the expected power generation would not be able to offset the losses associated with conversion to closed-loop cooling.

The administrative limits given in the Alarm Response Procedures [Ref. 12.15; Ref. 12.16] require that the main condenser vacuum be above approximately 3.92 and 4.92 in-Hg for Units 2 and 3, respectively.[4] These administrative limits, while considered in the PEPSE analysis, were not projected to be exceeded based on historical meteorological conditions.

3.2 Closed-Loop Operational Efficiency (PEPSE Analysis)

As discussed in the 2003 Report (Attachment 1), closed-loop cooling performance is based on the ambient meteorological conditions, with the result that operational losses at the Stations would vary based on seasonal wet-bulb temperature at IPEC. The wet bulb temperature is a meteorological measurement which incorporates both moisture content and temperature of the ambient air. Local meteorological data was obtained, reviewed, and analyzed for use as an input to the PEPSE models for each Unit. The PEPSE model uses, among other things, cooling water intake temperature and flow rates to accurately calculate plant operational parameters and the resulting net power generated. The PEPSE model provides the expected plant operational parameters and power reductions necessary to theoretically operate IPEC Units 2 and 3 without exceeding equipment limitations and/or resulting in nuclear safety considerations. It should be noted that conversion of a nuclear power plant designed for once-through cooling to closed-loop cooling has never occurred and as such, the following analysis is theoretical. Although benchmarked against actual plant data, the analysis is not reflective of any closed loop conversion of a nuclear power plant.

[4] The pressure setpoints listed in the Alarm Response Procedures [Ref. 12.15; Ref. 12.16] are 25 and 26 in-Hg absolute for Units 2 and 3, respectively. Subtracting each of these setpoints from a standard atmospheric pressure of 29.92 in-Hg results in the main condenser vacuum setpoints of 3.92 and 4.92 in-Hg for Units 2 and 3, respectively.

3.2.1 Cooling Tower Efficiency / PEPSE Analysis

The IPEC PEPSE models were reviewed and run to produce the results discussed herein.[5] A diagram of the IPEC PEPSE model has been included in Attachment 4, Figures 4-1 through 4-12.

3.2.1.1 Meteorological Data Analysis

The performance of any closed-loop cooling water system is primarily driven by the ambient weather conditions at the site and the baseline inlet water temperature values. Cooling towers define their performance via an approach to wet bulb temperature. The wet bulb temperature is necessary for closed-loop cooling analysis, as cooling towers utilize an evaporative process to remove heat from the continuously recirculated cooling water. The approach to wet bulb describes the number of degrees above the ambient wet bulb temperature by which the cooling tower can be expected to reduce the cooling water temperature, whereby a lower approach equates to lower cooling water temperature exiting the cooling tower. The approach to wet bulb is a value that is based on the size and efficiency of the cooling tower, and essentially represents the cooling ability of the equipment. Although wet bulb temperature is not measured directly by site meteorological instruments, wet bulb temperature was calculated using dry bulb temperature and dew point temperature, both of which are measured onsite.

Any data set used to predict the performance of the Stations relies heavily on the presence of either wet bulb temperature measurements or a combination of values that can be used to calculate the wet bulb temperature (e.g., dry bulb temperature and relative humidity, dry bulb temperature and dew point, etc.). Entergy provided eight years of meteorological data (2001-2008) and a thorough review was conducted to normalize the data, ensuring that a uniform data set with no erroneous data is used as the basis for analysis. Particular focus was paid to the review and acceptance of the meteorological data, as even minor errors present in the meteorological data would propagate throughout the analysis. Furthermore, there is almost always some degree of data loss associated with meteorological monitoring. This data loss may be due to a number of causes (equipment failure, biological/human error, etc.). A general guideline for meteorological data acceptance is that the data maintain an average 90% data recovery rate [Ref. 12.35]. The average recovery rate for the eight year period analyzed (2001-2008) was 97.2% as shown in Attachment 4, Table 4-1; therefore, the data provided by IPEC greatly exceeds the threshold for validity and represents an extremely robust data set.

3.2.1.2 Inlet Water Data Analysis

Entergy supplied eight years (2001-2008) of average daily inlet water temperatures. This data was reviewed to ensure that a uniform data set with no erroneous data is used as the basis for analysis. The average recovery rate for the eight year period analyzed was

[5] While finalizing the Report analysis, updated versions of the IPEC PEPSE models were again developed by Entergy. The new models were reviewed and compared to the PEPSE models originally used for this Report. It was determined that while previous updates were substantial, the most recent updates to the PEPSE model were less substantial and would not result in any significant differences in the analysis.

99.8%, representing an extremely robust data set. The monthly recovery rate per year is shown in Attachment 4, Table 4-2.

3.2.2 Closed-Loop Losses

Conversion of the Stations to closed-loop cooling would introduce both ongoing operational efficiency losses associated with operating beyond the original condenser design conditions and parasitic losses associated with the operation of the pumps and cooling tower fans. If the effect of closed-loop conversion on plant operation is averaged across the entire year, operational power losses would account for a loss in power generation of approximately 11.1 MWe and 4.7 MWe at Units 2 and 3, respectively; however, operational power losses would peak during the warmest temperature and highest dewpoint conditions, when electricity demand is at its highest. Over the historical data analyzed (2001-2008), the peak combined operational power loss occurred on June 7th, 2008 at 2PM, and accounted for a combined operational power loss of 85.4 MWe.

Additional parasitic losses from the circulating water pumps and the cooling tower fans and booster pumps would add an additional 36.1 MWe per Unit in power generation losses. Summing the operational and parasitic losses, Units 2 and 3 combined would experience an average power generation loss of 88.0 MWe and peak summer power generation loss of 157.6 MWe.

3.2.2.1 Operational Losses

After review and benchmarking, the IPEC PEPSE model was run over a theoretical bounding range of CW inlet temperatures to calculate the baseline closed-loop operation of the Stations (i.e., the performance of the Stations if converted to closed-loop operation). The PEPSE model allows for the calculation of system outputs and operational conditions as a direct function of various system inputs. Because these system outputs are fixed, the PEPSE model is limited to the unidirectional calculation of operational conditions via system input. To evaluate performance in the full range of operating conditions, the net thermal input (MWt) for the system was iterated over a series of CW inlet temperatures to find the closest parameters and linearly interpolate between them to calculate the system output and operational conditions (i.e., net power generated (MWe), hotwell temperatures (°F)/condenser backpressures (in-Hg) for each main condenser shell, and the condenser output temperatures (°F)). Overall, the CW inlet temperature for each hour is input across a set of data spreadsheets, which in turn allows for the calculation of the limiting operational parameters.

As the operation of cooling towers is driven primarily by ambient environmental temperatures, seasonal and daylight conditions have a significant impact on IPEC closed-loop operation (see Attachment 4, Sections 4 and 5). The average closed-loop cooling operational losses on a yearly basis, including the monthly operational power losses that would be incurred at each Unit, are provided in Attachment 4, Section 3. Table 3.1 presents the average continuous power generation losses that would be incurred at each Unit if the Stations were to be converted to closed-loop cooling. Since closed loop power loss is the difference in power generation from once-through to closed-loop cooling, the months with the highest average power loss, May and June, are those with the largest River water to ambient wet-bulb temperature differential.

Table 3.1 Unit 2 and Unit 3 Average Continuous Closed-Loop Cooling Power Generation Losses

Month	Power Loss (MWe)	
	Unit 2	Unit 3
January	5.7	0.1
February	5.3	0.1
March	8.2	0.2
April	15.8	3.2
May	20.8	9.4
June	19.3	13.6
July	9.8	8.5
August	6.2	5.6
September	7.6	6.0
October	12.2	6.1
November	14.1	3.4
December	7.9	0.4
Average Annual	**11.1**	**4.7**

As shown in Table 3.1, the overall effect of a closed-loop conversion on plant operation, examined using the IPEC PEPSE models would be an average continuous loss in power generation of approximately 11.1 MWe and 4.7 MWe at Units 2 and 3, respectively (15.8 MWe, total); however, power loss would vary both seasonally and intraday, dependent on the difference between River water and ambient wet-bulb temperature. Over the historical data analyzed (2001-2008), the peak combined operational power loss of 85.4 MWe occurred on June 7th, 2008 at 2PM, when electricity demand was at its highest.

3.2.2.2 Parasitic Losses

In addition to the operational losses, the new cooling towers and equipment would require an appreciable amount of power to operate (i.e., parasitic losses) which would effectively reduce each Unit's output power. The cooling towers selected for closed-loop operation of the Stations are round hybrid cooling towers, designed with noise and plume abatement features. In particular, round hybrid cooling towers require significant additional electrical loads since they utilize two fans per cell to draw air in through both the wet and dry sections of the cooling tower.

Also, the new circulating water pumps for closed-cycle cooling would require more power than the existing circulating water pumps. The additional power required over the existing circulating water pump requirements would be another parasitic loss associated with conversion to closed-loop cooling.

The parasitic losses associated with each component of closed-loop cooling would be as follows:

- Cooling Towers (26.5 MWe per Unit)
  - 44 wet fans (300 HP)
  - 44 dry fans (350 HP)
  - 4 booster pumps (61,250 gpm at 26 ft)
- Additional Circulating Water Pump Load (9.6 MWe per Unit)
  - 6 circulating water pumps (117,000 gpm at 72 ft)

Summing the additional parasitic losses from the circulating water pumps and the cooling tower fans and booster pumps would be approximately 36.1 MWe per Unit, or a combined parasitic loss of 72.2 MWe. Whenever a Unit would be online, these parasitic losses would continually draw from the net generating electricity.

3.2.2.3 Electrical Distribution Effects

Using the Electrical Transient Analyzer Program (ETAP) software, Attachment 5 provides a model of the anticipated electrical distribution system required to support the conversion of Units 2 and 3 to closed-loop operation. This analysis accounts for the expected electrical parasitic losses due to the new components required for closed loop operation at both Unit 2 and Unit 3 to determine if extensive improvement to the electrical distribution system would be required.

Reviewing the one line diagrams of this study, the available fault current at the Buchanan 138kV switchyard bus by the IPEC grid contribution is 16.73 kA . The additional loads added by conversion to closed-loop cooling would increase this available fault current by 1.75kA, or approximately 10%. Per discussions with site personnel, the Buchanan 138kV switchyard bus has a capacity rating in the order of 60kA, supplying significant margin against a short-circuit event. Due to the magnitude of this margin, and due to the relatively small increase of load, no modifications to the switchyard would be expected by conversion of IPEC to closed-loop cooling; however, additional electrical distribution analysis and consideration of the available protective devices ratings would be required in the detailed design phase to competely ensure adequate margin is present. Conversion of Unit 2 or Unit 3 individually to closed-loop cooling would impact the electrical distribution system to a lesser degree then conversion of both Units, and as such this analysis is bounding for each individual conversion scenario. Additional details on the electrical analysis conducted are included in Attachment 5.

4 Algonquin Pipeline Relocation

Due to physical site constraints and water flow requirements, the Unit 3 cooling tower must be located on the southwest portion of the IPEC site, as discussed in Section 2.1 and shown in Attachment 2 Sketch ENTGNU011-SK-001. However, a portion of this location overlaps the existing right-of-way (ROW) for the Algonquin Gas Transmission (Algonquin) pipelines. In order to accommodate excavation and construction of a cooling tower for Unit 3, the existing pipelines would have to be relocated within the IPEC site, pursuant to the terms of the pipeline easement. Spectra Energy Transmission, LLC (Spectra), owner and operator of the Algonquin pipelines, has preliminarily evaluated the feasibility of the required relocation (Attachment 6). The preliminary timeline for relocating the pipelines is approximately 24 months and the estimated cost is approximately $13.8 million, with an accuracy level of (-)25% to (+)40%. The feasibility evaluation considers design, permitting, material, labor, and construction, but does not include the cost and schedule of spoils removal, which would significantly increase the estimated cost provided by Spectra.

4.1 Pipeline Configuration

The regional interstate Algonquin pipeline system transports natural gas from New Jersey and southeastern New England to major markets in New England, including Boston, Hartford, and Providence [Ref. 12.27]. The Algonquin pipelines transport 2.5 billion cubic feet of gas per day to serve approximately fifty percent of the natural gas demand in New England (Attachment 6). Algonquin serves as a major artery through the northeast portion of the United States, connecting to Spectra's Texas Eastern Transmission and Maritimes & Northeast Pipeline.

Currently, the Algonquin Pipeline system crosses the Hudson River next to IPEC. Due to the significant level of service provided by Algonquin to the region, Spectra has advised that the Hudson River crossing is considered a critical site and the throughput of the pipeline facilities at this location cannot be interrupted. The Algonquin facilities crossing the IPEC site are comprised of two gas pipelines running east to west through the IPEC site on a 65 foot wide ROW. At the southwest property boundary, a third pipeline is tied into the two other pipelines along with valving and internal inspection facilities for all three pipelines. The valve site area is near the Hudson River bank, within the excavation area of the Unit 3 cooling tower. The connection piping is visible above ground, as shown in Figure 4.1. The ROW expands significantly at the valve site to accommodate the additional piping and equipment. The existing Algonquin pipeline ROW is shown by solid white lines in Figure 4.1. The proposed location for the Unit 3 cooling tower is shown by a dotted white oval. The excavation required for construction of the cooling towers would extend approximately 150 ft beyond the dotted oval, to create the 700 ft diameter clearing around the tower and gradual slope from the clearing to the existing grade.

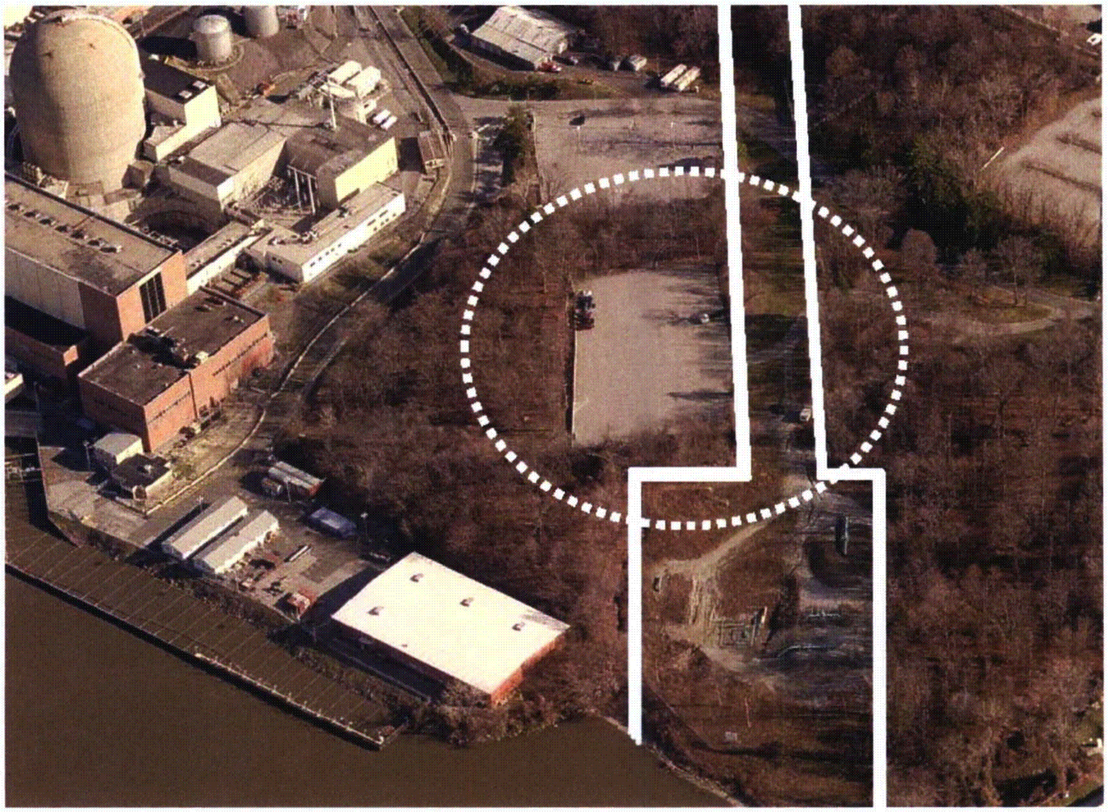


Figure 4.1 Existing Algonquin Gas Transmission Pipeline Right-Of-Way, With Proposed Unit 3 Cooling Tower Location Shown by Dotted Line

4.2 Feasibility of Relocation

In order to construct the Unit 3 cooling tower configuration shown in Attachment 2, the Algonquin pipeline would have to be relocated. Spectra has provided an evaluation of the required pipeline relocation and proposed that pipeline be rerouted around the Unit 3 cooling tower excavation area, as shown in Attachment 2 ENTGNU011-SK-001 (Attachment 6). The lack of available space between the cooling tower excavation area and the Hudson River bank would require relocation of the valve site and an extension of the third pipeline. The valve site would be relocated along the existing pipeline to the area adjacent to the Broadway roadway. An extension of the third pipeline would be installed running parallel to the existing pipelines across the IPEC site. At the Unit 3 cooling tower excavation location, all three pipelines would be rerouted around the cooling tower to tie into the existing Hudson River crossing. The existing 65 ft wide ROW would need to expand to 100 ft wide to accommodate the extension of the third pipeline. During blast excavation at the Unit 3 cooling tower location, the required blasting offset (50 ft) from the nearest relocated pipeline would prohibit blasting within 15 ft of the expanded 100 ft ROW. The Unit 3 cooling tower location has moved in a northerly direction from the original location considered in the 2003 Report (Attachment 1) to accommodate the expanded ROW and blasting offset proposed by Spectra. The revised Unit 3 cooling tower location is shown in this Report (Attachment 2) and is the basis for all excavation discussions in this Report (e.g., Sections 5 and 6).

The Algonquin Pipeline System is one of the largest interstate pipelines in the United States [Ref. 12.23]. As such, it is regulated by the Federal Energy Regulatory Commission (FERC). Any relocation of the Algonquin pipeline would require the prior approval of the FERC, a process which could take a year or more [Ref. 12.19]. If FERC approval could not be obtained, the feasibility of closed-loop cooling for Unit 3 would be in jeopardy, as site real estate constraints preclude alternate cooling tower sites.

4.3 Spectra Schedule and Cost Impacts

Siting of the Unit 3 cooling tower requires relocation of the Algonquin pipeline facilities, which must be approved by FERC. A preliminary timeline and feasibility cost estimate for the relocation is provided by Spectra in Attachment 6.

Spectra's preliminary timeline, shown in Table 4.1, was developed absent any detailed field work, facility design, or agency consultation and without any detailed construction coordination concerns. This timeline should therefore be considered a high level overview of the time required to relocate the pipeline facilities and may be understated. The relocated pipeline facilities would need to be constructed in a staged manner to allow tied-in to existing facilities during the months of June through September, when the typical system demands may allow for an approximate 7 day outage for each relocated pipeline to be tied-in and connected. By scheduling the tie-in during the summer months and in conjunction with any other planned system outages, there may be little to no impact to the services of Algonquin's customers (Attachment 6).

Table 4.1 Spectra's Preliminary Timeline for Algonquin Pipeline Relocation

Activity	Duration	Notes
Preliminary field work	2 months	
Facility design	4 months	
Permitting	14 months	Includes preparations of applications to FERC and New York State
Construction	4 months	
In-Service	21 days	7 day outage to tie-in each pipeline (in sequence) must occur between June and September
Total	24 months	Assumes 3 week tie-in occurs during planned system outages

The feasibility cost estimate provided by Spectra for the relocation of the pipeline facilities is approximately $13.8 million, with an accuracy level of (-) 25% to (+) 40% (Attachment 6). The feasibility estimate considers design, permitting, material, labor, and construction costs. Of note, the cost of spoils disposal is not included; therefore, the spoils generated by the pipeline relocation are included in considerations of the total spoils that would be generated by the conversion of IPEC to closed-loop cooling (Section 6).

The pipeline would have additional schedule and cost impacts on the conversion project as a whole. FERC approval for the pipeline relocation must be obtained before substantial design work for conversion of Unit 3 to closed-loop cooling would be undertaken, and the installation of the relocated pipeline would have to be complete before blast excavation could begin at the Unit 3 tower location. Each consideration would delay the overall schedule for both Units due to the combined outage at the end of the conversion. In addition, due to the significant amount and duration of blast removal, Spectra would require field personnel and experts to monitor the relocated pipeline facilities throughout the construction period (Attachment 6). The cost of pipeline monitoring would be estimated by Spectra after evaluation of the blasting plan and construction schedule, and is not currently included.

5 Blasting

Conversion of the Stations to closed-loop condenser cooling would require the excavation of approximately 2 million cubic yards of soil and inwood marble bedrock. Blast removal would be required to excavate large quantities of bedrock at the cooling tower locations and in the piping trenches outside of the Riverfront area. The feasibility, cost, and schedule of blast removal have been evaluated by Dr. Calvin J. Konya, a nationally recognized blasting consultant. Dr. Konya's report is included as Attachment 7, which updates the original analysis for the 2003 Report (Attachment 1). Dr. Konya's report describes the costs and duration associated with significant aspects of blast removal at IPEC, emphasizing the impact of site-specific vibration limits on blasting operations. Dr. Konya's cost estimate for drilling and blasting, excluding removal and disposal of spoils, is over $40 million. The drilling and blast removal would be expected to take approximately 4 years.

5.1 Restrictions to Blasting at IPEC

Blast removal at IPEC would be limited by proximity to Units 2 and 3, the Algonquin pipeline, and the Village of Buchanan. The respective vibration limitations imposed by these site-specific considerations were reviewed and incorporated into the blasting plan described in Attachment 7.

5.1.1 Onsite Blasting Restrictions

As discussed in Section 5.2, blasting excavation would be required for a period of 4 years, and blasting operations are proposed to occur while both Units are online. In addition, the continued operation of the relocated Algonquin pipeline, discussed in Section 4, would be required. Therefore, blasting limitations were determined that would allow and ensure the continued operation of Unit 2, Unit 3, and the relocated Algonquin pipeline.

Each Unit is designed to withstand an earthquake of Modified Mercalli Intensity VII, which corresponds to a maximum horizontal acceleration of approximately 0.15 g [Ref. 12.17; Ref. 12.18]. The seismic monitoring equipment, located in the Unit 3 containment building, is designed to detect ground motion approaching or exceeding this facility design basis. The equipment is triggered by a horizontal acceleration of ≥0.01g to record the magnitude, duration, frequency and direction of seismic events. Initiation of the seismic monitoring equipment is one of the entry conditions for the seismic event procedure, which requires the immediate inspection of various systems, structures, and components at both units. In addition, an engineering evaluation of the impact of the seismic event on the plant must be completed and the seismic instrumentation must be recalibrated. When a horizontal acceleration of ≥0.1 g is detected, an alarm in the Control Room initiates an abnormal operating procedure which could lead to shutdown of the reactors.

The maximum horizontal acceleration of ground motion due to blasting is therefore limited to 0.1 g, as measured at the containment structure. The 0.1 g acceleration limit translates to a vibration limit of 0.104 inch/sec due to the high frequencies of blasting compared to the frequencies of earthquakes. Small diameter blastholes and a tightly-spaced blasthole pattern would be used to meet this limit, as discussed in Attachment 7. At the edges of excavation closest to the containment buildings, additional vibration control would be implemented by deck loading the blastholes. Deck loading allows several charges in one blasthole to be fired independently on millisecond delays, thereby reducing the ground vibrations resulting from the blast.

As discussed in Section 4, the Algonquin pipelines cross the IPEC site to the south of Unit 3. Spectra, owner and operator of the Algonquin pipelines, has proposed an allowable blasting offset of 50 ft as part of a preliminary relocation plan (Attachment 6). Spectra Guideline TG-111 specifies a calculation to determine a maximum allowable charge weight based on distance from the pipelines. At the edge of the proposed blasting offset, 50 feet from the relocated pipeline, the maximum allowable charge weight would be greater than the charge weight specified in the blasting plan to meet the 0.1g horizontal acceleration limit at the containment building. Therefore, the blasting techniques that would be used to protect the Unit 3 facilities would satisfy Spectra's criteria as well, after relocation of the pipeline. Spectra would also require field personnel and experts to monitor the relocated pipeline facilities throughout the construction period (Attachment 6).

A thorough analysis of the impact of blasting vibration on specific Unit components and the relocated pipelines would be required to finalize blasting procedures. This analysis would require testing of individual components to determine appropriate vibration limits. Additionally, impact of vibration on construction activities would need to be determined, as cooling tower construction for Unit 2 would likely begin before blasting excavation ended at the Unit 3 cooling tower site. Each of these blasting considerations would be affected by the site-specific ground conditions, which would need to be determined by on-site ground calibration (Attachment 7).

IPEC personnel may experience noticeable vibration from blasting, e.g., loose objects around the site may rattle. There is a slight potential that these effects could also be experienced off-site near the Unit 3 tower excavation. The distance from the excavation to the nearest residential areas would be approximately 1000 ft; therefore, no noticeable blasting effects would be expected in these locations.

5.1.2 Code of the Village of Buchanan - Quarrying and Blasting

IPEC is located in the Village of Buchanan, New York. The Village of Buchanan designates acceptable hours for blasting operations, and controls the degree of velocity and displacement of vibrations during those hours when blasting is authorized [Ref. 12.5]. Blasting is not permitted in the incorporated portion of the Village of Buchanan except between the hours of 8:00 a.m. and 7:00 p.m., excluding Saturdays, Sundays, and public holidays when blasting is not permitted at any time. In compliance with regulated blasting industry standards, blasting operations would also only be conducted in daylight; thus, blasting operations would end at dusk or 7:00 p.m., whichever is earlier.

During the hours when blasting is permitted, peak particle velocity and overpressure produced by any blast measured at the closest structure or building not owned or used by the entity conducting the blast may not exceed 0.75 inch/sec for frequencies less than 40 Hz or 2.0 inch/sec for frequencies of 40 Hz or more. In addition, air pressure levels emanating from such blasts may not exceed 131 dB for a high pass filter of 0.1 Hz, 128 dB for a high pass filter of 2 Hz, or 125 dB for a high pass filter of 6 Hz. The blasting plan formulated by Dr. Konya was designed to comply with these Village of Buchanan restrictions.

5.1.3 Code of the Village of Buchanan - Soil Disturbances and Excavations

Entergy's counsel has advised that construction of the NYSDEC Proposed Project will require a soil and excavation permit from the Village of Buchanan. Section 159 of the Code states that an application must be submitted and a permit must be obtained from the Village Building Inspector prior to any excavation. The Inspector may issue the permit only after review and approval by the Village Planning Board. The application must demonstrate that the work will not cause, among other things, substantial traffic hazards. Also, the application must show that the period of time and the methods for the completion of the work are reasonable. Section 159 provides for 2 year excavation permits. Permits may also contain restrictions on the excavation, such as a limitation on the hours of authorized operations.

With respect to traffic hazards, and as noted in the discussion of blasting spoils removal in Section 6, blasting operations alone would produce between 364 and 518 truck loads per day (using 20-cy trucks). As discussed in Section 5.2, blasting and excavation could take as long as 4 years. These factors will be considered under Section 159 of the Code. Section 159 also requires a certificate of insurance, establishing the extent of liability of the applicant or contractor. Inquiries regarding insurance for the NYSDEC Proposed Project have received limited response and it may be difficult to obtain coverage for all associated risks, especially nuclear incident risks (Attachment 7, Section 3). Thus, permitting is not assured.

5.2 Cost and Schedule Impacts

The cost and duration of significant aspects of blast removal at IPEC are estimated in Dr. Konya's report (Attachment 7).

Blast removal duration would be primarily limited by the time necessary to drill the blastholes. All blastholes drilled in one day could be prepared, loaded, and fired in approximately 15 minutes at the end of the shift. Therefore, the maximum number of drills that could be efficiently used would control the project duration. Using typical drilling rates for the type of bedrock at IPEC, Dr. Konya estimates that 2078 10-hour days of drilling would be required to complete the project. The blasting plan calls for 10 drills to be used, reducing the overall project duration to 208 days of drilling. Assuming a typical 85% equipment availability, the drill days required would increase to 245 days. Based on actual blasting experience in the New York area, Dr. Konya estimates that drilling could only be conducted the equivalent of 150 10-hour days per year due to weather shutdowns, equipment delays, blasting delays, and shorter drilling and blasting hours in spring and fall due to reduced daylight hours. Under typical commercial operating conditions, the blasting would take approximately 1.6 years (see Attachment 7). However, at an operating nuclear site, the duration would necessarily increase to accommodate the various policies, procedures, and work practices dictated by industrial safety, nuclear safety, security, and other relevant site programs. Due to these additional considerations particular to the nuclear industry, the duration would be expected to be approximately 2.5 times longer than a comparable commercial operation, resulting in an expected duration of approximately 4 years.

Cost estimates for the significant aspects of blast removal at IPEC are based on the typical rates for similarly complex jobs and industry quotations. The overall cost estimate for blast excavation for conversion of both Unit 2 and Unit 3 to closed-loop cooling is detailed in Table 5.1. Blasting costs are estimated to be over $40 million, not including removal and disposal of the spoils (contaminated or clean) generated by blasting. The removal and disposal of all spoils generated by the conversion of IPEC to closed-loop cooling are discussed in Section 6.

Table 5.1 Blast Removal Cost Estimate for Conversion of Both Units

	Total Units	Rate [/Unit]	Cost
Cooling Towers	1,796,000 yd^3	$15	$26,940,000
Trenches	94,600 yd^3	$58	$5,487,000
Presplitting	61,080 yd^2	$85	$5,192,000
Blasting Consultant	800 days	$2000	$1,600,000
Seismic Monitoring	34 months	$26140	$889,000
		Total	$40,108,000

5.3 Blasting Outage Timing

In order to avoid a prolonged forced construction outage at each Unit, blasting operations would occur with both Units online, as discussed in Section 5.1.1.

Moreover, if blasting operations are able to be coordinated to overlap with scheduled outages, the cost of blasting could be marginally reduced. Per Attachment 7, a potential cost savings of approximately 5% could be realized during the outage duration by avoiding the need for deck loading in the blastholes near Unit 3. However, deck loading would still be required in blastholes near the Algonquin pipeline. Blasting during scheduled outages would not impact the total number of blastholes required or the presplitting costs. The blasting project duration would not be impacted by overlap with scheduled outages; only the cost of blasting in proximity of Unit 3 during an outage would be impacted.

6 Spoils Removal

Conversion of Unit 2 and Unit 3 to closed-loop cooling would require the excavation of approximately 2 million cubic yards of soil and bedrock, nearly all of which is expected to be crushed inwood marble. As detailed in Table 6.1, the total estimated disposal volume includes excavation for the cooling tower basins and clearings, the circulating water piping trenches, the Algonquin pipeline relocation, and miscellaneous requirements of the conversion to closed-loop cooling (e.g., parking lot relocation, pump skids, electrical duct banks). The total disposal volume is greater than 50% of the total crushed marble sold or used in the U.S. in 2007 [Ref. 12.34]. Some portion of the excavated material is likely to be radiologically contaminated. As such, a sampling program would be developed and implemented prior to excavation, so that radiologically contaminated material may be properly managed. The cost and rate of removal and disposal of the excavated material would be significant factors in the overall cost and duration of the conversion. Radiological contamination concerns may cause delay or increase the cost of removal.

Table 6.1 Estimated Excavation Volumes by Area

Excavation Area	Excavation Volume
Cooling Tower Basins and Clearings	1,794,300 yd^3
Piping Trenches	129,600 yd^3
Algonguin Pipeline Relocation	44,600 yd^3
Miscellaneous (Parking Relocation, Electrical Equipment, Etc.)	17,900 yd^3
Total	**1,986,400 yd^3**

6.1 Blasting Spoils

Most of the expected 2 million cubic yards of spoils would be produced by blast removal. Blast removal would produce rocks of varying size. Approximately 65-77% of the rocks produced in the cooling tower site excavation would be larger than 1.5 inch pieces (Attachment 7). The blasting in the piping trenches would produce smaller pieces of broken rock, with approximately 43-61% of the rocks larger than 1.5 inch pieces. These larger rocks would need to be crushed to facilitate transportation offsite. A procession of dump trucks would carry the blasted rock from loaders at the blasting site to mobile crushing plants setup near the River. One mobile crushing plant would be used at each cooling tower excavation. The crushed rock would be dropped directly from the crusher onto a conveyor belt for barge loading.

Each step of the excavation process must be carefully planned and executed to efficiently remove the blasted rock. The numbers and capacities of loaders, trucks, screens, crushers, conveyers, barges, etc. must be carefully balanced to prevent any individual step in the process from becoming a bottleneck. In theory, it may be feasible to remove the blasted rock at the maximum rate possible as limited by drilling. If limited only by the drill rate, the excavation would produce between 7,265 and 10,350 cubic yards of broken rock per day (equivalent to between 364 and 518 truck loads, with 20-cubic yard capacity). In practice, well coordinated efforts would be required to remove, process, and dispose of this expected quantity of material. Significant schedule delays could be introduced by any inefficiency in the rock removal operation.

Due to the large scale of the excavation, counsel for Entergy advises that crushing operations may be viewed by the Village of Buchanan as a primary use of the IPEC property that is prohibited by the Zoning Code, as discussed in Section 8.3.1.

6.2 Contamination of Spoils

Historical site assessments and groundwater sampling at IPEC, including that performed by GZA, have indicated that groundwater is radiologically contaminated in some areas of the site, primarily with strontium-90 and tritium [Ref. 12.14] (Attachment 3). A Long Term Groundwater Monitoring Program (LTMP) has been implemented at IPEC to characterize and monitor the extent of subsurface contamination. The results of the program have indicated relatively stable groundwater contamination plumes and a decreasing trend in radionuclide levels [Ref. 12.13]. GZA's groundwater contamination plume models indicate localized contamination near Units 1 and 2 that ultimately discharges to the Hudson River, as shown in Figures 1 and 2 of Attachment 3. GZA has advised that all spoils excavated from within the plume boundaries would likely be contaminated. Therefore, the volume of contaminated spoils that would be generated is expected to be at least 6350 cubic yards. As shown in Section 6.5, contamination would increase the cost of spoils disposal.

Additional sampling and radiological testing would be required to determine the quantities and locations of contaminated soil. The sampling program would cover areas that could potentially be contaminated, consistent with GZA's recommendations. The blasting/excavation schedule would allow workers sufficient time to monitor blasted rock.

6.3 On-Site Relocation of Spoils

A limited portion of the excavation spoils may theoretically be reused or stored onsite. However, the expected 2 million cubic yards of excavated spoils would greatly exceed IPEC's storage capacity. As such, most of the material would need to be removed. In addition, the only available area onsite for spoils storage would be the eastern hardwood forest habitat to the northeast of the Unit 2 cooling tower location. The potential impact on the local terrestrial ecology (which includes potential endangered species habit [Ref. 12.11]) would likely preclude spoils storage in that area. Due to these considerations and constraints, it has been assumed that spoils would not be relocated onsite.

6.4 Off-Site Relocation of Spoils

The entire 2 million cubic yards of excavated spoils are assumed to require off-site relocation, due to the constraints discussed in Section 6.3. Two separate methods of disposal would be required, respectively, for contaminated and clean spoils.

6.4.1 Radiologically Contaminated Spoils

Any detection of radiological contamination above a defined minimum detectable concentration would require the excavated spoils to be properly disposed of as radioactive waste. Contaminated spoils would be classified as directed by 10 CFR 61.55, based the types and quantities of radionuclides present. Class A wastes may have a maximum tritium concentration of 40 curies/m^3, or a maximum strontium concentration of 0.04 curies/m^3 [Ref. 12.3]. If both tritium and strontium contamination are present, the maximum concentration of both radionuclides is determined by the sum of fractions rule, as described in 10 CFR 61.55. The sum of fractions rule significantly reduces the maximum concentration allowed of both (or either) radionuclide.

NRC regulations stipulate that nuclear facilities may only dispose of licensed nuclear materials offsite by transfer to an authorized recipient, in this case a licensed disposal facility [Ref. 12.1]. Currently, there are three commercial low-level waste (LLW) disposal sites in the United States. Only one of these sites would accept waste from Indian Point: EnergySolutions Clive Operations (Clive), located in Clive, Utah. Clive is licensed by the State of Utah to accept Class A waste, and accepts waste from all regions of the United States [Ref. 12.22].

In addition to meeting the concentration limits listed in 10 CFR 61.55, Class A waste must be packaged according to 10 CFR 61.56. The processing, packaging, and final disposal of contaminated spoils would be conducted by specialists in radioactive waste handling and processing. In processing, contaminated materials would be identified and separated to minimize disposal volumes and reduce the cost of regulated and licensed disposal. Contaminated materials would likely be transported by truck to the processing facility.

6.4.2 Clean Spoils

Potential options for the off-site disposal of clean spoils include sale as a commodity, use as fill material, or artificial reef building projects. Site geologic studies indicate that most of the spoils would be inwood marble, a crystalline metamorphic rock "made from" limestone with considerable heat and pressure [Ref. 12.14]. Crushed stone is a major basic raw material for the construction industry. If clean inwood marble generated by excavation could be crushed onsite and sold as a crushed stone commodity, a portion of the cost of disposal could be recovered.

If the clean spoils are not suitable for sale as a crushed stone commodity, another potential option for disposal is use as backfill for mine reclamation. In 1975, New York State enacted the Mined Land Reclamation law to ensure the environmentally sound, economic development of New York's mineral resources and the return of affected land to productive use for current and future generations. The law requires each regulated mining operation to develop an approved reclamation plan that provides for return to productive use.

Donation of the crushed rock to artificial reef projects off the coasts of New Jersey and New York was considered as another potential method of disposal. The permitting process for this method of disposal would likely represent significant additional cost of disposal and may introduce schedule delays. Therefore, other options of disposal for the clean spoils would likely be preferred.

For each of the clean spoils disposal options considered, spoils would likely be removed from IPEC by barge. Transportation of the spoils by barge would be approximately half as expensive as transportation by trucks.[6] In addition, transportation by barge would reduce the impact of construction on the surrounding community, including traffic impacts. The shoreline locations of several aggregates terminals and existing mines in the region would enable direct barge transportation from IPEC. If the final disposal location was inland, spoils would likely be removed from IPEC by barge and transferred to trucks at another location due to roadway capacity constraints in the vicinity of IPEC. Transportation by rail has not been considered due to the lack of a rail spur at IPEC.

6.5 Cost and Schedule Impacts

The expected duration of removal and disposal of excavated spoils would be enveloped by the schedule for blast removal presented in Section 5.2. The estimated cost of spoils disposal is approximately $55,620,000, including radiological contamination testing, limited radiologically contaminated spoils removal and disposal, and clean spoils removal. The costs of clean spoils disposal would vary greatly depending on the final disposal method. The cost of radiological testing and disposal of limited contaminated spoils has been estimated to be approximately $9.2 million.[7]

The removal and transportation of clean spoils from the excavation would cost approximately $46,436,000, including labor and equipment (loaders, dump trucks, crushers, conveyers, barges, etc.). The final disposal location could significantly affect this estimate. Revenue from selling the spoils as a commodity or as backfill would offset a portion of the cost of removal, while permitting costs for artificial reef building would increase the total disposal cost.

The estimated cost/revenue of disposal would vary greatly, depending on the chosen clean spoils disposal option. Production of crushed marble in 2007 was 7.6 million metric tons valued at $71.1 million ($9.36 per metric ton) [Ref. 12.34]. Therefore, the potential revenue from selling the excavated spoils as crushed stone could theoretically be over $37 million. However, it is likely that the stone would be transported to and sold by a third party, which would likely significantly decrease the actual revenues that could be collected. Less revenue would be expected if the spoils were used as mine backfill. The costs of permitting would include preparation of the application, application fees, and any associated legal fees.

[6] The costs of transportation by barge and by truck were compared using 2009 cost data in MeansCostWorks.com. Estimated barge transport cost is based on the expected construction schedule while truck transport cost is based on total excavation spoils. Due to this discrepancy in cost rate basis, any change to the planned excavation methods that would lengthen construction schedule would also decrease the cost savings of barge transport.

[7] Cost of radiologically contaminated spoils testing and disposal is based on prior decommissioning work and disposal quotes from Toxco Materials Management Center, a radiological disposal company.

7 Cooling Tower Operation / Plume Emissions

The operation of the two hybrid cooling towers selected is described in detail in the 2003 Report (Attachment 1); however, several specific concerns are discussed in further detail below.

7.1 Water Consumption

Conversion of Unit 2 and Unit 3 to closed-loop cooling would significantly reduce the water intake currently required by each Unit. However, a continuous supply of water would still be withdrawn from the Hudson River for evaporative cooling tower operation, and 75% of the water withdrawn would be consumed. In terms of water consumption, closed-loop cooling systems have substantially more potential environmental impacts than once-through systems [Ref. 12.21].

Evaporation and drift from the cooling towers would represent a significant loss of circulating water that would have to be replenished. Unlike with the current once-through cooling, the water lost through evaporation and drift would not be returned directly to the Hudson River and would represent a true loss of River water. Typically, evaporating water leaves a cooling tower as a pure vapor, increasing the concentration of total dissolved solids (TDS) in the circulating water. Local air quality also contributes to circulating water quality degradation, as the air is effectively washed by the water in the tower (i.e., the cascading water in the cooling tower acts as a scrubber that removes particulates from the atmosphere and concentrates them in the circulating water). To maintain the required water quality for the cooling towers sited at IPEC, a portion of the concentrated circulating water, referred to as blowdown, would be released to and replaced with water from the Hudson River. Therefore, a continuous circulating water supply of 27,440 gpm (Equation 5) would be required to make up the total losses from evaporation, drift, and blowdown. Evaporation and drift from the towers would amount to 20,594 gpm (Equation 6), or nearly 30 million gallons per day, of lost Hudson River water.

7.1.1 Hudson River Water Consumption

The brackish water from the Hudson River currently used in the Stations' circulating water systems would also be used for the circulating water in a closed-loop system. Hudson River water analysis and flow rate data show that the plant intake is largely fresh water during times of relatively high River flow rate, and very brackish when River flows are low. As discussed above, evaporation in the cooling tower would increase the concentration of dissolved solids in the circulating water, as compared to the River water. The number of times the dissolved minerals in the circulating water are concentrated, versus the level in the River water, i.e., the cycles of concentration, is an important parameter for cooling tower operation. Since the intake water quality at IPEC varies dramatically based on Hudson River flow rate, an acceptable number of cycles of concentration would be dependent on the current intake water quality. The cooling tower circulating water salinity would be maintained at approximately 7200 ppm, or between three and five cycles, depending upon the makeup water salinity[8]. The higher the salt

[8] Chloride concentration (salinity) data was obtained by the U.S. Geological Service for the Verplanck Station, immediately adjacent to IPEC, for the period 1969 to 1975 (Attachment 1).

content of the makeup water, the fewer cycles of concentration are necessary to maintain 7200 ppm dissolved solids in the circulating water. Estimated blowdown and makeup flow rates would be based on an annual average Hudson River makeup water salinity of 1800 ppm and four cycles of concentration, meaning that the concentration of total dissolved solids in the circulating water would be four times that of the incoming Hudson River water [Ref. 12.29]. To achieve an average of four cycles of concentration in implementation, an automated control system would be required to reduce makeup flow during periods of good water quality (relatively fresh water) and increase makeup flow during periods of poor water quality (brackish water).

The evaporation and drift flow rates can be calculated using the tower specifications provided by the cooling tower vendor, SPX Cooling Technologies (SPX). Evaporation can be approximated by multiplying the maximum evaporation percentage, 1.47% for summer conditions with the dry section of the cooling towers in operation (Attachment 1), by the total water flow rate (gpm). Per the cooling tower vendor, SPX, the total circulating water flow rate required by each Unit at IPEC would be 700,000 gpm. Therefore, the maximum evaporation flow rate from the cooling towers for each Unit at IPEC is estimated as follows:

$$E_{\text{Unit}} = \%_{\text{Evaporation}} \times Q_{\text{Unit}} = 1.47\,\% \times 700{,}000\text{ gpm} = 10{,}290\text{ gpm} \tag{1}$$

The drift rate is calculated by multiplying the drift percentage, 0.001% in this case (Attachment 1), by the total water flow rate (gpm):

$$D_{\text{Unit}} = \%_{\text{Drift}} \times Q_{\text{Unit}} = 0.001\% \times 700{,}000\text{ gpm} = 7.0\text{ gpm} \tag{2}$$

The required blowdown to maintain 4 cycles of concentration, C_4, is estimated using the expected evaporation and drift rates [Ref. 12.28]:

$$B_{\text{Unit}} = \frac{E_{\text{Unit}} - [(C_4 - 1) \times D_{\text{Unit}}]}{(C_4 - 1)} = \frac{10{,}290\text{ gpm} - 3 \times 7.0\text{ gpm}}{3} = 3{,}423\text{ gpm} \tag{3}$$

The makeup flow required by each Unit for cooling tower operation at IPEC is the sum of tower water losses due to evaporation, drift, and blowdown:

$$M_{\text{Unit}} = E_{\text{Unit}} + D_{\text{Unit}} + B_{\text{Unit}} = 10{,}290\text{ gpm} + 7.0\text{ gpm} + 3{,}423\text{ gpm} = 13{,}720\text{ gpm} \tag{4}$$

Figure 7.1 provides a per Unit closed-loop flow cycle, including makeup, evaporation, drift, and blowdown flowrates.

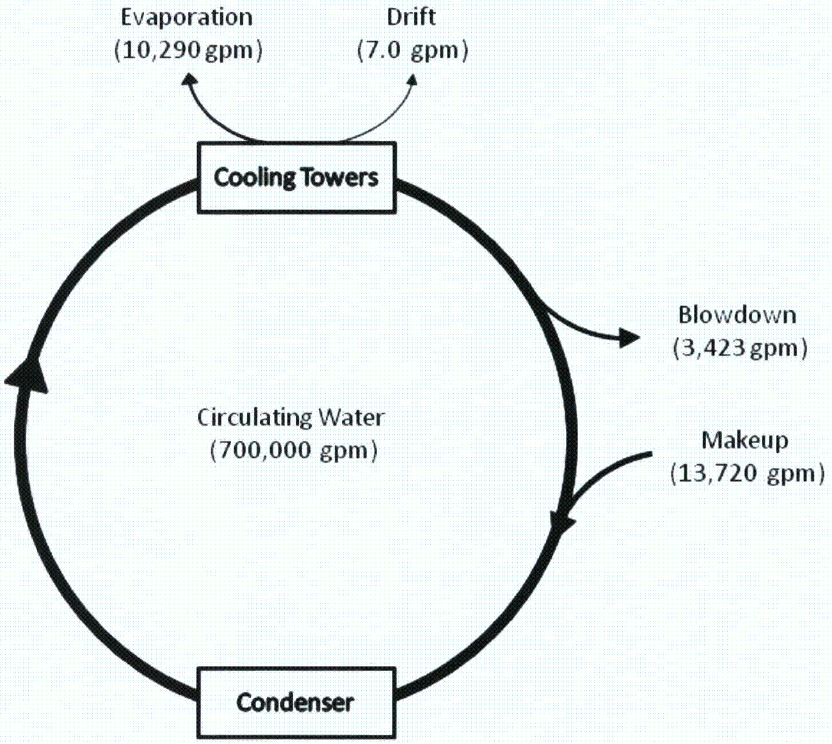


Figure 7.1 IPEC per Unit Closed-Loop Flow Cycle

The total estimated makeup flow required by IPEC is double the makeup flow required by each Unit:

$$M_{\text{Total}} = 2 \times M_{\text{Unit}} = 2 \times 13{,}720\ \text{gpm} = 27{,}440\ \text{gpm} = 39.5\ \text{MGD} \tag{5}$$

The total estimated water flow lost from the Hudson River is double the evaporation and drift flow from each Unit:

$$L_{\text{Total}} = 2 \times L_{\text{Unit}} = 2 \times (10{,}290\ \text{gpm} + 7.0\ \text{gpm}) = 20{,}594\ \text{gpm} = 29.7\ \text{MGD} \tag{6}$$

As described in Section 2.1.2.1, the closed-loop configuration considered in this Report would use service water discharge to provide makeup flow. The maximum required makeup flow, based on historical meteorological data and River conditions, would not exceed the design capacity of the Stations' service water systems, i.e., 46,000 gpm at Unit 2 (including Unit 1 River water flow of 16,000 gpm) and 36,000 gpm at Unit 3 [Ref. 12.17, 12.18]. IPEC has a maximum design flow capacity of 886,000 gpm for Unit 2 and 876,000 for Unit 3 [Ref. 12.8]. Therefore, the closed-loop cooling reductions in intake flow from total design flow would exceed 94.8% and 95.9% for Units 2 and 3, respectively. Based on historic flow data from 2001 to 2008, flow reductions would be approximately 98.0% at Unit 2 and 97.8% at Unit 3.

7.1.2 Recycled Wastewater Consumption

Consideration has been given to the use of recycled wastewater as an alternative to using Hudson River water as makeup water for a closed-loop cooling system at Units 2 and 3. The use of recycled wastewater as makeup for cooling towers has been studied at coastal power plants in California (Attachment 1). Recycled wastewater can be treated to enable cooling tower operation at six cycles of concentration, meaning that the concentration of TDS in the circulating water would be six times that of the incoming recycled wastewater

The estimated evaporation and drift rates would be unaffected by the allowable cycles of concentration; therefore, the values would be identical to those calculated in Section 7.1.1:

$$E_{\text{Unit}} = 10{,}290 \text{ gpm} \qquad D_{\text{Unit}} = 7.0 \text{ gpm}$$

The required blowdown to maintain 6 cycles of concentration, C_6, is estimated using the expected evaporation and drift rates [Ref. 12.28]:

$$B_{\text{Unit}} = \frac{E_{\text{Unit}} - [(C_6 - 1) \cdot D_{\text{Unit}}]}{(C_6 - 1)} = \frac{10{,}290 \text{ gpm} - 5 \cdot 7.0 \text{ gpm}}{5} = 2{,}051 \text{ gpm} \qquad (7)$$

The makeup flow required per Unit for cooling tower operation at IPEC using recycled wastewater would be the sum of tower water losses through evaporation, drift, and blowdown:

$$M_{\text{Unit}} = E_{\text{Unit}} + D_{\text{Unit}} + B_{\text{Unit}} = 10{,}290 \text{ gpm} + 7.0 \text{ gpm} + 2{,}051 \text{ gpm} = 12{,}348 \text{ gpm} \qquad (8)$$

The total makeup flow required by IPEC would double the makeup flow required by each Unit:

$$M_{\text{Total}} = 2 \cdot M_{\text{Unit}} = 2 \cdot 12{,}348 \text{ gpm} = 24{,}696 \text{ gpm} = 35.6 \text{ MGD} \qquad (9)$$

The feasibility of the recycled wastewater option depends on the distance between IPEC and the nearest wastewater treatment facilities able to provide adequate makeup flow, as well as the quality of the recycled wastewater and available treatment options.

The SPDES permits, discharge flow rates, and distances from IPEC for all SPDES-permitted wastewater treatment plants (WWTPs) located in Westchester County are shown in Table 7.1. The distances from IPEC are based on either the facility address or the outfall GPS coordinates listed in the SPDES permits.

Table 7.1 SPDES Water Discharge Permit Flows

Facility (SPDES Permit)	Flow	% Req'd Makeup Flow	Driving Distance to IPEC (approx.)	Direct Distance (approx.)
Buchanan WWTP (NY0029971)	0.5 MGD (347.2 gpm)	1.4%	<1 mi.	<1 mi.
Peekskill WWTP (NY100803)	10 MGD (6,944.4 gpm)	28.1%	4 mi.	3 mi.
Ossining WWTP (NY108324)	7 MGD (4,861.1 gpm)	19.7%	10 mi.	9 mi.

Facility (SPDES Permit)	Flow	% Req'd Makeup Flow	Driving Distance to IPEC (approx.)	Direct Distance (approx.)
Yorktown Heights WWTP (NY0026743)	1.5 MGD (1,041.7 gpm)	4.2%	13 mi.	9 mi.
North Castle WWTP (NY109584)	0.38 MGD (263.9 gpm)	1.1%	25 mi.	16 mi.
Wild Oaks WWTP (NY0065706)	0.06 MGD (41.7 gpm)	0.2%	29 mi.	16 mi.
Port Chester WWTP (NY0026786)	6 MGD (4,166.7 gpm)	16.9%	30 mi.	25 mi.
Oakridge WPCF (NY0030767)	0.08 MGD (55.6 gpm)	0.2%	31 mi.	23 mi.
Yonkers Joint WWTP (NY0026689)	92 MGD (63,888.9 gpm)	100% +	31 mi.	25 mi.
Blind Brook County WWTP (NY0026719)	5 MGD (3,472.2 gpm)	14.0%	32 mi.	26 mi.
Mamaroneck WWTP (NY0026701)	18 MGD (12,500.0 gpm)	50.6%	34 mi.	26 mi.
New Rochelle WWTP (NY0026697)	13.6 MGD (9,444.4 gpm)	38.2%	38 mi.	27 mi.

As shown in Table 7.1, the SPDES permits for the twelve SPDES-permitted WWTPs located in Westchester County indicate that only Yonkers Joint WWTP could provide sufficient makeup flow for closed-loop cooling towers. The Yonkers Joint WWTP is located approximately 25 miles south-southeast of IPEC along the eastern shore of the Hudson River. Pipelines directly connecting IPEC and the Yonkers Joint WWTP would have to be routed and installed through or around numerous waterfront commercial, residential, and industrial districts, an Amtrak commuter train rail line, and the Briarcliff Peekskill Parkway (New York State Route 9A). The considerable costs and numerous permits required for such an installation would represent considerable feasibility, cost and schedule impacts to the conversion project.

To avoid long stretches of pipe installation, combining the flow rate of multiple facilities closer to IPEC was considered. However, the combined discharge flow rates of all eight other WWTFs located less than 25 miles (direct distance) from IPEC would not provide sufficient makeup flow for closed-loop cooling towers.

Assuming recycled wastewater could be transported through 25 miles of heavily-developed New York shoreline, recycled wastewater from Yonkers Joint WWTP would need to undergo a series of further treatments to enable cooling tower operation at six cycles of concentration. This treatment would be similar to that of the 90 MGD recycled wastewater treatment plant located at the Palo Verde Nuclear Generating Station [Ref. 12.26], albeit utilizing approximately 40 percent of the flow rate (35.6 MGD). Using Palo Verde's recycled wastewater treatment plant (including the storage reservoir) for comparison, if recycled wastewater from Yonkers Joint WWTP was utilized, the water treatment system required by the Stations would occupy approximately 16 acres. Construction of a recycled wastewater treatment plant of this size would further increase the costs associated with transporting and processing recycled water for use as makeup flow for closed-loop cooling towers. As a result of the considerable unknowns, costs, and the numerous permits required, using recycled wastewater from Yonkers Joint WWTP is considered infeasible.

7.2 Cooling Tower Plume Emissions

Pursuant to the Interim Decision governing this SPDES permit proceeding, air permitting expert TRC Environmental Corporation (TRC) evaluated the potential air quality impacts of cooling tower plume emissions on the surrounding community, consistent with applicable federal, state and local law [Ref. 12.29]. TRC concluded that drift from the cooling towers would contain an appreciable concentration of dissolved minerals and additives that form particulate matter (PM10 and PM2.5). As such, the cooling towers, individually and collectively, would result in particulate matter emissions. TRC determined that these emissions would exceed the National Ambient Air Quality Standards for PM10 and PM2.5. TRC also examined mitigation measures to reduce particulate emissions, but concluded that available mitigation measures would not sufficiently redress air quality concerns in a manner consistent with applicable regulatory requirements. TRC concluded that the particulate emissions from the cooling towers will cause an adverse air quality impact to the surrounding community such that obtaining the required construction and operating air emissions permits would not be possible.

The conclusion reached by TRC for the Stations' cooling tower particulate emissions mirrors the conclusion reached for San Onofre Generating Station (SONGS) [Ref. 12.9]. SONGS is located in San Diego County, which like the area surrounding IPEC, is currently designated as non-attainment for PM10 and PM2.5. At SONGS, drift impacts due to the operation of closed-loop salt water cooling towers would be significant and require a major-source Title V air permit from the San Diego County Air Pollution Control District. It was determined that it would be unlikely that SONGS could locate and purchase a sufficient number of PM10 emission credits to cover the emissions from closed-loop salt water cooling towers. If the required drift offsets were unavailable, conversion of SONGS to closed-loop cooling would be infeasible.

7.3 Plume Abatement

As discussed in Section 2, the cooling towers that would be installed at Units 2 and 3 would be round hybrid towers designed with noise and plume abatement features, that come at a cost to electric output. When cooling towers are operated without abatement, visible water vapor plumes can form under certain meteorological conditions. According to TRC [Ref. 12.29], these visible plumes normally would be confined to the area immediately over the cooling tower and over the IPEC property, although under cool temperatures (typically during the late fall, winter, and early spring seasons) with high ambient humidity, elevated visible plumes could extend for several hundred to thousands of meters. TRC's results indicate that, without plume abatement (i.e., operation of the cooling towers without using the dry section), a visible plume would occur immediately south and northwest of each cooling tower for 610 daylight hours per year on average.

Plumes could not only result in complaints by local residents and businesses, but also may contribute to corrosion and ice formation on nearby components and plume shadowing (which could affect the local agriculture by decreasing the amount of ambient sunlight). Therefore, in order to avoid visible plumes, the cooling towers at IPEC would be operated with continuous plume abatement, with a corresponding loss in electricity output. As discussed in Section 3.2.2.2, utilizing the 44 dry section fans (350 HP) at maximum capacity to achieve continuous plume abatement would result in a loss of more than 13.5 MWe per Unit (over 100,000 MW-hrs annually per Unit).