

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.



SUPPLEMENTAL INFORMATION ON
GROUNDWATER QUALITY ISSUES
MARCH 31, 2014

GOODWIN PROCTER

Martin R. Healy
617.570.1371
mhealy@goodwinprocter.com

Goodwin Procter LLP
Counselors at Law
Exchange Place
Boston, MA 02109
T: 617.570.1000
F: 617.523.1231

March 31, 2014

BY FEDERAL EXPRESS AND E-MAIL

Linda M. Baldwin
General Counsel
New York State Department of State
Counsel's Office
One Commerce Plaza
99 Washington Street
Albany, NY 12231-0001

**Re: New York State Department of State File #F-2012-1028
Consistency Certification for Entergy Nuclear Indian Point 2 and
Entergy Nuclear Indian Point 3 License Renewal Application**

Dear Ms. Baldwin:

This letter provides supplemental information requested by the New York State Department of State (the "Department") in connection with the consistency certification (the "Consistency Certification") submitted on December 17, 2012, by Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (collectively, "Entergy") for Entergy's Indian Point 2 and 3 ("Indian Point") License Renewal Application pending before the Nuclear Regulatory Commission ("NRC"). During its consultation session with Entergy on December 3, 2013, the Department requested Entergy to provide information regarding past unplanned releases of radiological materials at Indian Point and the potential effects of those releases on groundwater quality. In particular, the Department inquired whether the Unit 2 spent fuel pool leak discovered in August of 2005 has been adequately addressed, and whether Entergy can provide more up-to-date information on the results of groundwater monitoring at Indian Point.

In response to the Department's requests, Entergy is providing information regarding groundwater quality issues at Indian Point previously filed by Entergy with NRC in connection with current plant operations and the ongoing NRC license renewal proceeding for Indian Point,¹ and with the New York

¹ NRC has exclusive jurisdiction to regulate radiological releases at Indian Point. *See, e.g., Train v. Colorado Public Interest Research Group, Inc.*, 426 U.S. 1, 16 n.12 (1976) ("States are precluded from playing any role in several significant areas of regulation, including the setting of limitations on radioactive discharges from nuclear power plants."); *N. States Power Co. v. Minnesota*, 447 F.2d 1143, 1151 (8th Cir. 1971) (stating "Congress intended to pre-empt the field of the licensing and

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State Department of Environmental Conservation (“NYSDEC”) in connection with its pending adjudicatory proceeding concerning Indian Point’s Water Quality Certification.² In addition, to assist the Department with its review of this technical information, Entergy is also providing a “white paper” that sets forth the relevant facts about groundwater at Indian Point.

Entergy reiterates that it is proceeding with federal consistency review by the Department under a full reservation of its rights under state and federal law, including, by way of example and without limitation, its right to argue that: (i) Indian Point is within a “grandfathering” exemption from federal consistency review under the New York Coastal Management Plan (the “CMP”); (ii) Indian Point has been previously reviewed for consistency with the CMP; and (iii) the Department’s purported federal consistency review under the CMP intrudes upon exclusive areas of federal regulatory authority and is preempted. Entergy additionally notes that the information being requested by the Department in this case was not requested by the Department in connection with its previous federal consistency reviews of nuclear power plants. Further, Entergy does not concede the relevance of the requested information to the Department’s review of Indian Point for consistency with the CMP.

Nonetheless, detailed information has already been prepared for both NRC and NYSDEC which demonstrates, as a factual matter, that: (i) the sources of past unplanned releases of radiological materials to groundwater at Indian Point have been eliminated or the causes have been addressed; (ii) the past unplanned releases of radiological materials to groundwater at Indian Point have not caused, and are not causing, threats to the public health or the environment; and (iii) the past unplanned releases of radiological materials to groundwater at Indian Point have not caused, and are not causing, a violation of state water quality standards. That supplemental information is being submitted in support of the Consistency Certification.

Due to the voluminous records associated with the aforementioned NRC and NYSDEC proceedings, Entergy has sought to identify and provide to the Department the subset of documents from those

regulation of nuclear reactors to the exclusion of the states and that it did not intend to provide for dual regulation of radiation hazards”) aff’d 405 U.S. 1035 (1972); *United States v. Kentucky*, 252 F.3d 816, 823 (6th Cir. 2001) (stating that “The [Atomic Energy Act (AEA) of 1954] preempts any state attempt to regulate materials covered by the Act for safety purposes”); *United States v. Manning*, 527 F.3d 828, 838 (9th Cir. 2008) (finding that a state law that seeks to regulate “AEA materials out of concern for the health and environmental risks that increased contamination will cause. . . falls squarely within the field preempted by the AEA”); *Missouri v. Westinghouse Elec., LLC*, 487 F. Supp. 2d 1076, 1087-88 (E.D. Mo. 2007) (refusing to ratify a proposed consent decree because it attempted “to regulate the safety of a site that contains nuclear contamination – a field completely pre-empted by the Atomic Energy Act,” and stating that “[t]he presence of radiation hazards is sufficient to give rise to the NRC’s exclusive jurisdiction”).

² This information is being submitted to the Department in fulfillment of the undertaking by Entergy, as set forth in its letter to the Department dated December 20, 2013, to provide to the Department by March 31, 2014, “information developed by Entergy before [NYSDEC] about groundwater quality issues at Indian Point.”

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proceedings that most directly address groundwater quality issues. Those documents (hard copies of which are enclosed) are listed on the charts below:

Entergy Nuclear Operations, Inc. (Indian Point Units 2 and 3)
Docket Nos. 50-247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01
Evidentiary Hearing
Selected Hearing Exhibits

Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
RIV000066	RK-EC-3/ CW-EC-1	GZA, GeoEnvironmental, Inc., Hydrogeologic Site Investigation Report, Indian Point Energy Center, January 7, 2008, IPEC00195418	12/22/2011	ML12335A626
RIV000067	RK-EC-3/ CW-EC-1	Letter from Marsha K. Gamberoni, NRC, to Joseph Pollock, Entergy, "Indian Point Nuclear Generating Units 1 & 2 – NRC Inspection Report Nos. 05000003/2007010 and 05000247/2007010 (dated May 13, 2008)" ³	12/22/2011	ML12335A624
RIV000068	RK-TC-2	Entergy, Groundwater Investigation Executive Summary, Indian Point Energy Center, Buchanan,	12/22/2011	ML12335A623

³ NRC periodically prepares inspection reports of its inspections pertaining to Indian Point. NRC inspection reports are available to the public at http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/listofrpts_body.html#inp. NRC inspection reports through 2009 are available at <http://www.nrc.gov/info-finder/reactor/ip/correspondence.html>. In addition, NRC inspection reports are available at the NRC "ADAMS" database <http://www.nrc.gov/reading-rm/adams.html> using the following ADAMS Accession Numbers, among others: ML12335A624, ML12338A648, ML12089A601, ML11356A520.

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Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
		NY (January 2008)		
RIVR00091	RK-EC-3/ CW-EC-1	Liquid Radioactive Release Lessons Learned Task Force Final Report, U.S. NRC (September 1, 2006)	12/22/2011	ML12335A608
NRC000095	RK-EC-3/ CW-EC-1	Ltr. To NRC from Entergy re: Remediation and Long Term Monitoring of Site Groundwater	3/30/2012	ML12339A651
ENT000300	RK-EC-3/ CW-EC-1	Entergy's Statement of Position on Consolidated Contention RK-TC-3/CW-EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12089A574
ENT000301	RK-EC-3/ CW-EC-1	Testimony of Entergy Witness Donald M. Mayer, Alan B. Cox, Thomas C. Esselman, Matthew J. Barvenik, Carl J. Paperiello, and F. Owen Hoffman Regarding Consolidated Contention RK-EC-3/CW-EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12338A621
ENT000302	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Donald M. Mayer	3/29/2012	ML12338A700
ENT000303	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Thomas C. Esselman	3/29/2012	ML12338A667
ENT000304	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Matthew J. Barvenik	3/29/2012	ML12338A679
ENT000305	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Carl J.	3/29/2012	ML12089A659

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Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
	CW-EC-1	Paperiello		
ENT000306	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of F. Owen Hoffman	3/29/2012	ML12089A637
ENT000313	RK-EC-3/ CW-EC-1	2010 Annual Radiological Environmental Operating Report (NL-11-038) (May 16, 2011) ⁴	3/29/2012	ML12339A710
ENT000319	RK-EC-3/ CW-EC-1	2010 Annual Radioactive Effluent Release Report, Rev. 1 (NL-11-068) (June 10, 2011) ⁵	3/29/2012	ML12089A670
ENT000321	RK-EC-3/ CW-EC-1	Lawrence C. Skinner and Timothy J. Sinnot, Measurement of Strontium (90Sr) and Other Radionuclides in Edible Tissues and Bone/Carapace of Fish and Blue Crabs from the Lower Hudson River (Nov. 2009)	3/29/2012	ML12338A680
ENT000332	RK-EC-3/	GZA GeoEnvironmental,	3/29/2012	ML12089A649

⁴ Entergy annually provides reports to NRC regarding radiological environmental monitoring. The reports are available to the public at the NRC "ADAMS" database <http://www.nrc.gov/reading-rm/adams.html> using the following ADAMS Accession Numbers, among others: ML061290085, ML071420088, ML081420476, ML091410203, ML101390564, ML11143A052, ML12144A412, ML13144A133.

⁵ Entergy annually provides reports to NRC regarding radiological effluent releases. Those reports are available to the public at <http://www.nrc.gov/info-finder/reactor/ip/ip-groundwater-leakage/on-going-activities/on-going-activities10.html>, and at the NRC "ADAMS" database <http://www.nrc.gov/reading-rm/adams.html> using the following ADAMS Accession Numbers, among others: ML061240373, ML071230305, ML081280744, ML091260208, ML101240989, ML11172A042, ML12132A122, ML131570158.

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Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
	CW-EC-1	Inc., Changes in Computed Tritium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011		
ENT000333	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Changes in Computed Strontium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011	3/29/2012	ML12089A663
ENT000343	RK-EC-3/ CW-EC-1	Letter from Darrel J. Roberts, NRC, to Joseph Pollock, Entergy, "[IP1, IP2 & IP 3] NRC Inspection Report Nos. 05000003/2009008; 05000247/2009008; and 05000286/2009008" (Oct. 19, 2009) ⁶	3/29/2012	ML12338A648
ENT000344	RK-EC-3/ CW-EC-1	Letter from D. C. Lew, NRC, to J. E. Pollock, Entergy, "Annual Assessment Letter – Indian Point Nuclear Generating Units 2 and 3 (Reports 05000247/2010001	3/29/2012	ML12089A601

⁶ See footnote 3, *supra*.

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Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
		& 05000286/20100001)" (Mar. 3, 2010) ⁷		
ENT000345	RK-EC-3/ CW-EC-1	NYSDEC Community Fact Sheet (May 2008)	3/29/2012	ML12089A608
ENT000360	RK-EC-3/ CW-EC-1	EPA, Basic Information about Radionuclides in Drinking Water, web page	3/29/2012	ML12089A666
ENT000371	RK-EC-3/CW-EC-1	Letter NL-08-023, from J. Pollock, Entergy, to NRC, Results of Ground Water Contamination Investigation (Jan. 11, 2008)	3/29/2012	ML12089A679
NRCR00088	RK-EC-3/ CW-EC-1	NRC Staff Testimony of Stephen P. Klementowicz and James D. Noggle Concerning Contention Riverkeeper EC-3/Clearwater EC-1 (Spent Fuel Pool Leaks)	9/21/2012	ML12340A747
NRC00089	RK-EC-3/ CW-EC-1	Professional Qualifications, Stephen P. Klementowicz	9/21/2012	ML12339A646
NRCR00090	RK-EC-3/ CW-EC-1	James D. Noggle, Statement of Professional Qualifications	9/21/2012	ML12265A720

⁷ See footnote 3, *supra*.

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Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
ENT00575 A	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Inc., Final IPEC Quarterly Long-Term Groundwater Monitoring Report, Quarters One Through Four 2011 (Sept. 26, 2012) ⁸	10/2/2012	ML12276A480

⁸ Entergy is providing to NRC quarterly updates of its groundwater monitoring reports. Those updated groundwater reports are available to the public at <http://www.safesecurevital.com>. Groundwater reports from 2008 through 2011 are available at the NRC "ADAMS" database <http://www.nrc.gov/reading-rm/adams.html> using the following ADAMS Accession Numbers, among others: ML080320540, ML12338A639, ML12089A597, ML12089A615, ML12089A614, ML12089A616, ML12338A637, ML12089A591, ML12089A596, ML12089A598, ML12094A117, ML12276A480, ML12276A486, ML12277A057, ML12276A493, ML12276A492.

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*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)*

Selected Testimony, Exhibits and Briefing

Entergy Exhibit #	Issue Addressed	Document Description	Date Submitted To Tribunal
N/A	Issue #3: Radiological ⁹	Pre-filed Testimony of Matthew J. Barvenik in Support of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (adopted under oath on January 23, 2012)	7/22/2011
N/A	Issue #3: Radiological	Pre-filed Testimony of F. Owen Hoffman in Support of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (adopted under oath on January 11, 2012)	7/22/2011
N/A	Issue #3: Radiological	Combined Pre-filed Rebuttal Testimony of Thomas C. Esselman, Ph.D., Matthew J. Barvenik, and F. Owen Hoffman, Ph.D. (adopted under oath on January 11 & 23, 2012)	10/4/2011
80	Issue #3: Radiological	NYSDEC Community Fact Sheet (Sept. 2007)	10/04/2011
121	Issue #3: Radiological	IPEC's Yearly Discharges vs Commonly Occurring Doses	1/11/2012
N/A	Issue #3: Radiological	Proposed Findings of Fact ("PFF") of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. Radiological Issues	4/27/2012
N/A	Issue #3: Radiological	Post Hearing Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point	4/27/2012

⁹ *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 ("WQC")*, DEC App. Nos. 3-5522-00011/00030 (IP2), Issues List, p.1 (Dec. 13, 2010) (defining issue #3 as "[w]hether Department Staff properly denied the WQC application based upon radiological considerations").

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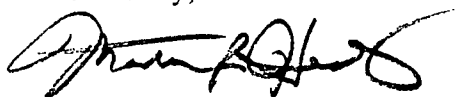
Linda M. Baldwin
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Entergy Exhibit #	Issue Addressed	Document Description	Date Submitted To Tribunal
		3, LLC, and Entergy Nuclear Operations, Inc., Radiological Issues	
N/A	Issue #3: Radiological	Post Hearing Reply Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc., Radiological Issues, dated October 5, 2012	10/5/2012

Several categories of documents listed above (*e.g.*, quarterly groundwater monitoring reports, annual radioactive effluent release reports) are updated and filed, or are otherwise made available to NRC, on a quarterly or annual basis. For such categories of documents, Entergy is providing to the Department written copies of documents that are most directly responsive to its specific information requests. For the Department's convenience, Entergy is also providing references to where related documents (*e.g.*, earlier or later versions of certain enclosed reports, as applicable) are publically available for the Department's examination. In addition, several documents being provided to the Department contain citations to supporting testimony and exhibits that are not specifically identified above or enclosed. If the Department would like copies of any such supporting testimony or exhibits, or other additional information with respect to unplanned radiological releases to groundwater, please let me know.

We look forward to discussing this supplemental information with you at your convenience.

Sincerely,



Martin R. Healy

MRH

cc:

U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk (w/encl. except for ADAMS documents)

Douglas V. Pickett, Senior Project Manager, NRC NRR DORL (w/encl. except for ADAMS documents)

William M. Dean, Regional Administrator, NRC Region 1 (w/encl. except for ADAMS documents)

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NRC Resident Inspectors Office (w/encl. except for ADAMS documents)
William Sharp, Principal Attorney (w/encl.)
Kari Gathen, Associate Attorney (w/encl.)
Jeffrey Herter, Assistant Bureau Chief, Division of Development (w/encl.)
Gregory Capobianco, Director, Division of Development (w/encl.)
Jeffrey Zappieri, Supervisor, Consistency Review Unit (w/encl.)
Matt Maraglio, Consistency Reviewer (w/encl.)
Fred Dacimo, Vice President License Renewal, Indian Point Energy Center (w/encl.)
William B. Glew, Jr., Associate General Counsel, Entergy Services, Inc. (w/encl.)
Kelli Dowell, Assistant General Counsel, Environmental, Entergy Services, Inc. (w/encl.)
Dara Gray, Chemistry/Environmental, Indian Point Energy Center (w/encl.)

March 31, 2014

**Response to New York State Department of State Request for Supplemental Information
Regarding Groundwater Quality Issues at Indian Point**

I. Request for Supplemental Information.

On December 3, 2013, Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (collectively, "Entergy") and the New York State Department of State (the "Department") engaged in a consultation session at which the Department requested supplemental information regarding past unplanned releases of radiological material to groundwater at Indian Point and the potential effects of those releases on groundwater quality. In Entergy's letter to the Department dated December 20, 2013, Entergy undertook to provide to the Department supplemental information on that topic on or before March 31, 2014.

II. The Source of Information Regarding Radiological Releases.

Indian Point, like all operating nuclear power plants, is designed and operated in accordance with strict Nuclear Regulatory Commission ("NRC") criteria that require, among other things, that any radiological releases, including unplanned releases, must comply with applicable NRC safety and health standards and, as appropriate, must be closely monitored. *See, e.g.*, Reference 1 (establishing annual dose limits to individual members of the public from the licensed activity), and Reference 2 (establishing standards to maintain releases of radiological materials to the

environment as low as reasonably achievable (“ALARA”)). In furtherance of its statutory responsibilities, NRC has conducted periodic inspections of Indian Point, and has required Energy to file periodic reports concerning any radiological releases to the environment. *See, e.g.*, Reference 3 (providing guidance to operators on the regulatory requirement to measure, evaluate and report radiological releases). In response to the discovery of unplanned releases of radiological material at Indian Point, and in order to minimize the possibility of a future unplanned or unmonitored release, NRC is overseeing Entergy’s implementation of a rigorous groundwater monitoring program. *See, e.g.*, Reference 4. Moreover, in connection with License Renewal at Indian Point (the “NRC Proceeding”), Entergy has submitted, and NRC has closely evaluated, detailed information regarding the potential effects on public health or the environment of unplanned radiological releases to groundwater. *See, e.g.*, Reference 5. Finally, in connection with the New York State Department of Environmental Conservation (“NYSDEC”) adjudicatory hearing for Indian Point (the “NYSDEC Proceeding”), Entergy has submitted evidence demonstrating that the unplanned releases of radiological materials to groundwater have not violated state water quality standards.

III. Summary of Facts Regarding Unplanned Radiological Releases to Groundwater at Indian Point.

A. The Sources of Past Unplanned Releases of Radiological Materials to Groundwater Have Been Eliminated or Their Causes Have Been Addressed.

The removal of all fuel from and the draining and de-sludging of the Unit 1 spent fuel pools was completed in late 2008. As a result, Unit 1 no longer is an active source of radionuclides to the subsurface. *See* Reference 6 at 43. In addition, the prior identified unplanned releases associated with Unit 2 have been repaired, and a robust monitoring system is in place to promptly identify and respond to any future releases. Reference 6 at 50; Reference 7 at pp. 15-19. There has been no identified unplanned spent fuel pool release to the environment from Unit 3.

Based upon an independent review, NYSDEC concluded that, with the removal of the active contamination source at Indian Point, planned use of monitored natural attenuation is an acceptable approach to managing the remaining radionuclide plumes. *See* Reference 8.

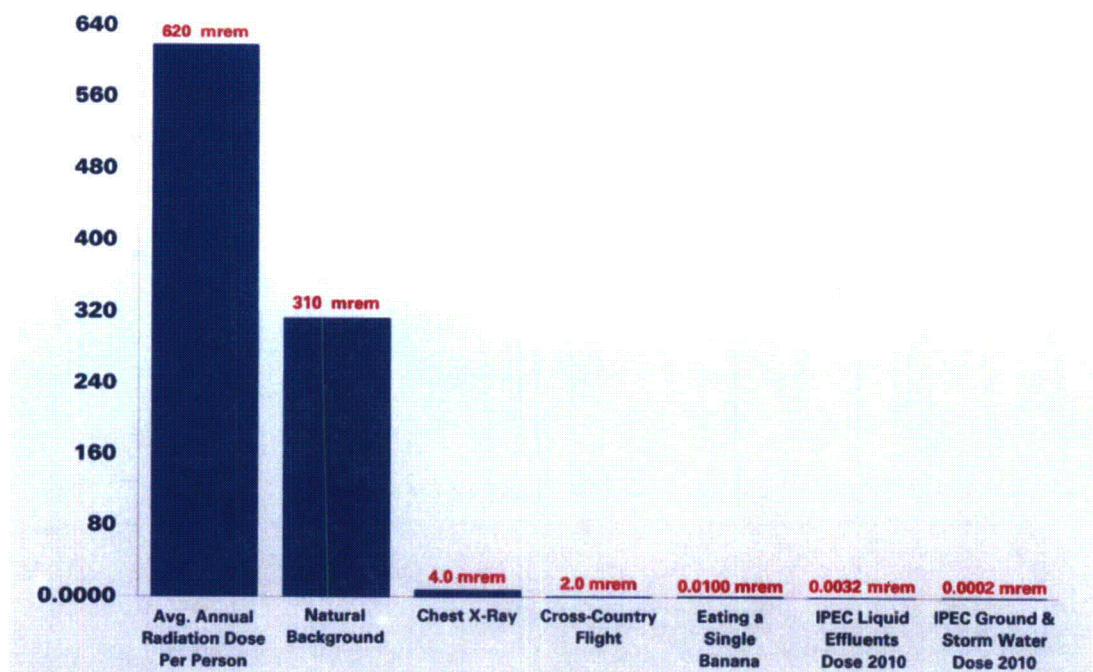
B. The Past Unplanned Releases of Radiological Materials to Groundwater Have Not Caused, and Are Not Causing, Threats to Public Health or the Environment.

- i. There is no credible scientific basis to conclude that Indian Point’s unplanned releases have impaired, or will impair, the public health or environment.*

One of Entergy’s groundwater experts, Dr. Hoffman, a pre-eminent scientist in the field of radiological health and safety: (i) identified the sources and amounts of radiological materials released into the environment from Indian Point; (ii) determined whether there were any exposure pathways for humans or aquatic biota to those radionuclides; (iii) calculated the radiation dose to humans or aquatic biota resulting from those exposure pathways; and (iv) translated that dose to risk to human health or impact on aquatic biota. *See* Reference 9 at 6-9, 11, 14.

To put things in perspective, Dr. Hoffman concluded that the annual dose in 2010 from Indian Point's unplanned releases (the year for which the most recent data was then available) to the hypothetical maximally-exposed individual was 0.0002 mrem, a small fraction of the dose that an individual would get from eating a single banana. See Reference 7 at ¶¶ 119, 127, 143; Reference 10.

IPEC's Yearly Discharges vs Commonly Occurring Doses



Dr. Hoffman then applied the linear no-threshold model to convert these doses into a risk to people of developing cancer in later life, finding that in order for such releases to cause a single incidence of cancer-related illness in later life, five billion people would have to be maximally exposed to Entergy's unplanned releases. Reference 7 at ¶ 136. After noting that an exposure to such a large population was impossible, Dr. Hoffman's conclusion was clear and uncontested: his expert opinion is that the unplanned releases from Indian Point are expected to have zero impact on the health of the public. Reference 7 at ¶ 138.

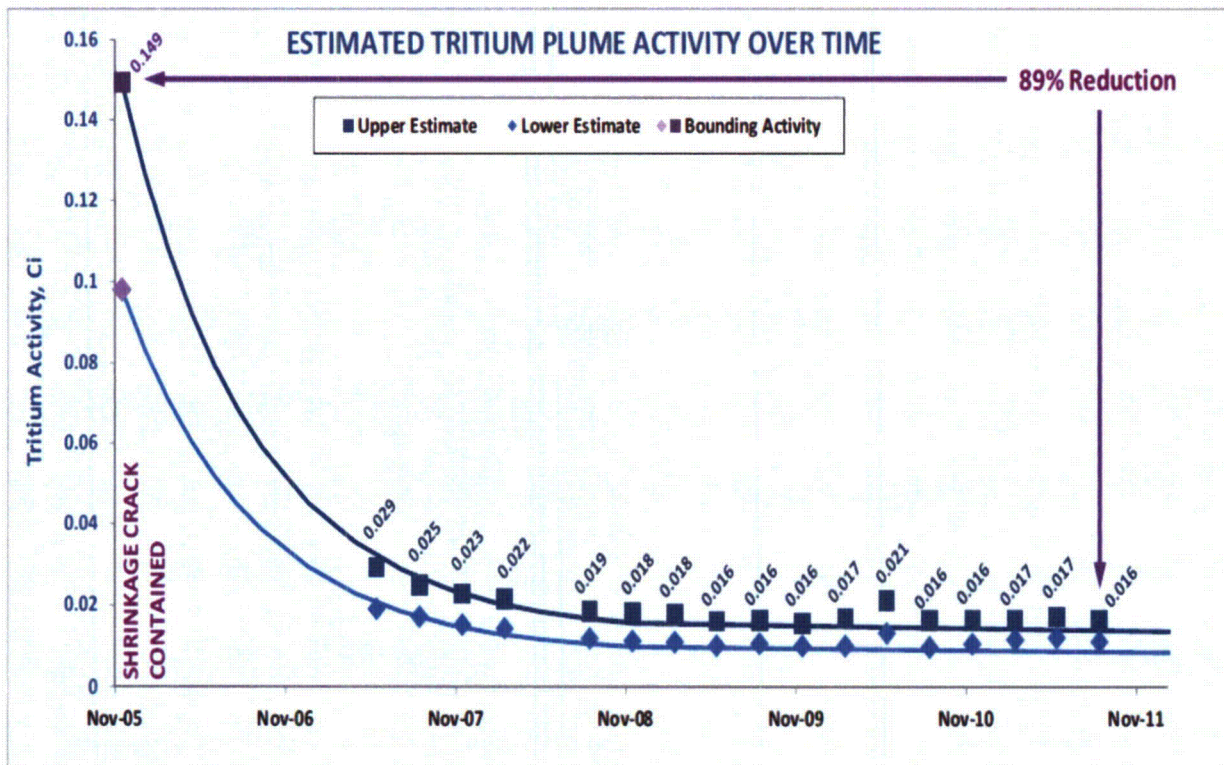
For purposes of evaluating impacts to the environment, Dr. Hoffman applied the two commonly accepted scientific methods for analyzing the potential dose to aquatic biota from radiological releases (the RESRAD-BIOTA dose model and the UNSCEAR model) to Indian Point's unplanned releases in 2010. Reference 7 at ¶¶ 139-141. His analysis confirmed that the dose rate (dose-per-day) to aquatic biota resulting from Indian Point's unplanned releases was "orders of magnitude" lower than the scientifically accepted threshold for protection of aquatic biota. Reference 7 at ¶ 142.

- ii. *There has been no discernible impact on the level of radionuclides in the Hudson River due to unplanned releases.*

Based on extensive, ongoing sampling and testing of Hudson River water in the vicinity of Indian Point and at control locations away from Indian Point, the migration of low levels of radionuclides to the Hudson River has no discernible effect on the levels of radionuclides contained in Hudson River water. Reference 6 at 99. NYSDEC sampling showed no significant difference between Strontium-90 in the flesh of fish caught near the site and fish caught as far as 70 miles upstream. See Reference 8. The radionuclide plumes in groundwater have not affected properties surrounding Indian Point. See Reference 11 at p. 30 n. 21 and Reference 12. Over time, the radionuclide plumes are diminishing in size. Reference 7 at ¶66.

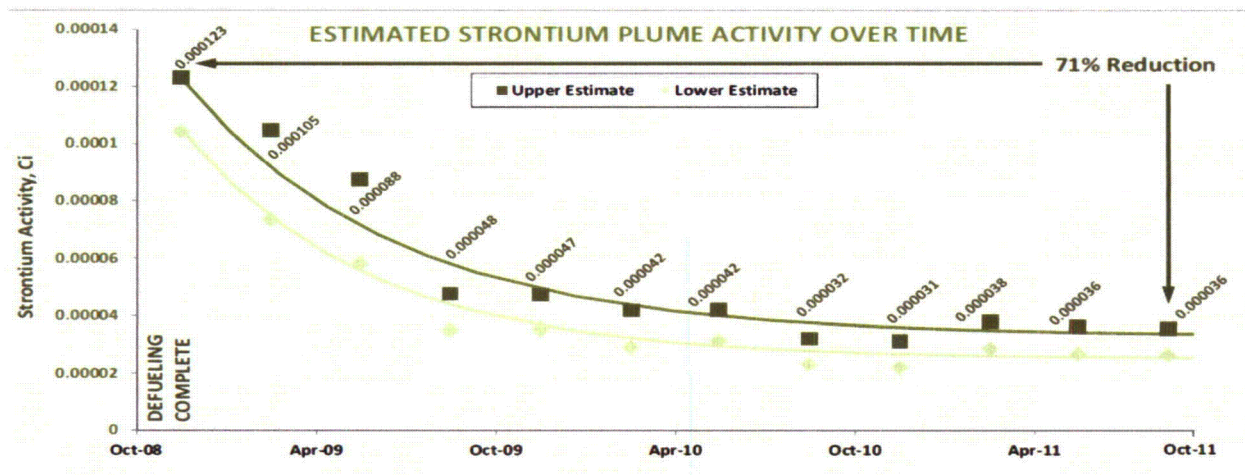
Between November 2005 (when the Unit 2 unplanned release was first addressed) and November 2011, estimated radionuclide concentrations in the plume associated with the Unit 2 unplanned release had diminished by approximately 89%. Reference 7 at ¶67.

ENT000332
Submitted: March 29, 2012



Between October 2008 (when the Unit 1 spent fuel pools were drained) and October 2011, estimated radionuclide concentrations associated with the Unit 1 unplanned release had diminished by approximately 71%. Reference 7 at ¶68.

ENT000333
Submitted: March 29, 2012



C. The Past Unplanned Releases of Radiological Materials to Groundwater Have Not Caused a Violation of State Water Quality Standards.

The Hudson River near Indian Point is classified as “SB” saline surface waters. *See* Reference 13 at Table 1, Item 2. “The best usages of Class SB waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish and wildlife propagation and survival.” Reference 14. Primary contact recreation consists of recreational activities where the human body may come in direct contact with raw water to the point of complete body submergence. Primary contact recreation includes, but is not limited to, swimming, diving, water skiing, skin diving and surfing. *See* Reference 15. Secondary contact recreation consists of recreational activities where contact with the water is minimal and where ingestion of the water is not probable. Secondary contact recreation includes, but is not limited to, fishing and boating. *See* Reference 16.

Dr. Hoffman’s analyses, described above, establish that Indian Point’s unplanned releases do not violate state water quality standards. First, Dr. Hoffman demonstrates that members of the public engaging in recreational activities on the Hudson River are unaffected by Indian Point’s unplanned releases. *See* Section III.B.ii. Accordingly, there is no credible scientific basis to conclude that Indian Point’s unplanned releases have impaired or will impair the use of the Hudson River for primary or secondary contact recreation, such as swimming, fishing, and boating. Second, Dr. Hoffman establishes that Indian Point’s unplanned releases were “orders of magnitude” lower than the scientifically accepted threshold for protection of aquatic biota. *See* Section III.B.ii. Accordingly, there is no credible scientific basis to conclude that releases of

radionuclides to groundwater that has migrated to the Hudson River have impaired or will impair the suitability of the Hudson River for fish, shellfish, and wildlife propagation and survival.

IV. Conclusions

The sources of past unplanned releases of radionuclides at Indian Point have been eliminated or their causes have been addressed. Those releases have not caused, and are not causing, threats to the public health or the environment. Nor have those releases caused a violation of state water quality standards.

REFERENCES

1. Radiation Dose Limits for Individual Members of the Public, 10 C.F.R. Part 20, Subpart D.
2. Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, 10 C.F.R. Part 50, Appendix I, Section II.
3. NRC, Regulatory Guide 1.21, Measuring, Evaluating, And Reporting Radioactive Material In Liquid And Gaseous Effluents And Solid Waste, Rev. 2 (June 2009).
4. Letter dated October 19, 2009, from Darrel J. Roberts, NRC, to Joseph Pollock, Entergy, Subject: Indian Point Nuclear Generating Units 1, 2 &3—NRC Inspection Report Nos. 05000003/2009008; 05000247/2009008; and 0400286/2009008 (ML12338A648).
5. Contentions RK-EC-3 and CW-EC-1, presented to and dismissed by the Atomic Safety and Licensing Board in connection with NRC Docket Nos. 50-247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01 (Entergy Nuclear Operations, Inc.—Indian Point Units 2 and 3).
6. NRC Proceeding, Entergy Exhibit ENT000301, Testimony of Entergy Witness Donald M. Mayer, Alan B. Cox, Thomas C. Esselman, Matthew J. Barvenik, Carl J. Paperiello, and F. Owen Hoffman Regarding Consolidated Contention RK-EC-3/CW-EC-1 (Spent Fuel Pool Leaks) (March 29, 2012) (ML12338A621).
7. NYSDEC Proceeding, Proposed Findings of Fact of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. Radiological Issues Entergy Proposed Findings of Fact (Apr. 29, 2012).
8. NRC Proceeding, Entergy Exhibit ENT000345, NYSDEC Community Fact Sheet (May 2008) (ML12089A608).
9. NYSDEC Proceeding, Prefiled Testimony of F. Owen Hoffman in Support of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (July 22, 2011).
10. NYSDEC Proceeding, Entergy Exhibit 121, IPEC's Yearly Discharges vs Commonly Occurring Doses.
11. NYSDEC Proceeding, Post Hearing Reply Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc., Radiological Issues (October 5, 2012).

12. NYSDEC Proceeding, Entergy Exhibit 80, NYSDEC Community Fact Sheet (Sept. 2007).

13. 6 NYCRR § 864.8.

14. 6 NYCRR § 701.11.

15. 6 NYCRR § 700.1(49).

16. 6 NYCRR § 700.1(56).

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1.	RIV000066	RK-EC-3/ CW-EC-1	GZA, GeoEnvironmental, Inc., Hydrogeologic Site Investigation Report, Indian Point Energy Center, January 7, 2008, IPEC00195418	12/22/2011	ML12335A626
2.	RIV000067	RK-EC-3/ CW-EC-1	Letter from Marsha K. Gamberoni, NRC, to Joseph Pollock, Entergy, "Indian Point Nuclear Generating Units 1 & 2 – NRC Inspection Report Nos. 05000003/2007010 and 05000247/2007010 (dated May 13, 2008)	12/22/2011	ML12335A624
3.	RIV000068	RK-TC-2	Entergy, Groundwater Investigation Executive Summary, Indian Point Energy Center, Buchanan, NY (January 2008)	12/22/2011	ML12335A623
4.	RIVR000091	RK-EC-3/ CW-EC-1	Liquid Radioactive Release Lessons Learned Task Force Final Report, U.S. NRC (September 1, 2006)	12/22/2011	ML12335A608
5.	NRC000095	RK-EC-3/ CW-EC-1	Ltr. To NRC from Entergy re: Remediation and Long Term Monitoring of Site Groundwater	3/30/2012	ML12339A651

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6.	ENT000300	RK-EC-3/ CW-EC-1	Entergy's Statement of Position on Consolidated Contention RK-TC-3/CW-EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12089A574
7.	ENT000301	RK-EC-3/ CW-EC-1	Testimony of Entergy Witness Donald M. Mayer, Alan B. Cox, Thomas C. Esselman, Matthew J. Barvenik, Carl J. Paperiello, and F. Owen Hoffman Regarding Consolidated Contention RK-EC-3/CW-EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12338A621
8.	ENT000302	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Donald M. Mayer	3/29/2012	ML12338A700
9.	ENT000303	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Thomas C. Esselman	3/29/2012	ML12338A667
10.	ENT000304	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Matthew J. Barvenik	3/29/2012	ML12338A679
11.	ENT000305	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Carl J. Paperiello	3/29/2012	ML12089A659
12.	ENT000306	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of F. Owen Hoffman	3/29/2012	ML12089A637
13.	ENT000313	RK-EC-3/ CW-EC-1	2010 Annual Radiological Environmental Operating Report (NL-11-038) (May 16, 2011)	3/29/2012	ML12339A710
14.	ENT000319	RK-EC-3/ CW-EC-1	2010 Annual Radioactive Effluent Release Report, Rev. 1 (NL-11-068) (June	3/29/2012	ML12089A670

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			10, 2011)		
15.	ENT000321	RK-EC-3/ CW-EC-1	Lawrence C. Skinner and Timothy J. Sinnot, Measurement of Strontium (90Sr) and Other Radionuclides in Edible Tissues and Bone/Carapace of Fish and Blue Crabs from the Lower Hudson River (Nov. 2009)	3/29/2012	ML12338A680
16.	ENT000332	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Inc., Changes in Computed Tritium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011	3/29/2012	ML12089A649
17.	ENT000333	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Changes in Computed Strontium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011	3/29/2012	ML12089A663

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19.	ENT000344	RK-EC-3/ CW-EC-1	Letter from D. C. Lew, NRC, to J. E. Pollock, Entergy, "Annual Assessment Letter – Indian Point Nuclear Generating Units 2 and 3 (Reports 05000247/2010001 & 05000286/2010001)" (Mar. 3, 2010)	3/29/2012	ML12089A601
20.	ENT000345	RK-EC-3/ CW-EC-1	NYSDEC Community Fact Sheet (May 2008)	3/29/2012	ML12089A608
21.	ENT000360	RK-EC-3/ CW-EC-1	EPA, Basic Information about Radionuclides in Drinking Water, web page	3/29/2012	ML12089A666
22.	ENT000371	RK-EC-3/CW-EC-1	Letter NL-08-023, from J. Pollock, Entergy, to NRC, Results of Ground Water Contamination Investigation (Jan. 11, 2008)	3/29/2012	ML12089A679

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24.	NRC00089	RK-EC-3/ CW-EC-1	Professional Qualifications, Stephen P. Klementowicz	9/21/2012	ML12339A646
25.	NRCR00090	RK-EC-3/ CW-EC-1	James D. Noggle, Statement of Professional Qualifications	9/21/2012	ML12265A720
26.	ENT00575 A	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Inc., Final IPEC Quarterly Long-Term Groundwater Monitoring Report, Quarters One Through Four 2011 (Sept. 26, 2012)	10/2/2012	ML12276A480

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PART TWO: 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)

Selected Testimony, Exhibits and Briefing

Tab #	Entergy Exhibit #	Issue Addressed	Document Description	Date Submitted To Tribunal
27.	N/A	Issue #3: Radiological	Pre-filed Testimony of Matthew J. Barvenik in Support of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (adopted under oath on January 23, 2012)	7/22/2011
28.	N/A	Issue #3: Radiological	Pre-filed Testimony of F. Owen Hoffman in Support of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (adopted under oath on January 11, 2012)	7/22/2011
29.	N/A	Issue #3: Radiological	Combined Pre-filed Rebuttal Testimony of Thomas C. Esselman, Ph.D., Matthew J. Barvenik, and F. Owen Hoffman, Ph.D. (adopted under oath on January 11 & 23, 2012)	10/4/2011
30.	80	Issue #3: Radiological	NYSDEC Community Fact Sheet (Sept. 2007)	10/04/2011
31.	121	Issue #3: Radiological	IPEC's Yearly Discharges vs Commonly Occurring Doses	1/11/2012
32.	N/A	Issue #3: Radiological	Proposed Findings of Fact ("PFF") of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. Radiological Issues	4/27/2012
33.	N/A	Issue #3: Radiological	Post Hearing Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc., Radiological Issues	4/27/2012
34.	N/A	Issue #3: Radiological	Post Hearing Reply Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc., Radiological Issues, dated October 5, 2012	10/5/2012

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
3.	RIV000068	RK-TC-2	Entergy, Groundwater Investigation Executive Summary, Indian Point Energy Center, Buchanan, NY (January 2008)	12/22/2011	ML12335A623

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
4.	RIVR00091	RK-EC-3/ CW-EC-1	Liquid Radioactive Release Lessons Learned Task Force Final Report, U.S. NRC (September 1, 2006)	12/22/2011	ML12335A608

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
5.	NRC000095	RK-EC-3/ CW-EC-1	Ltr. To NRC from Entergy re: Remediation and Long Term Monitoring of Site Groundwater	3/30/2012	ML12339A651

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
6.	ENT000300	RK-EC-3/ CW-EC-1	Entergy's Statement of Position on Consolidated Contention RK-TC-3/CW- EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12089A574

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
7.	ENT000301	RK-EC-3/ CW-EC-1	Testimony of Entergy Witness Donald M. Mayer, Alan B. Cox, Thomas C. Esselman, Matthew J. Barvenik, Carl J. Paperiello, and F. Owen Hoffman Regarding Consolidated Contention RK-EC-3/CW-EC-1 (Spent Fuel Pool Leaks)	3/29/2012	ML12338A621

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8.	ENT000302	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Donald M. Mayer	3/29/2012	ML12338A700

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
9.	ENT000303	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Thomas C. Esselman	3/29/2012	ML12338A667

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10.	ENT000304	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Matthew J. Barvenik	3/29/2012	ML12338A679

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11.	ENT000305	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of Carl J. Paperiello	3/29/2012	ML12089A659

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
12.	ENT000306	RK-EC-3/ CW-EC-1	<i>Curriculum Vitae</i> of F. Owen Hoffman	3/29/2012	ML12089A637

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
13.	ENT000313	RK-EC-3/ CW-EC-1	2010 Annual Radiological Environmental Operating Report (NL-11-038) (May 16, 2011)	3/29/2012	ML12339A710

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
14.	ENT000319	RK-EC-3/ CW-EC-1	2010 Annual Radioactive Effluent Release Report, Rev. 1 (NL-11-068) (June 10, 2011)	3/29/2012	ML12089A670

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16.	ENT000332	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Inc., Changes in Computed Tritium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011	3/29/2012	ML12089A649

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17.	ENT000333	RK-EC-3/ CW-EC-1	GZA GeoEnvironmental, Changes in Computed Strontium Plume Total Activity Over Time - Exponential Decay Curve Trending of Quarterly Data through Q3 2011	3/29/2012	ML12089A663

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ENT000345	RK-EC-3/ CW-EC-1	NYSDEC Community Fact Sheet (May 2008)	3/29/2012	ML12089A608

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Tab #	Exhibit #	Contentions Addressed by Exhibit	Exhibit Name	Exhibit Submission Date	Mandatory Log Number Identification for NRC Agency-wide Documents Access and Management System ("ADAMS") Database
21.	ENT000360	RK-EC-3/ CW-EC-1	EPA, Basic Information about Radionuclides in Drinking Water, web page	3/29/2012	ML12089A666

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22.	ENT000371	RK-EC-3/CW-EC-1	Letter NL-08-023, from J. Pollock, Entergy, to NRC, Results of Ground Water Contamination Investigation (Jan. 11, 2008)	3/29/2012	ML12089A679

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24.	NRC00089	RK-EC-3/ CW-EC-1	Professional Qualifications, Stephen P. Klementowicz	9/21/2012	ML12339A646

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25.	NRCR00090	RK-EC-3/ CW-EC-1	James D. Noggle, Statement of Professional Qualifications	9/21/2012	ML12265A720

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STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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 J. BARVENIK
IN SUPPORT OF ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY
NUCLEAR INDIAN POINT 3, LLC AND ENTERGY NUCLEAR OPERATIONS, INC.**

ISSUE FOR ADJUDICATION NO. 3 – RADIOLOGICAL MATERIALS

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

By its attorneys,



John C. Englander
Elise N. Zoli
U. Gwyn Williams
Robert Fitzgerald
Goodwin Procter LLP
53 State Street
Boston, Massachusetts 02109
Tel.: 617.570.1000
Fax: 617.523.1231

July 22, 2011

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

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1 **I. INTRODUCTION**

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

3 **A: My name is Matthew J. Barvenik. I am a Senior Principal with GZA GeoEnvironmental,**
4 **Inc., One Edgewater Drive, Norwood, MA 02062.**

5 **Q: Are you offering this testimony on behalf of Entergy in support of its application for**
6 **a Water Quality Certification (DEC App. Nos. 3-5522-00011/00030 ("IP2") and 3-**
7 **5522-00105/00031 ("IP3")) for Indian Point Units 2 and 3 (collectively the**
8 **"Proceeding")?**

9 **A: Yes. I am offering my testimony with respect to Issue for Adjudication No. 3 concerning**
10 **"radiological materials." In the Notice of Denial, DEC Staff states that "radiological**
11 **leaks have the potential to impair the best use of the water designated in 6 NYCRR**
12 **§ 701.11." I understand from counsel that § 701.11 contains the best usage classification**
13 **for the use of the Hudson River in the vicinity of Indian Point, and states that the "best**
14 **usages of Class SB waters are primary and secondary contact recreation and fishing.**
15 **These waters shall be suitable for fish, shellfish and wildlife propagation and survival."**
16 **Accordingly, I will offer expert testimony concerning the hydrogeology of the Indian**
17 **Point site, i.e. how groundwater is distributed and moves in the soil and bedrock beneath**
18 **the site, as well as the work GZA has done to create a network of monitoring installations**
19 **to allow Entergy to characterize the extent of existing radionuclides in the groundwater**
20 **beneath the site and ultimately to the Hudson River, and to detect and respond to**
21 **potential future releases to groundwater from continued operation of the plant during the**
22 **license renewal period. In support of my testimony I am submitting, *inter alia*, a report**
 entitled "Hydrogeologic Site Investigation Report for the Indian Point Energy Center,

(January 2008) ("Site Investigation Report") (Exh. 33).

II. SUMMARY OF EXPERT OPINIONS

Q: What opinions are you offering today with respect to this Proceeding?

A: GZA has studied the hydrogeology of the Indian Point site and the groundwater flow mechanisms at the site, and has installed a broad network of groundwater monitoring wells to test for radionuclides in order to monitor past releases and detect future releases of radionuclides to groundwater at the Indian Point site. As a result of this work, I have concluded the following:

- Principally as a result of past releases of water from Indian Point Unit 1 ("IP1") and Unit 2 ("IP2") spent fuel pools ("SFPs"), some of the groundwater beneath the site contains detectable levels of radionuclides, principally tritium (mostly resulting from the IP2 SFP), and strontium (resulting from the now-drained IP1 SFP). This groundwater migrates to the Hudson River, resulting in low levels of tritium and strontium reaching the river, amounts orders of magnitude below the allowable federal regulatory limits for radiological effluent releases. These previously identified releases from the IP1 and IP2 SFPs have been stopped, as documented in the Site Investigation Report, which has and should continue to result in a decrease in radionuclide activity (also commonly referred to as concentration) in the groundwater and reaching the river.
- Based on sampling and testing of Hudson River water in the vicinity of Indian Point and at control locations away from Indian Point, the low level migration of radionuclides to the Hudson River has had no discernible effect on the level of radionuclides contained in Hudson River water.

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- 1 • Entergy's network of groundwater monitoring wells is sufficient to allow Entergy to
2 detect comparable potential future releases to groundwater at the site and respond
3 rapidly and appropriately to such releases.

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

5 **A:** Yes.

6 **III. QUALIFICATIONS**

7 **Q: Please describe your educational and professional qualifications, including relevant**
8 **professional activities.**

9 **A:** My professional and educational qualifications are summarized in the attached
10 *curriculum vitae* (Exh. 54). In brief, I hold a BS degree in civil engineering from
11 Northeastern University and a MS degree in geotechnical engineering from the
12 Massachusetts Institute of Technology. I have over 35 years of professional experience
13 in hydrogeology, civil, geotechnical and instrumentation engineering. I am currently a
14 senior principal and senior VP at GZA GeoEnvironmental, Inc., a company that provides
15 a wide-range of geotechnical engineering, environmental consulting, and remediation
16 services, where I have overall responsibility for projects and contract signing authority. I
17 also hold the position of Senior Technical Consultant, GZA's highest technical position
18 through which I provide technical input and quality control for the firm's district offices. I
19 have also served on the board of directors for six years. I am a member of the American
20 Nuclear Society ("ANS"), where I served on the Working Group responsible for writing
21 the recently completed ANS standard for Evaluation of Subsurface Radionuclide
22 Transport at Commercial Nuclear Power Plants, and I am currently a member of two
3 newly formed Working Groups responsible for drafting future standards.

1 Q: Please describe the basis for your analysis of Indian Point's site hydrogeology and
2 your opinions contained herein.

3 A: In my capacity as the lead technical investigator for Entergy, I was responsible for
4 directing the technical aspects of the hydrogeologic site characterization. Based on my
5 direct involvement with issues related to the Indian Point hydrogeologic site investigation
6 and the ongoing groundwater monitoring, I am very familiar with the Indian Point
7 hydrogeologic setting and groundwater flow patterns, identified contaminant sources and
8 transport, historical and ongoing groundwater monitoring, and remediation plans.
9 Additionally, based on this experience, I am familiar with the history and status of Indian
10 Point SFP releases, dose assessments, and associated NRC inspection activities, as well
11 as other independent assessments of the SFP releases.

12 IV. INDIAN POINT SITE HYDROGEOLOGY AND RADIONUCLIDE
13 CHARACTERIZATION

14 Q: What is hydrogeology?

15 A: Hydrogeology is the study of movement, distribution, and quality of ground water. In the
16 context of Indian Point, the site hydrogeology work consisted in part of studying the
17 subsurface of the site in order to understand how groundwater is distributed and how it
18 moves across the site (we refer to that understanding as the "conceptual site model"). A
19 fuller description of the methods used to gain an understanding of the distribution and
20 movement of groundwater is contained below in Section IV. Our site hydrogeology work
21 also consisted of the construction of a broad network of groundwater monitoring
22 installations (also generally referred to as "wells"), which allow us to take samples of the
23 groundwater beneath the site at dozens of locations on a periodic basis, in order to test the

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1 samples for the presence of plant-related radionuclides. Presently, the monitoring
2 network installed by GZA contains 65 monitoring installations, including over 150
3 sampling intervals, which allow us to sample groundwater at various depths from the
4 groundwater surface to well below the top of bedrock. A depiction of the current array of
5 groundwater monitoring installations contained in Exhibit 42. In addition to these
6 installations, included in the overall groundwater monitoring program are approximately
7 75 storm drains and 25 sumps throughout the Indian Point site, from which samples are
8 periodically taken and tested by the Indian Point Chemistry Department. This broad
9 network of monitoring locations allows us to characterize the extent and concentration of
10 radionuclides present in the groundwater from past releases, and to detect potential future
11 releases of radionuclides to the groundwater at the site.

12 **Q: As a result of your site hydrogeology work, have you made any conclusions about**
13 **how water is distributed and moves beneath the site?**

14 **A:** Yes. The conceptual site model demonstrates that groundwater flows into the Indian
15 Point power block area from the North, East and South, and then flows to the Hudson
16 River to the West; groundwater, and thus any radionuclides contained in the groundwater,
17 does not flow off the site from the power block area, except to the river.

18 **Q: As a result of your site hydrogeology work, have you identified the presence of**
19 **plant-related radionuclides in the groundwater beneath the site?**

20 **A:** Yes. As a result of our groundwater monitoring program, we have identified two distinct
21 "plumes" of groundwater containing radionuclides, one containing principally tritium,
22 and one containing principally strontium. As a result of our site hydrogeology work, and
23 further investigation by Entergy, we have concluded that the "tritium plume" is primarily

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1 a result of past releases of water from the IP2 SFP, described more fully below. The
2 concentration of tritium in the groundwater beneath the site, and therefore the overall
3 tritium plume, has been generally decreasing over time. A depiction of the change in the
4 tritium plume activity over the span of our groundwater monitoring program is contained
5 at Exhibit 41. Based on our site hydrogeology work and further investigation by Entergy,
6 we have concluded that the "strontium plume" is primarily a result of a past release of
7 water from IP1 SFPs, described more fully below. While the plume from the IP1 SFPs
8 consists primarily of strontium, groundwater testing has also identified tritium and
9 sporadic observations of cesium-137, nickel-63, and cobalt-60 within the plume. *See Site*
10 *Investigation Report at 89 n.61.* The IP1 SFPs no longer contain any spent fuel and have
11 since been drained and, therefore, are no longer a current or potential future source of
12 radionuclide releases to the environment.

13 **Q: As a result of your site hydrogeology work, have you been able to conclude whether**
14 **any radionuclides detected in groundwater have reached the Hudson River?**

15 **A:** Yes. Because the groundwater beneath the site moves from the site to the river, the
16 groundwater containing both tritium and strontium (and potentially trace sporadic
17 amounts of cesium-137, nickel-63, and cobalt-60) eventually discharges to the Hudson
18 River. Our understanding of groundwater flow and distribution, coupled with our
19 network of monitoring wells, has allowed us to estimate the amount of radionuclides that
20 have reached the river on an annual basis as a result of the releases to groundwater.
21 These amounts are low, orders of magnitude below the allowable federal regulatory
22 limits for radiological effluent releases. Below is a table containing estimates of the
23 annual levels of radionuclides that have reached the river as a result of releases to

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groundwater since our monitoring program began, as reported in Entergy's Annual Radiological Effluent Release Reports ("ARERRs"):

Total Tritium Released from Groundwater

2006	0.19 curies
2007	0.064 curies
2008	0.2 curies
2009	0.07 curies
2010	0.12 curies

Total Other Radionuclides Released from Groundwater

2006	0.00057 curies
2007	0.00008 curies
2008	0.00016 curies
2009	0.00025 curies
2010	0.000042 curies

See Entergy's ARERR's, 2006-10, at Section H.

These levels of radionuclides are orders of magnitude below the allowable federal regulatory limits for radiological effluent releases.

V. DESCRIPTION OF RELEASES TO GROUNDWATER

Q: Please describe the past release of water from the IP2 SFP to groundwater.

A: In August 2005, Entergy began excavating adjacent to the south wall of the IP2 SFP, in preparation for installation of a crane. While removing material along the south exterior wall of the SFP, Entergy discovered a hairline crack, roughly 1/64" in width and 7 feet in length, at approximately the 65 foot elevation of the IP2 SFP south wall, that exhibited

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1 moisture. As excavation continued over the course of the next two weeks, Entergy
2 discovered two additional hairline cracks, this time at around the 60 foot elevation.
3 Entergy, as a precautionary measure, installed a temporary collection device over the
4 cracks to collect any leaking liquid. A permanent collection box installation was
5 completed in January 2006 and all collected water is piped to an adjacent building where
6 it is collected for final disposition. The discovery of this release is what prompted
7 Entergy to contract with GZA to conduct its investigation, develop the site conceptual
8 model, and install the network of monitoring wells discussed above.

9 In September 2007, in the course of its investigation of the source of the IP2 SFP
10 release, Entergy drained the IP2 SFP canal used to transfer spent fuel from the reactor to
11 the spent fuel pool in order to inspect the liner of the transfer canal. At that time, Entergy
12 identified a pinhole leak in a single small weld imperfection, which, in December 2007,
13 was repaired. Also, the entire surface and all the welds of the transfer canal were
14 inspected, but no further imperfections were identified. The accessible surfaces of the
15 adjoining fuel pool were also inspected and no additional imperfections were identified.
16 As of December 2007, Entergy had repaired all then-identified imperfections in the IP2
17 SFP.

18 **Q: Does Entergy's monitoring program establish that these repairs were successful?**

19 **A:** Yes. As stated above, from both qualitative and quantitative perspectives, the overall
20 quarterly monitoring data indicates that tritium activity in the IP2 SFP plume has been
21 generally decreasing and the plume undergoing long-term, overall reductions in activity.

22 **Q: Please describe past release of water from SFP1 to groundwater.**

A: IP1 ceased commercial operation on October 31, 1974. In 1992, the previous owner of

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1 IP1 identified a release of water from the IP1 SFP at a net leak rate of 25 gallons per day
2 (*i.e.*, 10 drops per second). The water released to the groundwater from IP1 SFP
3 contained plant-related radionuclides, principally strontium. See Site Investigation
4 Report at 89 n.61. Both NRC and NYSDEC were aware of the release, and the prior
5 owner's management of the release. The investigation performed at that time concluded
6 the releases were well within the 10 C.F.R. Part 50 dose guidelines.

7 The release of water from the IP1 SFPs continued until late 2008, when all the
8 fuel rods were removed from the IP1 SFPs and the pool water was subsequently drained.
9 See E-mail notification from Donald Mayer, Director, IPEC Unit 1, Entergy, to John
10 White, Branch Chief, Radiation Protection, NRC Region 1, "Subject: Indian Point 1"
11 (Nov. 5, 2008) (Exh. 47). As such, the IP1 SFPs are no longer an active source of
12 radionuclides to the subsurface. While the defueling process caused an initial increase in
13 the release rate from IP1 SFP, and therefore an increase in the measured levels of
14 strontium in the groundwater beneath the site, those levels have been decreasing as that
15 water flushes through the subsurface to the river, and have generally reached pre-
16 defueling levels.

17 **Q: Please provide an overview of the history of any SFP conditions relevant to releases**
18 **of water at IP3.**

19 **A:** No releases of water from the IP3 SFP to groundwater have been identified. The absence
20 of IP3 SFP releases to groundwater is attributed to the design upgrades incorporated in
21 the more recently constructed IP3-SFP, including the stainless steel liner (consistent with
22 IP2 but not included in the IP1 design) and the secondary leak detection drain system not
23 included in the IP2 design. The IP3 SFP contains a tell-tale leak collection system, which

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1 is regularly inspected to verify it is in good working condition. Following the discovery
2 of IP2 SFP releases, additional monitoring wells were put in place to monitor the
3 groundwater beneath IP3 as a proactive and precautionary measure.

4 **Q: Has the groundwater monitoring program allowed you to indentify and/or**
5 **characterize any additional releases to groundwater?**

6 Yes. As stated above, Entergy's broad array of monitoring installations, in addition to
7 characterizing the extent and movement of existing radionuclides in groundwater, is also
8 designed to assist Entergy in identifying possible future releases of radionuclides to the
9 groundwater beneath the site, and to assist Entergy in identifying and remediating the
10 source of such releases. This is part of Entergy's Long Term Monitoring Program
11 ("LTMP"), which is described more fully below. For example, since the LTMP began,
12 we have identified and/or characterized additional releases to groundwater beneath the
13 site:

- 14 • In the first quarter of 2009, a leakage of water occurred in a distillation tank valve
15 located within the IP1 chemical systems building. The result of this leakage was the
16 identification of a brief increase in tritium levels in a monitoring location in the area
17 of the chemical systems building. Since the leakage was repaired, levels in that
18 monitoring well have gone down to pre-leak levels. There is no indication that this
19 brief leakage caused any material increase in the amount of tritium reaching the river.
- 20 • In the fourth quarter of 2009, a leakage of water occurred during a temporary
21 operation to filter the water in the Refueling Water Storage Tank. This leakage
22 resulted in a temporary increase in tritium levels in various monitoring wells. The
23 leak was immediately fixed, and tritium levels have since gone down to pre-leak

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1 levels. Entergy has subsequently determined that the radionuclide dose consequence
2 as a result of this leak was immaterial.

- 3 • Beginning in the third quarter of 2010, we noticed increased tritium levels in a
4 monitoring location adjacent to the IP2 SFP, which generally coincided with an
5 increase in the rate of water flowing into the leak-collection box on the outside of the
6 IP2 SFP. As an initial finding of the on-going investigation, the increased flow
7 appears to be attributable to the periodic raising of the SFP water level, resulting in a
8 leak path from light boxes near the top of the SFP, allowing water to get behind the
9 stainless steel liner plates on the face of the SFP. This leak path has had a temporary
10 repair applied, through sealing of the light boxes. Those light boxes are planned to be
11 removed and permanently sealed in the near future. There is no indication that this
12 leakage has resulted in any material increase in the tritium plume but additional
13 evaluations continue, so as to fully understand this issue.

14 While the concentrations of tritium identified above have resulted in no material increase
15 in the offsite dose analyses regularly performed by Entergy, all such instances are
16 enveloped by the reporting and analysis requirements of the NRC's effluent regulations.
17 As such, they are included in the annual environmental and effluent release reporting
18 documents provided to the NRC.

19 In my professional opinion, Entergy's ability to identify, characterize, and
20 respond appropriately to these sporadic releases, which occur at any large industrial
21 facility, demonstrates the efficacy of the LTMP.

22 **VI. DETAILS OF GZA'S SITE HYDROGEOLOGY STUDY**

23 **Q: Please provide an overview of the purpose and objectives of Indian Point's**

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1 **hydrogeologic groundwater investigation.**

2 A: As previously stated, following the discovery of the IP2 SFP hairline cracks in September
3 2005, Entergy contracted with GZA to conduct a comprehensive groundwater
4 investigation. GZA executed its investigation by utilizing a three-phased approach
5 between September 2005 and September 2007. Phase I investigations began in
6 September 2005 and focused on identifying groundwater flow pathways from the IP2
7 SFP, and evaluating how radionuclides move through the environment beneath the site.
8 During this phase, groundwater sampling focused on tritium. A large portion of the work
9 in Phase I included development of the initial Conceptual Site Model ("CSM") to
10 understand the groundwater flow and radionuclide transport at Indian Point. Among
11 other things, activities during Phase I included the installation of four stilling wells (*i.e.*,
12 wells constructed of slotted pipe, and placed in surface water bodies to house pressure
13 transducers for monitoring surface water elevation fluctuations), borehole testing to
14 locate potential fractures in the bedrock that could conduct groundwater flow, and
15 extensive sampling and analysis of groundwater from a large number of monitoring
16 wells. *See* Investigation Report, Section 2.1 at 6-7; Section 4.2 at 17.

17 Phase II of the investigation commenced in January 2006. The focus of Phase II
18 work was to confirm the initial Phase I findings, better estimate the concentration of
19 radionuclides in groundwater at Indian Point, and augment the network of wells across
20 the site to allow identification of potential releases to groundwater on a long-term basis.
21 In support of these objectives, GZA drilled additional boreholes to locate potential
22 fractures in the bedrock that could conduct groundwater flow. As with the prior phase,
23 Phase II involved groundwater testing; while initially focused on tritium, in 2006 the

1 testing was expanded to encompass all radionuclides typically associated with nuclear
2 power generation (although tritium and strontium remained the principal constituents of
3 interest). *See* Investigation Report, Section 2.2 at 7-8.

4 In June 2006, the Phase III investigations began. Phase III of the investigation
5 focused on further defining the extent of strontium detected during Phase II, and
6 augmenting the characterization of bedrock aquifer properties to allow evaluation of
7 potential remedial options. Phase III also involved the installation of additional wells to
8 further define the horizontal and vertical extent of contamination. During Phase III, GZA
9 conducted various pumping and tracer tests to better assess the hydraulic properties of the
10 bedrock and to augment its understanding of contaminant migration and transport
11 mechanisms. *See* Investigation Report, Section 2.3 at 8.

12 **VII. CURRENT GROUNDWATER MONITORING PROGRAM**

13 **Q: Will Entergy continue to monitor groundwater to detect possible radionuclide**
14 **releases at Indian Point?**

15 Yes. To monitor groundwater for future releases, Entergy has established a long-term
16 groundwater monitoring program ("LTMP"). There are essentially four objectives to the
17 LTMP:

- 18 • Monitor groundwater flow rate and radionuclide concentrations
19 to both detect and characterize current and potential future
20 releases of radionuclides from groundwater to the Hudson
21 River;
- 22 • Monitor groundwater proximate to Indian Point systems,
3 structures, and components that may result in releases of

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1 radionuclides to groundwater at Indian Point;

- 2 • Monitor groundwater along the property boundary and off-site
- 3 to confirm that groundwater containing radionuclides is not
- 4 migrating off of the property to locations other than the river;
- 5 and
- 6 • Monitor groundwater plumes identified onsite to demonstrate
- 7 overall reductions in total activity over time.

8 The LTMP is designed to detect potential leaks from systems, structures, and components
9 that may result in releases of radionuclides to the groundwater at Indian Point. In order
10 to monitor SSCs, a broad network of on-site monitoring installations are used, in addition
11 to the numerous storm drains and sumps throughout the site, as described above. For
12 these monitoring wells, Entergy established investigation levels consisting of preset
13 quantitative radionuclide concentrations above which further action would be undertaken.
14 Those levels are well below applicable NRC limits, and therefore allow for timely
15 detection of potential new releases should they occur. This process is consistent with
16 NRC regulatory reporting guidance which recognizes that nuclear power plant operations
17 may have abnormal operational occurrences that take place and result in releases that
18 would be expected to be small fractions of regulatory limits. The LTMP positions
19 Entergy to investigate these occurrences should they occur and have an impact on
20 groundwater beneath the site.

21 **Q: Please describe briefly what GZA has done to develop and execute the LTMP.**

22 **A:** Under the LTMP, GZA continues to conduct groundwater monitoring and sampling
3 activities that are reported quarterly in the "Quarterly Long-Term Groundwater

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1 Monitoring Report.” *See, e.g.*, GZA, Final IPEC Quarterly Long-Term Groundwater
2 Monitoring Report, Quarter Two 2010 (Report No. 10) (Feb. 15, 2011) (Exh. 40); GZA,
3 Final IPEC Quarterly Long-Term Groundwater Monitoring Report, Quarter One 2009
4 (Report No. 5) (June 22, 2010) (Exh. 38). The groundwater monitoring activities are
5 conducted in support of Indian Point’s long-term monitoring efforts related to
6 radionuclide releases to groundwater. The overall foundation for the development and
7 execution of this LTMP is based on the CSM, as described in the Site Investigation
8 Report. Generally, the scope of work involved five separate areas:

9 First, GZA installed dedicated sampling equipment in the majority of monitoring
10 installations designated for sampling as part of this program. The use of dedicated
11 sampling equipment limits the possibility of cross-contamination between monitoring
12 installations or individual multi-level sampling intervals within a single installation.

13 Second, GZA maintains transducers and dataloggers, as part of the monitoring
14 instrumentation located across the site, which record groundwater elevation and
15 temperature measurements at regular time intervals. These data are then downloaded on
16 a quarterly basis.

17 Third, GZA collects groundwater samples for radionuclide analysis from the
18 scheduled sampling intervals within select monitoring installations. If unexpected
19 quarterly results are encountered, mid-quarter and confirmatory samples may also be
20 collected. When requested, split groundwater samples from select locations are provided
21 to NRC and NYSDEC.

22 Fourth, GZA collects water samples from drain lines in several manholes onsite to
3 characterize discharge from foundation drains around and below the IP2 and IP3

1 Containment Structures. These drains are part of the early leak detection monitoring
2 network.

3 Fifth, GZA performs general wellhead maintenance tasks, such as housekeeping
4 of well vaults and roadboxes, and replacement of dedicated sampling equipment, tubing
5 and transducers, as required.

6 **VIII. RESULTS OF HYDROGEOLOGIC INVESTIGATION AND CONTINUED**
7 **GROUNDWATER MONITORING AT INDIAN POINT**

8 **Q: Do you believe that Entergy's monitoring system provides reliable assurances that**
9 **future releases to groundwater will be detected?**

10 **A:** Yes. A primary purpose of the groundwater monitoring program, including GZA's
11 installations of a series of additional wells, was to do exactly that. It is my conclusion
12 that the current groundwater monitoring program, including the system of ground water
13 monitoring installations dispersed throughout the site, should detect future releases of
14 radionuclides to the groundwater from the operation of Indian Point comparable to those
15 described above, which are far below allowable federal regulatory limits. Entergy will
16 therefore be able to take timely and appropriate corrective action upon the detection of
17 any such releases.

18 **Q: Is the extent and level of groundwater contamination from the release of water from**
19 **the SFPs decreasing?**

20 Yes. It is our conclusion that the tritium and strontium plumes due to the historic
21 releases from the IP1 and IP2 SFPs have reached their maximum sizes and are
22 decreasing. These IP1 and IP2 plumes, however, are decreasing at varied rates, and with
23 periodic fluctuations, as expected. See Site Investigation Report at 97-101. The IP2

1 tritium plume is generally decreasing faster than the IP1 strontium plume given that
2 tritium does not partition to geologic and anthropogenic solid surfaces, while strontium
3 does. Data collected during and since the site investigation indicate that the tritium
4 concentrations in the IP2 plume have decreased. Similarly, the IP1 strontium plume has
5 decreased since 2009 and by removing all spent fuel and water from the spent fuel pools
6 the source has been eliminated. Our continued quarterly monitoring program has
7 confirmed these results. *See, e.g.*, GZA Q2 2010 Quarterly Monitoring Report at 3-13 to
8 3-22.

9 **IX. INDEPENDENT ASSESSMENTS OF SFPS AT INDIAN POINT**

10 **Q: Were any independent organizations involved with Entergy's assessments of the**
11 **impacts of the SFP releases?**

12 A: Yes. Throughout the two-year hydrogeologic site investigation study Entergy provided
13 full and open access, including holding regular meetings attended by the NRC, USGS,
14 NYSDEC, and the NY Public Service Commission. For example, early in the
15 investigation process, NYSDEC requested that the NYSDOH assess the presence of
16 drinking water supply wells in the vicinity of Indian Point.

17 **Q: Did NYSDEC conduct its own independent investigation?**

18 A: Yes. NYSDEC (with support from NYSDOH) actively monitored Entergy's
19 hydrological investigation, collected split samples of onsite and offsite monitoring wells,
20 and made recommendations on the work being performed. Importantly, NYSDEC
21 performed its own independent assessment of potential public health impacts. *See*
22 NYSDEC Community Fact Sheet (2007) (Exh. 46).

23 **Q: What did NYSDEC conclude during its own independent assessment?**

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1 A: In brief, NYSDEC's conclusions were consistent with the findings made in the Site
2 Investigation Report. As to any strontium contamination, NYSDEC concluded that
3 removal of the spent fuel and water from the IP1 SFP will (and did) halt the active source
4 of contamination. While public exposure can occur through consumption of fish from the
5 Hudson River, NYSDEC determined strontium levels in fish near the site are no higher
6 than those collected from other statewide locations. Here, NYSDEC corroborated
7 Entergy's finding that calculated doses to the public through fish consumption (0.00027
8 mrem whole body and 0.00099 mrem organ dose) are less than 1% of the allowable NRC
9 dose limits. See NYSDEC Community Fact Sheet (2007) (Exh. 46). NYSDEC's
10 findings support the conclusion that there is no effect on fish from the radionuclide
11 releases to groundwater, and no public health concern associated with eating fish from
12 the Hudson River. Finally, NYSDEC concluded that any radionuclides reaching the
13 Hudson River as a result of the radionuclide releases to groundwater did not violate state
14 and federal drinking water levels.

15 In addition, in 2007, NYSDEC conducted an enhanced, independent radiological
16 surveillance of several aquatic species in the lower Hudson River. The results from this
17 assessment were published in 2009. See Lawrence C. Skinner & Timothy J. Sinnot,
18 Measurement of Strontium (90Sr) and Other Radionuclides in Edible Tissues and
19 Bone/Carapace of Fish and Crabs from the Lower Hudson River, New York (Nov. 2009)
20 (Exh. 39). NYSDEC concluded that there were no significant differences in the
21 concentrations of strontium in fish and shellfish samples near the Indian Point site and
22 those sampled upriver at reference locations (which included an additional reference
23 location in the river, 50 miles north of Indian Point). *Id.* at 8. In addition, NYSDEC

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1 concluded that the levels of all radionuclides (including strontium) in fish and shellfish at
2 all of the sampling locations were two to five orders of magnitude lower than established
3 criteria for protection of freshwater ecosystems. *Id.*

4 **Q: Please provide a brief background of NRC inspection activities at Indian Point since**
5 **the September 2005 discovery of a crack in the IP2 SFP wall.**

6 **A:** After Entergy informed the NRC of the identified hairline cracks in the IP2 SFP wall,
7 which led to the discovery of low levels of radioactive tritium contamination in the
8 groundwater, NRC initiated a special inspection on September 20, 2005. Although
9 Entergy did not exceed any specific thresholds in the NRC Reactor Oversight Process
10 ("ROP") Action Matrix mandating additional regulatory oversight, NRC Staff
11 nonetheless increased its oversight relative to issues associated with the IP2 SFP. *See*
12 *Request for Deviation from the Reactor Oversight Process Action Matrix to Provide*
13 *Increased NRC Oversight of Specific Issues at Indian Point Energy Center (Oct. 28,*
14 *2005), available at ADAMS Accession No. ML053010404 (Exh. 31).* The purpose of
15 the inspection was to examine Entergy's performance and determine if the contaminated
16 groundwater affected, or could affect, public health and safety. *Id.*

17 NRC issued a special inspection report in March 2006 that assessed Entergy's
18 performance and plans for more extensive site characterization, and reported that the
19 groundwater contamination did not and was not likely to adversely affect public health
20 and safety. *See* NRC Special Inspection Report No. 05000247/2005011 (Mar. 16, 2006)
21 (Exh. 32). In that report, and subsequent public meetings, the NRC indicated that a final
22 conclusion would be reached after Entergy completed its groundwater characterization
3 initiative. While groundwater characterization was ongoing, NRC continued frequent

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1 inspections and implemented a monitoring regime for Entergy's onsite groundwater
2 monitoring activities.

3 Subsequently, the NRC continued to closely monitor Entergy's groundwater
4 characterization efforts, performed independent inspections and testing, and
5 independently evaluated radiological and hydrological conditions affecting groundwater
6 onsite. Additionally, the NRC independently verified groundwater radionuclide levels by
7 conducting split monitoring well sampling with Entergy and NYSDEC.

8 After receiving the results from the hydrogeologic site characterization
9 investigation contained in the Site Investigation Report in January 2008, including
10 Entergy's plan for remediation and long-term monitoring of onsite groundwater systems,
11 the NRC conducted its own, detailed review and inspection. The results of the NRC
12 Staff's May 13, 2008 inspection report confirmed the conclusions in the Site
13 Investigation Report. *See* NRC Inspection Report Nos. 05000003/2007010 and
14 05000247/2007010, *available at* ADAMS Accession No. ML081340425 (May 13, 2008)
15 ("May 13, 2008 Inspection Report") (Exh. 34). In the May 13, 2008 inspection report,
16 the NRC made several important findings, including: (1) Entergy had properly identified
17 the source of groundwater releases as resulting from the IP1 and IP2 SFPs; (2) no
18 releases were observed or detected from IP3; (3) Entergy's hydrogeologic site
19 characterization studies provide sufficiently detailed field observations, monitoring, and
20 test data that supported the development and confirmation of a reasonable CSM; (4) the
21 CSM provides a reasonable basis to support the finding that liquid effluent releases from
22 the SFPs migrate west towards the Hudson River and do not otherwise migrate offsite;
3 (5) there are no drinking water sources that can be impacted by the contaminated

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1 groundwater conditions; (6) the annual calculated exposure to the maximum exposed
2 hypothetical individual relative to the liquid effluent aquatic food exposure pathway is
3 currently, and is expected to remain, less than 0.1 % of the ALARA guidelines in
4 Appendix I of 10 C.F.R. Part 50, which are considered to be negligible with respect to
5 public health, safety, and the environment; (7) there is no evidence of any significant leak
6 or loss of radioactive water inventory from the site that was discernable in the offsite
7 environment; and (8) Entergy's plans for long-term monitoring of residual groundwater
8 contamination were reasonable. *Id* at vi to viii.

9 In reaching these conclusions regarding Entergy's hydrogeologic site
10 characterization, the NRC relied on an independent analysis of groundwater transport
11 through fractured bedrock utilizing geophysical well logging data that was conducted by
12 the U.S. Geological Survey ("USGS"). As the NRC pointed out in its inspection report,
13 the USGS assessment corroborated the groundwater transport characteristics that were
14 measured by GZA. *Id.* at vii. The NRC also worked closely with NYSDEC by sharing
15 data and assessment information, coordinating independent split sampling of various
16 sample media, and providing a combined oversight of licensee performance. *Id.* at 1.

17 **X. SUMMARY AND CONCLUSIONS**

18 **Q: Please summarize the results of your work at Indian Point since 2005, at it relates to**
19 **the past and potential future release of radionuclides to the Hudson River.**

20 **A:** GZA has used state of the practice methods to investigate the site hydrogeology and
21 develop the CSM to understand how groundwater flows beneath the site. As part of that,
22 GZA has installed a broad groundwater monitoring network, consisting of 65 monitoring
3 installations, including over 150 sampling intervals, in order to characterize the extent of

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1 past radionuclide releases to groundwater, and to proactively monitor for potential future
2 releases of radionuclides to groundwater from the operation of Indian Point. As a result,
3 GZA has concluded that low levels of radionuclides, principally tritium and strontium,
4 have migrated to the river as a result of past releases to groundwater, in amounts that are
5 orders of magnitude below allowable federal regulatory limits for radiological effluent
6 releases. Finally, GZA has concluded that the network of monitoring wells is sufficient
7 to allow Entergy to identify future potential comparable releases of radionuclides to
8 groundwater, and respond quickly and appropriately to such potential releases.

9 **Q: As a result of your work in this matter, have you formed an opinion as to whether**
10 **the releases of radionuclides to the Hudson River from groundwater have impaired,**
11 **or have the potential to impair, the quality of the water in the Hudson River for its**
12 **best uses?**

13 **A:** I have. As stated above, the levels of radionuclides released to the Hudson River from
14 groundwater are low, orders of magnitude below the allowable federal regulatory limits
15 for radiological effluent releases. Furthermore, the levels of radionuclides in the Hudson
16 River water in the vicinity of Indian Point are indistinguishable from the background
17 levels of radionuclides in Hudson River water taken from control locations far removed
18 from Indian Point, demonstrating that the releases do not have an effect on the
19 radionuclide levels of the Hudson River. As such, there is no scientific basis to conclude
20 that these releases will impair the quality of the Hudson River for its best uses.

21 **Q: As a result of your work in this matter, have you formed an opinion as to whether**
22 **the releases of radionuclides to the Hudson River from groundwater have impaired,**
23 **or have the potential to impair, the suitability of the Hudson River for fish, shellfish,**

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1 **and wildlife propagation and survival?**

2 A: I have. As stated above, the levels of radionuclides released to the Hudson River from
3 groundwater are extremely low, orders of magnitude below the allowable federal
4 regulatory limits for radiological effluent releases. As such, there is no scientific basis to
5 conclude that these releases have impaired the suitability of the Hudson River for fish,
6 shellfish, and wildlife propagation and survival.

7 **Q: As a result of your work in this matter, have you formed an opinion as to whether**
8 **there are reasonable assurances that no potential future releases of radionuclides to**
9 **groundwater at Indian Point will result in releases to the river that impair the**
10 **quality of the Hudson River water for its best uses?**

11 A: Yes, as stated above, I believe that the network of monitoring wells is sufficient to allow
12 Entergy to identify comparable potential future releases of radionuclides to groundwater
13 and to take action to investigate and respond appropriately to any such releases. As a
14 result, I believe that there are reasonable assurances that no future comparable release of
15 radionuclides to groundwater at Indian Point, should it occur, will result in releases to the
16 river that will impair the quality of the Hudson River for its best uses.

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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

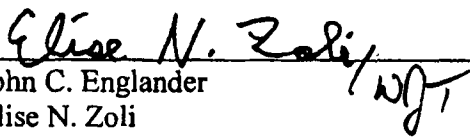
DEC App. Nos. 3-5522-00011/00030 (IP2)
3-5522-00105/00031 (IP3)

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IN SUPPORT OF ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY
NUCLEAR INDIAN POINT 3, LLC AND ENTERGY NUCLEAR OPERATIONS, INC.**

ISSUE FOR ADJUDICATION NO. 3 – RADIOLOGICAL MATERIALS

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

By its attorneys,


John C. Englander
Elise N. Zoli
U. Gwyn Williams
Robert Fitzgerald
Goodwin Procter LLP
53 State Street
Boston, Massachusetts 02109
Tel.: 617.570.1000
Fax: 617.523.1231

July 22, 2011

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I. INTRODUCTION

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

A: My name is F. Owen Hoffman. I am president and director of SENES Oak Ridge, Inc. Center for Risk Analysis, an organization that specializes in human health and ecological risk estimation, risk assessment, and risk communication. SENES Oak Ridge is located at 102 Donner Drive, Oak Ridge, TN, 37830.

Q: Are you offering this testimony on behalf of Entergy in support of its application for a Water Quality Certification (DEC App. Nos. 3-5522-00011/00030 ("IP2") and 3-5522-00105/00031 ("IP3")) for Indian Point Units 2 and 3 (collectively the "Proceeding")?

A: Yes. I am offering my testimony with respect to Issue for Adjudication No. 3 concerning "radiological materials". I will offer expert testimony concerning the lack of any material effects on human beings or aquatic biota that result from the low-level releases of radionuclides from Indian Point that have migrated through groundwater to the Hudson River.

II. SUMMARY OF EXPERT OPINIONS

Q: What is the purpose of your testimony?

A: In the Notice of Denial, DEC Staff states that "radiological leaks have the potential to impair the best use of the water designated in 6 NYCRR § 701.11." I understand from counsel that § 701.11 contains the best usage classification for the use of the Hudson River in the vicinity of Indian Point, and states that the "best usages of Class SB waters are primary and secondary contact recreation and fishing. These waters shall be suitable

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1 for fish, shellfish and wildlife propagation and survival.” Accordingly, the purpose of my
2 testimony is to analyze the calculated levels of radionuclides that have migrated to the
3 Hudson River as a result of past releases to groundwater at Indian Point, in order to
4 determine whether such releases have impaired, or have the potential to impair, the
5 Hudson River for the best usages set forth in 6 NYCRR § 701.11.

6 **Q: Please briefly describe the analysis you performed in preparing your testimony?**

7 A: In preparing my testimony, I: (i) reviewed the estimates of radionuclides (principally
8 tritium and strontium) that migrated to the Hudson River as a result of past releases to
9 groundwater from Indian Point; (ii) reviewed Entergy’s estimated radiological dose
10 calculations to humans as a result of such releases; (iii) performed my own independent
11 estimated dose calculations to aquatic biota as a result of such releases; and (iv) based on
12 my knowledge and expertise in the field, determined whether such releases have had, or
13 could have, any effect on the best usages of the Hudson River set forth in 6 NYCRR
14 § 701.11.

15 **Q: Based on your analysis, do you believe that radionuclide releases to groundwater at**
16 **Indian Point have impaired, or have the potential to impair, the best usages of**
17 **Hudson River?**

18 A: No. Based on my analysis, the calculated levels of radiological materials reaching the
19 Hudson River as a result of releases to the groundwater at Indian Point are extremely low.
20 Moreover, based on my review of monitoring results of radionuclide levels in Hudson
21 River samples taken both in the vicinity of Indian Point and at control locations away
22 from Indian Point, this low-level migration of radionuclides from groundwater at Indian

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1 Point to the Hudson River has had no discernible effect on the level of radionuclides
2 present in the Hudson River from sources unrelated to the operation of Indian Point. As
3 such, there is no credible scientific basis to conclude that releases of radionuclides to the
4 Hudson River from past releases to groundwater at Indian Point have impaired or will
5 impair the best usage of the Hudson River.

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

7 **A:** Yes.

8 **III. QUALIFICATIONS**

9 **Q: Please describe your educational and professional qualifications, including relevant**
10 **professional activities.**

11 **A:** My professional and educational qualifications are summarized in the attached
12 *curriculum vitae* (Exh. 53). In brief, I hold a Bachelor's degree in Biological
13 Conservation from the San Jose State College, a Master's degree in Fisheries Limnology
14 from Oregon State University, and a Ph.D in Ecology from the University of Tennessee.
15 I have more than 39 years of experience in issues related to the evaluation of human and
16 ecological risk from the release and transport of radionuclides and chemicals in terrestrial
17 and aquatic systems. I am a Distinguished Emeritus Member of the National Council on
18 Radiation Protection & Measurements ("NCRP") and a corresponding member of the
19 International Commission on Radiological Protection.

20 **IV. OVERVIEW AND METHODOLOGIES**

21 **Q: Please describe the exposure to radiation that a typical individual receives on an**
22 **annual basis.**

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1 A: According to a recent report of the NCRP, the average annual radiation dose per person
2 in the United States is 620 millirem ("mrem"). See NRC Report No. 160 (Exh. 37).
3 Approximately half of this radiation exposure comes from natural background sources:
4 cosmic radiation from space, naturally occurring radioactive minerals in the ground and
5 in your body, and from the radioactive gases radon and thoron, which are created when
6 other naturally occurring elements undergo radioactive decay. Approximately 48% of
7 that dose comes from medical procedures and treatments. See
8 <http://www.epa.gov/radiation/understand/perspective.html#average>.

9 Q: What is tritium?

10 A: Tritium is a naturally occurring radioactive form of hydrogen that is produced naturally
11 in the atmosphere when cosmic rays collide with air molecules. As a result, tritium is
12 found in very small or trace amounts in water throughout the world. Tritium has a half
13 life of 12.3 years. Tritium is also a byproduct of the production of electricity at nuclear
14 power plants, such as Indian Point. Tritium emits a weak form of radiation, a low-energy
15 beta particle similar to an electron. The tritium radiation does not travel very far in air
16 and cannot penetrate the skin. See NRC Backgrounder on Tritium, available at
17 <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html>.
18 Because tritium emits a very weak form of radiation and leaves the body relatively
19 quickly, it is one of the least dangerous radionuclides. See NRC: Frequently Asked
20 Questions About Liquid Radioactive Releases, available at
21 <http://www.nrc.gov/reactors/operating/operating/ops-experience/tritium/faqs.html>.

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1 Like normal hydrogen, tritium can bond with oxygen to form water. The resulting
2 water is called "tritiated water", which is chemically identical to normal water and the
3 tritium cannot be filtered out of the water.

4 **Q: Are people routinely exposed to tritium?**

5 A: Yes. Everyone is exposed to small amounts of tritium every day, because it occurs in the
6 environment and the foods we eat due to natural causes and prior weapons testing in the
7 atmosphere primarily during the 1950s and early 1960s.

8 **Q: What is strontium?**

9 A: Strontium is a soft, silvery metallic element found in rocks, soil, dust, coal and oil.
10 Strontium-90 is a radioactive form of strontium. Strontium-90 is formed in nuclear
11 reactors or during the explosion of nuclear weapons. Strontium-90 has a half live of
12 approximately 29 years.

13 **Q: Are people regularly exposed to strontium?**

14 A: Yes. Everyone is exposed to small amounts of strontium-90, since it is widely dispersed
15 in the environment and the food chain. The vast majority of strontium-90 in the
16 environment and food chain (approximately 99%) is a result of weapons testing that
17 occurred worldwide from approximately 1963 to 1980. See NRC: Frequently Asked
18 Questions About Liquid Radioactive Releases, *available at*
19 <http://www.nrc.gov/reactors/operating/operating/ops-experience/tritium/faqs.html>. Most
20 of the remaining strontium-90 is attributable to the Chernobyl nuclear power plant
21 accident. *Id.* Strontium-90 from releases from nuclear power plants is a small fraction of
22 the strontium-90 in the environment. *Id.*

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1 A. Liquid Effluent Radiological Dose Limits and Environmental Monitoring
2 Requirements

3 Q: Please provide an overview of the regulations that establish dose limits for members
4 of the public for nuclear power plants.

5 A: NRC regulations in 10 C.F.R. Part 20, "Standards for Protection Against Radiation," are
6 applicable to all nuclear power plants, including Indian Point, and establish several
7 relevant dose limitations. The regulations found in Part 20 establish standards for
8 protection against ionizing radiation resulting from activities of NRC licensees and are
9 intended to control, among other things, the possession and use of licensed materials such
10 that the total dose to an individual member of the public does not exceed radiation
11 protection standards. Pursuant to 10 C.F.R. § 20.1301(a), licensees must conduct
12 operations so that the maximum allowable concentrations of radionuclides in air and
13 water above background at the boundary of unrestricted areas (*i.e.*, areas for which access
14 is not limited or controlled by a licensee) does not exceed an annual total effective dose
15 equivalent of 100 mrem in a year to individual members of the public.

16 Furthermore, 10 C.F.R. § 20.1301(e) incorporates by reference the U.S.
17 Environmental Protection Agency's ("EPA") environmental radiation protection standard
18 found at 40 C.F.R. § 190.10. Section 190.10 imposes the following dose limits to any
19 member of the public resulting from planned discharges of radioactive materials to the
20 general environment from uranium fuel cycle operations (which includes nuclear power
21 plant operations): 25 mrem/yr to the whole body; 75 mrem/yr to the thyroid; and 25
22 mrem/yr to any other organ.

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1 In addition, to demonstrate compliance with dose limits for members of the
2 public, 10 C.F.R. § 20.1302 requires that licensees conduct surveys of radiation levels in
3 both unrestricted and controlled areas, and of radioactive materials in effluents released
4 to both unrestricted and controlled areas.

5 In addition to the Part 20 and EPA limits, 10 C.F.R. Part 50 places additional
6 restrictions on public dose from the operations of nuclear power plants such as IP2 and
7 IP3. Specifically, 10 C.F.R. § 50.36a imposes conditions on operating licensees in the
8 form of technical specifications on effluents from nuclear power reactors. These
9 specifications are intended to keep releases of radioactive materials to unrestricted areas
10 during normal operations, including expected operational occurrences, "as low as
11 reasonably achievable" ("ALARA"). Appendix I to 10 C.F.R. Part 50, "Numerical
12 Guides for Design Objectives and Limiting Conditions for Operation to Meet the
13 Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-
14 Water-Cooled Nuclear Power Reactor Effluents," provides numerical guidance on dose-
15 design objectives and limiting conditions for operation of light-water reactor effluents to
16 meet the ALARA requirement. Appendix I also establishes requirements for the
17 demonstration of compliance with the design objective, actions to be taken if the effluent
18 releases in any calendar quarter exceed any of the annual design objectives by one-half,
19 and requirements to conduct surveillance and monitoring programs to demonstrate
20 compliance.

21 The numerical design objectives of Appendix I to Part 50 are a fraction of the
22 Part 20 limits (including the EPA 40 C.F.R. § 190.10 limits). Thus, in practice, because

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1 the Part 50, Appendix I design objections are far more restrictive than Part 20 allowable
2 dose limits or effluent concentration levels, the Part 50, Appendix I ALARA objectives
3 and guidelines are controlling for power reactor licensees.

4 To implement 10 C.F.R. Part 50, Appendix I, the NRC Staff developed
5 Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of
6 Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50,
7 Appendix I," Rev. 1 (Oct. 1977) ("Regulatory Guide 1.109"). Regulatory Guide 1.109
8 describes basic features for calculation models and suggests parameters for the estimation
9 of radiation doses to members of the general public from effluent releases. The following
10 are the design objectives of Appendix I, 10 C.F.R. Part 50, as summarized in Table 1,
11 NRC Regulatory Guide 1.109, for the maximum exposed individual (integrated total dose
12 on an annual basis):

13 Liquid Effluents

- 14 • Annual dose to the total body from all pathways – 3 mrem per reactor – location
15 of highest dose offsite evaluated at a location that is anticipated to be occupied
16 during the plant lifetime or evaluated with respect to such potential land and water
17 usage and food pathways as could actually exist during the term of plant
18 operation.
- 19 • Annual dose to any organ from all pathways – 10 mrem per reactor – location
20 same as above.

21 In addition, 10 C.F.R. § 50.36a requires licensees to have technical specifications
22 (*i.e.*, license conditions) to ensure compliance with Sections 20.1301 and 50.34a, and to

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1 use operating procedures and radioactive waste systems to maintain radioactive effluents
2 ALARA—both during the current and extended periods of operation. Section 50.36a
3 also requires that licensees submit to the NRC an Annual Radiological Effluent Release
4 Report that specifies the quantity of each of the principal radionuclides released to the
5 unrestricted areas in liquid and in gaseous effluents during the previous 12 months.
6 Further, in accordance with 10 C.F.R. Part 50 Appendix I, Section IV.B, NRC regulations
7 require that nuclear power plant operators monitor the environment in the vicinity of the
8 nuclear power plant to assess the cumulative impact of the radionuclides that have been
9 released and, on an annual basis, to submit the results of this environmental monitoring
10 program to the NRC in an Annual Radiological Environmental Operating Report.

11 **Q: Do NRC regulations require that a licensee account for inadvertent or unanticipated**
12 **releases?**

13 **A:** Yes. The NRC limits and ALARA dose controls apply to both normal effluent
14 discharges and unplanned releases such as leaks or spills containing radionuclides.
15 Regardless of the source, each nuclear power plant is required to account for the
16 radionuclides released to the environment, including planned and unplanned releases.
17 Each licensee is responsible for accounting for the release, evaluating the release relative
18 to NRC regulatory requirements, and reporting the quantity of radionuclides released and
19 the highest dose to any theoretical member of the public. See SECY-11-0019, Senior
20 Management Review of Overall Regulatory Approach to Groundwater Protection, Encl.
21 2, Regulatory Framework at 2 (Exh. 44). Along with all other releases, unplanned or
22 abnormal releases are specifically identified in the required Annual Radiological Effluent

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1 Release Report provided to the NRC.

2 Q: Have you reviewed Entergy's Offsite Dose Calculation Manual ("ODCM")?

3 A: Yes.

4 Q: Does Entergy's ODCM comply with the NRC requirements for calculating the doses
5 of radiological releases from Indian Point?

6 A: Yes. Entergy's ODCM calculates dose in a manner consistent with the specification
7 requirements of Regulatory Guide 1.109 and the design objectives of 10 C.F.R. Part 50
8 Appendix I.

9 Q: Have you reviewed the calculations of the amount of tritium released to the Hudson
10 River from groundwater in 2006-10?

11 A: Yes. The estimates of the total tritium released to the Hudson River from groundwater
12 are contained in Entergy's Annual Radiological Effluent Release Reports ("ARERR"), at
13 Section H. They are summarized in the following table:

Total Tritium Released from Groundwater

15	2006	0.19 curies
16	2007	0.064 curies
17	2008	0.2 curies
18	2009	0.07 curies
19	2010	0.12 curies

20 See Entergy's ARERRs, 2006-10, at Section H.

21 Q: Have you reviewed the calculations of the annual dose from the tritium released to
22 the Hudson River from groundwater for 2006-10?

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1 A: Yes. The calculations of the annual dose from the tritium released to the Hudson River
2 from groundwater are contained in Entergy's ARERRs, at Section H. They are
3 summarized in the following table:

Annual Dose from Tritium Released from Groundwater

5	2006	2.1×10^{-6} mrem
6	2007	2.6×10^{-7} mrem
7	2008	2.2×10^{-7} mrem
8	2009	1.4×10^{-7} mrem
9	2010	1.9×10^{-7} mrem

10 See Entergy's ARERRs, 2006-10, at Section H.

11 Q: Were Entergy's calculation of annual radiation dose from the tritium released from
12 groundwater to the Hudson River consistent with the OCDM and the requirements
13 of NRC?

14 A: Yes.

15 Q: Do you have an opinion as to the effect on human health as a result of the releases of
16 tritium from groundwater to the Hudson River?

17 A: I do. The level of tritium released to the river from groundwater on an annual basis is
18 orders of magnitude lower than the allowable the allowable federal regulatory limits for
19 radioactive effluents, and orders of magnitude below allowable federal regulatory levels
20 of tritium that Entergy releases to the river on an annual basis through the discharge canal
21 pursuant to its NRC licenses, which levels are designed to protect human health and the
22 environment. See Entergy's ARERR's, 2006-10, at Table 2A. More importantly, the

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1 dose is so small as to be inconsequential to human health or the environment. To provide
2 an example, in 2010, the total annual radiation dose to a hypothetical maximally exposed
3 human being from the tritium released from groundwater was 0.00000019 mrem. As
4 stated above, the average annual radiation exposure for the typical individual in the
5 United States is 620 mrem. Indeed, the typical radiation exposure from eating a banana,
6 which contains small amounts of radioactive potassium, is 0.01 mrem. The low level of
7 tritium, and the low dose consequences from that tritium, demonstrates conclusively that
8 there is no material negative effect on human health or the environment from the releases
9 of tritium from groundwater to the Hudson River.

10 **Q: Have you reviewed the calculations of the radionuclides released to the Hudson**
11 **River from groundwater as a result of past releases from the IP1 SFP?**

12 **A:** Yes. While I understand that this proceeding relates solely to the continued operation of
13 Indian Point Unit 2 and Unit 3, and does not relate to any activity related to Unit 1, I have
14 also reviewed Entergy's estimates of radionuclides (principally strontium, and trace
15 amounts of cesium and cobalt) that have been released to the Hudson River as a result of
16 the past release to groundwater from IP1 SFP. These estimates are contained in
17 Entergy's ARERRs, at Section H. They are summarized in the following table:

Total Radionuclides Released from IP1 SFP

2006	0.00057 curies
2007	0.00008 curies
2008	0.00016 curies
2009	0.00025 curies

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1 2010 0.000042 curies

2 *See* Entergy's ARERRs, 2006-10, at Section H.

3 **Q: Have you reviewed the calculations of the annual radiation dose from radionuclides**
4 **released to the Hudson River from groundwater as a result of past releases from the**
5 **IP1 SFP?**

6 **A:** Yes. The calculations of the annual radiation dose from the radionuclides released to the
7 Hudson River from groundwater as a result of past releases from the IP1 SFP are
8 contained in Entergy's ARERRs, at Section H. They are summarized in the following
9 table:

Annual Dose from Radionuclides Released from IP1 SFP

	Total Body	Adult Bone
12 2006	0.00178 mrem	0.00721 mrem
13 2007	0.000266 mrem	0.000994 mrem
14 2008	0.000286 mrem	0.000935 mrem
15 2009	0.000256 mrem	0.00103 mrem
16 2010	0.000173 mrem	0.000706 mrem

17 *See* Entergy's ARERRs, 2006-10, at Section H.

18 **Q: Were Entergy's calculation of annual radiation dose from radionuclides released to**
19 **the Hudson River from groundwater as a result of past releases from the IP1 SFP**
20 **consistent with the OCDM and the requirements of NRC?**

21 **A:** Yes.

22 **Q: Do you have an opinion as to the effect on human health from the radionuclides**

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1 **released to the Hudson River from groundwater as a result of past releases from the**
2 **IP1 SFP?**

3 A: I do. The level of radionuclides released to the river on an annual as a result of past
4 releases to groundwater from the IP1 SFP is extremely low. Indeed, the level of
5 radionuclides released from groundwater is orders of magnitude lower than the allowable
6 federal regulatory limits for radioactive effluents, which levels are designed to protect
7 human health and the environment. More importantly, the radiation dose is so small as to
8 be inconsequential to human health or the environment. To provide an example, in 2010,
9 the total annual dose to the most affected human being from the radionuclides released
10 from the IP1 SFP was 0.000173 mrem. As stated above, the average annual radiation
11 exposure for the typical individual in the United States is 620 mrem. Again, the typical
12 radiation exposure from eating a banana, which contains small amounts of radioactive
13 potassium, is 0.01 mrem. The low level of radionuclides, and the low dose consequences
14 from those radionuclides, demonstrates conclusively that there is no material negative
15 effect on human health or the environment from the release of groundwater to the Hudson
16 River containing radionuclides as a result of releases from the IP1 SFP.

17 **Q: Have you reviewed the results of the testing of radionuclides in Hudson River water**
18 **samples?**

19 A: Yes. The Annual Radiological Environmental Operating Reports ("AREOR") for Indian
20 Point contain the results of testing for plant related radionuclides in the vicinity of Indian
21 Point, and at the Hudson River inlet, which is used as a control location. This is
22 important, as there are low levels of "background" radionuclides in surface waters

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1 throughout the world as a result of nuclear weapons testing and the Chernobyl incident.
2 As such, comparing the levels of radionuclides in river water in the vicinity of the plant
3 to that of a control location can assist one in determining whether the radiological
4 releases from the plant are having a measurable effect on the Hudson River. I have
5 reviewed the AREORs from 2006 through 2010, and have concluded that there are no
6 material differences in the levels of radionuclides contained in the samples taken from the
7 vicinity of the plant and from the control location over that time period. This is as I
8 would expect, given the low levels of radionuclides being released, and the large volume
9 of water in the river.

10 **Q: Do you have an opinion as to the effect on aquatic biota as a result of the releases of**
11 **radionuclides from groundwater to the Hudson River?**

12 **A:** Yes. The Department of Energy ("DOE") has promulgated a guideline for radiation dose
13 rates from environmental media, which recommends limiting the dose to aquatic biota to
14 less than 1.0 rad/day (0.01 Gy/day). See DOE-STD-1153-2002, DOE Standard, A
15 Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota (2002)
16 (excerpts included at Exh. 45). These guidelines were developed on the basis of
17 experimental data that indicated that there would not be any negative population-level
18 effects at these doses.

19 **Q: Did you perform any dose rate calculations for aquatic biota in the area in the**
20 **vicinity of the IPEC site?**

21 **A:** Yes. As part of my preparation in this matter, I used the DOE's RESRAD-BIOTA dose
22 evaluation model (v.1.5/level 3) to calculate the dose rate to aquatic organisms in the

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1 vicinity of the IPEC site. Furthermore, I compared the estimates of dose rate obtained
2 with RESRAD-BIOTA with dose rates calculated with the use of biota dose coefficients
3 for tritium and strontium-90 documented for external and internal exposures in
4 UNSCEAR 2008 (Vol. II, Annex E) (Exh. 35-36), and an assumed water-to-whole
5 organism bioconcentration factor of 320 for strontium-90. To perform these calculations,
6 I used conservative upper-bound estimates of the rolling average concentration of both
7 tritium and strontium in the groundwater migrating to the River. Using the RESRAD-
8 BIOTA dose model, I calculated a dose rate to aquatic organisms in the vicinity of the
9 IPEC site of 2.05×10^{-9} rad/d for tritium, and 3.71×10^{-4} rad/d for strontium-90. Using
10 the UNSCEAR approach, I calculated a dose rate to aquatic organisms in the vicinity of
11 the IPEC site of 2.9×10^{-9} rad/d for tritium, and 4.7×10^{-4} rad/d for strontium-90. These
12 dose rates are orders of magnitude below the DOE 1 rad/d guideline, and support my
13 conclusion that effluent releases from the IP SFPs have not resulted in any negative
14 effects on the ecosystem.

15 **Q: Are you aware of any other independent dose assessments of the impact of releases**
16 **of radionuclides to groundwater on aquatic biota in the vicinity of the IPEC site?**

17 **A:** Yes. In 2009, the NYSDEC published the results of enhanced, independent radiological
18 surveillance of several aquatic species in the lower Hudson River conducted in 2007. *See*
19 *Lawrence C. Skinner & Timothy J. Sinnot, Measurement of Strontium (90Sr) and Other*
20 *Radionuclides in Edible Tissues and Bone/Carapace of Fish and Crabs from the Lower*
21 *Hudson River, New York (Nov. 2009) (Exh. 39).* The NYSDEC study involved an
22 independent assessment of fish and invertebrates sampling performed as part of Entergy's

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1 Radiological Environmental Monitoring Program ("REMP"). Typically, radiological
2 surveillance under the REMP involves samples of edible tissues of two or more important
3 commercial or recreational fish or invertebrate species (*e.g.*, striped bass, white perch,
4 American eel, catfish, sunfish, or blue crab) performed in spring and fall of each year at
5 two locations—in the vicinity of the IPEC site (approximately river mile 42) and the
6 vicinity of Roseton Generating Station (the traditional reference station at approximate
7 river mile 65). The one-time design modifications for the 2007 effort included: the
8 addition of carp to the target species list; adding strontium to the list of radionuclide
9 analyzed; analysis of fish bone or crab carapace; and sampling fish at a third location in
10 the Catskill Region between river miles 107 and 125 to help assure appropriate separation
11 of fish populations that are resident to the river, and, consequently, assure isolation of
12 resident fish populations from the potential influence of IPEC.

13 Sampling was conducted by Normandeau Associates, Inc., under contract with
14 Entergy. Samples were split three ways between Entergy's contract laboratory, AREVA,
15 Inc.; the NRC for analysis at Oak Ridge Institute for Science and Education; and
16 NYSDOH Wadsworth Center for Labs and Research. The NYSDEC study found that
17 there were no spatial differences in the concentrations of strontium-90 or radium-224
18 from the three locations in the lower Hudson River. In contrast, K-40 levels were
19 somewhat greater in the vicinity of Roseton Generating Station. Furthermore, the
20 NYSDEC study calculated dose rates from strontium-90, uranium-238, and thorium-232
21 and compared those rates to the DOE standard for protecting aquatic biota. NYSDEC
22 concluded that the levels of radionuclides—including strontium-90—were two to five

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1 orders of magnitude lower than the 1.0 rad/day criterion established for protection of
2 freshwater ecosystems.

3 **V. SUMMARY AND CONCLUSIONS**

4 **Q: As a result of your work in this matter, have you formed an opinion as to whether**
5 **the releases of radionuclides to groundwater that has migrated to the Hudson River**
6 **have impaired, or have the potential to impair, the use of the Hudson River for**
7 **recreation activities such as swimming, fishing, and boating?**

8 **A:** I have. As stated above, the levels of radionuclides released to the Hudson River from
9 groundwater are extremely low, with an immaterial effect on annual dose consequence to
10 man or aquatic biota. Moreover, given the low levels of these releases, and the large
11 volume of water in the Hudson River, there is no credible evidence that the releases of
12 radionuclides from groundwater have any measurable effect on the level of radionuclides
13 present in the Hudson River from historical sources. As such, there is no credible
14 scientific basis to conclude that releases of radionuclides to groundwater that has
15 migrated to the Hudson River have impaired or will impair the use of the Hudson for
16 primary or secondary contact recreation, such as swimming, fishing, and boating.

17 **Q: As a result of your work in this matter, have you formed an opinion as to whether**
18 **the releases of radionuclides to groundwater that has migrated to the Hudson River**
19 **have impaired, or have the potential to impair, the suitability of the Hudson River**
20 **for fish, shellfish, and wildlife propagation and survival?**

21 **A:** I have. As stated above, the levels of radionuclides released to the Hudson River from
22 groundwater are extremely low, with an immaterial effect on annual dose consequence to

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1 aquatic biota. Moreover, given the low levels of these releases, and the large volume of
2 water in the Hudson River, there is no evidence that the releases of radionuclides from
3 groundwater have any material effect on the level of radionuclides present in the Hudson
4 River from historical sources. Given all this, there is no credible scientific basis to
5 conclude that releases of radionuclides to groundwater that has migrated to the Hudson
6 River have impaired or will impair the suitability of the Hudson River for fish, shellfish,
7 and wildlife propagation and survival.
8

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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

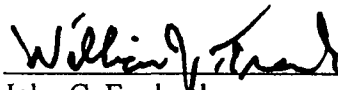
DEC App. Nos. 3-5522-00011/00030 (IP2)
3-5522-00105/00031 (IP3)

**COMBINED PREFILED REBUTTAL TESTIMONY OF THOMAS C. ESSELMAN,
PH.D., MATTHEW J. BARVENIK, AND F. OWEN HOFFMAN, PH.D**

RADIOLOGICAL - ISSUE FOR ADJUDICATION NO. 3

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

By its attorneys,



John C. Englander
Elise N. Zoli
U. Gwyn Williams
William J. Trach
Goodwin Procter LLP
53 State Street
Boston, Massachusetts 02109
Tel.: 617.570.1000
Fax: 617.523.1231

October 4, 2011

COMBINED PREFILED REBUTTAL TESTIMONY OF THOMAS C. ESSELMAN, PH.D., AND MATTHEW J.
BARVENIK, AND F. OWEN HOFFMAN; PH.D

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1 **I. Introduction**

2 **Q: Please identify yourselves.**

3 **A: Dr. Esselman:** My name is Thomas C. Esselman. I am a Principal of Lucius
4 Pitkin, Inc., 304 Hudson Street, New York, NY 10013. I have over thirty-five
5 years experience in engineering including the areas of component and structure
6 performance, aging, stress analysis, dynamics, seismic design and analysis.
7 mechanical design, thermo-hydraulics, materials, materials degradation, and
8 failure analysis, including extensive experience with nuclear power facilities. My
9 responsibilities have included performance and management of a large variety of
10 engineering, engineering development, and engineering evaluation issues. I
11 consult frequently on power generation and delivery, generating plant design and
12 operation, material degradation, plant and system aging issues, and materials
13 evaluations. A copy of my resume is attached as Exhibit 77.

14 **A: Mr. Barvenik:** My name is Matthew Barvenik. I am a Senior Principal with
15 GZA GeoEnvironmental, Inc., One Edgewater Drive, Norwood, MA 02062. I
16 submitted direct prefiled testimony, which included my qualifications and resume,
17 on July 22, 2011.

18 **A: Dr. Hoffman:** My name is F. Owen Hoffman. I am president and director of
19 SENES Oak Ridge, Inc. Center for Risk Analysis, an organization that specializes
20 in human health and ecological risk estimation, risk assessment, and risk
21 communication. SENES Oak Ridge is located at 102 Donner Drive, Oak Ridge,
22 TN, 37830. I submitted direct prefiled testimony which included my
23 qualifications and resume, on July 22, 2011.

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1 **Q: Please state the purpose of your rebuttal testimony.**

2 A: **All Experts:** The purpose of our testimony is to address certain portions of the
3 prefiled direct testimony of Mr. Arnold Gunderson (Riverkeeper), and Mr. Paul
4 Kolakowski (NYSDEC) with respect to Issue for Adjudication No. 3
5 (Radiological Issues). We have each individually reviewed Mr. Gunderson's and
6 Mr. Kolakowski's testimony. In our individual professional opinions, their
7 testimony and conclusions contain numerous errors, inaccuracies, and
8 deficiencies. For ease of reference, the initials of the individual or individuals
9 responsible for providing the testimony in response to each particular question are
10 provided herein.

11 **II. Background**

12 **Q: Please describe any background information on radiation exposure and**
13 **regulations necessary to provide context for your rebuttal testimony.**

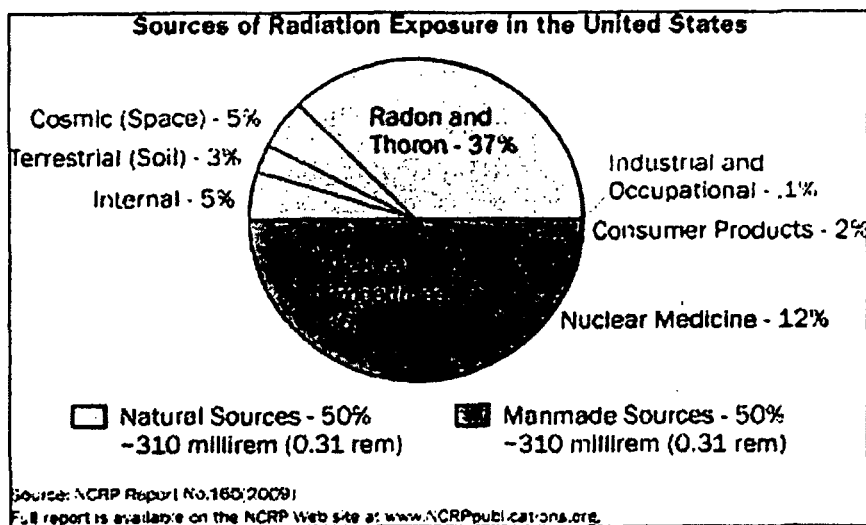
14 A: (TCE, MJB, FOH): While Mr. Gunderson and Mr. Kolakowski discuss in detail
15 Entergy's unplanned releases of radionuclides from groundwater to the Hudson
16 River, neither discusses the effects of such releases or the relevant regulatory
17 guidelines that govern such releases. That basic information, provided herein,
18 provides an important context for our rebuttal testimony.

19 According to a recent report of the National Council on Radiation
20 Protection and Measurements ("NCRP"),¹ the average annual radiation dose per

¹ The NRC is an organization chartered by the U.S. Congress in 1964 to, *inter alia*, "collect, analyze, develop and disseminate in the public interest information and recommendations about (a) protection against radiation . . . and (b) radiation measurements, quantities and units, particularly those concerned with radiation protection." See

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1 person in the United States is 620 millirem ("mrem"). See NCRP Report No. 160
2 (Exh. 37). Approximately half of this radiation exposure comes from natural
3 background sources, such as cosmic radiation from space, naturally occurring
4 radioactive minerals in the ground and in your body, and from the radioactive
5 gases radon and thoron, which are created when other naturally occurring
6 elements undergo radioactive decay. Accordingly, the average individual will
7 receive over 300 mrem of radiation exposure each year from naturally occurring
8 background radiation. Another 48% of the average total radiation exposure of
9 620 mrem received each year is from medical procedures, many routine. Below
10 is a chart detailing the average sources of radiation exposure:

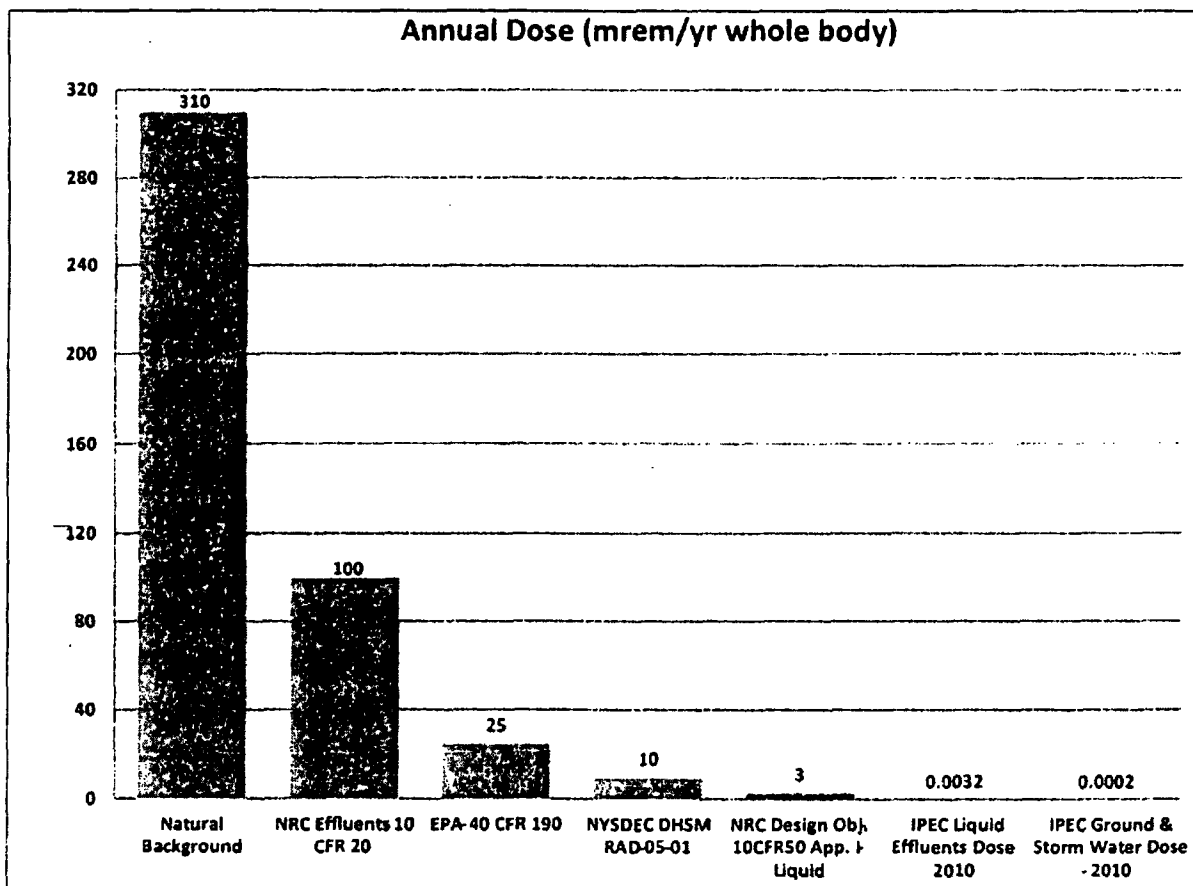


11
12 As is evident from above, the average radiation exposure resulting from
13 industrial and occupational activities, which includes but is not limited to
14 exposure resulting from the operation of nuclear facilities, contributes just 0.1%

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of the average annual radiation exposure.

Both state and federal regulators (including NYSDEC) have promulgated regulations setting limits on the increased radiation exposure to individuals from industrial facilities. While the relevant federal regulations are discussed in detail in the pre-filed testimony of Dr. Hoffman, below is a chart setting forth the federal and state regulations regarding potential dose from industrial facilities, as well as the calculated dose resulting from Indian Point's liquid effluents, and from the unplanned releases of radionuclides specifically:



In addition to the relevant federal regulatory limits, NYSDEC has promulgated limits for the dose resulting from the operation of industrial facilities

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1 subject to its jurisdiction. Those limits are contained in two relevant regulations.
2 First, NYSDEC's radiological regulations at 6 NYCRR Part 380, "requires parties
3 who discharge radioactive material to keep records of the radioactive material
4 discharged and to maintain those discharges as low as reasonably achievable
5 ("ALARA"). The regulations set radiation dose limits and emission levels above
6 which a party must obtain a radiation control permit from NYSDEC." See
7 <http://www.dec.ny.gov/chemical/23475.html>. Accordingly, 6 NYCRR Part 380-
8 5.1, entitled "Dose Limits for Individual Members of the Public," sets a limit of
9 100 mrem/year resulting from discharges of radioactive material to the
10 environment.² NYSDEC also has promulgated guidance for cleanup of sites
11 contaminated with radiological materials that sets a 10 mrem/year dose limit. See
12 NYSDEC DSHM-RAD-05-01, "Cleanup Guidelines for Soils Contaminated with
13 Radioactive Materials" ("The total effective dose equivalent to the maximally
14 exposed individual of the general public, from radioactive material remaining at a
15 site after cleanup, shall be as low as reasonably achievable and less than 10 mrem
16 above that received from background levels of radiation in any one year.")).
17 Furthermore, NYSDEC has applied this guidance when analyzing impacts from
18 the release of radionuclides, and has determined that dose levels that are 10,000
19 times higher than the doses from Entergy's unplanned releases presented no harm
20 to public health or the environment. Specifically, GZA reviewed NYSDEC's

² Because of federal preemption, the limits in Part 380 expressly do not apply to nuclear facilities subject to NRC regulation, such as Indian Point. See 6 NYCRR Part 380-1.2 ("This Part does not apply to any person to the extent that such person is subject to regulation by the U.S. Nuclear Regulatory Commission or the U.S. Department of Energy.").

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1 investigation of naturally occurring radioactive materials (NORM) associated
2 with oil and gas drilling in New York State. *See* An Investigation of Naturally
3 Occurring Radioactive Materials (NORM) in Oil and Gas Wells in New York
4 State, <http://www.dec.ny.gov/chemical/23473.html>. The focus of NYSDEC's
5 work on this issue was to evaluate the potential impact to the public and the
6 environment associated with this industry. As part of this investigation,
7 NYSDEC specifically evaluated the spreading of hydrofracking brine generated
8 by this industry, which contains NORM, on local roads. The dose computed by
9 NYSDEC for brine spread on roads for snow removal and dust control was
10 between 1.7 and 2.9 mrem/year. Based on these potential exposure levels,
11 NYSDEC concluded that: *"Even given the "worst-case" assumptions cited above,*
12 *the output from the RESRAD model showed that the dose rate upon the 20th year*
13 *of exposure (the year of highest possible exposure) from all radium isotopes and*
14 *its progeny would still be well below the NYSDEC [DSHM-RAD-05-01] cleanup*
15 *guideline of 10 mrem/yr. This result was based upon conservative modeling and*
16 *demonstrates that there is no reason to believe that the public health or the*
17 *environment would be threatened."* As such, in performing this analysis,
18 NYSDEC concluded that a 2.9 mrem/year exposure results in *"no reason to*
19 *believe that the public health or the environment would be threatened."* By
20 contrast, the whole body dose in 2010 at Indian Point for all radionuclides
21 resulting from unplanned releases was 0.0002 mrem/year, an exposure more than
22 10,000 times lower than that considered acceptable by NYSDEC. As such,
23 according to NYSDEC's own analysis, the release of radionuclides to the Hudson

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1 River at Indian Point constitutes no threat to public health or the environment.

2 In sum, the total calculated potential radiation dose from Entergy's
3 unplanned releases of radiological materials in all of 2010 was 0.0002 mrem. To
4 provide some context as to the insignificant dose from Entergy's unplanned
5 releases, it is helpful to understand the radiation dose from certain common,
6 everyday activities: eating a single banana: 0.01 mrem; a single cross-country
7 flight: 2 mrem; a single chest x-ray: 4 mrem. Each of these common activities
8 results in a dose that is orders of magnitude more than the **total annual dose** from
9 Entergy's unplanned releases.

10 **III. Rebuttal to Testimony of Mr. Gunderson**

11 **Q: Mr. Gunderson's testimony references, at several points, EPA limits for**
12 **tritium. Are there any aspects of Mr. Gunderson's testimony regarding EPA**
13 **limits for tritium with which you disagree?**

14 **A:** (MJB, FOH) Yes. Mr. Gunderson's statements regarding what he characterizes as
15 leaks of tritium at nuclear plants in excess of EPA limits are misleading. For
16 instance, Mr. Gunderson's testimony states that "According to an NRC document
17 entitled *List of Historical Leaks and Spills at U.S. Commercial Nuclear Power*
18 *Plants*, 38 of the 65 nuclear power plant sites have reported tritium leaks in excess
19 of U.S. Environmental Protection Agency (EPA) limits." This statement is a
20 mischaracterization of the document on which Mr. Gunderson purports to rely.
21 To demonstrate this mischaracterization, some background on the referenced
22 regulatory limits is necessary. In 1976, EPA issued standards under the Safe
23 Drinking Water Act, which apply to "drinking water providers" as defined in the

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1 Act, and includes dose-based drinking water standards for, *inter alia*, tritium and
2 strontium. The EPA established a maximum contaminant level of 20,000
3 picocuries per liter (pCi/L) for tritium and 8 picocuries per liter for strontium.
4 This regulation applies to drinking water sources (i.e., at the tap). It does not
5 apply to wells on the site at Indian Point which are not used as a drinking water
6 source. See [Http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-](http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html)
7 [radiation-fs.html](http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html).

8 The NRC document on which Mr. Gunderson purports to rely for his
9 statement that "38 of the 65 nuclear power plant sites have reported tritium leaks
10 in excess of U.S. Environmental Protection Agency (EPA) limits" demonstrates
11 clearly the falsity of this testimony. In fact, that document states that no nuclear
12 facility has ever had leaks that resulted in **drinking water levels** in excess of EPA
13 limits:

14 "There are 65 sites with operating commercial nuclear power
15 plants in the United States. Records indicate 38 of these sites have
16 had leaks or spills that involved tritium in excess of 20,000 pCi/L
17 at some time during their operating history. Fourteen sites are
18 currently reporting tritium, from a leak or spill, in excess of 20,000
19 pCi/L. Although many sites have had leaks or spills involving
20 tritium, no site is currently detecting tritium in the offsite
21 environment, or in drinking water, in excess of 20,000 pCi/L.

22 * * *

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1 **This list demonstrates that in all of that time, and with all the**
2 **leaks and spills that have occurred, no drinking water supply**
3 **has exceeded the allowable level for tritium specified in EPA's**
4 **Safe Drinking Water Act."**

5 *See List of Historical Leaks and Spills at U.S. Commercial Nuclear Power*
6 *Plants, Rev 7 (emphasis added) (Ex. AG-Rad-2).*

7 **Q: Beginning at page 6, line 12 of his pre-filed testimony, Mr. Gunderson**
8 **references a report of the U.S. General Accounting Office ("GAO"), stating**
9 **that the "GAO concludes that the elimination or reduction in the frequency**
10 **of radioactive leaks into the soil has not been solved by industry initiatives**
11 **and is likely to continue or worsen as nuclear plants continue to age." Do**
12 **you agree with Mr. Gunderson's summary of the GAO's conclusions?**

13 **A:** (TCE, MJB) No. First, the GAO report was an independent review of tritium
14 leaks by two panels of experts from the National Academy of Sciences. They
15 examined tritium leaks that had occurred at three nuclear power plants
16 specifically (Braidwood Generating Station, Oyster Creek Generating Station, and
17 Vermont Yankee Nuclear Power Station), and also looked broadly at the issue
18 across the nuclear industry. As part of their work, they also visited the Indian
19 Point Nuclear Station. Mr. Gunderson mischaracterizes the GAO report and its
20 conclusions in several significant ways. Contrary to Mr. Gunderson's testimony,
21 the GAO report did not conclude that "the elimination or reduction in the
22 frequency of radioactive leaks into the soil has not been solved by industry
23 initiatives." Rather, the report highlights the NRC's conclusion "that licensees'

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1 groundwater monitoring programs implemented under the voluntary groundwater
2 initiative go beyond what the agency requires for groundwater monitoring and
3 could enhance licensees' prevention of and response to potential leaks by
4 detecting them early." (Ex. AG-Rad-4 at 22-23).

5 Further, the principal conclusion of the GAO report was that **no**
6 **discernible public health effect and no discernible off site environmental**
7 **effects had occurred from any of the studied leaks.** The two panels'
8 conclusions were clear and unequivocal:

9 "According to the experts in our public health discussion group, **no**
10 **impacts on public health have been discernible** from leaks at the
11 three case study nuclear power plants we [the GAO] asked the
12 experts to consider.

13 *Id.* at 9.

14 "Based on the information that is available on the case studies
15 considered by the experts, the experts in our environmental
16 impacts discussion group concluded that **the leaks have had no**
17 **discernible impact on off-site environmental resources.**"

18 *Id.* at 10 (emphasis added).

19 While the GAO Report did state that "occurrence of leaks at nuclear power plants
20 from underground piping systems is expected to continue as nuclear power plants
21 age" *id.* at 22, the entire purpose of the industry initiatives highlighted in the
22 report (both the Groundwater Protection Initiative and the Buried
23 Piping/Underground Piping and Tanks Integrity Initiative) is to greatly reduce the

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1 likelihood that leaks will occur and to detect leaks more quickly and more
2 effectively than had been done in the past. *Id.* at 22-23.

3 **Q: Mr. Gunderson relies on the Indian Point Independent Safety Evaluation**
4 **(“ISE”) Report and the Supplemental Report of the Public Oversight Panel**
5 **Regarding the Comprehensive Reliability Assessment of the Vermont**
6 **Yankee Nuclear Power Plant (“VY Report”) to support statements on pages**
7 **7, 20, and 21 that Entergy “appears” not to be committing adequate**
8 **resources to maintain its nuclear reactors, including Indian Point. Do you**
9 **agree with Mr. Gunderson’s characterization of the referenced reports, and**
10 **his assertion that Entergy is not committing adequate resources to maintain**
11 **its nuclear reactors?**

12 **A: (TCE, MJB) No. First, Mr. Gunderson’s conclusory characterization of the ISE**
13 **and VY Reports is not accurate. On page 20 of his testimony, Mr. Gunderson**
14 **contends that the ISE Report demonstrates that “Entergy is failing to sufficiently**
15 **fund its maintenance programs.” This is not correct. To provide context, the ISE**
16 **report resulted from Entergy’s commission of a panel of experts (the “ISE Panel”)**
17 **to conduct “an independent evaluation of Indian Point’s safety, security, and**
18 **emergency preparedness.” ISE Report at 6 (Ex. 78). The ISE Panel, consisting of**
19 **distinguished experts in the nuclear field with no professional ties to Entergy or**
20 **Indian Point, “represented virtually every facet of nuclear plant safety, security,**
21 **and emergency preparedness, from a variety of vantage points, and with full**
22 **independence.” *Id.* The ISE Panel specifically concluded that Indian Point had**
23 **been adequately maintained:**

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1 “The Panel found that Indian Point nuclear safety meets the U.S.
2 nuclear industry highest standards in most respects. **Indian Point**
3 **nuclear operations are conducted competently and**
4 **professionally, plant safety systems are well maintained,**
5 **reliable and are backed with full resource commitment by the**
6 **plant owner.** Control Room operations -- a key indicator of plant
7 nuclear safety culture -- were observed frequently by the Nuclear
8 Safety Team and other ISE Panelists and found to be consistently
9 professional and effective. **Indian Point management, at all**
10 **levels, is clearly attentive to nuclear safety.”**

11 *Id.* at 146. The ISE did find that while station personnel paid close attention to
12 the plant safety systems, there were some deficiencies in the physical condition of
13 some non-safety parts of the plant. Entergy has heavily invested in the
14 improvement of such non-safety portions of the plant. Indeed, as the ISE Report
15 concluded: “Entergy has invested heavily in improving the overall material
16 condition of the plant.” *Id.* at 47. Since the issuance of the ISE Report, Entergy
17 has continued to invest heavily in the overall material condition of the plant.

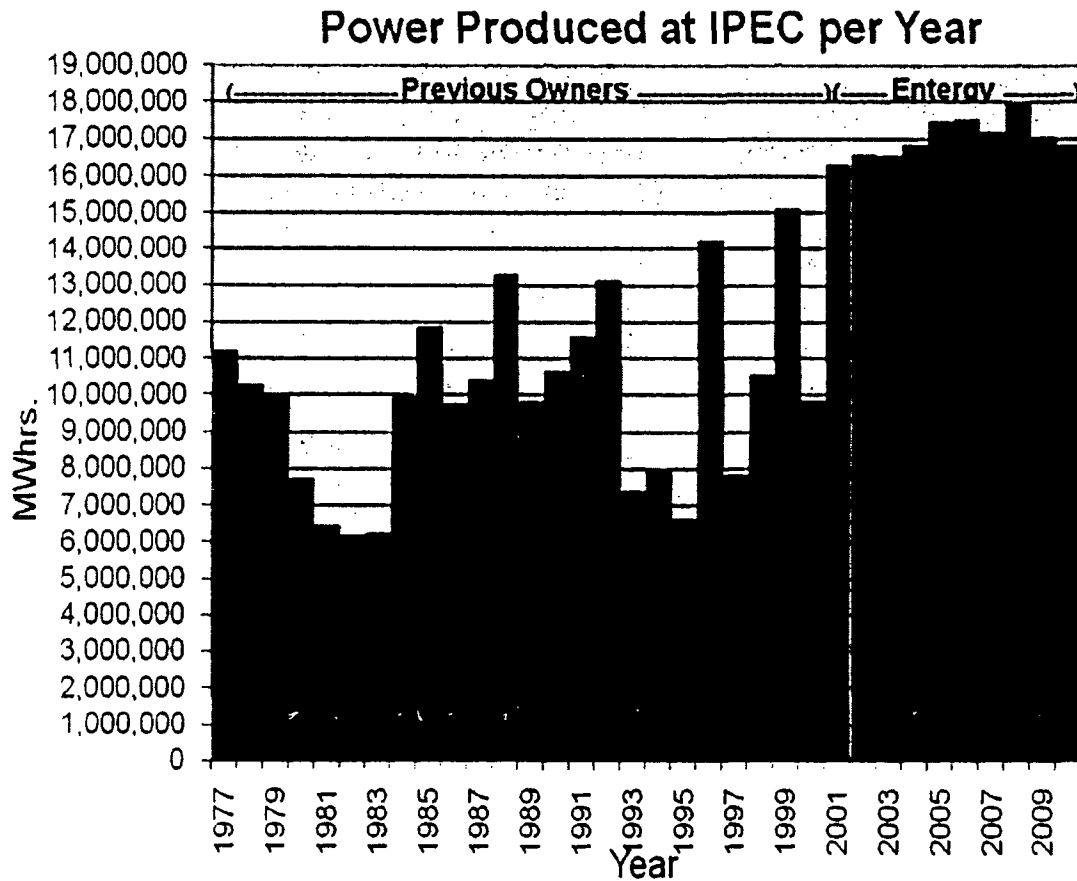
18 Likewise, contrary to Mr. Gunderson’s statement, the VY Report
19 referenced on page 7 of Mr. Gunderson’s testimony, which resulted from a review
20 of the reliability of the Vermont Yankee plant, actually says nothing about
21 Entergy Nuclear Operations’ “corporate structure,” and neither evaluated nor
22 commented on “resource weakness within Entergy’s corporate structure.” Other
23 than a passing reference to the unrelated ISE Report, the VY Report says nothing

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1 about the operation of or conditions at Indian Point. As such, it provides no basis
2 to make conclusions as to the funding of maintenance operations at Indian Point.

3 Setting aside the conclusions of the ISE and VY Reports, an analysis of
4 the operation of Indian Point during the time Entergy has owned it demonstrates
5 that Entergy is adequately funding its maintenance. Specifically, two factors
6 concerning the operation of a nuclear plant are highly indicative of the quality of a
7 nuclear power plant's owner/operator: gross generation and capacity factor.
8 "Gross generation" measures the total annual amount of electricity generated by
9 Indian Point Units 2 and 3. Below is a chart representing gross generation in
10 megawatt-hours from 1977 to 2010:

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1

2 There are two conclusions that can be drawn from this data. First, power

3 production since 2001, when Entergy completed acquisition of both units, has

4 been higher each year than it ever had been previously. Entergy has operated the

5 plant at a high level of efficiency since they took ownership. Second, the

6 operation of Indian Point has been consistent since 2001. The annual power

7 generation varies between 16,000,000 and 18,000,000 Megawatt-hours. Such

8 consistent, high-efficiency operation of a facility for a ten year period cannot be

9 achieved without having a strong focus on the efficiency of operation, the

10 efficiency of maintenance, and a focus on safety.

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1 The second important metric that can provide insight into the quality of
2 maintenance at Indian Point is the capacity factor in comparison to the average in
3 the industry. The "capacity factor" of a power plant is the ratio of the actual
4 output of a power plant over a period of time and its potential output if it had
5 operated at full power for the entire time. A consistently high capacity factor over
6 a number of years is a strong indicator the plant is being run well and adequately
7 maintained. Capacity factors for US nuclear plants are published in the NRC's
8 annual Information Digest, NUREG 1350 (available at
9 <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/>). Below is a
10 table of capacity factors of the Indian Point plants, the Entergy fleet, and the
11 industry average from 2001 to 2010:

Capacity Factors			
Year	Indian Point	All Entergy Plants Average	US Plants Average
2010	90.5%	93.2%	91.2%
2009	91.5%	93.5%	91.1%
2008	99.2%	91.1%	92.0%
2007	92.9%	91.4%	91.8%
2006	94.5%	95.4%	91.0%
2005	94.5%	88.8%	90.1%
2004	94.5%	93.2%	90.9%

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2003	93.5%	90.7%	88.0%
2002	94.5%	89.3%	90.9%
2001	93.7%	93.3%	90.9%

1
2 As the chart shows, Entergy operated the Indian Point stations at greater than 90%
3 capacity factor every year for the past ten years. The Indian Point average
4 capacity factor for the ten years is 93.9%. The average capacity factor in the
5 industry for this ten year period is 90.9% -- 3 percentage points lower than the
6 average at the Indian Point stations. The average for all the Entergy plants was
7 92.0% which also exceeded the industry average by 1.1%. Further, Indian Point
8 was one of only six multiple plant sites in the United States to operate with a site
9 average capacity factor that exceeded 90% in each year between 2001 and 2010.
10 These results cannot have been attained without sustained management
11 commitment to adequate maintenance funding.

12 These statistics demonstrate that Mr. Gunderson's conclusory statement
13 that "Entergy appears to have failed to adequately fund [Indian Point's]
14 maintenance" is not correct. The operating results from the last ten years clearly
15 indicate that Entergy has consistently and efficiently operated the Indian Point
16 stations, and that the maintenance has been appropriately funded.

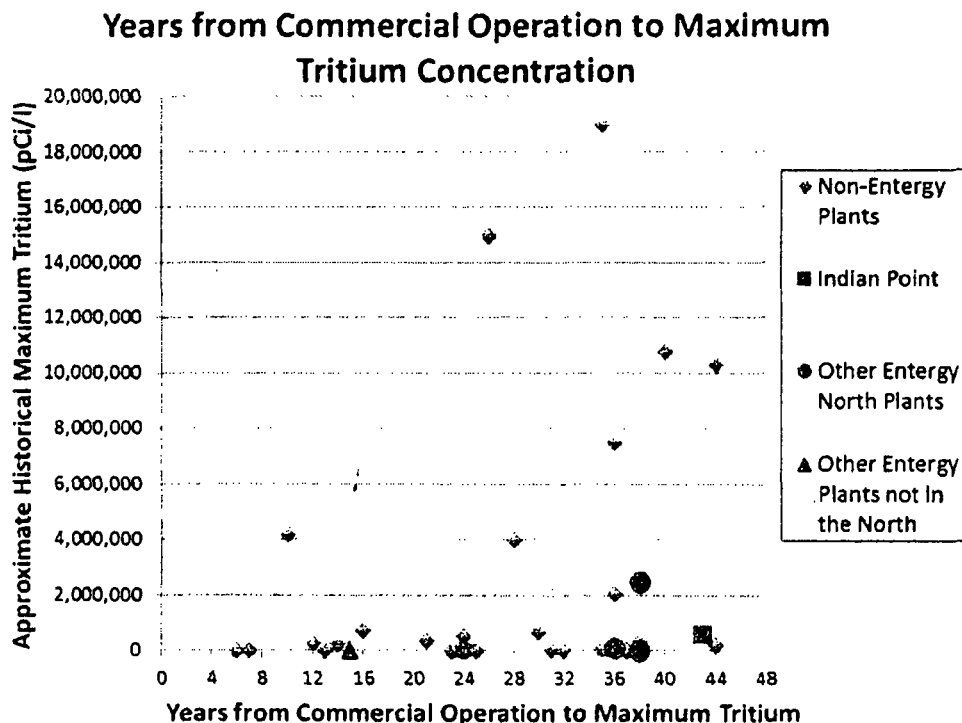
17 **Q: On page 7 of his testimony, Mr. Gunderson states that "more than half**
18 **(59%) of U.S. nuclear power plants are leaking tritium and other longer-**
19 **lived radioactive isotopes while almost three-quarters (73%) of Entergy's**

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1 **nuclear plant sites are leaking tritium and other longer-lived radioactive**
2 **isotopes,” and further states that Entergy’s “older” nuclear reactors located**
3 **in the northern part of the U.S. are more prone to experience piping failures**
4 **as a result of their age. How do you interpret this data?**

5 A: (TCE, MJB) Mr. Gunderson’s statement implies that Entergy’s operation of its
6 facilities is worse than the rest of the industry and communicates a false
7 impression of Entergy’s performance to date on a fleet-wide basis and at Indian
8 Point. First, Mr. Gunderson’s assertion implies that the age of the nuclear reactor
9 is the principal factor affecting the likelihood of piping failures. However,
10 experience with corrosion of piping that is buried or encased underground shows
11 that the chemistry of the soil and groundwater, as well as the design of the piping,
12 are more important contributors to corrosion than age. For this reason, plant
13 buried piping programs, including the Entergy programs, focus principally on
14 design and environmental conditions rather than on age. In this regard, an
15 analysis of the NRC data on nuclear plant leaks identified in the June 2011 NRC
16 Report shows that the age of a plant is not a correlated with leakage (see chart
17 below). This chart plots the maximum tritium concentration experienced for
18 plants with reported historical leaks versus the number of years from the start of
19 commercial operation to the time of detection of the maximum tritium
20 concentration. Indian Point, the Entergy “northern” nuclear reactors (i.e. the
21 “older” reactors in Mr. Gunderson’s testimony), and the other Entergy plants are
22 identified separately from the remainder of the industry:

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This figure provides a basis for two conclusions:

- The first conclusion is that the occurrence of maximum concentration of tritium is not dependent on the age of the plant. Many plants experienced their maximum concentration of tritium with operating times of less than twenty years.
- The second conclusion is that the performance of Indian Point and the other Entergy plants is not worse than the industry standard, and is indistinguishable from the other plants in the industry.

Despite the lack of any evidence that Entergy's "older" plants are experiencing greater likelihood of leakage just because they are old, Entergy is taking a number of actions by implementing initiatives that will reduce the likelihood of leakage and will provide greater assurance that any leakage is

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1 detected. These programs include both inspections to accurately determine the
2 condition of piping and systems as well as physical modifications that will greatly
3 reduce the likelihood of corrosion. A physical modification that is in the process
4 of being implemented is the addition of cathodic protection to selected buried
5 piping. Cathodic protection is a method that is used to control the corrosion of a
6 metal surface by making it the cathode of an electrochemical cell, basically, to
7 transfer a preference for corrosion away from the pipe to another location. This is
8 accomplished by imposing a voltage between the metal to be protected with
9 another more easily corroded metal. The result is that the rate of corrosion in the
10 metal to be protected is either greatly reduced or eliminated. For example,
11 Entergy is adding cathodic protection to selected piping below ground at lower
12 elevations of the plant where the water table is relatively high in comparison to
13 the elevation of the buried piping. See Entergy SEP-UIP-IPEC Rev 0 "Indian
14 Point 2 & 3, Underground Components Inspection Plan." (Ex. 79).

15 **Q: On page nine of his testimony, Mr. Gunderson states that: "In September**
16 **2005, Entergy discovered a crack in the Unit 2 pool and observed seepage of**
17 **water out of the pool. Monitoring of liquid radioactive waste leaks did not**
18 **begin at the Indian Point site until this time." Do you agree that monitoring**
19 **of liquid radioactive waste leaks did not occur until September 2005?**

20 **A: (MJB) No, this statement is incorrect. Upon completing the purchase on of the**
21 **Indian Point units in November 2001, Entergy quickly concluded that the**
22 **identified IP1 SFP leakage was an issue that could be further addressed with a**
23 **more effective and efficient system. After the previous owner discovered that the**

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1 IP1 SFPs may be leaking to the subsurface and into the North Curtain Drain
2 ("NCD") in the early 1990s, the NCD was re-piped to allow its discharge to be
3 redirected from the storm drain system to internal storage. This water was
4 monitored, and monitoring indicated that the total release activity was below
5 ALARA standards. In addition, to further monitor this release, additional
6 Radiological Environmental Monitoring Program ("REMP") sampling was
7 implemented along the southern portion of the plant property proximate to the
8 Algonquin pipe line.

9 While routine monitoring and treatment of the NCD discharge was already
10 ongoing and indicated that the discharge complied with regulatory limits, Entergy
11 nonetheless decided to do more to address this release. In 2002, Entergy
12 formulated a plan and committed to, among other items, an analysis to validate
13 the NCD removal efficiency, and monitoring of the NCD. As part of this plan,
14 routine monthly sampling of the NCD, prior to processing, was implemented by
15 April 2003, less than 18 months after Entergy assumed full ownership of the
16 plant. To further this plan, a separate treatment system was designed, constructed
17 and installed on the NCD, and was fully operational by February 2004. This
18 system was proactively implemented by Entergy, even though the release it
19 addressed was below regulatory limits. Since it was installed, this system has
20 been removing radionuclides captured from the IP1 SFPs leakage prior to release
21 of this water through monitored pathways. This new system also allowed both the
22 influent and effluent radionuclide levels to be routinely monitored on a monthly
23 basis. As such, contrary to Mr. Gunderson's statement, Entergy was actively

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1 monitoring the groundwater associated with IP1 leakage well before 2005. In
2 addition, not only was routine monitoring in place before 2005, but Entergy was
3 also already capturing and treating the identified leakage.

4 **Q: On page 9 of his testimony, Mr. Gunderson states that Entergy's**
5 **groundwater "monitoring detected elevated levels of cesium, strontium,**
6 **tritium, and other radionuclides well in excess of EPA Maximum**
7 **Contaminant Levels . . . [at] hundreds and thousands times EPA limits." Do**
8 **you agree with this statement?**

9 **A:** (MJB) Mr. Gunderson's statement is misleading. First, as explained above, Mr.
10 Gunderson wrongly states that the leakage from Indian Point resulted in levels of
11 radionuclides "in excess of EPA Maximum Contaminant Levels." EPA
12 Maximum Contaminant Levels ("MCLs") are for **drinking water** from defined
13 drinking water providers. Indian Point is not a drinking water provider, and **no**
14 plant-related radionuclides attributable to the Indian Point leakage have affected
15 drinking water wells in the vicinity of Indian Point, let alone in excess of EPA
16 MCLs. This has been confirmed by NYSDEC, NYSDOH, and the NRC. *See*
17 *NYSDEC 2007 Community Fact Sheet (Ex. 80)* ("There are no known impacts to
18 any drinking water sources [from Indian Point leaks]"); *NYSDEC 2008*
19 *Community Fact Sheet (Exh. 46)* ("No drinking water sources are effected [by
20 Indian Point leaks]"); *2008 NRC Inspection Report at vii (Exh. 34)* ("Currently,
21 there is no drinking water exposure pathway to humans that is affected by the
22 contaminated groundwater conditions at Indian Point Energy Center. Potable
23 water sources in the area of concern are not presently derived from groundwater

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1 sources or the Hudson River, a fact confirmed by the New York State Department
2 of Health.”). Furthermore, the well data referenced by Mr. Gunderson (which are
3 groundwater monitoring wells, and not drinking water wells), has not reached
4 levels of “thousands times” EPA limits for drinking water. Ex. AG-Rad-11.
5 Moreover, these data are taken from the early stages of the investigation, before
6 the weld imperfection identified in the IP2 SFP liner was repaired and before the
7 IP1 SFPs were defueled and drained. Current conditions reflect decreasing trends
8 in activity as a direct result of the interdiction measures completed by Entergy,
9 with the result that Mr. Gunderson’s statement is even less correct with respect to
10 current conditions.

11 **Q: On page nine of his testimony, Mr. Gunderson states that in 2006, the Unit 1**
12 **pool ‘leak collection system’ was found to be “completely failing.” Do you**
13 **agree with this statement?**

14 **A: (TCE, MJB) No, this statement is incorrect and highly misleading. As stated**
15 **above, once the IP1 SFPs were found to be leaking by the prior owner, the NCD**
16 **and the sphere foundation drain sump (“SFDS”) were modified to monitor and**
17 **collect groundwater and, only as appropriate, release it through monitored**
18 **pathways. Shortly after completing the purchase of Indian Point, Entergy**
19 **installed a system to treat the groundwater collected by the NCD. Entergy**
20 **believed that the leak-collection system was adequately capturing the leakage**
21 **from the Unit 1 SFPs until 2006, when it was discovered that some of the leakage**
22 **had bypassed the system (as documented in the Site Investigation Report, Exhibit**
23 **33). By this time, Entergy already had begun the project to empty and drain the**

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1 Unit 1 SFPs as a proactive measure, which was ultimately completed in 2008.

2 While the NCD and SFDS were not fully successful in containing all the leakage
3 from the IP1 SFPs (as described in Exhibit 33), they did, and currently still do,
4 contain the vast majority of this historical leakage and subsequent residual
5 contaminant migration.

6 More specifically, while the IP1 SFPs still contained spent fuel and water,
7 the NCD and SFDS were collecting 20 to 40 times more strontium than was
8 discharging to the river through the groundwater. These drains were then
9 particularly effective during the period when the water level in the IP1 SFPs had
10 to be raised to allow defueling. During this period of time, the two drains were
11 capturing nearly 300 times as much strontium as was discharging to the river
12 through the groundwater. In addition, even now that the IP1 SFPs have been
13 emptied and are no longer a source of releases, these collection drains are still
14 serving to capture residual contamination partitioning off of the subsurface
15 materials into the groundwater. Currently, the NCD and SFDS drains are still
16 capturing approximately ten times as much strontium as is discharging to the river
17 through the groundwater. As such, these drains function as a valuable ongoing
18 source control portion of the Monitored Natural Attenuation at the Indian Point
19 site, and routine sampling and analysis of their discharge is incorporated into the
20 Long-Term Monitoring Program.

21 **Q: On pages 9-10 of his testimony, Mr. Gunderson states that "leaks from the**
22 **Unit 2 refueling pool have also been a substantial problem." Do you agree**
23 **with this statement?**

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1 A: (TCE, MJB) No. Mr. Gunderson's statement, and the out-of-context email cited
2 in support of it, implies that the Unit 2 refueling pool has been a source of the
3 leakage to groundwater that has occurred from the Unit 2 SFP. This is not the
4 case. The email referred to in Mr. Gunderson's testimony is associated with
5 leakage that has occurred from the Containment Reactor Refuel Cavity. This is a
6 structure that is located entirely within the Unit 2 Containment building, and is
7 not part of the SFP or the building in which it is contained. The Reactor Refuel
8 Cavity is flooded with water each time the reactor is refueled, approximately for
9 two weeks every two years. Leakage from the Reactor Refuel Cavity is collected
10 within the Containment structure, without release to the environment, and
11 appropriately processed. The Containment structure is constructed with walls that
12 are approximately 4.5 feet thick of reinforced concrete with a steel liner. The
13 basement of the containment incorporates a steel liner that is 0.25 inches thick,
14 embedded three feet below the reinforced concrete floor, with an additional nine
15 feet of reinforced concrete below the steel liner. The combination of the
16 Containment drainage collection system and construction configuration of the
17 Containment Structure is designed to ensure that any resulting leakage that occurs
18 from the Reactor Refuel Cavity during the short period of time it is flooded is
19 contained and is appropriately processed.

20 Q: On page 10 of his testimony, Mr. Gunderson states that "a buried pipe leak
21 in 2009 resulted in more than 100,000 gallons of tritiated water being
22 released to the Hudson River." Do you agree with this statement?

23 A: (TCE, MJB) Mr. Gunderson's statement is misleading. In February 2009,

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1 Entergy did identify a leak in an 8-inch diameter buried piping line at Indian Point
2 Unit 2. This pipe returned water from the Condensate System pump discharge
3 and the Auxiliary Feedwater ("AFW") Pump discharge recirculation lines to the
4 Condensate Storage Tank ("CST"). The leakage resulted in water containing low
5 levels of tritium reaching the subsurface beneath the site, but that water was not
6 released directly to the Hudson River as Mr. Gunderson claims. The cause of the
7 pipe leak was attributed to external corrosion of the pipe at a location where the
8 corrosion protection covering on the pipe was damaged during initial
9 construction, combined with the water table elevation being at approximately the
10 same elevation as the pipe. *See* Entergy Root Cause Analysis Report CR-IP2-
11 2009-00666 (Ex. 81).

12 While the total amount of leakage from the pipe cannot be determined
13 accurately, using the reference sources identified by Mr. Gunderson, an
14 estimation of approximately 100,000 gallons is reasonable. However, what Mr.
15 Gunderson fails to state is that the water contained in this pipe had very low
16 concentrations of tritium. A review of sample analysis performed by the Entergy
17 chemistry department of the leaked water identified varying levels of tritium, with
18 the maximum value of the tested samples of 2,700 pCi/l, and with many other
19 samples being significantly lower than this recorded value. As such, the release
20 of tritium from this event is an extremely small value in comparison to Entergy's
21 permitted releases, and as a result had insignificant affect on the health and safety
22 of the public or the environment.

23 Moreover, as set forth in greater detail above, to preclude reoccurrence of

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1 such an event in the future, Entergy is currently in the process of installing
2 cathodic protection to protect certain buried piping from external corrosion. *See*
3 IPEC SEP-UIP-IPEC, Rev 0 "Indian Point 2 & 3 Underground Components
4 Inspection Plan." (Ex. 79).

5 **Q: On page 10 of his testimony, Mr. Gunderson states that "a crack in a**
6 **condenser blowdown line in 1988 resulted in 8400 gallons of contaminated**
7 **water leaking into the Hudson River." Do you agree with this statement?**

8 **A:** (TCE, MJB) Mr. Gunderson's statement is misleading. In March 1988, Indian
9 Point Unit 2's prior owners determined that a leak in the Refueling Water Storage
10 Tank ("RWST") heating coil had allowed approximately 8400 gallons of RWST
11 water to drain from the tank into the house service boiler system over a period of
12 approximately 90 hours. Again, contrary to Mr. Gunderson's testimony, water
13 did not leak into the Hudson River. Rather, this water drained into the house
14 service boiler system, which eventually discharges into the discharge canal, is
15 monitored, and is released pursuant to Indian Point's NRC license. The former
16 owner of the plant calculated the total activity released to the river to be
17 approximately 0.028 curies. This is less than 0.01% of the Maximum Permissible
18 Concentration ("MPC"). This level of radioactivity is well within the limits of
19 what Indian Point is routinely allowed to release. *See* May 13, 2008 NRC
20 Inspection Report at 4 (Ex. 34).

21 **Q: On page 11 of his testimony, Mr. Gunderson says that "Indian Point is more**
22 **susceptible to washout which results in radioactive rain falling on landscape**
23 **and directly into Hudson River (i.e., clouds of tritiated water migrating**

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1 **offsite and depositing tritium into the Hudson River).” Do you agree with**
2 **that statement?**

3 A: (MJB, FOH) The term “washout” is simply a term that describes the natural result
4 of mixing warm effluents and cooler air or rain. It is not a unique process to
5 Indian Point or to radioactive effluents, and Indian Point is no more susceptible to
6 this natural phenomenon than other facilities. At Indian Point, washout can occur
7 when small fraction of airborne tritium is condensed and removed from the air. It
8 is useful to put this condensation into perspective relative to the overall effluent
9 monitoring and dose limitation requirements. In accordance with NRC
10 regulations and guidance, Indian Point monitors a number of liquid and gaseous
11 radioactive effluent pathways. The concentration and the dose to an individual in
12 the environment are generally too low to be detected; therefore, it is necessary to
13 measure it at the effluent source prior to dilution. NRC requires detailed
14 calculations estimating the dose based on the effluent concentrations onsite. *See*
15 USNRC Regulatory Guide 1.21, Regulatory Guide 1.109, NUREG-1301. These
16 calculated levels are subject to dose limitations contained in 10 CFR 50,
17 Appendix I, as follows:

- 18 • Liquid Effluents (dose to a hypothetical offsite individual):
 - 19 ○ 3 mrem/year whole body dose
 - 20 ○ 10 mrem/year highest organ dose
- 21 • Gaseous Effluents (dose to an offsite location where a member of the
22 public may be present):
 - 23 ○ 5 mrem/year whole body dose

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- o 15 mrem/year skin dose

Tritium in liquid effluents is monitored and/or accounted for from monitor tank discharges and other similar planned releases, groundwater, and storm drains. Airborne effluents include releases from the ventilation systems from plant buildings and releases from steam generator blowdown. The liquid and gaseous releases are converted into dose values by methods described in the Offsite Dose Calculation Manual ("ODCM"), which is consistent with NRC guidance (USNRC Regulatory Guides 1.21 and 1.109, and NUREG-1301). Tritium is included in the gaseous dose calculation. In addition, the tritium condensed will be detected in storm drains and will be added to any dose from storm drain effluent estimates. This may result in conservative double counting of the activity (accounted in gaseous effluents, then recounted in storm drains). In any case, the total dose from all liquid releases is less than 1% of the 3 mrem/year whole body limit. The table below shows the doses from the 2010 Annual Radiological Environmental Operating Report. The amount attributable to the condensation/washout phenomenon is a small fraction of the liquid effluent dose.

Type of Release	Natural Background (mrem/yr)	Effluent Limit (mrem/yr)*	2010 IPEC Liquid Effluent Whole Body Dose** (mrem/yr)
Liquid	310	3	0.0032
*Effluent Limits are the 10CFR50 Design Objectives, which are de facto NRC limits, and they are applicable per unit; however, for purposes of this table, it is conservatively shown as a site limit.			
** Sum of all units, all liquid pathways			

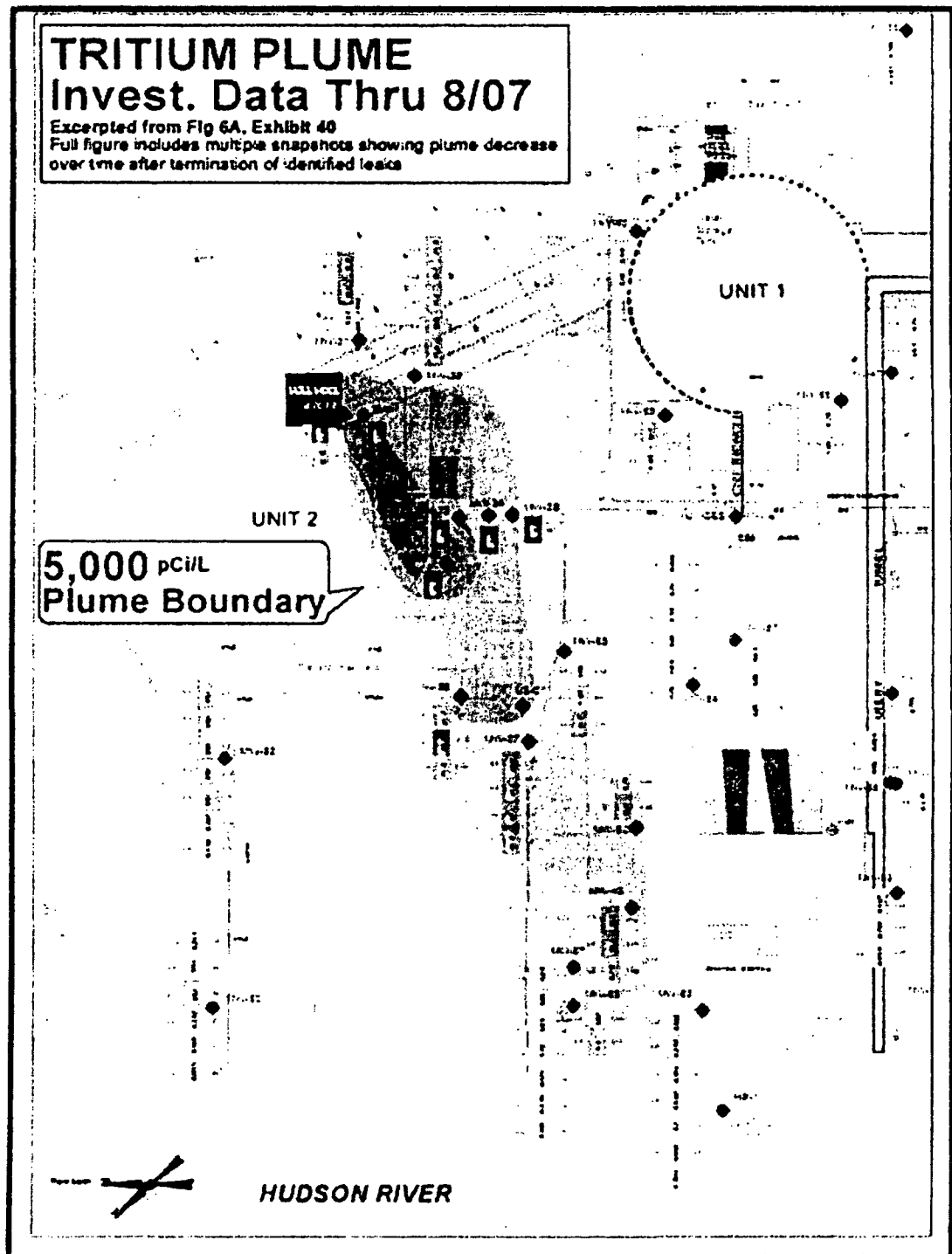
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1 Q: On page 13 of his testimony, Mr. Gunderson states the "level of
2 [groundwater] contamination will likely remain high for the foreseeable
3 future." Do you agree with these statements?

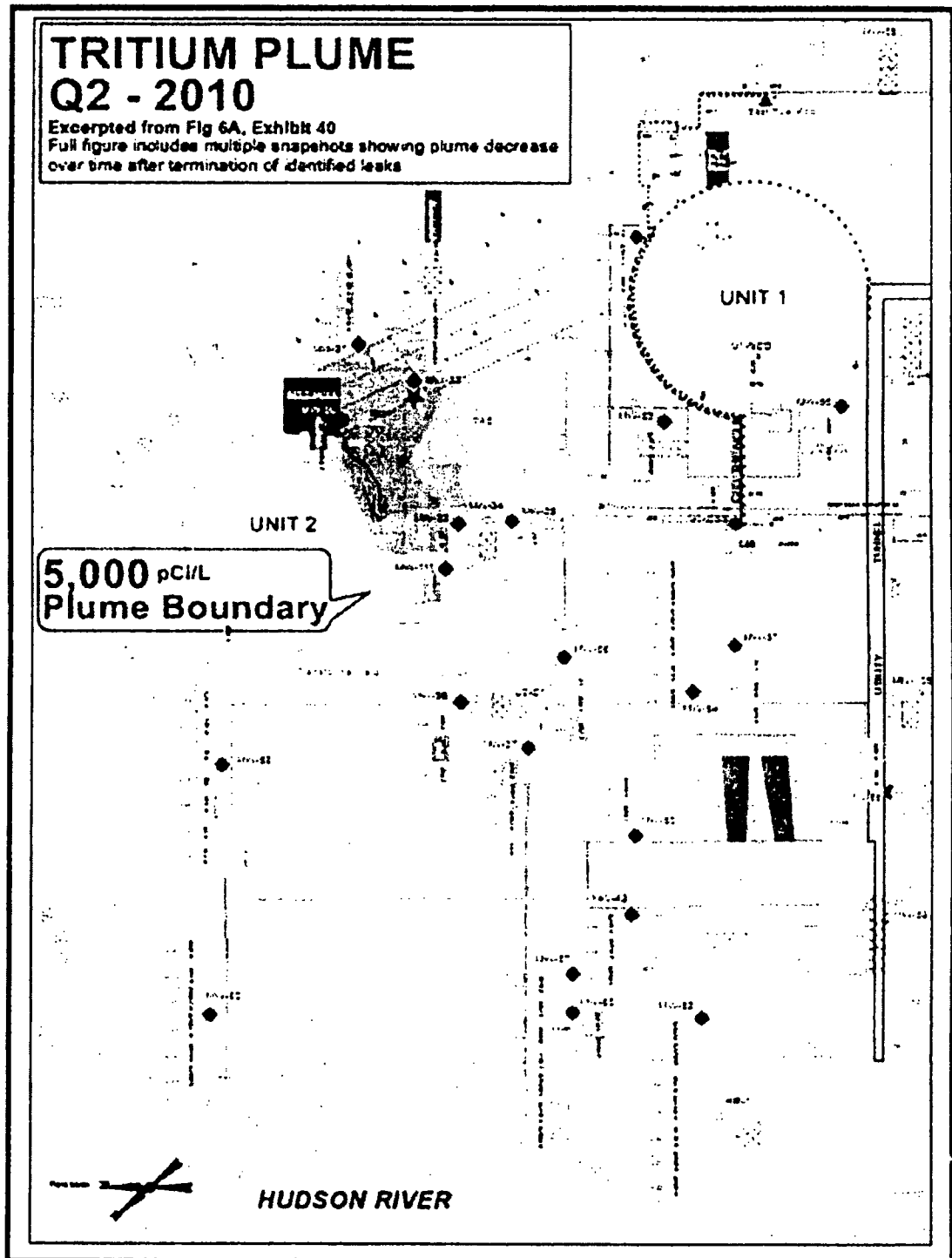
4 A: (MJB) No. Contrary to Mr. Gunderson's misleading characterization, the
5 "current" state of radionuclides in groundwater is not "high." In the context of
6 evaluating a leak, a "high" level of contamination is best understood as one that
7 has a negative effect on human health or the environment. As set forth in detail in
8 the initial pre-filed testimony of Dr. Hoffman, the radiation dose and impact on
9 the environment from Entergy's groundwater contamination has always been
10 extremely low. Mr. Gunderson alludes to "the breadth and extensive nature of the
11 contamination" in reference to the plumes presented in the figures in Entergy's
12 quarterly groundwater reports. As explained in these reports, the tritium plume
13 boundary³ (i.e., the plume shading in Figure 6A of Exhibit 40), demarks the
14 estimated boundary that separates tritium levels greater than 5,000 pCi/L from
15 those below this value, a level of one-quarter the drinking water standard. Two
16 portions of this overall figure, which shows plume attenuation over time, are
17 excerpted and included below. As shown, the tritium plume boundary no longer
18 even extends to the river.

³ We focus here on the tritium plume boundary because the Unit 2 SFP leakage was the principal source of the tritium plume, and did not contribute to the strontium plume. I understand from counsel that the present proceeding concerns the continued operation of Units 2 and 3, and does not concern Unit 1.

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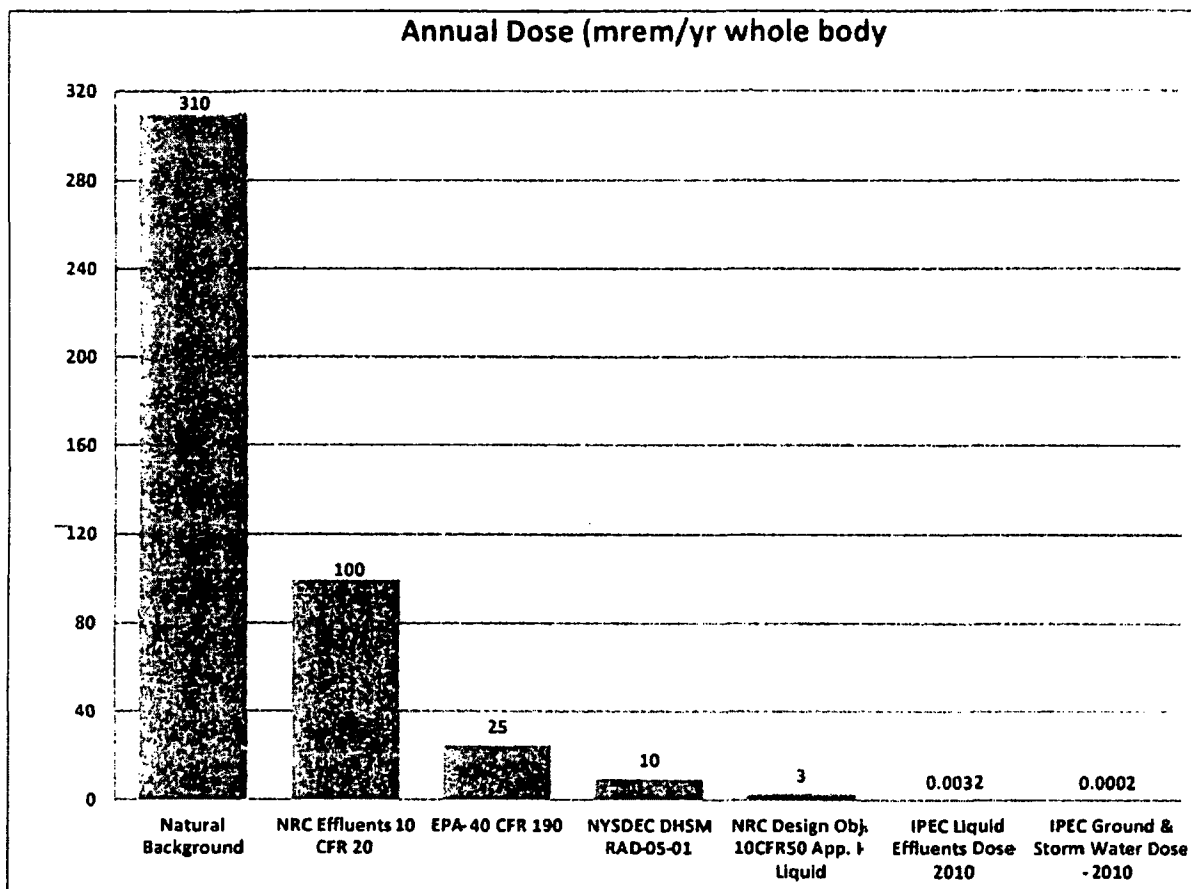
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1 Further, viewing both the tritium and strontium groundwater radionuclide
2 plumes in terms of their potential impact on the public health and the environment
3 demonstrates just how incorrect it is to claim that the contamination is "high." As
4 shown on the figure below, the total dose from all sources released to the Hudson
5 River from unplanned releases in 2010 was only two ten-thousandths (0.0002) of
6 a single mrem. This is only 5 percent of the dose associated with radionuclides
7 released as part of normal plant operations. The vanishingly small potential
8 impact of the groundwater release is stark when contrasted to the NRC permitted
9 dose level; the potential groundwater dose impact is less than 0.01% of the NRC
10 permitted dose as set forth 10 CFR Part 50, Appendix I. Finally, it is most
11 important to recognize that even the NRC permitted level is less than one percent
12 of the level experienced by the general public due to natural background exposure
13 during every day activities. As such, the potential exposure due to Indian Point
14 radionuclides in groundwater is an insignificant fraction of natural background
15 radiation exposure, as shown in the following figure:

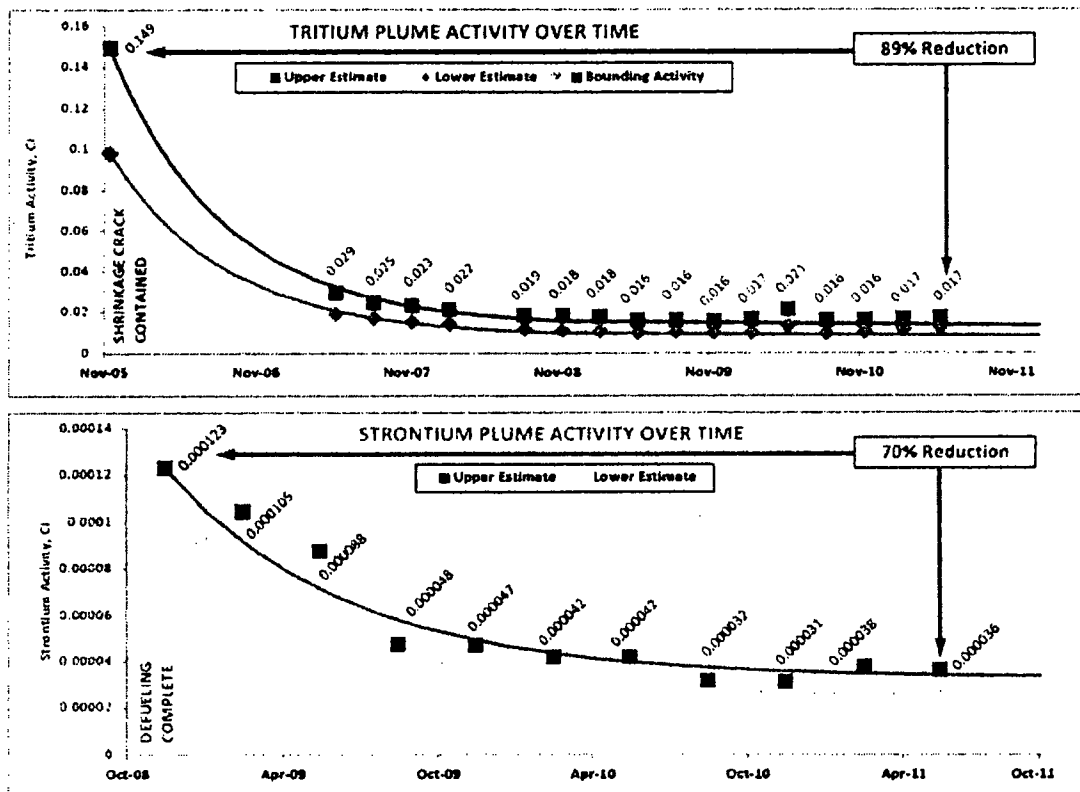
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3 Finally, the actual current levels of radionuclides detected in the
4 groundwater monitoring wells beneath the Indian Point site have shown dramatic
5 decreases since the groundwater investigation began in 2005 (as shown in the two
6 graphs below and further discussed in Exhibit 40 "Plume Total Activity Analysis,
7 pp. 3-19), with the result that the initially low levels of tritium and strontium in
8 the plumes have decreased even further in response to the interdiction measures
9 implemented by Entergy.

10

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2 Q: On page 13 of his testimony, Mr. Gunderson quotes from a GZA
3 groundwater monitoring report that “approximately 70% of the sampling
4 intervals exhibited an increase in Tritium levels.” Can you provide context
5 for this quoted language?

6 A: (MJB) Yes. First, by quoting this statement out of context, Mr. Gunderson gives
7 the impression that the current groundwater tritium plume is increasing. In fact,
8 the opposite is true. The 2010 Second Quarter Groundwater Monitoring Report
9 referred to by Mr. Gunderson in his testimony, in discussing the “Unit 2 Tritium
10 Plume Attenuation,” concludes: “Based on the data and analyses provided
11 above, our conclusion is that the Tritium plume associated with the historic Unit 2
12 SFP leaks is undergoing overall, long-term reductions in activity which are

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1 *consistent with Monitored Natural Attenuation (MNA), the remedial technology*
2 *selected for the IPEC Site.” See Report at pp. 3-22 (Ex. 40).*

3 More specifically, while Mr. Gunderson quotes from the cited report that:
4 *“approximately 70% of the sampling intervals exhibited an increase in tritium*
5 *levels,” the report clearly states that this short term increase was as a result of an*
6 *inadvertent mobile skid spill by a subcontractor (described more fully at pp. 10-11*
7 *of Mr. Barvenik’s initial pre-filed testimony) and is not associated with the Unit 2*
8 *SFP or any other in-place system, structure, or component. As the Report*
9 *concludes: “As such, the increase in total Tritium activity is likely to be transient*
10 *in nature, as was the surface spill [mobile R.O. skid]. However, even accounting*
11 *for this current peak, the total Tritium activity in the plume has still decreased 28*
12 *percent since Q2 2007, and has decreased by 86 percent when compared to the*
13 *bounding level [concentrations at start of monitoring] Tritium concentrations.”*
14 *Id. pp. 3-19.*

15 **Q: At several points in his testimony, Mr. Gunderson states that Entergy does**
16 **not have adequate aging-management methods in place in order to be able to**
17 **detect and prevent future leaks. Do you agree with this assessment?**

18 (TCE, MJB) No. In fact, Entergy has developed and is implementing aging-
19 management programs that include, among other things , inspecting the highest
20 priority buried and underground piping and tanks at Indian Point. The Entergy
21 Underground Piping and Tanks program was developed to ensure that the
22 systems, structures, and components with the greatest potential for leakage to the
23 environment are given top priority. Other potential sources of radionuclides

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1 gaining access to the subsurface, *e.g.*, from leaks in above ground storage tanks,
2 have also been identified and included in the program. The prioritization leads to
3 a direct examination of selected piping and tanks to determine the condition based
4 on a direct examination of the component and the coating. In many cases, this
5 requires excavation of the piping. The potential for leaks from buried piping will
6 be significantly reduced by the continuing implementation of Entergy's programs.
7 Active monitoring of wells will also be ongoing to provide notice of any increase
8 in releases to groundwater. Entergy's aging-management programs coupled with
9 ongoing monitoring will be effective in reducing the likelihood of leaks and to
10 assure that any leaks are detected so as to prevent any harm to the off-site
11 environment. Furthermore, Entergy's aging-management programs, which are
12 subject to regulation by the NRC, are being reviewed in connection with
13 Entergy's federal relicensing proceeding.

14 **Q: Mr. Gunderson states that Monitored Natural Attenuation "is not a valid**
15 **remedial approach." Do you agree with this statement?**

16 (MJB) No. In direct contrast to Gunderson's statement, Monitored Natural
17 Attenuation ("MNA") is a recognized and proven remedial approach that allows
18 natural processes to reduce contaminant concentrations. EPA has long recognized
19 MNA as an appropriate remedial approach to reduce contaminant concentrations.
20 EPA's guidance on the use of Monitored Natural Attenuation (MNA), OSWER
21 Directive 9200.4-17P, states that:

22 "The term 'monitored natural attenuation,' as used in this Directive,
23 refers to the reliance on natural attenuation processes (within the

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1 context of a carefully controlled and monitored site cleanup
2 approach) to achieve site-specific remediation objectives within a
3 time frame that is reasonable compared to that offered by other more
4 active methods. The 'natural attenuation processes' that are at work
5 in such a remediation approach include a variety of physical,
6 chemical, or biological processes that, under favorable conditions,
7 act without human intervention to reduce the mass, toxicity,
8 mobility, volume, or concentration of contaminants in soil or
9 groundwater. These *in-situ* processes include biodegradation;
10 dispersion; dilution; sorption; volatilization; radioactive decay; and
11 chemical or biological stabilization, transformation, or destruction of
12 contaminants." (Ex. 82 at p. 3).

13 OSWER Directive 9200.4-17P also states that: "EPA advocates using the
14 most appropriate technology for a given site. EPA does not consider MNA to be a
15 'presumptive' or 'default' remedy—it is merely one option that should be
16 evaluated with other applicable remedies. EPA does not view MNA to be a 'no
17 action' or "walk-away" approach, but rather considers it to be an alternative
18 means of achieving remediation objectives that may be appropriate for specific,
19 well-documented site circumstances where its use meets the applicable statutory
20 and regulatory requirements." *Id.* at 1.

21 Moreover, also contrary to Mr. Gunderson's statement, NYSDEC
22 specifically **endorsed** MNA as the appropriate remedial approach for addressing
23 the tritium and strontium plumes: "With the removal of the active contamination

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1 source, Entergy's planned use of monitored natural attenuation is an acceptable
2 approach to managing the remaining Sr-90 and H-3 plumes." See NYSDEC
3 Community Fact Sheet (Ex. 32).

4 **Q: Does GZA continue to believe that Monitored Natural Attenuation is the**
5 **correct remediation strategy for Indian Point's groundwater contamination?**

6 (MJB) Yes. GZA selected, and continues to recommend, Monitored Natural
7 Attenuation as the remediation strategy for Indian Point because:

- 8 • Interdiction measures to date have eliminated and/or controlled the
9 identified active sources of groundwater contamination.
- 10 • Groundwater flow at the Site precludes off-Site migration of contaminated
11 groundwater to the North, South or East.
- 12 • Consistent with the Conceptual Site Model, no Indian Point contaminants
13 have been detected above regional background in any of the off-Site
14 monitoring locations or drinking water supply systems in the region.
- 15 • The only on-Site exposure route for the documented contamination is
16 through direct exposure. Because the majority of the Site is capped by
17 impermeable surfaces, there is no uncontrolled direct contact with
18 contaminants.
- 19 • Our studies indicate that under existing conditions, the spatial extent of the
20 groundwater plume should continue to decrease with time. Overall
21 decreases in the plume have been observed since the original
22 recommendation for MNA was made.

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- Groundwater is not used as a source of drinking water on the Site or in the immediate vicinity of the Site, and there is no reason to believe that this practice will change in the foreseeable future.

At the locations where contaminated groundwater discharges to the Hudson River, the concentrations have been, and will continue to be, reduced by sorption, hydrodynamic dispersion, dilution, and radioactive decay. As set forth in my initial pre-filed testimony, and in the pre-filed testimony of Dr. Hoffman, given the extremely small dose to the public and aquatic organisms resulting from the unplanned releases, the use of MNA will provide reasonable assurances that Entegy's unplanned releases will comply with New York water quality standards and other applicable law.

IV. Rebuttal to Testimony of Mr. Kolakowski

Q: On page 11 of his testimony, Mr. Kolakowski claims that the radionuclides that have reached the Hudson River from groundwater as described in GZA's 2008 Site Investigation Report are "high-level radioactive waste," and that their discharge is proscribed by law. First, do you agree that the radionuclide releases described in GZA's 2008 Site Investigation Report are "high-level radioactive waste" as that term is defined in ECL § 17-0807?

A: (FOH) No. ECL § 17-0807, which is part of New York State's legislation implementing SPDES, prohibits "the discharge of any radiological, chemical or biological warfare agent or high-level radioactive waste, as such terms are defined by the Act or pursuant thereto." As set forth in ECL § 17-0801, "the Act" referred to in § 17-0807 is the federal Clean Water Act. The federal Clean Water

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1 Act has an identical provision, which prohibits any permit from authorizing the
2 discharge of high-level radioactive waste. *See* 33 U.S.C § 1311. While the Clean
3 Water Act does not define “high-level radioactive waste,” EPA regulations define
4 “high-level radioactive waste” according to the definition contained in the
5 Nuclear Waste Policy Act of 1982. *See* 40 CFR 191.02(h) (“*High-level*
6 *radioactive waste*, as used in this part, means high-level radioactive waste as
7 defined in the Nuclear Waste Policy Act of 1982 (Pub. L. 97–425)”). The
8 Nuclear Waste Policy Act defines “high-level radioactive waste” as:

9 “(A) the highly radioactive material resulting from the
10 reprocessing of spent nuclear fuel, including liquid waste produced
11 directly in reprocessing and any solid material derived from such
12 liquid waste that contains fission products in sufficient
13 concentrations; and

14 (B) other highly radioactive material that the Commission,
15 consistent with existing law, determines by rule requires
16 permanent isolation.”

17 42 U.S.C. § 10101(12). The water containing principally tritium and strontium
18 identified in GZA’s 2008 Site Investigation Report is not “high-level radioactive
19 waste” as that term is defined by law.

20 **Q: While Entergy believes that NYSDEC’s legal position that Entergy’s**
21 **unplanned radionuclide releases are proscribed by law is erroneous, are**
22 **there measures that could be taken during the license renewal term to**
23 **provide reasonable assurances that groundwater containing these**

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radionuclides will not reach the Hudson River?

1
2 A: (MJB) Yes. As set forth in my initial prefiled testimony, the Indian Point site is
3 primarily underlain by bedrock. As such, the volume of groundwater moving
4 beneath the site toward the Hudson River is constrained to flow through relatively
5 thin fractures in the bedrock. This, in part, accounts for the small total
6 radionuclide activity actually reaching the Hudson River from groundwater on an
7 annual basis. Further, as demonstrated in the Site Investigation Report (Ex. 33),
8 the groundwater containing the identified tritium and strontium plumes discharges
9 to the river through a relatively small section of waterfront along the perimeter of
10 the site.

11 Based on my knowledge of the Indian Point site hydrogeology, and my
12 experience with groundwater remediation, I have performed an analysis of
13 possible measures that could be taken to prevent these radionuclides from
14 reaching the Hudson River. Based on that analysis, I have concluded that Entergy
15 could install a sufficient number of groundwater extraction wells so as to contain
16 these radionuclides on-site by establishing a groundwater gradient reversal. A
17 gradient reversal in this context refers to a change in the direction of groundwater
18 flow; rather than the current flow from the site to the Hudson River, the extraction
19 wells would result in groundwater flowing from the Hudson River toward the
20 wells located on-site. Entergy would then extract the groundwater containing
21 radionuclides from the subsurface, and process that groundwater in an appropriate
22 manner. I believe that the installation of such extraction wells would provide
23 reasonable assurances that groundwater containing these radionuclides will not

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1 reach the Hudson River as a result of the operation of Indian Point during the
2 license renewal term.

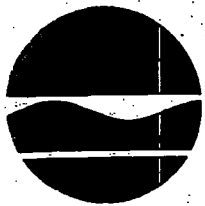
3 **Q: Are extraction wells a proven, reliable method for creating a gradient**
4 **reversal in order to prevent groundwater containing contaminants from**
5 **moving away from a site?**

6 **A:** (MJB) The use of extraction wells specifically to prevent groundwater from
7 moving away from a site is, and has been a commonly employed technique for
8 approximately 40 years, including at EPA superfund sites, as well as many other
9 non-superfund sites. In its Report No. 2003-P-000006 dated March 27, 2003,
10 EPA concluded that: "Pumping contaminated groundwater from the subsurface and
11 treating the water to rid it of contamination has been a generally accepted means of
12 remediation in the Superfund program. In January 2002, EPA reported that although
13 the number of Records of Decision selecting the pump-and-treat remedy decreased
14 from 92 percent in 1986 to 30 percent in 1999, pump-and-treat remedies are still the
15 most common groundwater cleanup remedies used at National Priority List [NPL]
16 sites. . . . EPA estimates that over 700 groundwater pump-and-treat systems are
17 operating at National Priority List sites." (Ex. 83). This equates to the use of
18 groundwater extraction for containment and/or cleanup at 57 percent of the NPL sites
19 (700/1233). In this regard, I have been personally involved in the investigation
20 and remediation design for a number of superfund sites, as well as state-led
21 remediation sites, employing this technique, beginning in the 1970s. One such
22 site, Grace Chemical and the Town of Acton, Massachusetts, was the second EPA
23 NPL enforcement action in the nation resulting in a remedial action consent

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1 decree. Another such site, the Gilson Road/Sylvester Site, was the nation's first
2 cooperatively funded Superfund hazardous waste site hydrodynamic
3 isolation/cutoff wall remediation. As part of this remediation of chlorinated
4 solvents in groundwater, GZA used extraction wells to capture and contain the
5 contaminated groundwater flowing through the bedrock on site. This work was
6 completed on behalf of the State of NH and the EPA. In recognition of this work,
7 GZA was awarded the ASCE Outstanding Engineering Achievement Award, the
8 ACEC New England Grand Conceptor Award and the National ACEC Grand
9 Award for Engineering Excellence, as well as a \$250,000 sole-source R&D full-
10 scale test section contract by EPA.

11
12 **END OF TESTIMONY**



NYS Department of Environmental Conservation

Community Fact Sheet

Prepared for the 9/19/07 NRC Relicensing Environmental Scoping Meeting for
Indian Point Energy Center

Indian Point Energy Center Buchanan, NY

September 2007

If you would like more information about the DEC or DOH activities relative to the groundwater investigations at Indian Point, please contact one of the representatives listed below:

Mr. Tim Rice

Env. Radiation Specialist, Project Lead
NYSDEC
Div. of Solid & Hazardous Materials
625 Broadway
Albany, NY 12233-7255
(518) 402-8579
tbrice@gw.dec.state.ny.us

Mr. Larry Rosenmann

Engineering Geologist
NYSDEC
Div. of Solid & Hazardous Materials
625 Broadway
Albany, NY 12233-7258
(518) 402-8594
larosenm@gw.dec.state.ny.us

Mr. Robert Snyder

Radiological Health Specialist
NYS DOH
Bureau of Env. Radiation Protection
547 River Street
Troy, NY 12180
(800)458-1158 ext. 27550
BERP@health.state.ny.us

Background/History

The Indian Point Energy Center is a nuclear energy powered electrical generating station located in Buchanan, NY. It is wholly owned by Entergy Nuclear. There are three commercial reactors on the property. Unit 1 stopped operation in the 1970s and is currently maintained in an unfueled state pending decommissioning. Spent fuel still remains in storage in the spent fuel pool. Units 2 & 3 continue to generate electricity. Entergy has applied to the Nuclear Regulatory Commission (NRC) to renew its operating license for both operating units for an additional 20 years.

The investigation of the leaks from the Unit 1 & 2 spent fuel pools into groundwater on-site is nearing completion. Entergy is performing the investigation under the direct regulatory authority of the NRC, with State review provided by DEC and DOH.

Groundwater Investigation

The New York State Department of Environmental Conservation (DEC) and the New York State Department of Health (DOH) have been participating in the ongoing groundwater investigation of radionuclide contamination in groundwater under the plant, and the release of that water to the Hudson River. The purpose of our involvement is to protect the interests of the citizens and the environment of the State of New York by helping to ensure that Entergy performs a timely, comprehensive characterization of site groundwater contamination, takes appropriate actions to identify and stop the sources of the leak, and undertakes any necessary remedial actions.

General

In 2005 Entergy was preparing to install a new crane at the Unit 2 Spent Fuel Pool (SFP) to support its dry cask spent fuel storage operation. During that work, Entergy discovered water leaking from a crack in the exterior of the concrete SFP wall. The subsequent investigation identified tritium (radioactive hydrogen or H-3) contamination in groundwater on-site coming from the vicinity of the Unit 2 SFP and radioactive Strontium-90 (Sr-90) and other isotopes coming from the Unit 1 SFP.

Entergy hired a hydrology contractor who, with involvement from the NRC, USGS, DEC, and DOH, determined that there were two active groundwater plumes on site;

- a H-3 plume coming from the Unit 2 SFP, and
- a Sr-90 plume coming from the Unit 1 SFP.

State Activities

- Collecting split samples of water from on-site and off-site monitoring wells, focusing on wells along the riverfront and to the south of the sources of the leaks.
- Recommended that Entergy enhance its Hudson River fish sampling program this year to help answer

questions regarding potential Sr-90 impacts.

- Collected split samples of fish flesh from this enhanced effort, as well as unilaterally analyze bone samples.
- Analyzing samples at the DOH Wadsworth Center public health laboratory. Compare results with Entergy's.
- Participating in and provide recommendations on the hydrology investigation into the extent and movement of contaminated groundwater on the site, including independent review of contractor work.
- Performed an independent assessment of potential public health impacts.

- Participating in periodic stakeholder calls and meetings.

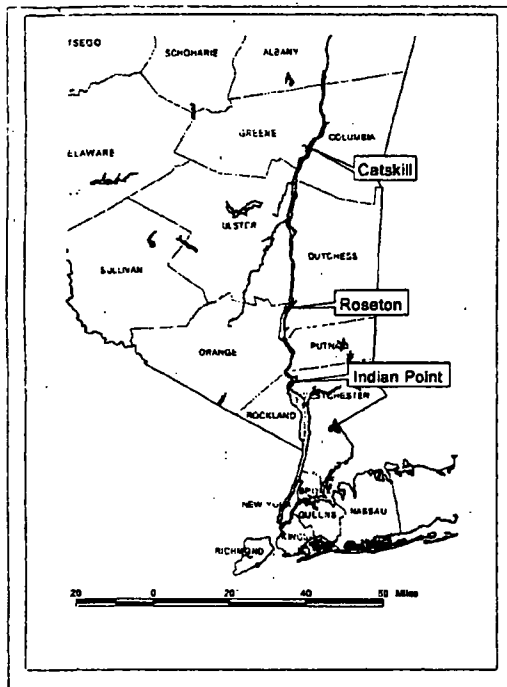
Key Findings to Date

- There are no residential or municipal drinking water wells or surface reservoirs near the plant.
- There are no known impacts to any drinking water source.
- No contaminated groundwater is moving towards surrounding properties.
- Contaminated groundwater is moving into the Hudson River.

- Public exposure can occur from the groundwater entering the Hudson River through consumption of fish.
- The DOH has confirmed Entergy's calculated dose to humans from fish.
- Sr-90 levels in fish near the site (18.8 pCi/kg) are no higher than those in fish collected from background locations across the state.
- Recent Sr-90 data in fish is limited. (New samples are being analyzed.)

Ongoing Activities

- Coordinate an enhanced fish sampling effort.
- Continue to participate in public communication activities.
- Continue to monitor Entergy's progress on determining the source of the Unit 2 H-3 plume.
- Participate in the final assessment of groundwater conditions on the site.
- Evaluate any plans for leak repairs or site remediation.
- Continue to provide an independent source of information for the counties and other interested parties on topics related to the groundwater investigation.
- Evaluate long-term monitoring plans.



Enhanced Fish Sampling

DEC and DOH worked with Entergy and the NRC to develop this year's enhanced fish sampling effort. The intent is to meet these three goals: 1. develop a more scientifically rigorous sampling program, 2. evaluate the appropriateness of Entergy's environmental background (control) location, and 3. perform a thorough evaluation of this potential human exposure pathway. To accomplish this:

- Sampling focused on species that do not migrate over significant distances in the river and are expected to be present at all sampling locations, or are of commercial or recreational importance, including striped bass, blue crab, carp, white perch, American eel, catfish, and sunfish.
- Samples were collected from the area near Indian Point, the existing upstream control area near Roseton, and from far-upstream near the Village of Catskill. (see map)
- Samples of edible portions of each species at each location are being analyzed by NYS, NRC, and Entergy.
- Bone samples are being analyzed by NYS.
- Both flesh and bone are being analyzed for Sr-90 and gamma emitting radionuclides.
- NYS will review the data to assess the current environmental monitoring program, and to evaluate any potential impacts to public health and the environment.

Fish Results to Date

NRC fish results have been received and show no detectable Sr-90 or gamma emitters. Entergy and State analyses are not yet available from our respective labs, but will be

reported to stakeholders when received.

Regulatory Authority

The federal government regulates the use of radioactive materials at Indian Point under the federal Atomic Energy Act.

At present, there are no off-site groundwater impacts, and releases of contaminated groundwater to the river do not violate state surface water standards for H-3 (20,000 pCi/l) and Sr-90 (8 pCi/l).

Remedial Actions

Tritium

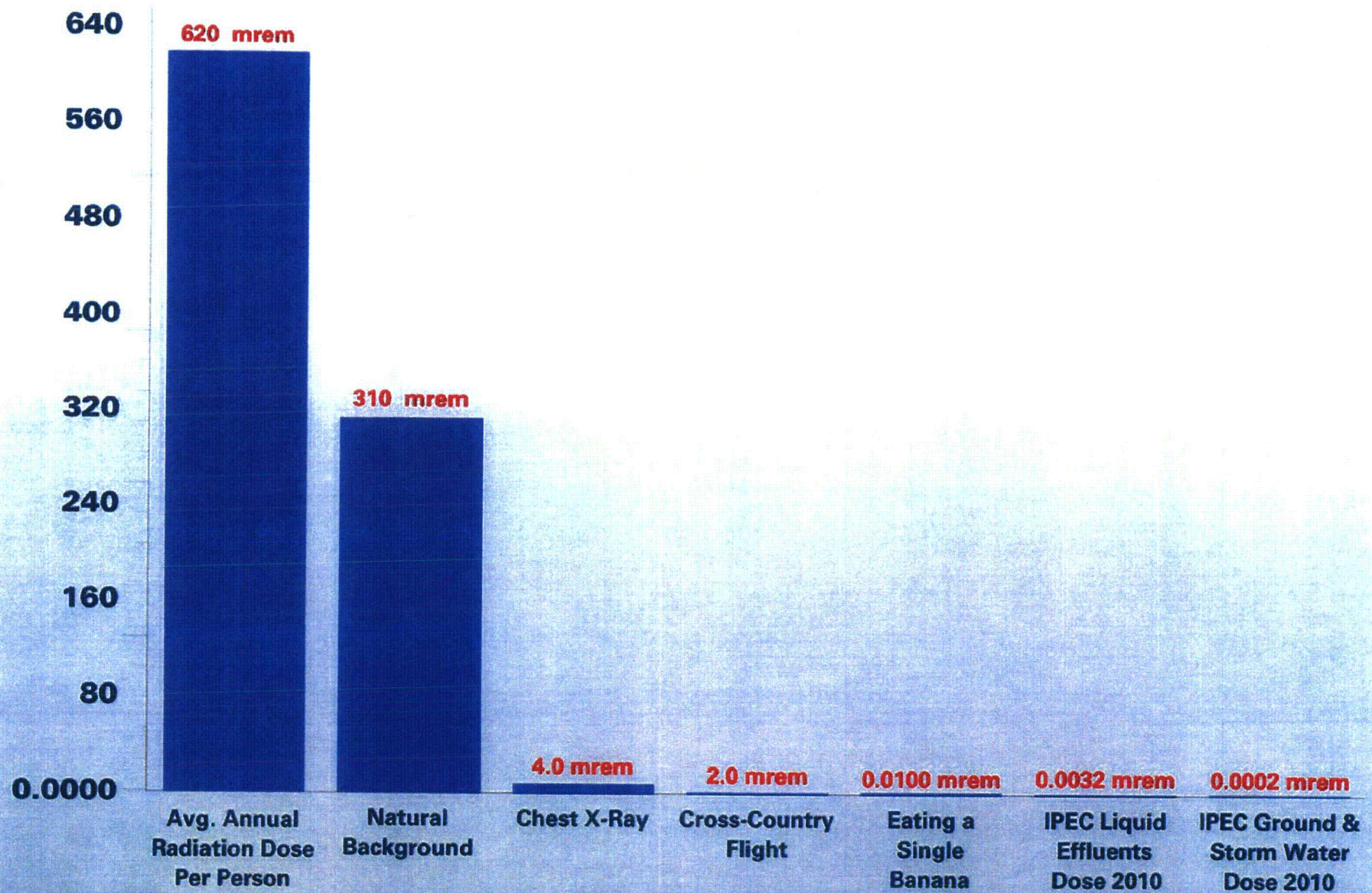
Because tritium (H-3) is actually an isotope of hydrogen, it is not feasible to remediate H-3 contaminated groundwater other than by removing the source of contamination. Entergy has identified a leak in a portion of the Unit 2 SFP (a probable source of the H-3 plume) and will repair this leak (and any others discovered) after completion of its inspection of the stainless steel liner.

Strontium

Unlike H-3, Sr-90 contamination can be removed from water through readily available treatment processes. Entergy has reduced the source of the Sr-90 plume by >97% through operation of a water treatment system in the Unit 1 SFP. This has resulted in measurable reductions in Sr-90 groundwater concentrations. The company has also agreed to remove the spent fuel and remaining contaminated water from the Unit 1 SFP in 2008, stopping the contamination source.

The agencies will be monitoring the progress of these source remediation efforts closely and will be reviewing and commenting on the final site hydrology report and long-term monitoring plans Entergy is anticipated to finalize in the next couple of month.

IPEC's Yearly Discharges vs Commonly Occurring Doses



NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of

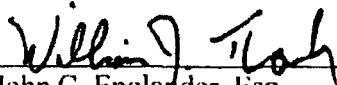
Entergy Nuclear Indian Point 2, LLC, Entergy
Nuclear Indian Point 3, LLC, and Entergy
Nuclear Operations, Inc.'s Joint Application
for CWA §401 Water Quality Certification

DEC App. Nos. 3-5522-00011/00030 (IP2)
3-5522-00105/00031 (IP3)

PROPOSED FINDINGS OF FACT OF
ENTERGY NUCLEAR INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN
POINT 3, LLC, AND ENTERGY NUCLEAR OPERATIONS, INC.
RADIOLOGICAL ISSUES

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

By Their Attorneys,


John C. Englander, Esq.
Elise N. Zoli, Esq.
William J. Trach, Esq.
Robert H. Fitzgerald, Esq.
Goodwin|Procter LLP
Exchange Place
Boston, MA 02109-2881
(617) 570-1000

Dated: April 27, 2012

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I. Nuclear Regulatory Commission ("NRC") Regulation of Indian Point Planned and Unplanned Radiological Discharges.

1. Indian Point Units 2 and 3 have operated pursuant to 40-year licenses issued by the Nuclear Regulatory Commission ("NRC") with nominal expiration dates of September 28, 2013 and December 12, 2015, respectively, subject to renewal. Entergy Ex. #161,¹ Joint Application Form, Supplemental Response to Item 9.

2. Operations at Units 2 and 3 result in "planned" or routine releases of radionuclides incident to everyday operations, as well as "unplanned" or non-routine discharges that occur as a result of operational occurrences such as leaks or spills. Hoffman Prefiled at 9.²

3. Both planned and unplanned releases are subject to NRC regulation and oversight. Hoffman Prefiled at 9; NRC Regulatory Guide 1.21 (Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste) at §§1.5 (Monitoring Leaks and Spills) and 1.10 (Abnormal Releases and Abnormal Discharges); NRC Policy Issue, "Senior Management Review of Regulatory Approach to Groundwater Protection," SECY-11-0019, Feb. 9, 2011, Enclosure 2 at p. 2; Entergy Ex. #32 at vii; Riverkeeper Ex. #7 at 4-9.

4. The New York State Department of Environmental Conservation ("NYSDEC") has never regulated Indian Point's radiological releases through the State Pollutant Discharge Elimination System ("SPDES") permit program, but rather consistently has maintained that it has no authority to do so. Entergy Ex. #120, at 90-91.

II. The Indian Point Site

5. The Indian Point Energy Center ("IPEC") is located on the eastern bank of the Hudson River, in the Village of Buchanan, in upper Westchester County, New York. Entergy Ex. #161, Att. A and B.

¹ References to record exhibits are cited "[Party Name] Ex. # ____."

² References to prefiled testimony are cited "[Witness Name] Prefiled at ____."

6. IPEC consists of three nuclear reactors and associated equipment, referred to as Units 1, 2 and 3. Hearing Tr. at 2699 (Kolakowski)³; Entergy Ex. #33 at 2.

7. Unit 1 ceased operations in October 1974 and is currently in safe storage condition ("SAFSTOR"). Kolakowski Prefiled at 10, Hearing Tr. at 2709 (Kolakowski); Barvenik Prefiled at 8; Entergy Ex. #33 at 129; Entergy Ex. #34 at §4.0.1 (Report Details).

8. Indian Point does not utilize groundwater either for plant operations or for potable water. Entergy Ex. #33 at 13.

9. There are no active potable water wells or other production wells in the vicinity of Indian Point. Entergy Ex. #33 at 13-14.

10. In the vicinity of Indian Point, the Hudson River is not used for drinking water purposes. Entergy Ex. #46.

11. Drinking water in the area surrounding Indian Point is supplied from surface water reservoirs located in Westchester County and the Catskills region. Entergy Ex. #33 at 14. The nearest of these reservoirs is the Camp Field Reservoir, which is located 3.3 miles north-northeast of Indian Point, in a cross-gradient direction (i.e., perpendicular to the direction that groundwater flows), several watersheds away and at an elevation hundreds of feet above the Indian Point power block. Entergy Ex. #33 at 14.

III. Unplanned Releases of Radiological Materials at Indian Point

12. Indian Point's three Units include spent fuel pools ("SFP"), which are structures typically consisting of two containment barriers – one of thick-walled concrete and one of steel – used to store on a temporary basis spent fuel from the operation of the nuclear reactor. Entergy Ex. #32 at Report Details, p. 2; Hearing Tr. at 3163-3164 (Esselman); Hearing Tr. at 3171-3172

³ References to the hearing transcripts are cited "Hearing Tr. at ____ (Witness Name)."

(Esselman). The Unit 1 SFP complex was constructed of reinforced concrete with an internal low permeability coating, but its design did not include a stainless steel liner. Entergy Ex. #33 at 102. The Unit 2 SFP consists of four- to six-foot thick concrete that is heavily reinforced with steel rebar. The inside of the SFP is lined with 1/4-inch stainless steel plate anchored to the concrete such that the plate and concrete are in contact, with only a small interstitial area between. Entergy Ex. #32 at 2 (Report Details); Entergy Ex. #33 at 92. The Unit 3 SFP is similar in design to the Unit 2 SFP but also includes a tell-tale leak collection system designed to collect any leakage through the stainless steel liner. Entergy Ex. #32 at 14; Barvenik Prefiled at 9-10.

13. In August 2005, Entergy began excavating adjacent to the south wall of the Unit 2 SFP to install a crane for Unit 2's dry cask storage system. Entergy Ex. #31 at 1; Entergy Ex. #32 at iv; Barvenik Prefiled at 7.

14. During the excavation, concrete shrinkage cracks (1/64" wide and seven feet in length) were observed to exhibit moisture in and near the cracks. Entergy Ex. #31 at 1; Entergy Ex. #32 at iv.; Barvenik Prefiled at 7-8; Hearing Tr. at 3912 (Barvenik).

15. Entergy installed a temporary device to collect any fluids emanating from the cracks and prevent the addition of these materials to the groundwater. Barvenik Prefiled at 8. The first measureable liquid sample collected by the device was 12 ml collected on September 13, 2005. During the next several weeks, the average leakage rate was between 1 and 2 liters per day, which then declined to minimal by late December 2005. Entergy Ex. #32 at 1 (Report Details).

16. The primary radioactive constituent of the moisture was identified as tritium. Entergy Ex. #32 at iv.

17. Tritium is a naturally occurring radioactive form of hydrogen that is produced naturally in the atmosphere when cosmic rays collide with air molecules. As a result, tritium is found in very small or trace quantities in water throughout the world. Tritium is also a byproduct of the production of electricity at nuclear power plants, such as Indian Point. Tritium has a half-life of 12.3 years and emits a weak form of radiation, a low-energy beta particle similar to an electron. The tritium radiation does not travel very far in air and cannot penetrate the skin. Because tritium emits a very weak form of radiation and leaves the body relatively quickly, it is one of the least dangerous radionuclides. Hoffman Prefiled at 4.

18. A permanent collection box was installed around the shrinkage cracks in January 2006, and all collected water is piped to an adjacent building where it is collected for final disposition. Barvenik Prefiled at 8; Entergy Ex. #32 at 2 (Report Details).

19. Entergy retained GZA GeoEnvironmental, Inc. ("GZA") to perform a hydrogeologic investigation at Indian Point with respect to the radionuclides evident in the moisture from the shrinkage cracks at the Unit 2 SFP. Hearing Tr. at 3912-3913 (Barvenik).

20. The purpose of the hydrogeologic investigation was to study the nature, scope, distribution and quality of groundwater at and moving from the Indian Point site, specifically as it related to radionuclides associated with the Unit 2 SFP. Barvenik Prefiled at 4-5; Hearing Tr. at 3912-3913 (Barvenik); Entergy Ex. #33 at 1-2.

21. The fundamental components of the groundwater investigation, the implementation of which was overseen by NRC and involved stakeholders such as NYSDEC and the New York State Department of Health ("NYSDOH"), generally included:

- a. The drilling of boreholes into the subsurface to extract geological materials for study;

- b. The installation of instruments for the determination of radionuclide concentrations, groundwater elevations, groundwater flow direction and speed; and
- c. The preparation of a Conceptual Site Model, which embodies the understanding of the nature, distribution and quality of groundwater moving below the Indian Point site.

Hearing Tr. at 3913 (Barvenik); Barvenik Prefiled at 1-5, 8, 12-13; *see also* Entergy Ex. #33 at 6-8 (Scope of Work for hydrogeological investigation); Entergy Ex. #34 at iv.

22. Several months into the investigation, strontium-90 was detected in a groundwater sample. Entergy Ex. #32 at 9.

23. Strontium is a soft, silvery metallic element found in rocks, soil, dust, coal and oil. Strontium-90 is a radioactive form of strontium with a half-life of 29 years, and is formed in nuclear reactors or during the explosion of nuclear weapons. The vast majority of strontium-90 in the environment and food chain (approximately 99%) is a result of weapons testing that occurred worldwide. Strontium-90 from releases of nuclear power plants is a small fraction of the strontium-90 in the environment. Hoffman Prefiled at 5.

24. As a result of the detection of strontium-90, GZA's hydrogeologic investigation was expanded to investigate the source of the strontium-90 and cover potential radionuclide releases from all three Units, and was performed under NRC's oversight over the two-year period from September 2005 to September 2007. Entergy Ex. #33 at 1; Hearing Tr. at 3913-3914 (Barvenik); Barvenik Prefiled at 12-13; Entergy Ex. #34 at iv. NRC performed independent (or split) sampling, laboratory analysis and review of the information obtained pursuant to the hydrogeologic investigation. Entergy Ex. #32 at 4-5 (Report Details).

25. On January 7, 2008, GZA issued its "Hydrogeologic Site Investigation Report" (the "GZA Report"), providing the details of its investigations and the conclusions reached as a result. Entergy Ex. #33.

26. The GZA Report included GZA's Conceptual Site Model ("CSM"), a description of the site understanding, including that regarding the hydrogeologic setting at and in the vicinity of Indian Point, general groundwater flow patterns in the vicinity of Indian Point, identified unplanned and planned radionuclide release sources at Indian Point, radiological contaminants of potential concern, and identified receptors, including the Hudson River. Entergy Ex. #33 at 9.

27. As information was collected during the hydrogeologic investigation, the CSM was updated and refined to fit conditions observed in the field and, by the conclusion of the investigation, the CSM was consistent with both the site-specific project data and published data on the hydrogeology of the Indian Point area. Entergy Ex. #33 at 9. The CSM is essentially an "understanding" of hydrogeologic conditions at and around the Indian Point site, as they relate to the movement of groundwater and radionuclides attributable to Indian Point. Barvenik Prefiled at 4.

28. The conclusions from the GZA Report include the following:

- a. Two plumes of radiologically contaminated water, the first primarily contaminated with tritium (H-3) ("tritium plume") and the second primarily contaminated with strontium-90 (Sr-90) ("strontium plume"). Entergy Ex. #33 at 114.
- b. The tritium and strontium plumes ultimately discharge to the Hudson River, but do not otherwise migrate from the Indian Point site to the North, East or South. Entergy Ex. #33 at viii, 114, 127; Hearing Tr. at 3925-3926 (Barvenik); *see also* Entergy Ex. #38 at 1-1; Entergy Ex. #40 at 1-1.

- c. The source of the tritium plume was the Unit 2 SFP and the source of the strontium plume was the Unit 1 SFP. Entergy Ex. #33 at viii; Barvenik Prefiled at 5-6; Hearing Tr. at 2708 (Kolakowski).
- d. Unit 3 was not a source of radionuclide groundwater contamination at Indian Point. Entergy Ex. #33 at viii, 128; Barvenik Prefiled at 9-10; Hearing Tr. at 2703 (Kolakowski).

29. As part of an extensive public process involving a variety of stakeholders, NYSDEC (with support from NYSDOH) actively monitored Entergy's hydrological investigation, independently analyzed split samples from onsite and offsite monitoring wells, and made recommendations on the work being performed. Hearing Tr. at 3920-3922 (Barvenik); Entergy Ex. #32 at 5, Entergy Ex. #34 at § 4.0.3(a) (Report Details); Entergy Ex. #46; Entergy Ex. #80.

30. Among the individuals at NYSDEC who participated in the investigation was Tim Rice of NYSDEC's radiation protection section. Hearing Tr. at 3921-3922 (Barvenik).

31. Mr. Rice did not testify on behalf of NYSDEC Staff in this proceeding. Hearing Tr., *passim*.

32. Based upon its own analysis, NYSDEC and NYSDOH made several findings, including the following, each of which is consistent with the findings of Entergy and GZA:

- a. Groundwater from the site flows east to west and does not flow to surrounding properties; Entergy Ex. #46 at 1.
- b. Contaminated groundwater is moving into the Hudson River, but the levels of radionuclides in the River are below state surface water standards for tritium and strontium; Entergy Ex. #46 at 1.

- c. No drinking water sources are affected because the Hudson River in this area is brackish and is not used as a drinking water source; Entergy Ex. #46 at 1.
 - d. Because the Hudson River is not used as a drinking water source in this area, the only pathway for a dose to the public from groundwater entering the River is through fish consumption; Entergy Ex. #46 at 1.
 - e. Entergy's characterization of the extent and levels of contamination reported in the GZA Report is acceptable; Entergy Ex. #46 at 1.
 - f. With the removal of the active contamination source, Entergy's planned use of monitored natural attenuation is an acceptable approach to managing the remaining strontium and tritium plumes; Entergy Ex. #46 at 1.
 - g. NYSDOH confirmed Entergy's calculated doses to the public through fish consumption which are less than 1% of the NRC dose limits; Entergy Ex. #46 at 1.
 - h. An enhanced fish sampling effort in 2007 showed no significant difference between strontium-90 in the flesh of fish caught near the site and fish caught as far as 70 miles upstream. Entergy Ex. #46 at 2.
33. NYSDEC also conducted an enhanced, independent radiological survey of several aquatic species in the lower Hudson River and published the results of this assessment in November 2009 ("2009 Fish Report"). Entergy Ex. #39.
34. The 2009 Fish Report reached two conclusions:
- a. There are no apparent excursions above criteria for the protection of biota based on the radionuclide data available. The levels of radionuclides – including [strontium-90] – were two to five orders of magnitude lower than criteria established for protection of freshwater ecosystems.

- b. There were no spatial differences in concentrations of [strontium-90] and [radium-224] in resident fish from the three locations sampled in the lower Hudson River (i.e., Indian Point Nuclear Power Plant, and the reference sites at the Roseton Generating Station and at Catskill). In contrast, [potassium-40] levels were somewhat greater in the vicinity of Roseton Generating Station, but the differing concentrations have no known significance.

Entergy Ex. #39 at 8.

35. Throughout the Entergy, GZA, NYSDEC and NYSDOH investigations, NRC was performing its regulatory oversight function and reaching findings consistent with those of NYSDEC, NYSDOH, Entergy and GZA. On September 20, 2005, NCR's Region 1 initiated a Special Inspection regarding identified leaks from the Unit 2 SFP and the potential for associated groundwater contamination. Entergy Ex. #31 at 1-2.

36. On October 5, 2005, Entergy reported to the NRC the detection of tritium in an on-site test well and, thereafter, the scope of the Special Inspection was expanded to include a review of the extent of onsite groundwater contamination. Entergy Ex. #31 at 1-3; Entergy Ex. #32 at iv.

37. As expanded, the purpose of the Special Inspection was to oversee and evaluate Entergy's efforts to: (a) determine the location of the Unit 2 SFP leak(s), repair the affected area(s), and install a leak detection/monitoring system; and (b) characterize the on-site tritium contamination, determining the source(s) of the contamination, and establishing appropriate monitoring and control. Entergy Ex. #31 at 2-3; Entergy Ex. #32 at iv; Entergy Ex. #32 at Attachment A6-3 to A6-4.

38. On October 28, 2005, the NRC's Region 1 Executive Director of Operations requested approval from the NRC's Office of Nuclear Reactor Regulation for permission to expand NRC's oversight of the leak investigation and groundwater contamination. Entergy Ex. #31 at 1. At the time of this request, NRC Region 1 stated that "we see no hazard to public health and safety, and we expect any off-site radiological releases to be very small (i.e., offsite doses, if any would be negligible with respect to normal background)." Entergy Ex. #31 at 2.

39. NRC Region 1's expanded oversight efforts at Indian Point were to continue "until the NRC is satisfied that the leakage of water from the Unit 2 spent fuel pool has either been stopped or is being effectively monitored and controlled; and on-site tritium contamination has been properly characterized, and is being effectively monitored and controlled." Entergy Ex. #31 at 3.

40. On March 16, 2006, the NRC issued its first Special Inspection Report. The inspection consisted of a selected examination of procedures and representative records, observations of activities, interviews with Entergy personnel, and independent analyses of groundwater samples. Entergy Ex. at #32 at 1.

41. NRC's Special Inspection Report reached the following conclusions with respect to Entergy's activities from the discovery of the Unit 2 SPF leak to the close of the Special Inspection:

- a. Entergy's response to identified conditions was reasonable and technically sound.
Entergy Ex. #32 at 2.
- b. The existence of onsite groundwater contamination, as well as the underlying sources of leakage, are conditions warranting continued efforts by Entergy to resolve, but do

- not present significant risk to public health and safety and the environment. Entergy Ex. #32 at 2, iv-v, 6 (Report Details).
- c. Public health has not been, nor is likely to be, adversely affected, and the dose consequence to the public that can be attributed to current onsite conditions is negligible with respect to conservatively established NRC regulatory limits. Entergy Ex. #32 at 2, iv-v and 6 (Report Details).
 - d. A refined calculation, based upon tritium detected in monitoring well samples, of the dose estimate to the public indicated a whole body dose to the maximally exposed individual of 1.5×10^{-5} mrem/year, which represents 0.00005% of the 3 mrem/year limit for liquid effluent releases. Entergy Ex. #32 at v.
 - e. Independent sampling and analysis of onsite and offsite groundwater sampling locations by Entergy, NYSDEC and NRC produced results that were in good agreement, and no plant-related radioactivity was identified in any offsite sample of surface or groundwater. Entergy Ex. #32 at v-vi.
 - f. Entergy's measurements of radioactivity in various samples taken to ascertain the extent of groundwater contamination were of good quality and of sufficient sensitivity to assess radiological impact, and the quality of Entergy's measurements were confirmed by various split samples analyzed by NRC, NYSDEC and NYSDOH. Entergy Ex. #32 at 3 (Report Details).
 - g. The inspectors found no circumstance that could reasonably be viewed as a failure of Entergy to follow standards or take measures that would have prevented the current onsite conditions; or react to circumstances and conditions that would have led to earlier detection. Entergy Ex. #32 at vi.

- h. Entergy is adequately following its corrective action process relative to the current onsite conditions, including conditions affecting the Unit 2 SPF. Entergy Ex. #32 at vii.
 - i. There is no drinking water pathway associated with groundwater or the Hudson River in the region surrounding Indian Point, and samples taken in support of the NRC-required Radiological Environmental Monitoring Program continue to indicate no detectable plant-related radioactivity in groundwater beyond the site boundary, including in samples collected from local municipal drinking water reservoirs and other groundwater monitoring wells located in the immediate vicinity of Indian Point. Entergy Ex. #32 at viii.
 - j. The identified groundwater release was classified by Entergy as an abnormal release, as specified in NRC Regulatory Guide 1.21, and will be included in effluent release reports as required. Entergy Ex. #32 at vii.
 - k. All releases from the Unit 1 SPF are documented in the NRC-required annual effluent and environmental monitoring reports. Entergy Ex. #32 at 11 (Report Details).
42. Throughout the performance of NRC's Special Inspection, NRC coordinated its activities with NYSDEC which had initiated its own independent assessment of the groundwater conditions, including observation of NRC's inspection activities. Entergy Ex. #34 at iv.
43. On November 7, 2007, the NRC initiated another inspection of Indian Point, the purpose of which was to assess Entergy's groundwater investigation to evaluate the extent of contamination, the effectiveness of actions, taken or planned, to effect appropriate mitigation and remediation of the conditions resulting from the Unit 1 and Unit 2 SFP leaks. Entergy Ex. #34 at 1.

44. NRC's inspection, which concluded on May 7, 2008, determined that public health and safety had not been, and was not likely to be, adversely affected, and the dose consequence to the public attributable to on-site conditions associated with groundwater contamination was negligible. Entergy Ex. #34 at 1-2.

45. In its inspection report dated May 13, 2008, the NRC made several findings including the following:

- a. The radiological significance from the groundwater conditions at Indian Point is currently, and is expected to remain, negligible with respect to impact on public health and safety and the environment. Entergy Ex. #34 at v.
- b. NRC confirmed with NYSDOH that drinking water is not derived from groundwater or the Hudson River in the areas surrounding or influenced by effluent release from Indian Point and, therefore, the only human exposure pathway of merit is from the possible consumption of aquatic foods from the Hudson River, such as fish and invertebrates. Entergy Ex. #34 at v-vi.
- c. Entergy's actions to investigate the radiological release conformed to the requirements of NRC regulations – 10 C.F.R. §20.1501 – to ensure compliance with dose limits for individual members of the public. Entergy Ex. #34 at vi.
- d. No evidence was found that indicated that the events at Indian Point, that resulted in the onsite groundwater contamination were the result of Entergy's failure to meet a regulatory requirement or standard. Entergy Ex. #34 at vi.
- e. Off-site groundwater samples collected since the fall of 2005 have never detected any off-site groundwater contamination. Entergy Ex. #34 at iv.

- f. Entergy had properly identified the source of groundwater releases as the Unit 1 and Unit 2 SFPs. Entergy Ex. #34 at vi.
- g. No releases were observed or detected from Unit 3. Entergy Ex. #34 at viii.
- h. Entergy's hydrogeologic site characterization studies provide sufficient detailed field observations, monitoring, and test data that supported the development and conformation of a reasonable Conceptual Site Model. Entergy Ex. #34 at vii.
- i. The Conceptual Site Model provides a reasonable basis to support the finding that liquid effluent releases from the SFPs migrate west toward the Hudson River and do not otherwise migrate offsite. Entergy Ex. #34 at vii.
- j. No radioactivity distinguishable from background was detected during the most recent sampling and analysis of fish and crabs taken from the affected portion of the Hudson River and designated control locations. Entergy Ex. #34 at vii.
- k. The annual calculated exposure to the hypothetically maximally exposed individual relative to the liquid effluent aquatic food exposure pathway is currently, and is expected to remain, less than 0.1 percent of the ALARA guidelines in Appendix I of 10 C.F.R. Part 50, which are considered to be negligible with respect to public health, safety and the environment. Entergy Ex. #34 at vii.
- l. There is no evidence of any significant leak or loss of radioactive water inventory from the site that was discernable in the offsite environment. Entergy Ex. #34 at viii.
- m. Entergy's remediation approach (i.e., Monitored Natural Attenuation) and plans for long-term monitoring of residual groundwater contamination were reasonable. Entergy Ex. #34 at vi-viii.

46. In reaching these conclusions, NRC staff relied, in part, on an independent analysis of groundwater transport through fractured bedrock (utilizing geophysical well logging data) conducted by the United States Geological Survey which confirmed GZA's conclusions. Entergy Ex. #34 at vii.

IV. Entergy's Corrective Actions

47. In 2007 and 2008, Entergy performed a comprehensive assessment of the accessible portions of the Unit 2 SFP for the purpose of identifying potential sources of the tritium plume. Hearing Tr. at 3168, 3173 (Esselman).

48. Sixty-five percent (65%) or more of the liner of the entire Unit 2 SFP, including the fuel transfer canal area, has been inspected. Hearing Tr. at 3174 (Esselman); Barvenik Prefiled at 8.

49. In September 2007, Entergy drained the fuel transfer canal within the Unit 2 SFP in order to inspect the liner of that canal; during that process, Entergy identified one weld imperfection, i.e., the source of the tritium contamination, that was subsequently repaired in December 2007. Barvenik Prefiled at 8.

50. Other than the shrinkage cracks discussed in Paragraph 14 above and the one weld imperfection that was repaired in December 2007, no other leaks were identified as a result of the inspection of the SFP liner, including the fuel transfer canal. Barvenik Prefiled at 8.

51. The inspection of the Unit 2 SFP liner has not identified any degradation mechanisms (e.g., corrosion) that would cause a SFP leak or would increase the size of any undetected existing leak. Hearing Tr. at 3169-3170 (Esselman).

52. Entergy implemented a program to remove the spent fuel and all water from within the Unit 1 SFP; that process was completed in 2008. Barvenik Prefiled at 9; Entergy Ex. #47.

53. Because the Unit 1 SFPs have been drained of their contents, they are no longer a source of radionuclides to the subsurface. Barvenik Prefiled at 9, Hearing Tr. at 2710 (Kolakowski); Hearing Tr. at 3920 (Barvenik).

54. In addition to work on the Unit 1 and Unit 2 SFPs, Entergy retained Lucius Pitkin, Inc. ("LPI") in 2010 to assist in the development of an underground piping management program. Hearing Tr. at 3110 (Essleman); *see also* Entergy Ex. #77 and Entergy Ex. #79.

55. Entergy's underground piping program consists of a four-step process as follows:

- a. Conduct an inventory of underground pipes and their design characteristics;
- b. Prioritize piping systems on the basis of the consequences of a leak or failure and the susceptibility of the pipe to degradation;
- c. Perform inspections of piping systems to gain information; and
- d. Perform an engineering evaluation of the inspection data to determine remedial actions required, if any.

Hearing Tr. at 3111 (Esselman); Entergy Ex. #79.

56. The first two steps of this process have been completed at Indian Point, and inspections of underground piping occurred in 2008 (prior to the implementation of this program) and continue each year, with 38 pipe inspections completed through 2011 and nine additional pipe inspections scheduled in 2012. Hearing Tr. at 3111-3113 (Esselman).

57. Pipe inspections under this program utilize a variety of techniques to gain information regarding pipe conditions, including new ultrasonic technologies that allow for an inspection of pipe lengths that have not been exposed by excavation. Hearing Tr. at 3114-3115 (Esselman).

58. The results of these inspections indicated that many of the pipe locations were determined to be satisfactory, while a relatively small number of locations with indications of the possibility of corrosion. Hearing Tr. at 3112-3113 (Esselman).

59. In response to the information indicating the possibility of corrosion, Entergy installed a cathodic protection system – a commonly used and well understood device which introduces a sacrificial anode that corrodes while the pipe itself is protected. Hearing Tr. at 3113-3114 (Esselman).

60. The implementation of this program reduces the likelihood and potential severity of leaks over time. Hearing Tr. at 3117 (Esselman).

V. Entergy's Long Term Monitoring Program

61. After the completion of the hydrogeologic investigation, Entergy established a Long-Term Groundwater Monitoring Program ("LTMP"); the LTMP's purposes are: (1) to continue to assess the tritium and strontium plumes associated with the historic Unit 1 and Unit 2 SFP leaks; and (2) to monitor for potential new radionuclide releases through the groundwater monitoring network consisting of an array of groundwater monitoring wells located near systems, structures and components that have the potential to impact the groundwater should they leak in the future. Barvenik Prefiled at 13-16; Hearing Tr. at 3914-3915 (Barvenik).

62. The current groundwater monitoring array consists of 65 separate groundwater monitoring well locations, with over 150 monitoring intervals at different depths within those 65 installations. Barvenik Prefiled at 4-5; Hearing Tr. at 3917-3918 (Barvenik); Entergy Ex. #124.

63. In addition to the groundwater monitoring well installations, included in the overall groundwater monitoring network are approximately 75 storm drains and 25 sumps located throughout the Indian Point site, from which samples are periodically collected for analysis. Barvenik Prefiled at 5.

64. This groundwater monitoring network of over 250 different monitoring points is among the most extensive of Mr. Barvenik's professional experience for any site subject to a groundwater investigation. Hearing Tr. at 3914 (Barvenik).

65. Under the LTMP, Entergy conducts ongoing periodic groundwater monitoring and sampling activities, and evaluates the sampled data, for four primary purposes:

- a. Monitor groundwater flow rate and radionuclide concentrations to both detect and characterize current and potential future releases of radionuclides from groundwater to the Hudson River;
- b. Monitor groundwater proximate to Indian Point systems, structures, and components that may result in releases of radionuclides to groundwater at Indian Point;
- c. Monitor groundwater along the property boundary and off-site to confirm that groundwater containing radionuclides is not migrating off of the property to locations other than the Hudson River; and
- d. Monitor groundwater plumes identified onsite to determine overall reductions in total radioactivity over time.

Barvenik Prefiled at 13-14.

66. Based upon the data collected during the hydrogeologic investigation and the LTMP, the tritium and strontium plumes resulting from historic releases from the Unit 1 and Unit 2 SFPs had reached their maximum sizes and have been decreasing at varied rates with periodic fluctuations, as would be expected. Barvenik Prefiled at 16; Entergy Ex. #33 at 97-101.

67. The groundwater data collected since the installation in 2005 of the temporary collection device on the exterior of the Unit 2 SFP wall indicates that the amount of tritium in the

groundwater beneath Indian Point has diminished by 89%. Prefiled Rebuttal at 29-34; Hearing Tr. at 3918-3920 (Barvenik); Entergy Ex. #126.

68. Since the draining of the Unit 1 SFPs, groundwater data indicate that the amount of strontium-90 in the groundwater beneath Indian Point has diminished by 70%. Prefiled Rebuttal at 29-34; Hearing Tr. at 3920 (Barvenik); Entergy Ex. #126.

69. The LTMP will detect future releases of radionuclides to the groundwater comparable to those associated with the historic corrected Unit 1 and Unit 2 SFP leaks, thereby allowing Entergy to take timely and appropriate corrective action upon the detection of such releases, should they occur. Barvenik Prefiled at 16; Hearing Tr. 3914-3915 (Barvenik).

70. Entergy has played a leadership role in the development of the tritium groundwater investigation process on a nationwide basis. For example, the LTMP at Indian Point predates the recommendation of experts contributing to a report by the United States Government Accountability Office ("GAO") to place groundwater monitoring wells near system, structures and components with a potential for leaking and impacting groundwater. In June 2011, the GAO recommended an increased focus on on-site groundwater monitoring at nuclear power plant sites for prompt leak detection, and (2) additional efforts to provide reasonable assurance of underground piping systems' structural and leak-tight integrity. As noted above, Entergy already had implemented the LTMP before this recommendation appeared in the GAO's report. Riverkeeper Ex. #7 at 11; *see also* Prefiled Rebuttal at 9-11.

VI. Monitored Natural Attenuation

71. As a result of the hydrogeologic investigation, GZA and Entergy selected Monitored Natural Attenuation as the appropriate remedial action for the groundwater at Indian Point. Prefiled Rebuttal at 38.

72. Monitored Natural Attenuation is a recognized and proven remedial approach for contaminated groundwater sites that allows natural processes to reduce contaminant concentrations. Prefiled Rebuttal at 36.

73. The United States Environmental Protection Agency ("EPA") has recognized Monitored Natural Attenuation as a valid remedial approach generally, and Entergy, the NRC and NYSDEC concluded that it is the correct remediation strategy for Indian Point for several reasons:

- a. Interdiction measures to date have eliminated and/or controlled the identified active sources of groundwater contamination.
- b. Groundwater flow at the Site precludes off-Site migration of contaminated groundwater to the North, South or East.
- c. Consistent with the Conceptual Site Model, no Indian Point contaminants have been detected above regional background in any of the off-Site monitoring locations or drinking water supply systems in the region.
- d. The only on-Site exposure route for the documented contamination is through direct exposure and, because the majority of the Site is capped by impermeable surfaces, there is no uncontrolled direct contact with contaminants.
- e. The spatial extent of the groundwater plume should continue to decrease with time.
- f. Groundwater is not used as a source of drinking water on the Site or in the immediate vicinity of the Site, and there is no reason to believe that this practice will change in the foreseeable future.

Prefiled Rebuttal at 36-39; Entergy Ex. #34 at vi-viii; Entergy Ex. #46; Entergy Ex. #82.

74. In addition to Monitored Natural Attenuation, Entergy continues to extract groundwater from foundation drains located near the Unit 1 SFP, removing radionuclides in groundwater for collection and discharge through monitored pathways. Prefiled Rebuttal at 22-23.

75. These drains have captured approximately 10 times the quantity of strontium-90 entering the Hudson River via the groundwater. Prefiled Rebuttal at 23.

VII. WQC Process

76. By letter dated April 3, 2009, Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc., (collectively, "Entergy"), submitted to NYSDEC an application for a water quality certificate ("WQC") under §401 of the federal Clean Water Act (the "Application"). Entergy Ex. #161.

77. The Application was submitted in relation to Entergy's application to the NRC to renew the NRC-issued operating licenses for Units 2 and 3, which would extend the operation of Unit 2 to September 28, 2033, and Unit 3 to December 12, 2035. Entergy Ex. #161, Joint Application Form, Supplemental Response to Item 9.

78. Entergy has not applied to NYSDEC for a WQC for the operation of Unit 1. Entergy Ex. #161; Hearing Tr. at 2709 (Kolakowski).

79. On May 13, 2009, NYSDEC staff requested additional information from Entergy relating to the Application, including with respect to whether releases of radiological materials from Indian Point to the Hudson River comply with New York State water quality standards ("NYWQS"). Entergy Ex. #99.

80. On February 12, 2010, Entergy responded to NYSDEC Staff's request, stating that (i) the Department had no authority to regulate radiological releases from Indian Point under the federal Clean Water Act (the "CWA") and as a result of the doctrine of federal preemption,

and (ii) the releases of radiological materials from Indian Point do not violate NYWQS. Entergy Ex. #100.

81. By letter dated April 2, 2010 (the "Notice"), NYSDEC staff proposed to deny the Application due to, among other things, the releases of radiological materials from Indian Point to the Hudson River. Entergy Ex. #9 at 11.

82. Specifically, the Notice stated that "radioactive material (including tritium, strontium-90, cesium, and nickel) from spent fuel pools, pipes, tanks, and other systems, structures and components at Indian Point has reached the Hudson River via groundwater flow from the site and, moreover, continue to do so." Entergy Ex. #9 at 11.

83. The Notice asserted that "the discharge of radiological substances (including, but not limited to, radioactive liquids, radioactive solids, radioactive gases, and stormwater) from the Indian Point site into a water of the State, here the Hudson River, are 'deleterious substances' and could impair the water for their best usage [citing 6 NYCRR §703.2]" and that "radiological leaks have the potential to impair the best use of the water designated in 6 NYCRR §701.11." Entergy Ex. #9 at 11; Hearing Tr. at 2730 (Kolakowski). The Notice relied upon a standard necessitating a finding of impairment to support noncompliance.

84. The Notice did not mention or otherwise distinguish the conclusions reached by NYSDEC and NYSDOH in their capacity as stakeholders in the NRC's Special Inspection and subsequent inspection of Indian Point that no human health or environmental impacts were associated with or attributable to the "unplanned" releases from Indian Point prior to the date the Notice was issued. Entergy Ex. #9 at 11.

85. The Notice did not state any other reason for the denial of Entergy's Application on the basis of radiological releases from Indian Point. Entergy Ex. #9; Hearing Tr. at 2729-2730 (Kolakowski).

86. On April 29, 2010, Entergy submitted a request for adjudicatory hearing to challenge the Notice, arguing again that Department Staff's attempt to deny the Application based upon radiological releases was: (i) outside NYSDEC's statutory authority under the CWA; (ii) preempted by federal law; and (iii) without factual basis. *See* Request for Adjudicatory Hearing on NYSDEC Staff's April 2, 2010 Notice of Denial of Joint Application for CWA Section 401 Water Quality Certification, NRC License Renewal – Entergy Nuclear Indian Point Units 2 and 3, dated April 29, 2010.

87. On December 13, 2010, the Ruling on Proposed Issues for Adjudication and Petitions for Party Status (the "Issues Ruling") concluded that the issue of federal preemption remained an "open question," and set for adjudication the issue of "whether Department Staff properly denied the Application based upon radiological considerations." Issues Ruling at 25-27, 40.

88. The Issues Ruling did not address the issue of whether the regulation of radiological releases was outside NYSDEC's statutory authority under the Clean Water Act. Issues Ruling, *passim*.

89. Direct prefiled testimony from the parties' witnesses was received on July 22, 2011, and rebuttal prefiled testimony was received on October 4, 2011.

90. In direct prefiled testimony submitted on behalf of NYSDEC Staff, NYSDEC Staff, for the first time, advance the following new legal position: "The discharge of such radiological materials, including high-level radioactive waste, from spent fuel pools, pipes, tanks,

and other systems, structures, and components at the Indian Point nuclear facilities into groundwaters and surface waters of the State is prohibited by ECL §17-0807 and 6 NYCRR §750-1.3, and could impair the waters for their best usages (6 NYCRR §703.2).” Kolakowski Prefiled at 11. In other words, in its direct prefiled testimony, NYSDEC Staff advanced a new legal position that there was a categoric prohibition on the discharge of radiological substances to the Hudson River.

91. In rebuttal prefiled testimony, NYSDEC Staff’s witness clarified his direct prefiled testimony, stating: “The unintentional discharge, leak or spill of such radiological materials, including high-level radioactive waste, from spent fuel pools, pipes, tanks, and other systems, structures, and components at the Indian Point nuclear facilities into groundwaters and surface waters of the State is prohibited by ECL §17-0807(1), (4), and 6 NYCRR §750-1.3(a).” Kolakowski Rebuttal Prefiled at 4. Thus, NYSDEC Staff echoed its position that radiological releases were subject to a categoric prohibition, but limited the scope of the prohibition to unintentional or unplanned releases.

92. A hearing on this issue was held on November 15-16, 2011, January 11, 2012, and January 23, 2012.

VIII. Hearing Testimony

A. Witnesses

93. Entergy provided three highly qualified expert witnesses in support of its case, all of whom are leaders on the subjects on which they testified, with longstanding direct and relevant experience in their respective fields: (1) Dr. F. Owen Hoffman, a leading national expert on radiological dose assessment and environmental impact, including the release, transport and behavior of radionuclides in the aquatic environment; (2) Mr. Matthew Barvenik, a well regarded hydrogeologist who acted as the lead technical investigator of the Indian Point site investigation

associated with the unplanned releases of radiological materials; and (3) Dr. Thomas Esselman, an expert in aging management at nuclear facilities, particularly for structures and components involved in the handling or storage of radiological materials. Barvenik Prefiled at 1-4; Hoffman Prefiled at 1-3; Prefiled Rebuttal at 1; Hearing Tr. at 3086-3089 (Hoffman), 3108-3110 (Esselman), 3912 (Barvenik); Entergy Ex. #53, Entergy Ex. #54, Entergy Ex. #77.

94. Dr. F. Owen Hoffman provided testimony concerning the potential effects on human beings or aquatic biota of radiological materials that have migrated with the groundwater beneath Indian Point to the Hudson River. Hoffman Prefiled at 1.

95. Dr. Hoffman is president and director of SENES Oak Ridge, Inc. Center for Risk Analysis, an organization that specializes in human health and ecological risk estimation, risk assessment, and risk communication. Dr. Hoffman has more than 39 years of experience in issues related to evaluating human and ecological risk from the release and transport of radionuclides and chemicals in terrestrial and aquatic systems. He is a Distinguished Emeritus Member of the National Council on Radiation Protection & Measurements ("NCRP"), and a corresponding member of the International Commission on Radiological Protection ("ICRP"). Dr. Hoffman is also a consultant to the United Nations Scientific Committee on the Effects of Atomic Radiation ("UNSCEAR"). He holds a Bachelor of Science degree in Biological Conservation from the San Jose State College, a Master of Science degree in Fisheries Limnology from Oregon State University, and a Ph.D in Ecology, with a specialty in Radiation Ecology. Entergy Ex. #53; Hoffman Prefiled at 1, 3; Hearing Tr. at 3086-3089 (Hoffman).

96. Dr. Hoffman has extensive experience assessing human health and aquatic biota impacts from radionuclide releases, including releases to aquatic environments. He is familiar with the Indian Point Offsite Dose Calculation Manual, Annual Radioactive Effluent Release

Reports, and Annual Radiological Environmental Operating Reports, as well as Indian Point's compliance with NRC dose regulations. Hoffman Prefiled at 6-11, 14-16. Dr. Hoffman has also independently assessed the radiological impacts to the Hudson River ecosystem from Indian Point SFP leaks to site groundwater. Hoffman Prefiled at 15-16.

97. Mr. Matthew J. Barvenik provided testimony regarding unplanned releases of radiological materials from Indian Point Units 1 and 2. Entergy's corrective actions undertaken in response to unplanned releases, and the investigation of groundwater contamination at Indian Point. Barvenik Prefiled at 1-2.

98. Mr. Barvenik is a Senior Principal and Senior Technical Consultant with GZA GeoEnvironmental, Inc. ("GZA"), a national consulting firm that provides wide-ranging geotechnical engineering, environmental consulting, and remediation services. Mr. Barvenik has over 35 years of professional experience in hydrogeology, civil, geotechnical, and instrumentation engineering, and has focused on contaminated soil and groundwater investigation and remediation. He holds a Bachelor of Science degree in Civil Engineering from Northeastern University and a Master of Science degree in Geotechnical Engineering from the Massachusetts Institute of Technology. Mr. Barvenik is a registered Licensed Site Professional in Massachusetts and a member of the American Nuclear Society ("ANS"). He served on the ANS Working Group responsible for the recently completed standard for Evaluation of Subsurface Radionuclide Transport at Commercial Nuclear Power Plants, and is a member of two newly formed ANS Working Groups responsible for drafting future standards on the evaluation of groundwater supplies and remediation methods for nuclear power sites. Entergy Ex. #54; Barvenik Prefiled at 1, 3; Hearing Tr. at 3912 (Barvenik).

99. Mr. Barvenik was the lead technical investigator for the Indian Point hydrogeologic site characterization program resulting in the January 7, 2008 Site Investigation Report. As a result of these duties, Mr. Barvenik became very familiar with the Indian Point hydrogeologic setting and groundwater flow patterns, identified contaminant sources and transport, historical and ongoing groundwater monitoring, remediation plans, the history and status of releases of radiological materials from Indian Point spent fuel pools, dose assessments, and associated NRC inspection activities, as well as other independent assessments of the SFP releases. Barvenik Prefiled at 4.

100. Dr. Thomas C. Esselman provided testimony with regard to, among other things, Entergy's underground piping inspection program and Entergy's inspection of the Unit 2 SFP. Combined Prefiled Rebuttal at passim.

101. Dr. Esselman is a Principal at Lucius Pitkin, Inc., which provides engineering services to the nuclear power industry, among others. Dr. Essleman has over 35 years of engineering experience, including experience in component and structure performance, aging, stress analysis, materials, materials degradation, and failure analysis, including extensive experience with nuclear power facilities. He holds a Bachelor of Science degree in Mechanical Engineering, and a Master of Science degree and a Ph.D. in Engineering Mechanics, all from Case Western Reserve University. Entergy Ex. #77; Combined Prefiled Rebuttal at 1; Hearing Tr. at 3108-3110 (Esselman).

102. Throughout his career, Dr. Esselman has worked periodically with the Indian Point plants, including on the development of an underground piping management program and the investigation of the integrity of the Unit 2 SFP. Hearing Tr. at 3109, 3162 (Esselman).

103. Dr. Hoffman and Dr. Esselman provided limited, live direct testimony and were cross-examined on January 11, 2012. Hearing Tr. 3071. Mr. Barvenik provided limited, live direct testimony and was cross-examined on January 23, 2012. Hearing Tr. at 3895.

104. Mr. Paul J. Kolakowski provided prefiled and rebuttal testimony, on behalf of NYSDEC Staff, regarding those aspects of the Notice dealing with the release of radiological materials to the Hudson River from groundwater beneath Indian Point. Kolakowski Prefiled at 1; Kolakowski Prefiled Rebuttal at 1.

105. Mr. Kolakowski holds a BS in Civil/Environmental Engineering, and has been an Environmental Engineer with NYSDEC since 1989. Staff Ex. #1. Mr. Kolakowski has no educational or work experience related to nuclear engineering, radiation protection, human health effects of exposure to radiation, dose assessment from the exposure to radiological materials, or the ecological effects of radiological materials in the environment. Hearing Tr. at 2690-2692 (Kolakowski); Staff Ex. #1. He performed no scientific analysis of the record evidence provided by Entergy. See Paragraphs 144, 147, 149-151 and 156-157 below.

106. Mr. Arnold Gundersen provided prefiled and rebuttal testimony, on behalf of Riverkeeper, Inc., Scenic Hudson, Inc., and Natural Resources Defense Council, Inc., regarding radiological materials. Gundersen Prefiled at 1; Gundersen Prefiled Rebuttal at 1.

107. Mr. Gundersen holds an MS in Nuclear Engineering from Rensselaer Polytechnic University and has more than 39 years of experience on nuclear matters generally. Gundersen Prefiled at 1-2. Mr. Gundersen performed no dose assessment associated with the radiological releases from Indian Point. Hearing Tr. at 2897, 2922, 2976 (Gundersen).

108. Mr. Kolakowski and Mr. Gundersen provided limited, live direct testimony and were cross-examined on November 15-16, 2011. Hearing Tr. at 2654, 2973.

109. On November 15, 2011, after hearing from the parties on Entergy's motion *in limine* to exclude, among other things, Mr. Gundersen's testimony regarding the impacts of planned releases of radionuclides from Indian Point, this Tribunal granted Entergy's motion and struck Mr. Gundersen's testimony associated with the planned releases from Indian Point. Hearing Tr. at 2806 (Judge Villa).

B. Compliance with Applicable Dose Limits

110. Entergy conducts periodic environmental monitoring surveys to assess the cumulative potential impact of radionuclides that have been released from Indian Point, and, on an annual basis, submits the results of these surveys to the NRC in Annual Radioactive Effluent Release Reports ("ARERR"). Hoffman Prefiled at 9-13.

111. NRC imposes technical specifications on effluents from nuclear power stations in order to keep releases of radioactive materials "as low as reasonable achievable" ("ALARA"). Hoffman Prefiled at 7.

112. The ARERRs include quantification of both planned and unplanned releases of radiological materials; since 2006, the Indian Point ARERRs have included estimates of the radionuclides entering the Hudson River via groundwater based upon the Indian Point hydrogeologic investigation and the subsequent LTMP. Hoffman Prefiled at 10-13.

113. The ARERRs indicate that the amount of radioactivity associated with tritium released from groundwater and stormwater (i.e., rainwater collected onsite and discharged to the Hudson River via storm drains) to the Hudson River since 2006 on an annual basis is as follows: 0.28 curies (2006); 0.064 curies (2007); 0.2 curies (2008); 0.07 curies (2009), and 0.12 curies (2010). These levels of radionuclide releases are orders of magnitude below the allowable federal regulatory limits. Barvenik Prefiled at 6-7; Hearing Tr. at 3922-3923 (Barvenik).

114. The ARERRs also indicate the amount of radioactivity associated with all radionuclides other than tritium released from groundwater and stormwater to the Hudson River since 2006 on an annual basis are as follows: 0.00057 curies (2006); 0.00008 curies (2007); 0.00016 curies (2008); 0.00025 curies (2009); and 0.000042 curies (2010). These levels of radionuclide release are orders of magnitude below the allowable federal regulatory limits. Barvenik Prefiled at 6-7; Hearing Tr. at 3922-3923 (Barvenik).

115. NRC Regulations require all NRC licensed facilities to calculate the annual release of radiological materials to the environment, and to calculate the dose to a hypothetically maximally exposed individual to ensure compliance with ALARA design objectives. Hoffman Prefiled at 7-9.

116. Entergy's Offsite Dose Calculation Manual ("ODCM") specifies the methods to be used in calculating estimated off site doses of radiation, consistent with the NRC's Regulatory Guide 1.109, which was developed to provide the methodology to estimate radiation doses to the public. Hoffman Prefiled at 8; Hearing Tr. at 3092 (Hoffman).

117. In addition to documenting the quantity of radioactivity released to the environment, Entergy's ARERRs also contain estimates of the dose associated with such releases, which were correctly calculated in accordance with methodologies required by NRC's Regulatory Guide 1.109 and memorialized in Entergy's ODCM. Hoffman Prefiled at 10-13.

118. Dose calculation methodologies are conservative, and focus on a hypothetically maximally-exposed individual. Entergy Ex. #43 at 1; Hearing Tr. at 3103-3104 (Hoffman). Thus, dose assessment typically overstates potential radiation risk. Entergy Ex. #43 at 1.

119. Based upon the dose calculations performed in Entergy's ARERRs, the annual whole body dose associated with releases from Indian Point to the Hudson River via

groundwater and stormwater in 2010 was 0.0002 millirem ("mrem"). Prefiled Rebuttal at 4. The whole body dose for the years 2006-2009 was a small fraction of a millirem. similar to the 2010 figure. Hoffman Prefiled Testimony at 11, 13.

120. This calculated dose is several orders of magnitude lower than the dose limits for members of the public established by NRC's Standards for Protection Against Radiation at 10 C.F.R. Part 20 (100 mrem whole body), EPA's radiation protection standard at 40 C.F.R. Part 190 (25 mrem whole body), and the NRC's design objectives at 10 C.F.R. Part 50, Appendix I (3 mrem whole body). Hoffman Prefiled at 6-9, 11, 14; Combined Prefiled Rebuttal at 28; Entergy Ex. #34 at vii; Barvenik Prefiled at 20-21.

121. As noted previously, the NRC reached the same conclusions as Dr. Hoffman:

- a. The annual calculated exposure to the hypothetically maximally exposed individual relative to the liquid effluent aquatic food exposure pathway is expected to remain, less than 0.1 percent of the ALARA guidelines in Appendix I of 10 C.F.R. Part 50, which are considered to be negligible with respect to public health, safety and the environment. Entergy Ex. #34 at vii.
- b. NRC's inspection determined that public health and safety had not been, and was not likely to be, adversely affected, and the dose consequence to the public attributable to on-site conditions associated with groundwater contamination was negligible. Entergy Ex. #34 at 1-2.
- c. Public health has not been, nor is likely to be, adversely affected, and the dose consequence to the public that can be attributed to current onsite conditions is negligible with respect to conservatively established NRC regulatory limits. Entergy Ex. #32 at 2, iv and 5 (Report Details).

122. NYSDEC also reached the same conclusions as Dr. Hoffman and the NRC – that Entergy’s calculated doses to the public through fish consumption which are less than 1% of the NRC dose limits. Entergy Ex. #46 at 1.

123. Neither Mr. Kolakowski nor Mr. Gundersen testified that Entergy was not in compliance with applicable NRC dose limits. Hearing Tr., *passim*.

C. Absence of Impacts to the Best Usages of the Hudson River

124. The scientific approach to evaluating whether the radiological materials within the groundwater at Indian Point impact the best usages of the Hudson River consists of:

(1) identifying the sources and amounts of radiological materials released into the environment; (2) calculating the concentrations of radiological materials in environmental media (*e.g.*, soil, groundwater, etc.); (3) identifying any “exposure pathways” – that is, any means by which people or other biota could come into contact with these materials (*i.e.*, through drinking water, swimming, fish consumption, etc.); (4) calculate the dose received to people or other biota based upon any completed exposure pathway; and (5) translate those doses into risks – *i.e.*, in the case of human health, the risk of developing a radiation-related cancer in later life; in the case of aquatic biota, comparing doses against accepted impact thresholds deemed to be of no risk.

Hoffman Prefiled at 2, 17; Hearing Tr. at 3090, 3105 (Hoffman).

125. The effective dose is the most commonly used indicator of the potential biological effects associated with human exposure to radiation. Entergy Ex. #35 at 5.

126. Although radiation may cause cancers at high dose rates (*i.e.*, 50,000 mrem or greater), currently there are no data to establish unequivocally the occurrence of cancer following exposure to low doses and dose rates below 10,000 mrem. Entergy Ex. #43.

127. Dr. Hoffman employed this approach in his independent assessment of the risks to human health and aquatic biota associated with the unplanned releases of tritium and strontium-

90 to the Hudson River in 2010 via groundwater and stormwater from Indian Point. Specifically, Dr. Hoffman obtained the sources and concentrations of tritium and strontium-90 entering the Hudson River via groundwater based upon Entergy's ARERR for 2010. He then reviewed Entergy's NRC-required Offsite Dose Calculation Manual, which both identifies the potential exposure pathways for the planned and unplanned release of these materials and calculates the doses to humans and other biota associated with completed pathways, based upon on-site and off-site sampling of groundwater and surface water conducted by Entergy, and confirmed that Entergy's calculations were correct and satisfied NRC's required methodologies. Then, he translated the doses to the hypothetical maximally-exposed individual, assuming completed exposure pathways into an increased cancer risk in humans. Finally, he compared the doses potentially received by aquatic biota to accepted impact threshold standards using two separate approaches. Hoffman Prefiled at 7-11, 15-16; Hearing Tr. at 3092-3107 (Hoffman).

128. No witness other than Dr. Hoffman testified as to the proper approach to assessing whether the best usages of the Hudson River would be impaired by the release of radiological materials in the environment, and no other witness challenged Dr. Hoffman's approach. Hearing Tr., *passim*.

129. Given that demonstrating any increased risk from low doses of radioactivity is beyond the limits of epidemiological detection, the conversion of calculated doses to an estimate of risk to human health requires the use of a model, typically the "linear no-threshold model" described in the 2006 National Research Council of the National Academies report entitled "Health Risks from Exposure to Low Levels of Ionizing Radiation" commonly referred to as the Biological Effects of Ionizing Radiation ("BEIR") VII Report. Entergy Ex. #43 at 1; Entergy Ex. 101; Hearing Tr. at 3098-3102 (Hoffman).

130. The BEIR VII Report indicates that, as a result of exposure to all sources of carcinogens including natural background radiation, the risk of developing cancer in later life is 0.42 or 42%. Entergy Ex. #101 at 7; Entergy Ex. #123A-123C; Hearing Tr. at 3100-3101 (Hoffman).

131. The BEIR VII Report also indicates that, if a population of 100 individuals has a lifetime exposure to ionizing radiation dose of 10,000 mrem *in addition to* the lifetime exposure to natural background radiation and all other sources of carcinogens, that additional exposure to 10,000 mrem results in one excess cancer in the population – in other words, a 1 in 100 chance of developing cancer. Hearing Tr. at 3100-3101; Entergy Ex. #123B.

132. To estimate the risk of cancer at excess doses lower than 10,000 mrem, the BEIR VI Report applies a “linear no-threshold” model to calculate the risk of cancer in later life due to excess exposures to ionizing radiation over a lifetime. Entergy Ex. #101 at 6-7.

133. The “linear no-threshold model” assumes a reduction in risk that is proportional to a reduction in dose – for example, a lifetime excess exposure to a dose of 1 mrem equates to a risk that is 1 in 1,000,000 or 1/10,000 the risk associated with an excess dose of 10,000 mrem. Hearing Tr. at 3102 (Hoffman). While this linear no-threshold model may not actually mirror experienced conditions, it is a conservative methodology for calculating increased risk as a measure of dose. Entergy Ex. #43.

134. Pursuant to the BEIR VII linear no-threshold model, in order to experience one (1) excess cancer in a given population, one million (1,000,000) people would need to be exposed to the 1 mrem excess dose. Hearing Tr. at 3102 (Hoffman).

135. As noted above, the excess dose associated with the radiological materials entering the Hudson River via groundwater and stormwater from Indian Point in 2010 was 0.0002 millirem. *See* Paragraph 119 above.

136. Using the BEIR VII linear no-threshold model, this excess dose level equates to a risk of 1 in 5 billion – in other words, five billion (5,000,000,000) people would have to be exposed to the maximum excess dose attributable to Indian Point groundwater and stormwater in 2010 in order to expect one (1) additional case of cancer. Hearing Tr. at 3102-3103 (Hoffman).

137. This risk is based upon the human consumption of fish maximally exposed to the radionuclides entering the Hudson River from groundwater and stormwater at Indian Point, and also assumes that each human being in the population consumes one (1) pound of these fish each week during the entire one-year period. Hearing Tr. at 3103-3015 (Hoffman).

138. As a practical matter, it is not possible for five billion (5,000,000,000) people to consume that quantity of fish; let alone fish maximally exposed to radionuclides entering the Hudson River from groundwater and stormwater at Indian Point; therefore, the actual risk to human health associated with the 2010 unplanned releases to the Hudson River from groundwater and stormwater at Indian Point is expected to be zero. Hearing Tr. at 3104-3105 (Hoffman).

139. With respect to potential impacts to aquatic biota, the United States Department of Energy (“DOE”) has promulgated guidelines for radiation dose rates from environmental media that are widely employed to calculate impacts to biota and considered authoritative on the issue; the DOE guidelines recommend limiting the dose to aquatic biota to less than 1.0 rad/day. Hoffman Prefiled at 15; Entergy Ex. #45 at M1-1, M1-4.

140. Using the DOE's RESRAD-BIOTA dose model, Dr. Hoffman calculated the dose rates to aquatic organisms associated with the maximum concentrations of radionuclides estimated to be migrating to the Hudson River related to unplanned releases via groundwater and stormwater at Indian Point in 2010 to be 0.00000000205 rad/day for tritium and 0.000371 rad/day for strontium. Hoffman Prefiled at 15-16.

141. Dr. Hoffman also calculated dose rates to aquatic biota using dose coefficients for tritium and strontium-90 documented for external and internal exposures developed by the United Nations Scientific Committee on Exposure to Atomic Radiation ("UNSCEAR"), and those doses were 0.0000000029 rad/day and 0.00047 rad/day for tritium and strontium-90, respectively. Hoffman Prefiled at 16. Dr. Hoffman indicated that these doses effectively equate to zero risk to the ecosystem. Hoffman Prefiled at 16; Hearing Tr. at 3105-3107 (Hoffman).

142. The doses to aquatic biota calculated using DOE's RESRAD-BIOTA model and the UNSCEAR dose coefficients are orders of magnitude below DOE's 1 rad/day guideline. Hoffman Prefiled at 16.

143. To provide context for the doses at issue in this case, the excess dose of .0002 mrem associated with Indian Point's 2010 releases to the Hudson River via groundwater and stormwater is orders of magnitude lower than the average radiation dose experienced by an individual in the United States (620 millirem), a single chest x-ray (4 mrem), a one-way cross country flight (2 mrem), or eating a single banana, which contains naturally occurring radioactive potassium (0.01 mrem). Rebuttal Prefiled at 2-3; Hearing Tr. at 3095-3097; Entergy Ex. 121; Entergy Ex. #37 at 12; Entergy Ex. #43.

144. No other witness suggested another calculation methodology for assessing the impact of radiological releases to aquatic organisms, or identified any error in Dr. Hoffman's

approach or calculations. Prefiled and Rebuttal Testimony of Kolakowski and Gundersen; Hearing Tr., passim.

145. Assuming comparable levels of releases to the Hudson River throughout the license renewal period for Units 2 and 3, the resulting risk to human health and the environment is similarly expected to be zero. Hearing Tr. at 3107 (Hoffman).

146. To the extent any small, undetected leak from the Unit 2 SFP may still exist, it must be smaller than those identified and repaired by Entergy given the subsequent attenuation of the tritium plume. Hearing Tr. at 3970-3971 (Barvenik); Entergy Ex. #33 at 92.

147. No other witness analyzed the effects on human health or aquatic biota of the releases of radiological materials to the Hudson River via the groundwater at Indian Point. Hearing Tr., passim.

148. Mr. Kolakowski acknowledged that the potential impairment to the best usages of the Hudson River was a reason for the denial of the Section 401 WQC. Kowalski Prefiled at 11, Hearing Tr. at 2728 (Kowalski).

149. Mr. Kolakowski stated that Entergy provides to NYSDEC copies of its annual radiological release reports, but he did not review them for purposes of preparing his testimony. Hearing Tr. at 2771-2772 (Kolakowski).

150. Analyzing the impacts of radiological releases on Hudson River aquatic organisms was beyond Mr. Kolakowski's area of expertise. Hearing Tr. at 2768 (Kolakowski).

151. Mr. Kolakowski reviewed GZA's Site Investigation Report and the testimony of Entergy's experts. Kolakowski Prefiled at 12; Kolakowski Rebuttal at 6.

152. Mr. Kolakowski agreed with Entergy's experts on the absence of impacts on the best uses of the Hudson River associated with unplanned releases of radiological materials to groundwater at Indian Point. Hearing Tr. at 2745 (Kolakowski).

153. Mr. Kolakowski admitted that *any* discharge into the waters of the state, if in sufficient concentration, could impair the waters for their best usages. Hearing Tr. at 2746 (Kolakowski).

154. Mr. Kolakowski agreed with NYSDEC's conclusion on the absence of impacts to Hudson River fish from Indian Point's unplanned releases. Hearing Tr. at 2768 (Kolakowski).

155. Mr. Kolakowski agreed with NRC's conclusions on the absence of impacts to public health and safety and the environment from Indian Point's unplanned releases. Hearing Tr. at 2770-2771 (Kolakowski).

156. Mr. Kolakowski had no evidence of impacts to the best usages of the Hudson River based on Indian Point's unplanned releases. Hearing Tr. at 2750 (Kolakowski).

157. Mr. Kolakowski had no factual basis for believing that the continued operation of Units 2 and 3 during license renewal would result in a leak sufficiently large to impair the Hudson River for its best usages. Hearing Tr. at 2759-2760.

158. Mr. Gundersen's dose assessment testimony in Finestone v. Florida Power & Light Co., 2006 WL 267330 (S.D. Fla.) was rejected as "belied by the contemporaneous reports of the NRC and the [Florida Department of Health and Radiological Safety]" and "rife with conclusory statements", id at * 10, which on appeal were characterized as a "scientifically unsupported leap of faith" that disqualified him as an expert. *Finestone v. Florida Power & Light Co.*, 2006 WL 267330, at *11 (S.D. Fla. Jan. 6, 2006); *Finestone v. Florida Power & Light Co.*, 272 Fed. Appx. 761, 768 (11th Cir. 2008); Hearing Tr. at 2885, 2887 (Gundersen).

159. Since the decision in Finestone, Mr. Gundersen has not pursued any education or training in the area of dose assessment. Hearing Tr. at 2889-2990 (Gundersen).

160. Mr. Gundersen did not perform a dose assessment to evaluate whether the unplanned releases of radiological materials at Indian Point were in amounts that will impair the Hudson River for its best usages. Hearing Tr. at 2897, 2922, 2976.

161. Instead, Mr. Gundersen assumed that an impairment would result if any amount of radiological materials reached the Hudson River. Hearing Tr. at 2815 (Gundersen).

162. Mr. Gundersen did not review or comment on the testimony provided by Entergy's witness, Dr. F. Owen Hoffman, stating the he had "no idea who Dr. Hoffman is or what he wrote." Hearing Trans at 2892 (Gundersen).

163. Mr. Gundersen agreed that tritium has not been detected in water samples collected from the Hudson River. Hearing Tr. at 2977 (Gundersen).

164. When asked on the stand to calculate the increased risk of cancer associated with the 2010 unplanned releases from Indian Point to the Hudson River, Mr. Gundersen applied the BEIR VII "linear no-threshold model" and arrived at the same risk level calculated by Dr. Hoffman – i.e., one in five billion. Hearing Tr. at 2919 (Gundersen).

165. Mr. Gundersen did not perform any calculations to determine whether strontium-90 released from Indian Point was found in Hudson River fish. Hearing Tr. at 2977 (Gundersen).

166. When questioned about the significance of a particular release associated with a pipe leak at Indian Point, Mr. Gundersen stated that the concentrations of tritium in that water was less than one tenth of the federal safe drinking water standards. Hearing Tr. at 2959.

167. Neither Mr. Kolakowski nor Mr. Gundersen provided any scientific basis to support the conclusion that radiological releases from Indian Point have the potential to impair the Hudson River for its best usages for primary and secondary contact recreation and fishing. Hoffman Prefiled at 14, 18; Hearing Tr. at 3102-3107 (Hoffman); Kolakowski Prefiled and Prefiled Rebuttal, passim; Gundersen Prefiled and Prefiled Rebuttal, passim; Hearing Tr. (Kolakowski), passim; Hearing Tr. (Gundersen), passim.

D. Inapplicability of ECL §17-0807(1) and 6 NYCRR §750-1.3(a)

168. The radiological materials associated with the unplanned releases at issue in this case are neither radiological warfare agents nor high-level radioactive wastes. Prefiled Rebuttal at 39-40; Hearing Tr. at 2734-2737 (Kolakowski).

169. Mr. Kolakowski recanted his position that the radiological releases at issue in this proceeding were prohibited by ECL §17-0807(1) and 6 NYCRR §750-1.3(a) because he concluded that such releases did not constitute “the discharge of any radiological, chemical, or biological warfare agent or high-level radioactive waste” as prohibited by those provisions. Hearing Tr. at 2734-2737 (Kolakowski).

E. Inapplicability of ECL §17-0807(4)

170. It is feasible to install a sufficient number of groundwater extraction wells at the perimeter of the Indian Point site to reverse the hydraulic gradient at Indian Point sufficient to ensure that no radionuclides from the identified Indian Point groundwater plumes would reach the Hudson River via the groundwater pathway during license renewal term. See Prefiled Rebuttal at 40-41; Hearing Tr. at 4038, 4041, 4093-4094 (Barvenik).

F. Inapplicability of ECL §17-0501 as a separate basis for the Notice.

171. After taking the stand, Mr. Kolakowski inserted another basis for denial of the Application, specifically ECL §17-0501. Hearing Tr. at 2736 (Kolakowski).

172. This basis for denial did not appear in the Notice or in Mr. Kolakowski's prefiled testimony. Entergy Ex. #9; Kolakowski Prefiled; Kolakowski Prefiled Rebuttal.

173. Mr. Kolakowski testified that ECL §17-0501 was not an independent basis for denial of the Application but, instead, constituted the statutory authority for the Department to classify waters for their best usages and to adopt standards for the protection of the best usage of those waters. Hearing Tr. at 2742-2743 (Kolakowski).

G. Inapplicability of EPA's Safe Drinking Water Standards

174. For purposes of evaluating the Application, Department Staff did not evaluate whether unplanned radiological releases from Indian Point impair the groundwater beneath Indian Point for its best usages. Hearing Tr. at 2759-2763 (Kolakowski).

175. Department Staff did, however, review the groundwater concentrations of radionuclides presented in the GZA Report and concluded that those concentrations did not exceed the Department's groundwater standards. Hearing Tr. at 2763 (Kolakowski).

176. The federal Safe Drinking Water Act ("SDWA") sets forth "maximum contaminant levels" for various contaminants, which is defined as "the maximum permissible level of a contaminant in water *which is delivered to any user of a public water system.*" 42 U.S.C. §300f(3) (emphasis added). The maximum contaminant levels do not apply to levels of contamination contained in groundwater, but rather apply at the "tap" where that water is delivered. Prefiled Rebuttal at 8. Furthermore, the term "public water system" is defined in the SDWA as "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals." 42 U.S.C. §§300f(1) – (4), 300g. As such, the EPA's maximum contaminant levels do not apply to wells on the site at Indian Point which are not used as a drinking water source at all, much less to a public water system. Entergy Ex. 33 at

13-14; *see also* <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html>.

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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)

CERTIFICATE OF SERVICE

I, William J. Trach, hereby certify that, on this 27th day of April, 2012, I caused a true and accurate copy of:

1. Post Hearing Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. – Radiological Issues; and
2. Proposed Findings of Fact of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. – Radiological Issues,

to be served on all counsel of record in the above-captioned action via First Class Mail and/or e-mail as specified in the appended Service List.



William J. Trach

Dated: April 27, 2012

SERVICE LIST
(Updated 4/27/2012)

Service by E-mail and First Class Mail

Maria E. Villa
Daniel P. O'Connell
Administrative Law Judges
Office of Hearings and Mediation
Services
New York State Department of
Environmental Conservation
625 Broadway, First Floor
Albany, New York 12233-1550
518-402-9003
518-402-9037 (fax)
mevilla@gw.dec.state.ny.us
dpconne@gw.dec.state.ny.us

Mark Lucas, Esq.
COUNSEL FOR RIVERKEEPER INC.,
SCENIC HUDSON, INC. and THE
NATURAL RESOURCES DEFENSE
COUNCIL
Riverkeeper, Inc.
20 Secor Road
Ossining, New York 10562
914-478-4501, ext. 241
914-478-4527 (fax)
rtroutman@riverkeeper.org
mlucas@riverkeeper.org

Richard L. Brodsky
2121 Saw Mill River Road
White Plains, NY 10607
Tel: 914.720.8830
richardlbrodsky@gmail.com

Mark D. Sanza, Esq.
Assistant Counsel
William G. Little, Esq.
Associate Counsel
COUNSEL FOR DEPARTMENT STAFF
New York State Department of Environmental
Conservation
Division of Legal Affairs
625 Broadway, 14th Floor
Albany, New York 12233-1500
518-402-9195
518-402-9018 (fax)
wglittle@gw.dec.state.ny.us
mdsanza@gw.dec.state.ny.us

Robert L. Sweeney, Esq.
COUNSEL FOR AFRICAN AMERICAN
ENVIRONMENTALIST ASSOCIATION
Whiteman Osterman & Hanna
One Commerce Plaza
Albany, New York 12260
518-487-7670
518-487-7777 (fax)
rsweeney@woh.com

Melissa-Jean Rotini, Esq.
Assistant County Attorney, Of Counsel
Westchester County Attorney's Office
Michaelian Office Building
148 Martine Avenue, 6th Floor
White Plains, NY 10601
914-995-3630
914-995-3132 (Fax)
Email: MJR1@westchestergov.com

Thomas F. Wood, Esq.
Town Attorney, Town of Cortlandt
Daniel Riesel, Esq.
COUNSEL FOR TOWN OF
CORTLANDT
Sive, Paget & Riesel, P.C.
460 Park Avenue, 10th Floor
New York, New York 10022
212-421-2150
212-421-1891 (fax)
driesel@sprlaw.com

Michael J. Delaney, Esq.
Director, Energy Regulatory Affairs
New York City Department of
Environmental Protection
59-17 Junction Boulevard
Flushing, NY 11373
(718) 595-3982
mdelaney@dep.nyc.gov

Daniel Riesel, Esq.
Victoria Shiah, Esq.
Adam Stolorow, Esq.
Sive, Paget & Riesel, P.C.
460 Park Avenue, 10th Floor
New York, NY 10022
driesel@sprlaw.com
vshiah@sprlaw.com
astolorow@sprlaw.com

Robert J. Glasser, Esq.
Robert J. Glasser, P.C.
COUNSEL FOR CENTRAL HUDSON GAS &
ELECTRIC CORPORATION
284 South Avenue
Poughkeepsie, New York 12601
Cellphone (preferred): 646-318-0522
845-486-5292
845-486-5782
Bob.glasser@robertjglasserpc.com

Norris McDonald
President
Center for Environment, Commerce & Energy
AFRICAN AMERICAN ENVIRONMENTALIST
ASSOCIATION
1629 K Street, N.W., Suite 300
Washington, D.C. 20006
301-265-8185 (direct)
443-569-5102
norrismcdonald@msn.com
www.aaenvironment.com/CECE.htm

Service E-mail Only

Ned Sullivan
President, Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, New York 10591
845-473-4440, ext. 224
845-452-7567 (fax)
nsullivan@scenichudson.org

Hayley Mauskapf, Esq.
Environmental Advocacy Associate
Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, NY 10591
845-473-4440, ext. 210
845-473-2649 (fax)
hmauskapf@scenichudson.org

Paul Schwartzberg
Land Projects Specialist
Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, New York 10591
845 242-2915
845 255-2827 (fax)
schwartzberg@scenichudson.org

Karl S. Coplan, Esq.
Daniel E. Estrin, Esq.
Supervising Attorney/Adjunct Professor of
Law
Pace Environmental Litigation Clinic, Inc.
Pace University School of Law
78 North Broadway
White Plains, New York 10603
914-422-4343
914-422-4661 (fax)
kcoplan@law.pace.edu
destrin@law.pace.edu

Interns:

Amber Paterson
apaterson@law.pace.edu

Kimberly Klein
kklein@law.pace.edu

Geoffrey H. Fettus, Esq.
Senior Project Attorney
COUNSEL FOR NATURAL
RESOURCES DEFENSE COUNCIL
1200 New York Avenue, N.W., # 400
Washington, D.C. 20005
202-289-2371
202-289-1060 (fax)
gfettus@nrde.org

Deborah Brancato, Esq.
Staff Attorney
Riverkeeper, Inc.
828 South Broadway
Tarrytown, New York 10591
914-478-4501, ext. 230
914-478-4527 (fax)
dbrancato@riverkeeper.org

Phillip H. Musegaas, Esq.
Hudson River Program Director
Riverkeeper, Inc.
828 South Broadway
Tarrytown, New York 10591
914-478-4501, ext. 224
phillip@riverkeeper.org

Steven Blow, Esq.
Assistant General Counsel
New York State Department of Public
Service
Agency Building Three
Empire State Plaza
Albany, New York 12223-1350
518-474-6955
518-486-5710 (fax)
steven.blow@dps.ny.gov

Frank V. Bifera, Esq.
COUNSEL FOR MIRANT BOWLINE
Hiscock & Barclay, LLP
50 Beaver Street
Albany, New York 12207
518-429-4224
518-427-3487 (fax)
fbifera@hblaw.com

Kelli M. Dowell, Esq.
Assistant General Counsel/Environmental
Entergy Services, Inc.
308 East Pearl Street, Suite 700
Jackson, MS 39201
601-969-2596
Cell: 601-519-6823
601-969-2696 Fax
kdowell@entergy.com

Sam M. Laniado, Esq.
David B. Johnson, Esq.
Read and Laniado, LLP
COUNSEL FOR INDEPENDENT
POWER PRODUCERS
OF NEW YORK
25 Eagle Street
Albany, New York 12207-1901
518-465-9313
518-465-9315 (fax)
sml@readlaniado.com
dbj@readlaniado.com

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of

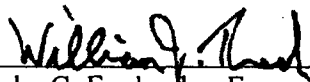
Entergy Nuclear Indian Point 2, LLC, Entergy
Nuclear Indian Point 3, LLC, and Entergy
Nuclear Operations, Inc.'s Joint Application
for CWA §401 Water Quality Certification

DEC App. Nos. 3-5522-00011/00030 (Unit 2)
3-5522-00105/00031 (IP3)

POST HEARING MEMORANDUM OF ENTERGY NUCLEAR
INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC,
AND ENTERGY NUCLEAR OPERATIONS, INC.
RADIOLOGICAL ISSUES

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

By Their Attorneys,



John C. Englander, Esq.
Elise N. Zoli, Esq.
William J. Trach, Esq.
Robert H. Fitzgerald, Esq.
Goodwin Procter LLP
Exchange Place
Boston, MA 02109-2881
(617) 570-1000

Dated: April 27, 2012

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Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (collectively, "Entergy") submit this post-hearing memorandum and accompanying proposed findings of fact to demonstrate that this Tribunal should disregard the New York State Department of Environmental Conservation ("NYSDEC" or "Department") Staff's April 2, 2010 proposed notice of denial (the "Notice") of Entergy's application (the "Application") for a Water Quality Certification ("WQC") under § 401 of the federal Clean Water Act ("CWA") on the basis of unplanned releases of radiological materials from Indian Point to the Hudson River.

PRELIMINARY STATEMENT

The Notice's proposal that the Commissioner deny Entergy's WQC Application based on the discharge to the Hudson River of groundwater containing inconsequential amounts of radionuclides resulting from the operation of Indian Point Units 1 and 2 is without basis in law or fact. First, NYSDEC lacks jurisdiction to regulate radiological releases from Indian Point under § 401 of the CWA because Congress has expressly exempted radiological materials subject to regulation by the Nuclear Regulatory Commission ("NRC") from the reach of the CWA. Furthermore, even if regulation of Indian Point's releases were not outside the scope of NYSDEC's statutory authority under the CWA, federal field preemption prohibits the proposed denial by NYSDEC Staff on radiological grounds, as sole authority over the regulation of radiological materials from NRC-licensed facilities has been given to the NRC by the Atomic Energy Act ("AEA"). Indeed, NYSDEC has repeatedly acknowledged its lack of authority under the CWA to regulate radionuclide releases from Indian Point and other nuclear facilities, and NYSDEC Staff provides no credible basis for its inconsistent position in this case.

Furthermore, even if NYSDEC possessed jurisdiction to regulate Indian Point's unplanned releases, the Notice is deficient as a matter of law. NYSDEC Staff premised the

Notice on the unsubstantiated assertion that Indian Point's radiological releases "could" potentially impair the Hudson River for its best uses. The Notice was thus infirm when issued in April 2010, because it was based not on an analysis – as required by law – of whether there were reasonable assurances that Indian Point's unplanned releases would comply with the designated best uses of the Hudson River, but rather on mere speculation about the possibility of future releases impairing the best uses of the Hudson River. Such speculation cannot as a matter of law support the Notice, particularly in light of the uncontroverted findings of the NRC, NYSDEC radiological experts, and the New York State Department of Health ("NYSDOH"), all of whom concluded that the radiological releases at issue in this proceeding (i) did not violate any federal or state radiological release standards, and (ii) posed no threat to public health and safety or the environment.

The evidence adduced at hearing proves the utter lack of any factual basis for NYSDEC Staff's Notice. The uncontroverted testimony of Entergy's leading radiological experts is that the unplanned radionuclide releases from Indian Point are insignificant, with a total annual dose to a hypothetical maximally-exposed individual of less than that received by eating a single banana. Consequently, there is no evidence that there has been any impact on human health or safety or Hudson River biota from the releases. This evidence is corroborated by the independent assessment performed by NRC investigators and NYSDEC's own radiological experts, which confirmed that Indian Point's releases have had no effect on the best uses of the Hudson River and are otherwise in compliance with applicable law. In what can only be seen as an acknowledgement of the lack of any credible evidence to support its position, NYSDEC Staff refused to present the testimony of its radiological experts who actually participated in the investigation of Entergy's unplanned releases, instead offering the testimony of a single staff

engineer. Paul Kolakowski, who conceded that he had no radiological training, education, or expertise, had performed no dose or risk assessment, and offered no criticism of the evidence offered by Entergy. Indeed, time and again, Mr. Kolakowski conceded that NYSDEC Staff's position, as reflected in the Notice and his prefiled testimony, was either incorrect or not in conformity with applicable law.

For all of these reasons, as set forth in greater detail below, this Tribunal should find that NYSDEC Staff did not properly purport to deny the Application based on radiological considerations.

RELEVANT FACTS¹

1. Indian Point's Radiological Releases

Indian Point Units 2 and 3 have operated pursuant to 40-year NRC-issued licenses since 1973 and 1975, respectively. Proposed Findings of Fact ("PFF"), at ¶ 1. Pursuant to the requirements of those licenses, releases of radiological materials from Units 2 and 3 into the Hudson River must comply with all release requirements of the AEA, and NRC regulations promulgated pursuant thereto. These include "planned" or routine releases of radiological materials incident to the everyday operation of the Units, as well as "unplanned," or non-routine releases that occur as a result of operational occurrences such as leaks or spills.² PFF at ¶ 2. Both such "planned" and "unplanned" releases are regulated by the NRC pursuant to its authority under the AEA, and are authorized by Entergy's federal NRC operating licenses. See PFF at ¶ 3.

¹ The factual citations in the Memorandum of Law are to Entergy's Proposed Findings of Fact ("PFF"), submitted along with the Memorandum of Law. All citations to the record are in the format set forth in the PFF.

² Entergy notes that the Notice only asserts regulatory authority over Indian Point's unplanned discharges, and does not seek to regulate Indian Point's planned discharges. This Tribunal granted Entergy's motion *in limine* to preclude any evidence regarding the effect of Indian Point's planned discharges on the Hudson River. See PFF at ¶ 108. As set forth in Section I, below, NYSDEC Staff's attempt to distinguish between Indian Point's planned and unplanned releases is without basis in law, as both are regulated by the NRC pursuant to its exclusive authority over radiological releases from licensed nuclear facilities.

2. Site Groundwater Investigation

In 2005, Entergy identified the presence of small, unplanned releases of radionuclides to groundwater at Indian Point. PFF at ¶¶ 13-14. Two sources of radionuclides ultimately were identified: (1) the Unit 2 spent fuel pool ("SFP"), and (2) the Unit 1 SFPs. PFF at ¶¶ 14, 28(c), 45(g).³ The identified unplanned releases from the Unit 1 and the Unit 2 SFPs have been the subject of a comprehensive NRC-overseen investigation (in which NYSDEC and NYSDOH have participated as stakeholders), with the sources of radionuclides located, eliminated, and redressed. PFF at ¶¶ 35-46. The groundwater conditions as a result of these past releases also have been intensively investigated under NRC's oversight, and are currently being monitored through an extensive groundwater monitoring network that has demonstrated, and is expected to continue to demonstrate, decreases – or attenuation – of the original identified radionuclide conditions. PFF at ¶¶ 35-46, 61-69. Thus, it is undisputed that the sources of past unplanned releases of radionuclides at Indian Point have been identified and remediated. Entergy further determined that some amount of those radionuclides discharged into the Hudson River, although in extremely small amounts that were a fraction of the allowable radiation protection limits pursuant to Indian Point's NRC licenses and NRC regulations, and that had no impact on the best uses of the Hudson River. PFF at ¶¶ 32(b), (g), 38, 45(k), 119-20.

Specifically, following the discovery in August 2005 of shrinkage cracks exhibiting moisture on an excavated exterior Unit 2 SFP wall, Entergy retained GZA GeoEnvironmental, Inc. ("GZA"), a leading hydrogeologic consulting firm, to perform a comprehensive, multi-year groundwater investigation of all three Indian Point units and surrounding areas, focusing on potential discharges of radionuclides to groundwater and the potential movement of that

³ There have been no past releases of radionuclides from the Unit 3 SFP, which contains a tell-tale drain system that provides high confidence that no potential future radionuclide releases to the environment will occur. PFF at ¶¶ 12, 28(d).

groundwater on and off the Indian Point site. PFF at ¶¶ 19-20, 24. The purpose of the investigation was to identify the nature and extent of radiological groundwater contamination and, by using state-of-the-practice science and technologies, to develop a comprehensive understanding of the Indian Point site hydrogeology. PFF at ¶¶ 20-21, 24. This led to the development of the January 7, 2008 Site Investigation Report (“GZA Report”), a key component of which was the Conceptual Site Model, which provides a thorough understanding of site groundwater flow (and thus radionuclide transport) at Indian Point. PFF at ¶¶ 25-26.

Specifically, the GZA Report identifies two distinct “plumes” of groundwater containing radionuclides, one containing principally tritium, and one containing principally strontium. PFF at ¶ 28(a). The “tritium plume” is primarily a result of past releases of water from the Unit 2 SFP, and the “strontium plume” is primarily a result of past releases of water from Unit 1 SFPs. PFF at ¶¶ 28(a), (c). The total radiological activities of these two plumes have been decreasing since source termination, with periodic, localized fluctuations in activity and overall reductions in the rate of decrease, as would be expected. PFF at ¶ 66. The total amount of tritium in the Unit 2 plume has decreased substantially – approximately 89 percent – since the shrinkage crack leaks were contained in late 2005. PFF at ¶¶ 67. Likewise, the total amount of strontium in the Unit 1 plume has decreased substantially – approximately 70 percent – since the spent fuel was removed from the Unit 1 SFPs and the pool water was subsequently drained in late 2008. PFF at ¶ 68.

3. Regulatory Oversight of Entergy’s Unplanned Releases

Pursuant to its exclusive regulatory jurisdiction over Indian Point’s unplanned releases, the NRC oversaw Indian Point’s groundwater investigation, issuing a comprehensive report analyzing the results of the investigation and evaluating Indian Point’s compliance with federal

radiation protection limits. The conclusion of the NRC was identical to Entergy's, namely, that the low-level discharges of radiological materials to the Hudson River from releases from the Unit 1 and Unit 2 SFPs were in full compliance with all federal radiation protection requirements, and that the releases did not, and in the future would not, have any impact on public health and safety or the environment. PFF at ¶¶ 41, 45, 111-12.

NYSDEC and NYSDOH also participated as stakeholders in Entergy's site investigation, analyzing split samples of groundwater to confirm the accuracy of Entergy's testing, performing a test of Hudson River fish to confirm the releases had no impact on fish, and providing input into the analysis, direction, and interpretation of the results of the investigation. *See* PFF at ¶¶ 32-34. NYSDEC issued findings at the end of its investigation that mirrored those of Entergy and the NRC, concluding that: (i) the discharges from the SFP releases to the Hudson River complied with all state surface water radiological limits; (ii) there was no evidence that the releases had any effect on aquatic biota in the Hudson River; and (iii) Entergy's remedial approach for the releases was acceptable. PFF at ¶¶ 32-34.

4. Compliance with All Regulatory Requirements

NRC regulations for the release of radiological materials require all NRC-licensed nuclear facilities to calculate the annual release of radiological materials to the environment, and to calculate the dose to a hypothetical maximally-exposed individual resulting from those releases, in order to ensure compliance with NRC's radiation protection standards and "As Low As Reasonably Achievable" ("ALARA") design objectives. 10 C.F.R. Part 50, Appendix I; PFF at ¶¶ 110-11, 115-17. NRC's regulations do not differentiate between planned releases and unplanned releases, both of which are subject to NRC's regulation and must be quantified. PFF at ¶¶ 110, 112. Consistent with NRC guidance and regulations, Entergy's Offsite Dose

Calculation Manual ("ODCM") specifies the methods for performing the required quantification and dose assessment of all pathways of exposure, including radionuclides from unplanned releases entering the Hudson River. PFF at ¶ 116. Consistent with its ODCM, Entergy performs calculations annually to account for the dose from its unplanned releases. PFF at ¶¶ 110, 117, 119. Entergy's unplanned releases comply with all NRC radiological discharge limits by a very wide margin, as the NRC itself confirmed in its comprehensive review of Indian Point's site groundwater investigation. PFF at ¶ 121(a). Indeed, the combined dose from Entergy's unplanned releases is less than 0.1 percent of the NRC's ALARA guidelines. PFF at ¶ 121(a).

Specifically, the annual dose to a hypothetical maximally-exposed individual from the unplanned releases from Indian Point since Entergy began calculating such doses (in 2005) has been a small fraction of one millirem, as compared to the annual average dose of 620 millirem that the typical U.S. resident receives in one year from all radiation sources. PFF at ¶¶ 121-22, 119, 143. The estimated dose attributable to unplanned releases in 2010, the year for which the most recent data were available, was 0.0002 mrem. PFF at ¶¶ 119, 143. In comparison, the dose that an individual receives from eating a single banana, which contains small amounts of radioactive potassium, is 0.01 mrem, orders of magnitude higher than the dose to the hypothetical maximally-exposed user of the Hudson River from Indian Point's entire annual unplanned releases. PFF at ¶ 143.

The dose from Indian Point's unplanned releases can be translated into health risk, as it was by a leading radiological dose assessment expert, Dr. Owen Hoffman, using a well-accepted model for calculating cancer risk from radiation exposure. Dr. Hoffman concluded that five billion people would have to be maximally-exposed to an entire year of Entergy's unplanned radiological releases for there to be an expectation of one increased incidence of cancer in later

life, a conclusion that was undisputed by any other witness, whether for NYSDEC Staff or Riverkeeper. PFF at ¶¶ 136, 147. Given the likelihood that **no** individuals are maximally-exposed to Indian Point's unplanned releases, Dr. Hoffman concluded that there will be **zero adverse health impacts** expected to individuals using the Hudson River (as measured by the expectation of excess cases of radiation-induced disease) as a result of Entergy's unplanned releases, both historically and during the license renewal term. PFF at ¶¶ 138, 145.

Moreover, all investigations to date, including those performed by the radiological division of NYSDEC, have concluded there is no evidence of radiological material from Indian Point in Hudson River aquatic biota. PFF at ¶¶ 33-34. Further, using commonly-accepted methods for calculating the dose to aquatic biota in the vicinity of Indian Point from the unplanned releases, Dr. Hoffman concluded, and it is undisputed, that the dose per day to aquatic organisms is orders of magnitude below all accepted limits for the protection of aquatic biota. PFF at ¶¶ 139-142. As such, there is no evidence that Indian Point's unplanned releases have, or could in the future have, an adverse effect on Hudson River aquatic biota. PFF at ¶ 141.

While effects on groundwater are not subject to state certification requirements under § 401, it is equally clear that drinking water has not been affected by Indian Point's unplanned releases. It is undisputed that Indian Point does not utilize groundwater either for plant operational or for potable purposes. PFF at ¶ 8. In fact, there are no active potable water or other production wells in the vicinity of Indian Point. PFF at ¶ 9. Likewise, in the vicinity of Indian Point, the Hudson River is not used for drinking water purposes. PFF at ¶ 10. Instead, drinking water in the vicinity of Indian Point is supplied from surface water reservoirs located in Westchester County and the Catskills region; the nearest of these reservoirs to Indian Point is the Camp Field Reservoir, which is located 3.3 miles north-northeast of Indian Point, in a cross-

gradient direction (*i.e.*, perpendicular to the direction that groundwater flows), several watersheds away and at an elevation of several hundred feet above the Indian Point power block. PFF at ¶ 11. Moreover, it is undisputed that groundwater beneath the Indian Point power block does not flow off-site to anywhere other than the Hudson River. Thus, it is undisputed that no potable water or other production wells are reasonably subject to influence by on-site conditions at Indian Point.

PROCEDURAL HISTORY

By letter dated April 3, 2009, and subject to a reservation of rights,⁴ Entergy submitted to NYSDEC the Application for water quality certifications for Unit 2 and Unit 3 under § 401 of the CWA. PFF at ¶ 76. The Application was submitted in relation to Entergy's application to the NRC to renew the federal operating licenses for Indian Point Units 2 and 3 for an additional 20 years, which would extend the operation of Unit 2 to September 28, 2033 and Unit 3 to December 12, 2035. PFF at ¶ 77. On May 13, 2009, NYSDEC Staff requested additional information from Entergy, including with respect to whether releases of radiological materials from Indian Point to the Hudson River comply with New York State water quality standards ("NYWQS"). PFF at ¶ 79. On February 12, 2010, Entergy responded to NYSDEC Staff's request, asserting (i) that NYSDEC had no authority to regulate radiological releases from Indian Point either under the CWA or as a result of the doctrine of federal preemption, and (ii) that even

⁴ The issue of whether § 401 applies at all to the renewal of a federal operating license is certainly not assured. *See, e.g.*, NRC, Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding James A. FitzPatrick Nuclear Power Plant (NUREG-1437, Supplement 31) Final Report (Jan. 2008), at A-18 ("we do not believe that an entirely new Section 401(a)(1) certification must always be tendered as part of the renewal application," *e.g.*, where existing WQC "did not include an expiration date" or certification "is evidenced by a valid state water quality permit which is effective into the renewal period"). Specifically, Entergy does not concede any obligation to obtain a new WQC, in light of its existing SPDES permit and WQCs. *See, e.g.*, Indian Point License Renewal Application, App. E (Environmental Report), at §9.4 (Apr. 30, 2007). Entergy nonetheless has pursued the Application, reserving all rights, in the interest of cooperation and avoiding disputes that could result in litigation and material practical interference with Entergy's license renewal application before the NRC. *See* Entergy Ex. #161 at 5.

if NYSDEC had authority to regulate Indian Point's radiological releases, such releases did not violate NYWQS. PFF at ¶ 80.

On April 2, 2010, NYSDEC Staff issued the Notice, proposing to deny the WQC Application due to, among other things, the release of radiological materials from the Indian Point site to the Hudson River. PFF at ¶ 81. Specifically, the Notice asserted that "the discharge of radiological substances (including, but not limited to, radioactive liquids, radioactive solids, radioactive gases, and stormwater) from the Indian Point site into a water of the State, here the Hudson River, are 'deleterious substances' and could impair the water for their best usage [citing 6 NYCRR §703.2]" and that "radiological leaks have the potential to impair the best use of the water designated in 6 NYCRR §701.11." PFF at ¶ 83. Notably, the Notice did not reach a conclusion that releases of radiological materials either had impaired, or will impair during the license renewal term, the Hudson River for its best uses, but merely that they "could" or "had the potential" to do so. Furthermore, the Notice did not attempt to reconcile the conclusion that Indian Point's unplanned releases "could" result in an impairment of the best usage of the Hudson River with the contrary conclusion made by NYSDEC's and NYSDOH's radiological experts participating in the Indian Point site investigation. Finally, the Notice did not state any other reason for the denial of the Application on the basis of radiological releases from Indian Point. PFF at ¶ 85.

On April 29, 2010, Entergy submitted a request for adjudicatory hearing to challenge the Notice, again asserting that NYSDEC Staff's attempt to deny the Application based upon radiological releases was: (i) outside NYSDEC's statutory authority under the CWA; (ii) preempted by federal law; and (iii) without factual basis. PFF at ¶ 86. On December 13, 2010, this Tribunal issued the Ruling on Proposed Issues for Adjudication and Petitions for Party

Status in this proceeding (the “Issues Ruling”). As to Entergy’s legal arguments, the Issues Ruling: (i) did not address the issue of whether the regulation of radiological releases was outside NYSDEC’s statutory authority under the CWA; and (ii) concluded that the issue of whether NYSDEC was preempted from regulating Indian Point’s radiological releases remained an “open question.” PFF at ¶¶ 87-88. Accordingly, the Tribunal set for adjudication the following issue: “Whether Department Staff properly denied the WQC application based upon radiological considerations.” PFF at ¶ 87.

Prefiled testimony from the parties’ witnesses was received on July 22, 2011, and rebuttal prefiled testimony was received on October 4, 2011. PFF at ¶ 88. A hearing on this issue was held on November 15-16, 2011, January 11, 2012, and January 23, 2012. PFF at ¶ 91.

ARGUMENT

I. NYSDEC Staff’s Denial of the Application on the Basis of Radiological Releases from Indian Point Is Outside NYSDEC’s Statutory CWA Authority and Is Preempted by Federal Law.

As Entergy has already argued in prior briefing, without definitive ruling from this Tribunal, NYSDEC Staff’s attempt to deny Entergy’s Application on the basis of radiological releases from Indian Point is both outside NYSDEC’s statutory CWA authority and otherwise preempted by federal law. Entergy expressly incorporates the arguments previously made in its Memorandum of Law Regarding Threshold Legal Issues, and its Post-Issues Conference Reply Brief, and provides further argument to address the issues, including in light of the relevant evidence adduced at hearing.

A. NYSDEC has no statutory authority to regulate radiological releases from NRC-regulated facilities under the CWA.

A threshold issue in this proceeding, which Entergy has raised but the Tribunal has never ruled on and that must be decided before the Tribunal may assess the impacts of Indian Point’s

unplanned releases, is whether NYSDEC's certification authority under § 401 of the CWA allows for regulation of discharges of radiological materials from an NRC-regulated facility. Under § 401(a) of the CWA, a reviewing state's authority is limited to determining whether any "discharge" from a facility, as that term is defined in the CWA, will comply with relevant state water quality standards promulgated pursuant to state authority granted by the CWA. To that end, § 401(a) states as follows:

Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates or will originate, that any such discharge will comply with the applicable provisions of sections 1311, 1312, 1313, 1316, and 1317 [*i.e.*, §§ 301, 302, 303, 306, and 307 of the CWA].

33 U.S.C. § 1341(a)(1). Thus, § 401(a) only permits states to certify compliance of "discharges" as that term is defined by the CWA. According to 33 U.S.C. §1362(16), the word "discharge" refers a "discharge of a pollutant," and a "discharge of pollutants," as those terms are defined in the CWA. As set forth below, radiological releases from NRC-regulated facilities are not "discharges" under the CWA, and therefore cannot be regulated pursuant to NYSDEC's CWA authority.

The U.S. Supreme Court has held that Congress has expressly limited the ability of either the federal government (through the EPA) or states to regulate, pursuant to their CWA authority, releases of radiological materials from NRC-regulated facilities. *See Train v. Colorado Public Interest Research Group, Inc.* 426 U.S. 1 (1976). In *Train*, the Court unequivocally held that Congress expressly exempted the regulation of radiological releases from nuclear facilities from the reach of the CWA, holding that the discharge of NRC-regulated materials did not constitute

the “discharge of a pollutant” as defined under the CWA. *Id.* at 15.⁵ Accordingly, under the CWA, neither the EPA nor the states may issue or enforce WQS relating to radiological releases from NRC-regulated facilities, and the limited ability of a state to certify the compliance of “discharges” with WQS under § 401(a) of the CWA does not extend to radiological releases from AEA-regulated facilities.

Recognizing this limitation, NYSDEC has never regulated Indian Point’s radiological releases through the SPDES permit program, but rather has consistently maintained that it has no authority to do so. This position was set forth clearly by NYSDEC in the current, ongoing SPDES permit renewal proceeding:

[R]adioactive releases or discharges from nuclear power generation facilities are regulated, today, by the NRC, not NYS. . . . [C]oncerns for possible radioactive releases in the cooling water discharged from Indian Point, or concerns for possible health effects from radioactive emissions, should be addressed directly to the NRC, not the Department, either as a license compliance matter or in the course of license extension proceedings. Such concerns cannot be addressed in conditions to a SPDES permit.

See Entergy Ex. #120, pp. 90-91. Accordingly, because Entergy’s radiological releases are not “discharges” subject to CWA regulation, NYSDEC Staff has no statutory authority under § 401 of the CWA to address those releases, and this Tribunal should recommend that the Commissioner decline to deny the WQC based on Indian Point’s unplanned radiological releases.

B. NYSDEC is preempted from regulating Indian Point’s radiological releases.

1. The evidence adduced at hearing mandates a determination that the Notice is preempted, which the Issues Ruling recognized as a possibility depending on the facts.

⁵ Entergy notes that this limitation is separate and apart from the limitation of federal preemption resulting from the passage of the AEA; rather, it is a statutory limitation of authority pursuant to the CWA, and is an issue this Tribunal has never decided.

The Tribunal has already recognized that the issue of field preemption may apply to bar NYSDEC's regulation of Indian Point's unplanned releases, holding that the issue was an "open question" to be decided on the facts of the case. Issues Ruling, p. 25. Specifically, the Issues Ruling raised the possibility that the field of exclusive federal regulation over radiological materials under the AEA *might* not extend to unplanned releases (*i.e.*, leaks from pipes or other components) of those materials from NRC-licensed facilities. *See* Issues Ruling, p. 26 (stating that federal precedent "does not appear to contemplate a situation where, as here, radioactive materials are leaking from a facility" or "a situation where radioactive material is leaking from a nuclear power plant and entering groundwater"). The Issues Ruling thus found that the "open question" regarding the applicability of federal preemption was premised on what this Tribunal viewed as two key factual issues: whether the radiological releases from Indian Point were (i) regulated by the NRC,⁶ and (ii) in compliance with NRC regulations. *See* Issues Ruling, p. 26 (stating that nuclear plants at issue in certain federal cases were found to be operating in compliance with federal radiation protection standards, but "[t]hat is not the case here, because the radioactive material that has escaped from the Facilities is not a regulated discharge").⁷ An analysis of NRC rules and regulations, as well as the evidence adduced at hearing, demonstrates

⁶ The Issues Ruling also concluded, without explanation, that the leaks of radiological materials at issue in this case were not releases "incident to operation." Issues Ruling, p. 26. This conclusion is not supported in the record. The leaks involved in this case were associated with operational activities conducted at Indian Point, including the storage of materials in spent fuel pools. PFF at ¶¶ 14-16, 28(c). These activities are – under any reasonable interpretation of the term – "incident to" the operation of the Indian Point nuclear facilities. *See* Webster's Third New International Dictionary (2002) (defining "incident" as "occurring or likely to occur esp. as a minor consequence or accompaniment"); Oxford English Dictionary (defining "incident" as "liable or apt to befall or occur to;" "relating or pertinent to;" "occurring or liable to occur by the way, or in the course of something else of which it forms no essential part.").

⁷ Entergy disagrees with the Issues Ruling's conclusion that the question of the applicability of federal preemption turns on a factual determination of whether radiological releases from a nuclear facility are in compliance with NRC regulations. As discussed in detail below, and in Entergy's Issues Ruling briefing, the federal government, through the NRC, retains exclusive authority in the area of radiation hazards posed by AEA-licensed facilities and materials. Thus, the determination of whether a facility is in or out of compliance with NRC radiation protection regulations is exclusively within the authority of the NRC to determine.

conclusively that Indian Point's unplanned releases are both subject to NRC regulation, and in full compliance with all applicable NRC regulations, and as such require a finding that NYSDEC's attempt to regulate Indian Point's radiological releases is preempted.

a. *The NRC does regulate Indian Point's unplanned radiological releases.*

NRC's rules and regulations, as well as the uncontroverted evidence adduced at hearing demonstrate that the NRC *does* in fact regulate unplanned releases from nuclear facilities, and has specifically exercised that regulatory authority with respect to Indian Point's unplanned releases. The law and the evidence adduced at hearing demonstrates that all NRC licensees are required to operate and maintain their licensed facilities and materials so as to keep radiological doses to the public below specified, protective standards,⁸ and that these requirements apply equally to planned and unplanned releases. NRC itself made this clear in a recent policy statement regarding its regulatory review of NRC licensee's groundwater protection programs:

As with any industrial facility, a nuclear power plant may deviate from normal operation with a spill or leak of liquid material. **However, the plant design and the NRC's inspection program both provide reasonable assurance that safety limits will be met – even in situations where leaks occur. The NRC limits and ALARA dose controls apply to both normal effluent discharges and unplanned releases such as leaks or spills containing radioactive materials.** Regardless of the source, each nuclear power plant is required to account for the radioactivity released to the environment, including planned and unplanned releases. Each licensee is responsible for accounting for the release, evaluating

⁸ Specifically, those standards include "Radiation Dose Limits for Individual Members of the Public" found at 10 C.F.R. Part 20, Subpart D. See PFF at ¶ 45(c). These provisions establish annual dose limits to individual members of the public from the licensed activity (*i.e.*, operation of the nuclear power plant and possession and use of radiological materials). See 10 C.F.R. §20.1301(a). Surveys of radiation levels throughout the licensed facility – including areas where access is not restricted – are mandatory, and the results of those surveys must demonstrate compliance with the dose limits for individual members of the public. See 10 C.F.R. §20.1302(a). Moreover, nuclear power plants are designed with the objective of maintaining releases of radiological materials to the environment as low as reasonably achievable ("ALARA") – that is, far below the radiation standards deemed protective of the public and the environment under 10 C.F.R. Part 20. These design objectives are set forth in Appendix I to 10 C.F.R. Part 50 and establish standards which are a fraction of the Part 20 limits. Compare 10 C.F.R. Part 50, Appendix I, Section II (establishing annual total body dose limit of 3 millirem from all exposure pathways) with 10 C.F.R. §20.1301(a) (establishing annual total body dose limit of 100 millirem) and 40 C.F.R. §190.10(a) (establishing annual total body dose limit of 25 millirem). Appendix I requires a licensee to conduct surveys of radiological conditions at its facility to demonstrate compliance with these design objectives. See 10 C.F.R. Part 50, Appendix I, Section IV.B.

the release relative to NRC regulatory requirements, and reporting the quantity of radioactivity released and the highest radiation dose to any member of the public.

See NRC Policy Issue, "Senior Management Review of Regulatory Approach to Groundwater Protection," SECY-11-0019, Feb. 9, 2011, Enclosure 2 at p. 2 (emphasis added). Moreover, that NRC's limits and ALARA dose controls apply to unplanned releases is reflected in NRC Regulatory Guide 1.21, entitled "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," which sets forth, in part, the regulatory requirement for measuring and evaluating unplanned releases, including from leaks and spills, to ensure compliance with NRC requirements. *Id.* at §§ 1.5 ("Monitoring Leaks and Spills"), 1.10 ("Abnormal Releases and Abnormal Discharges"). If more were needed, the uncontroverted testimony at hearing from Dr. Hoffman, setting forth the framework for NRC regulation of releases from nuclear facilities, made clear that NRC's regulations apply equally to planned and unplanned releases, both of which must be reported in the site's Annual Radioactive Effluent Release Reports ("ARERRs"), and the resulting dose from such releases must be calculated and reported in accordance with the site's Offsite Dose Calculation Manual ("ODCM"). PFF at ¶¶ 110-120. Accordingly, it is simply uncontestable that the unplanned releases at issue in this proceeding are subject to NRC's exclusive regulatory authority.

In confirmation of the fact that Indian Point's unplanned releases are subject to the NRC's oversight, the NRC in fact exercised its regulatory oversight over Indian Point's unplanned releases in this case. Once Entergy notified the NRC that it had identified the possibility of groundwater contamination at Indian Point, the NRC immediately initiated a special inspection to assess this possibility. See Entergy Ex. #32 (NRC March 16, 2006

Inspection Report) at 1. The NRC documented the initial results of its investigation in a report, which describes the extensive scope of NRC's regulatory oversight of Entergy's unplanned releases:

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations, and with the conditions of your license. Within these areas, the inspection consisted of a selected examination of procedures and representative records, observations of activities, interviews with personnel, and independent analyses of water samples.

Id. Further, the NRC determined in its preliminary investigation "that public health and safety has not been, nor is likely to be, adversely affected; and the dose consequence to the public that can be attributed to current onsite conditions is negligible with respect to conservatively established NRC regulatory limits." *Id.* at 2.

The NRC continued with its investigation, and upon the completion of Entergy's groundwater investigation, issued a second inspection report. *See* Entergy Ex. #34 (NRC May 13, 2008 Inspection Report). Once again, the NRC confirmed the breadth of the regulatory oversight it exercised with respect to Entergy's unplanned releases and subsequent groundwater investigation:

In September 2005, a crack was discovered leaking on the outside of the Unit 2 spent fuel pool south wall (approximately 30 feet below the top) during excavation of the spent fuel building loading bay. The NRC initiated a special inspection on September 21, 2005, to investigate the implications of the observed Unit 2 spent fuel pool leakage. . . . Though the radiological significance of the circumstance was negligible, the condition was unexpected. Accordingly, NRC Region I was authorized by the Executive Director of Operations (EDO) to conduct additional oversight inspection of licensee performance and the circumstances surrounding this contamination

Id. at 1 (Report Details). Moreover, the NRC increased the scope of its regulatory review throughout Entergy's groundwater investigation:

[T]he EDO renewed the increased inspection authorization each year to permit active and frequent inspection oversight. As a result, inspection of the Indian

Point contaminated groundwater conditions evolved to include not only radiological environmental and effluent expertise from Region I, but also hydrological assessment expertise from NRC's Office of Research, and later, from the US Geological Survey (USGS). The application of such resources permitted the NRC to conduct several independent reviews and assessments of data, information, and analysis on which the licensee based its conclusions and determinations.

Id. As such, a review of the relevant law, regulations, and the uncontroverted evidence at hearing makes clear that Entergy's unplanned releases are subject to NRC oversight.

b. *Entergy's unplanned releases fully comply with NRC radiation protection limits and other applicable regulations.*

The evidence adduced at hearing also proved that Indian Point's unplanned releases are in full compliance with all applicable federal radiation protection standards. As set forth above, the NRC conducted an extensive, multi-year review of Indian Point's unplanned releases, the purpose of which was to review the releases **"as they relate to safety and compliance with the Commission's rules and regulations."** Entergy Ex. #32 at 1 (emphasis added). The NRC's findings were unequivocal, concluding that **no** violation of NRC regulations resulted from the releases. First, NRC confirmed that Indian Point adequately surveyed and estimated the unplanned releases to ensure compliance with the NRC radiological dose limits:

Upon the initial identification of conditions that provided evidence of an abnormal radiological effluent release affecting ground water, the licensee implemented actions that conformed to the radiological survey requirements of 10 CFR 20.1501 to ensure compliance with dose limits for individual members of the public as specified in 10 CFR 20.1302

Entergy Ex. #34 at vi. NRC then determined that the unplanned releases were a small fraction of the regulatory limits for radiological discharges:

The annual calculated exposure to the maximum exposed hypothetical individual, based on application of Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluation Compliance with 10 CFR Part 50, Appendix I," relative to the liquid effluent aquatic food exposure pathway is currently, and expected to remain, less than 0.1

% of the NRC's "As Low As is Reasonably Achievable (ALARA)" guidelines of Appendix I of Part 50 (3 mrem/yr total body and 10 mrem/yr maximum organ), which is considered to be negligible with respect to public health and safety, and the environment.

Id. at vii. As such, the unequivocal and uncontested conclusion of the NRC, after a multi-year investigation into Indian Point's unplanned releases, is that no violation of NRC regulations occurred.

Furthermore, Dr. Hoffman's testimony is completely consistent with the findings of the NRC: he reviewed the Indian Point ODCM and ARERRs, confirmed that the calculations were performed correctly, and concluded that radiation levels associated with these leaks were orders of magnitude lower than the allowable federal regulatory limits designed to protect human health and the environment. *See* PFF at ¶¶ 114-117, 120-21. The Department agrees with Dr. Hoffman. *See* PFF at ¶ 32(g). No contrary evidence was offered during the hearing.

Accordingly, the evidence at hearing demonstrates conclusively that Entergy's unplanned releases comply with all NRC rules and regulations.

According to these facts, under the terms of the Issues Ruling, the Notice's proposal to deny the Application based on radiological releases is preempted by federal law. As recognized by this Tribunal in the Issues Ruling, courts have repeatedly cited to federal field preemption of regulation of radiological releases from NRC-regulated nuclear facilities to invalidate state attempts to regulate such releases. Issues Ruling p. 25. The Issues Ruling's sole basis for suggesting that preemption remained an "open question" was the possibility that Indian Point's radiological releases were either (i) not regulated by the NRC, or (ii) not in compliance with federal laws and regulations. Because the law and evidence adduced at hearing demonstrate that these facts are simply untrue, NYSDEC Staff's proposal to foreclose the relicensing of Indian

Point based on releases of radiological materials that are both regulated by the NRC and in compliance with all NRC requirements is plainly preempted.

2. New case law post-dating the Issues Ruling confirms that NYSDEC has no authority to regulate Indian Point's radiological releases.

Moreover, while the case law cited in Entergy's Issues Ruling briefing delineating the scope of federal AEA preemption demonstrates clearly that NYSDEC is preempted from regulating Indian Point's unplanned releases, the recent decision in *Entergy Nuclear Vermont Yankee, LLC v. Shumlin*, --- F.Supp.2d ----, 2012 WL 162400 (D. Vt. 2012), removes any remaining doubt and reaffirms that regulation of Entergy's radiological releases by NYSDEC is preempted. Containing the most recent and most extensive review of federal preemption of state regulation of radiological materials, the decision invalidated the state of Vermont's attempt to regulate the relicensing of the Vermont Yankee nuclear power plant on preemption grounds. In doing so, the court held that the state's attempted regulation of the Vermont Yankee relicensing process was both motivated by radiological safety concerns and had the effect of regulating radiological safety aspects of the operation of an NRC-regulated nuclear facility. *Id.* at *36. After reviewing the case law setting forth the extent of AEA preemption, including the very same cases relied upon by Entergy in its Issues Ruling briefing, the court concluded that "[w]here radiological safety concerns are the sole purpose for an enactment or regulation, courts have easily concluded the state action is preempted." *Id.* at *34. The court then concluded that Vermont's attempt to regulate the relicensing of Vermont Yankee was based on concerns about radiological safety, including specifically the release of tritium from groundwater into a water of the state of Vermont, and struck down the statute as preempted under the AEA. *Id.*

The reasoning of *Vermont Yankee* requires the conclusion that NYSDEC Staff's proposed denial of the WQC Application based on radiological considerations is preempted. There can be

no doubt that NYSDEC Staff's Notice, to the extent it relates to radiological considerations, is based solely upon radionuclide discharges, and therefore perceived radiological safety considerations, associated with the operation of Indian Point. In particular, the Notice stated that radiological releases from Indian Point could impair the Hudson River for its best usages – that is, they could pose a hazard to swimmers, boaters, and fish.⁹ Mr. Kolakowski also agreed that this was a basis for denial stated in the Notice. *See* PFF at ¶ 83. Accordingly, the Notice falls squarely within the field reserved to the federal government – the regulation of radionuclide releases associated with AEA-licensed facilities – and is preempted.

II. Even if NYSDEC Has Some Authority to Regulate Radiological Releases from Indian Point, NYSDEC Staff's Attempt to Deny the WQC on the Basis of Radiological Releases Is Unsupported and Improper.

For the reasons stated above Entergy continues to maintain that NYSDEC has no authority to regulate radiological releases from Indian Point. Nevertheless, Entergy herein addresses each of the WQS that NYSDEC Staff has contended applies to Indian Point's unplanned radiological releases, and demonstrates that there is no factual basis to conclude that Indian Point will not comply with those standards during the license renewal term. Accordingly, a denial of the requested WQC would be inappropriate.

A. The Notice is improper on its face, as NYSDEC Staff employed the wrong standard in purporting to deny the Application.

To begin, it is clear from the outset that the Notice – at least insofar as it is based on radiological considerations – was improper and should be disregarded: the Notice is facially deficient in that it applied the wrong standard in purporting to determine that Indian Point did not comply with applicable WQS. In its Notice, NYSDEC Staff asserted that the radiological

⁹ As discussed in further detail in Section II, the best usages of the Hudson River near Indian Point include its suitability for primary and secondary contact recreation and fish, shellfish and wildlife propagation and survival.

materials released from Indian Point are “deleterious substances” that “**could**” or “**have the potential to**” impair the Hudson River for its best usages. Entergy Ex. #9, p. 11 (emphasis added).¹⁰ But even if NYSDEC did possess authority to apply CWA-derived WQS to Indian Point’s NRC-regulated radiological releases, the permissible scope of NYSDEC Staff’s review is limited to determining whether there are “**reasonable assurances**” of an applicant’s compliance with applicable WQS during the license renewal term, not simply whether releases “**could impair** the waters for their best usage.” *See* 40 C.F.R. § 121.2(a)(3); *In re Erie Boulevard Hydropower L.P.*, Decision of the Deputy Commissioner, No. 4-6103-00027/00001-9, 2006 WL 2951127, at *7 (Oct. 6, 2006) (“It is also well settled that Clean Water Act § 401 provides the State with only a limited role . . . to certify whether a ‘reasonable assurance’ exists that the project will not violate applicable water quality standards promulgated by the State and approved by the federal Environmental Protection Agency (“EPA”) pursuant to Clean Water Act § 303.”)

As NYSDEC Staff’s lone witness conceded during this proceeding, the release of *any* material to the waters of the state “could” impair the waters for their best usage, and therefore the mere possibility of future impairment is not the proper standard to apply to a WQC application. *See* PFF at ¶ 153. The failure to apply the proper standard is rendered even more egregious by

¹⁰ The narrative water quality standard for “deleterious substances” consists of two components. It prohibits the discharge of deleterious substances in amounts which will either (i) adversely affect the taste, color or odor of water, or (ii) impair the waters for their best usages. *See* 6 NYCRR §703.2. NYSDEC Staff’s Notice does not say anything about the first component of the narrative standard, and Mr. Kolakowski testified that he had no evidence that the radionuclides at issue in this case adversely affect the taste, color or odor of water. *See* Hearing Tr. at 2749 (Kolakowski) (“Q: Do you have any evidence that the radionuclides identified in the GZA report adversely affect the taste, color or odor of the water? A: No.”). No contrary evidence is found in the record. As such, the reference to Indian Point’s releases as “deleterious substances” simply prohibits their discharge in amounts that will “impair the waters for their best usages,” rendering the bases for denial essentially redundant. Entergy further notes that the two provisions cited by NYSDEC Staff, 6 NYCRR §§701.11 and 703.2, are both WQS promulgated by NYSDEC pursuant to the state of New York’s authority to promulgate WQS under the CWA, and pursuant to the authority granted NYSDEC by the New York Legislature in the state’s SPDES implementing legislation. NYSDEC Staff have never explained why NYSDEC has no authority to apply these provisions to Entergy’s radiological releases in the context of its SPDES permit, but somehow does have authority to apply these same provisions in the context of § 401(a). Indeed, as Entergy has maintained from the start of this proceeding, there is no basis in law or logic for this position.

the fact that NYSDEC Staff's witness admitted that the releases of radiological materials that had occurred prior to the Notice had **not** actually impaired the Hudson River for its best uses; and his testimony made clear that he had done no analysis to determine the likelihood that any potential future releases could occur in sufficient amounts to impair the Hudson River for its best uses. See PFF at ¶¶ 147, 149-50. Department Staff's decision to deny the WQC on radiological considerations contradicted its own previous findings, was wholly speculative, and without any factual support. As such, it was improper and should be disregarded.

B. The unplanned release of radiological materials from Indian Point has not impaired, and will not impair, the Hudson River for its best usage.

Further, even if NYSDEC had authority to regulate Indian Point's radiological releases under the CWA, the best usage standard is clearly met by Entergy, and accordingly there is no factual basis to deny the WQC Application. The evidence at hearing demonstrates conclusively that unplanned releases from Indian Point have not impaired, and will not impair, either recreational uses of the Hudson River or aquatic biota.¹¹ Accordingly, NYSDEC Staff's proposed denial of Entergy's Application on this basis is unsupported and improper.

1. Entergy's witnesses and evidence demonstrate that there is no scientific basis to conclude that unplanned releases from Indian Point have impaired or will impair the Hudson River for its best uses.

The record evidence supports only one conclusion – that the unplanned releases of radiological materials from Indian Point have not impaired the Hudson River for its best usages. Only Entergy provided any evidence and analysis by which to evaluate the question of the

¹¹ The Hudson River near Indian Point is classified as "SB" saline surface waters. See 6 NYCRR §864.8, Table 1, Item 2. The best usages of SB waters are set forth in 6 NYCRR §701.11: "The best usages of Class SB waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish and wildlife propagation and survival." Primary contact recreation consists of recreational activities where the human body may come in direct contact with raw water to the point of complete body submergence. Primary contact recreation includes, but is not limited to, swimming, diving, water skiing, skin diving and surfing. 6 NYCRR §700.1(49). Secondary contact recreation consists of recreational activities where contact with the water is minimal and where ingestion of the water is not probable. Secondary contact recreation includes, but is not limited to, fishing and boating. 6 NYCRR §700.1(56).

potential impacts of Indian Point's unplanned releases of radiological materials on the best uses of the Hudson River. Dr. Hoffman, a pre-eminent scientist in the field of radiological health and safety, set forth the scientifically accepted method to evaluate whether radiological releases to the environment have impaired, or have the potential to impair, the best uses of the Hudson River. As he explained, to perform such an analysis, one must: (i) identify the sources and amounts of radiological materials released into the environment; (ii) determine whether there are any exposure pathways for humans or aquatic biota to those radionuclides; (iii) calculate the radiation dose to humans or aquatic biota resulting from those exposure pathways; and (iv) translate that dose to risk to human health or impact on aquatic biota. PFF at ¶¶ 120.

Dr. Hoffman testified that he performed the above analysis in connection with Indian Point's unplanned releases, and concluded unequivocally that the radiological releases and resulting potential exposure was so low as to be inconsequential, and could have no impact on the best uses of the Hudson River. PFF at ¶¶ 127-144. With respect to potential impacts to humans from the designated best uses of the river (in other words, potential impacts to humans using the Hudson River in the vicinity of Indian Point for recreation or fishing), Dr. Hoffman identified the sources and concentrations of radiological materials based upon the uncontroverted findings of the GZA Report and the Indian Point Annual Radiological Effluent Release Reports, both in terms of the type and concentration of radionuclides estimated to be reaching the Hudson River from Indian Point's unplanned releases. PFF at ¶ 127. He further reviewed and confirmed the accuracy of the methods for calculating off-site doses associated with the migration of on-site groundwater to the Hudson River as documented in Entergy's NRC-required ODCM. PFF at ¶ 127. In doing so, he concluded that the annual dose in 2010 from Indian Point's unplanned releases to the hypothetical maximally-exposed individual was 0.0002 mrem, a small fraction of

the dose that an individual would get from eating a single banana. PFF at ¶¶ 119, 127, 143. He then applied the commonly accepted linear no-threshold model to convert these doses into a risk to people of developing cancer in later life, finding that in order for such releases to cause a single incidence of cancer-related illness in later life, five billion people would have to be maximally exposed to Entergy's unplanned releases. PFF at ¶ 136. After noting that an exposure to such a large population was impossible, Dr. Hoffman's conclusion was clear and uncontested: his expert opinion is that the unplanned releases from Indian Point are expected to have **zero impact** on the health of the public. PFF at ¶¶ 138.

Based on this scientific analysis, Dr. Hoffman made the following conclusion:

[T]he levels of radionuclides released to the Hudson River from groundwater are extremely low, with an immaterial effect on annual dose consequence to man or aquatic biota. Moreover, given the low levels of these releases, and the large volume of water in the Hudson River, there is no credible evidence that the releases of radionuclides from groundwater have any measurable effect on the level of radionuclides present in the Hudson River from historical sources. As such, **there is no credible scientific basis to conclude that releases of radionuclides to groundwater that has migrated to the Hudson River have impaired or will impair the use of the Hudson for primary or secondary contact recreation, such as swimming, fishing, and boating.**

Hoffman Prefiled at 18 (emphasis added).

With respect to the potential impact of Indian Point's unplanned releases on the best usage of the Hudson River for fish, shellfish, and wildlife propagation and survival, Dr. Hoffman testified that there are two commonly accepted scientific methods for analyzing the potential dose to aquatic biota from radiological releases, the RESRAD-BIOTA dose model and the UNSCEAR model, both of which he applied to Indian Point's unplanned releases. PFF at ¶¶ 139-141. Dr. Hoffman testified that he personally analyzed the radiation dose to aquatic biota from Entergy's unplanned releases in 2010 (the year for which the most recent data was available), using the maximum concentrations of radionuclides estimated to be reaching the river

at the shoreline of the Indian Point site. PFF at ¶ 140. His analysis confirmed that the dose rate (dose-per-day) to aquatic biota resulting from Indian Point's unplanned releases was "orders of magnitude" lower than the scientifically accepted threshold for protection of aquatic biota. PFF at ¶ 142. Based on his scientific analysis, Dr. Hoffman made the following conclusion:

[T]he levels of radionuclides released to the Hudson River from groundwater are extremely low, with an immaterial effect on annual dose consequence to aquatic biota. Moreover, given the low levels of these releases, and the large volume of water in the Hudson River, there is no evidence that the releases of radionuclides from groundwater have any material effect on the level of radionuclides present in the Hudson River from historical sources. Given all this, **there is no credible scientific basis to conclude that releases of radionuclides to groundwater that has migrated to the Hudson River have impaired or will impair the suitability of the Hudson River for fish, shellfish, and wildlife propagation and survival.**

Hoffman Prefiled at 18-19 (emphasis added).

Dr. Hoffman's conclusion that the unplanned releases from Indian Point have no potential to impair the best uses of the Hudson River was uncontested, and requires a finding that NYSDEC Staff erred in purporting to deny the Application based on radiological considerations. Moreover, as set forth below, this conclusion was corroborated by independent analysis performed by both NYSDEC and the NRC, and no other party to this proceeding offered any contradictory analysis in support of the Notice.

2. Both NYSDEC and the NRC agree with Entergy's conclusion that unplanned releases have not impaired the best usage of the Hudson River.

Dr. Hoffman's conclusions regarding the lack of any effect on the best uses of the Hudson River from Entergy's unplanned releases are well supported by other evidence in the record, including independent analysis performed by NYSDEC. As Mr. Barvenik, who led the Indian Point site investigation, explained, NYSDEC actively participated in the site investigation, including: (i) analyzing split samples of groundwater to confirm Entergy's radionuclide calculations; (ii) attending meetings to discuss the results of the investigation; and

(iii) participating in major decisions regarding the scope and conclusions of the investigation. PFF at ¶ 29. Among the individuals at NYSDEC who participated in the investigation was Tim Rice, an expert in NYSDEC's radiation protection division. PFF at ¶ 30. NYSDEC and NYSDOH issued two documents that set forth their conclusions regarding the ongoing site investigation, including a community fact sheet in May 2008 ("2008 Fact Sheet"). PFF at ¶¶ 32-33. The 2008 Fact Sheet documents New York State's involvement during the course of Entergy's groundwater investigation, including its collection of split samples of groundwater and fish flesh and independent assessment of potential public health impacts. PFF at ¶ 32. In that document, NYSDEC and NYSDOH confirmed that the levels of radionuclides entering the Hudson River from the groundwater beneath Indian Point are below State surface water standards for tritium and strontium-90, and that Entergy's calculated dose to the public through fish consumption is less than 1% of the NRC dose limits. PFF at ¶ 32(b), (g). NYSDEC also concluded that Entergy's use of monitored natural attenuation as the remediation action for the groundwater contamination at Indian Point was appropriate. PFF at ¶ 32(f).

In addition, the Department conducted a study of concentrations of strontium-90 in fish collected near Indian Point and compared them to concentrations found in fish collected from areas far removed from Indian Point's influence, documenting its results in a 2009 report (the "2009 Fish Report"). PFF at ¶ 33. The 2009 Fish Report reached two conclusions:

1. There are no apparent excursions above criteria for the protection of biota based on the radionuclide data available. The levels of radionuclides – including [strontium-90] – were two to five orders of magnitude lower than criteria established for protection of freshwater ecosystems.
2. There were no spatial differences in concentrations of [strontium-90] and [radium-224] in resident fish from the three locations sampled in the lower Hudson River (i.e., Indian Point Nuclear Power Plant, and the reference sites at the Roseton Generating Station and at Catskill). In contrast, [potassium-40]

levels were somewhat greater in the vicinity of Roseton Generating Station, but the differing concentrations have no known significance.

Entergy Ex. 38, at 8.

Thus, the conclusions of NYSDEC and NYSDOH staff members who had both personal knowledge of and involvement in the Indian Point groundwater investigation and who had actual expertise to analyze the effects of radionuclide releases to the public are identical to those of Dr. Hoffman: namely, that Entergy's unplanned releases did not violate state water quality standards and had no effect on aquatic biota in the Hudson River.

Moreover, the conclusions of the NRC also corroborate Dr. Hoffman's testimony. After conducting a comprehensive investigation of Indian Point's unplanned releases, documented in a full site investigation report, the NRC concluded that "radiological significance from the groundwater conditions at Indian Point is currently, and is expected to remain, negligible with respect to impact on public health and safety and the environment." PFF at ¶ 45(a). NRC also confirmed that no violation of any federal radiological discharge standards occurred, concluding that Entergy's releases were less than 1% of NRC discharge limits. PFF at ¶ 45(k).

3. DEC Staff offered no evidence to support its assertion that unplanned releases have the potential to impair the best usage of the Hudson River.

As set forth above, NYSDEC Staff offered no witness at the hearing who conducted an analysis of the effect of Indian Point's unplanned releases on the best uses of the Hudson River. This is so despite the fact that experts in radiological analysis from NYSDEC Staff were personally involved in the Indian Point groundwater investigation and had both the knowledge and expertise to opine on the question at issue in this proceeding. Instead, NYSDEC Staff offered the testimony of only one witness, Mr. Kolakowski, a staff engineer who readily admitted that he has no educational or work experience on matters of potential relevance to this

issue for adjudication, *e.g.*, nuclear engineering, radiation protection, human health effects of exposure to radiation, dose assessment from the exposure to radiological materials, or the ecological effects of radiological materials in the environment. PFF at ¶¶ 104-105. Mr. Kolakowski testified that the sum total of the “analysis” he performed was reading the GZA Report, which confirmed that radiological materials were entering the Hudson River due to unplanned releases at Indian Point at the time Entergy applied for its WQC. PFF at ¶ 151. Mr. Kolakowski, without analysis or explanation, then concluded that such radiological materials “could impair the waters for their best usage.” PFF at ¶ 153. When pressed as to whether he had any actual evidence that the radiological materials identified in the GZA Report had in fact impaired the waters for the best usage, Mr. Kolakowski unequivocally admitted that he had **none:**

Q. Do you have any evidence that the past leakage of radiological materials identified in the GZA report have impaired the Hudson River for primary and secondary contact recreation and fishing?

Kolakowski: No.

Q. Do you have any evidence that the radiological materials identified in the GZA report have impaired the Hudson River for its suitability for fish, shellfish and wildlife propagation and survival?

Kolakowski: No.

See Hearing Tr. at 2750 (Kolakowski), PFF at ¶ 156. Furthermore, Mr. Kolakowski testified that based on the information he reviewed, there was “no factual basis” to conclude that a leak of tritium from either Unit 2 or Unit 3 during license renewal could result in an impairment of the waters for their best usage. PFF at ¶ 157. Indeed, when asked, in conjunction with questions regarding NYSDEC’s 2009 Fish Study, whether he had conducted “analysis that suggests that the release of radionuclides from Indian Point has affected fish in the Hudson River,” Mr. Kolakowski admitted that he had not and that such an analysis is “outside my area of expertise.”

Hearing Tr. at 2768 (Kolakowski); PFF at ¶ 150. Moreover, Mr. Kolakowski went further, admitting on cross-examination that he agreed with the expert conclusions of the NRC in connection with its oversight of Entergy's site investigation that "radiological significance from the groundwater conditions at Indian Point is **currently, and is expected to remain, negligible** with respect to impact on public health and safety and the environment." Hearing Tr. at 2770 (Kolakowski) (emphasis added), PFF at ¶ 155.

In light of Mr. Kolakowski's admissions on cross-examination that (i) he had performed no independent analysis of the effect of Entergy's releases on the best usage of the Hudson River, (ii) he had no factual basis to conclude that past or future releases from Unit 2 or Unit 3 have or could in the future impair the waters for their best uses, and (iii) he agreed with the expert conclusion of Entergy's witnesses, NYSDEC radiological staff, and NRC that the releases have had, and are not expected to have, any effect on the environment, the Notice's unsupported assertion that unplanned releases from Indian Point "could impair the waters for their best usage" has no basis whatsoever in law or fact. Simply put, Mr. Kolakowski had no relevant evidence to support his opinions or NYSDEC Staff's position.¹² Given that this unsupported testimony, much of which Mr. Kolakowski effectively recanted on cross-examination, is the only basis to support the Notice's conclusion that unplanned releases could impair the waters for their best usage, the Notice lacks any factual basis, and must be disregarded.

¹² Given Mr. Kolakowski's lack of education, training, expertise, or personal knowledge to opine on the issue of the effect of Indian Point's releases on the best usage of the Hudson River, and NYSDEC Staff's refusal to offer the testimony of (or even allow Entergy to speak to) its own radiation expert who actually participated in the investigation into these releases, Entergy moved to have an adverse inference drawn against NYSDEC Staff. that if called to testify, Mr. Tim Rice, NYDSEC's lead radiological expert who participated in the investigation, would have testified consistently with Entergy's experts that there was no basis to conclude that unplanned releases from Indian Point would impair the best uses of the River. Hearing. Tr. at 4110-4120. The Tribunal denied the motion, but held that "the motion goes to the weight to be afforded to the testimony of Mr. Kolakowski" and that "[a]ll evidence with respect to this issue will be considered and accorded the appropriate weight." See Jan. 27, 2012 Memorandum Order at 2. Consistent with that ruling, Entergy argues that Mr. Kolakowski's unsupported testimony, for which he lacks any expert qualification and which is backed by no expert analysis, should be afforded no weight.

Thus, the evidence in the record supports only one conclusion – that the unplanned releases from Indian Point have not impaired the Hudson River for its best usages.

4. Riverkeeper's witness offered no relevant testimony regarding the effect of Indian Point's unplanned releases on the best usage of the Hudson River.

Riverkeeper's witness, Mr. Gundersen, provided no testimony to even address, let alone to refute, the uncontroverted conclusions of Entergy's witnesses, NYSDEC and NYSDOH radiation experts, and the NRC, regarding the lack of any effect of Indian Point's unplanned releases on the Hudson River's best uses. He said he did not review Dr. Hoffman's testimony and did not perform either a human or aquatic biota dose assessment – a critical step in the assessment of impact from radiological materials – saying "I was not contracted to do a dose calculation for Indian Point."¹³ Hearing Tr. at 2922 (Gundersen); PFF at ¶ 160, 162. Instead, Mr. Gundersen assumed that the introduction of any amount of a "deleterious substance" would result in a per se impairment of the best uses of the Hudson River. PFF at ¶ 161. However, such a "zero discharge" standard is not supported in law and is inconsistent with the water quality standard at issue here, which only prohibits the release of deleterious substances in such amounts that would result in an impairment of the designated best usages.¹⁴ See 6 NYCRR 703.2. Accordingly, Mr. Gundersen's testimony regarding the releases of radiological materials at Indian Point is irrelevant to the question of whether those releases will impair the best uses of the Hudson River, amounts to no more than speculation, lacks the scientific foundation for an appropriate expert opinion on the matter, and should be afforded no weight.

¹³ Riverkeeper's decision not to have Mr. Gundersen perform a dose assessment may be attributed to the fact that his prior dose assessment testimony has been rejected in federal court as "rife with conclusory statements" which on appeal were characterized as a "scientifically unsupported leap of faith." *Finestone v. Florida Power & Light Co.*, 2006 WL 267330, at *11 (S.D. Fla. Jan. 6, 2006); *Finestone v. Florida Power & Light Co.*, 272 Fed. Appx. 761, 768 (11th Cir. 2008); PFF at ¶ 158. Since the *Finestone* decision, he has not pursued any education in the area of dose assessment. PFF at ¶ 159.

¹⁴ Entergy notes that a "zero discharge" standard would also conflict with NRC regulations, which plainly permit discharges from NRC-regulated facilities in compliance with its radiation protection standards.

5. Entergy has demonstrated that there are reasonable assurances that any potential unplanned radiological releases from Indian Point during the license renewal period will not impair the best uses of the Hudson River.

The record demonstrates that there are reasonable assurances that any potential unplanned releases of radiological materials from Indian Point during the license renewal period will not impair the Hudson River for its best uses. As noted above, it is undisputed that the past releases from Indian Point have not impaired the Hudson River for its best usages, nor would future releases of similar magnitude, if they were to occur during the license renewal period.

Moreover, the potential for any future releases of similar magnitude is significantly reduced based upon initiatives already being implemented at Indian Point and among the industry in general, as a result of the discovery of tritium conditions at other nuclear power plants throughout the nation. First, the known sources of past releases either have been eliminated or remediated by Entergy. Second, Entergy has undertaken substantial operations and maintenance programs, including new underground piping assessments, designed to manage proactively those systems, structures and components that could be a source of future releases. Third, Entergy has installed, and will maintain, an extensive, state-of-the-practice monitoring well array designed to detect and allow rapid response to future releases, should they occur. It is, therefore, unreasonable to conclude that future unplanned releases from Indian Point could be of such significance as to impair the Hudson River for its best uses.

- a. *The sources of past unplanned releases from Indian Point have been eliminated or remediated.*

The evidence at hearing demonstrated that the past unplanned releases from Indian Point have been eliminated or remediated. GZA's groundwater investigation, which covered all "areas of the Site where credible potential sources of leakage might exist, and encompassed all three reactor units," concluded that the radiological contamination of groundwater at Indian Point is

the result of releases from the Unit 1 and Unit 2 SFPs.¹⁵ Entergy Ex. #33 at viii ; PFF at ¶24-28. GZA found no evidence of any radiological release to groundwater from the Unit 3 SFP. PFF at ¶ 28. Thus, with regard to Unit 3, there is no evidence of past radiological releases that could result in even speculative assertions about potential releases from Unit 3 during license renewal term.

With respect to Unit 1, GZA concluded that the source of strontium-90 found in the Indian Point groundwater was the Unit 1 SFPs. PFF at ¶ 28. There is no dispute that the fuel and water from the Unit 1 SFPs has been removed from the pools, thereby eliminating the pools as a continuing source of radiological materials to the groundwater beneath Indian Point. PFF at ¶ 52-53. Accordingly, the Unit 1 SFPs cannot be a source of future releases of radiological materials to the environment during the license renewal period. Moreover, it is uncontested that the concentration of strontium-90 in on-site groundwater has been reduced by 70% since the defueling and draining of the Unit 1 SFPs. PFF at ¶ 68.

With respect to Unit 2, GZA concluded that the leaks from the SFP resulted in a plume of tritium in the groundwater beneath Indian Point. PFF at ¶ 28. GZA summarized the actions taken by Entergy in response to this leak as follows:

The releases were due to: 1) historic damage in 1990 to the [spent fuel pool] liner, with subsequent discovery and repair in 1992; and 2) a weld imperfection in the stainless steel Transfer Canal liner identified by Entergy in September 2007, and repaired in December 2007. . . . To the extent possible, the Unit 2 pool liner has been fully tested and repairs have been completed. Specifically, Entergy has: 1) confirmed that the damage to the liner associated with the 1992 release was repaired by the prior owner and is no longer leaking; 2) installed a containment system (collection box) at the site of the leakage discovered in 2005, which precludes further release to the groundwater; and 3) after an exhaustive liner inspection, identified a weld imperfection in the Transfer Canal that was then

¹⁵ No one contested the methodologies used in, or the conclusions drawn from, the GZA Report. Indeed, the Department participated actively in the GZA investigation, collecting split samples of groundwater and independently analyzing them for contaminant concentrations, and stated unequivocally that it agreed with GZA's approach and conclusions. PFF at ¶¶ 29-34.

prevented from leaking by draining the canal. The weld was then subsequently repaired by Entergy in mid-December 2007. Therefore, all identified Unit 2 [spent fuel pool] leaks have been addressed.

Entergy Ex. #33 at viii-ix. As a result of Entergy's efforts, the concentration of tritium in the groundwater beneath Indian Point has been reduced by 89% since 2005. PFF at ¶ 67. While future leaks from the Unit 2 SFP cannot be completely ruled out, Mr. Barvenik testified that the size of any persistent leaks would have to be very small in order to evade the wells used to monitor groundwater at Indian Point. PFF at ¶ 146. Thus, any ongoing migration of tritium to the Hudson River, consistent with the inconsequential past releases, is expected to have no impact on human health or aquatic biota. The NRC has confirmed this conclusion.

Therefore, the sources of past releases to groundwater at Indian Point – specifically the SFPs at Units 1 and 2 – have been identified, repaired, and remediated, with corresponding reductions in tritium and strontium-90 concentrations since the repairs were instituted.

b. *Entergy has implemented programs to prevent future leaks of radiological materials from Indian Point.*

In addition to the remedial measures described in the GZA Report, Entergy has developed and implemented various initiatives to reduce the likelihood and severity of future releases of radiological materials. Entergy has developed an underground piping management program, the purpose of which is to decrease the likelihood of future unplanned releases to the environment from underground pipes. PFF at ¶ 54. That program involves a four-step process as follows: (1) conduct an inventory of underground pipes and their design characteristics; (2) prioritize piping systems on the basis of the consequences of a leak or failure and the susceptibility of the pipe to degradation; (3) perform inspections on piping systems to gain information; and (4) perform an engineering evaluation of the inspection data to determine remedial actions required, if any. PFF at ¶ 55. The first two steps of this process have been

completed at Indian Point, and inspections of underground piping have been ongoing since 2008. PFF at ¶ 56. The inspections utilize a variety of techniques to gain information regarding pipe conditions, including new ultrasonic technologies that allow for an inspection of pipe lengths that have not been exposed by excavation. PFF at ¶ 57.

As Dr. Esselman testified, the implementation of this program reduces the likelihood of leaks over time:

Q: Should Indian Point Units 2 and 3 be relicensed, what is your opinion about the effect that Indian Point's enhanced buried-piping program will have on the likelihood of future leaks from underground piping during license renewal?

Dr. Esselman: These programs were designed to reduce the likelihood of leaks occurring in the future. They are being implemented as they were designed. The likelihood of leaks in buried piping occurring should and is expected to go down with the passage of time. Particularly as this program is implemented, there will be more inspections in 2012 that will provide more information. There will be inspections in 2013 that will provide more information. There should be a decreasing likelihood of the lack of integrity of buried pipes with the passage of time.

Hearing Tr. at 3117 (Esselman), PFF at ¶ 60.

c. Entergy's long-term groundwater monitoring system has been designed to identify releases from systems, structures and components containing radiological materials should they leak in the future.

Following the completion of GZA's groundwater investigation, the number of groundwater monitoring locations was expanded to include monitoring locations near structures, systems and components ("SSC") that have the potential to impact groundwater should they leak in the future. PFF at ¶¶ 61-65. According to Mr. Barvenik, GZA's lead investigator:

[W]e targeted those specific SSCs with additional borings so that we could then effectively monitor those and use those to quickly determine, because they're very close to the SSCs, quickly determine if there was a leak, to allow Entergy then to react quickly to the leak and address it.

Hearing Tr. at 3915 (Barvenik). Thus, in addition to the underground piping program, which actively evaluates underground piping systems and, where necessary, requires remedial action with respect to piping showing significant degradation, Entergy's long-term groundwater monitoring program assists in identifying releases, connecting them to their likely sources, and allowing targeted remedial action to proceed as needed.

Based upon the above, there are reasonable assurances that releases of radiological materials during the license renewal period, if any, will not impair the Hudson River for its best uses. The past releases of radiological materials identified by GZA's comprehensive groundwater investigation have resulted in no impacts to human health or the environment, and their sources have been identified and repaired, leading to significantly reduced concentrations of radiological materials in Indian Point groundwater over time. Moreover, Entergy has implemented an underground piping program that systematically evaluates the condition of underground pipes containing radiological materials at Indian Point and requires corrective action where necessary. In addition, Entergy's long term groundwater monitoring program assists in identifying leaks should they occur and targets likely sources for prompt investigation. Accordingly, there is no reasonable basis to conclude that unplanned releases of radiological materials during the license renewal period will impair the best usages of the Hudson River.

C. DEC Staff's attempts to support the proposed denial of the Application on grounds other than those set forth in the Notice are improper and should be rejected.

While, as demonstrated above, the actual reasons stated in the Notice for proposing to deny the Application are without any basis in fact or law, in its pre-filed testimony NYSDEC Staff attempted to provide belated support for the Notice by citing to other provisions of New York law that were supposedly violated by Indian Point's unplanned releases. In particular, in his initial pre-filed testimony, NYSDEC Staff's witness, for the first time, contended that Indian

Point's radiological releases are "prohibited by ECL § 17-0807 and 6 NYCRR §750-1.3." Kolakowski Prefiled at 11, PFF at ¶ 90. In his prefiled rebuttal testimony, NYSDEC Staff's witness clarified this testimony, stating more specifically that Indian Point's "unintentional" releases are "prohibited by ECL §17-0807(1),(4), and 6 NYCRR §750-1.3(a)." Kolakowski Rebuttal Prefiled at 4. PFF at ¶ 91. Notably, nowhere in the Notice is NYSDEC Staff's contention that Entergy's unplanned releases are subject to the categorical prohibitions of "ECL §17-0807 and 6 NYCRR §750-1.3." PFF at ¶¶ 83, 85. For the reasons stated below, NYSDEC Staff's attempt to support the Notice by asserting new bases not set forth in the Notice is in contravention of DEC regulations, and therefore must be rejected as a matter of law. Moreover, as set forth below, no reasonable view of the evidence amassed at hearing would support denial of the WQC Application, even under NYSDEC Staff's belatedly-asserted legal theories.

1. NYSDEC Staff's attempt to support the proposed denial on grounds not set forth in the Notice should be rejected as a matter of law.

NYSDEC Staff's eleventh-hour assertion of new legal bases for denial of the WQC Application is impermissible. According to 6 NYCRR §621.10(a), NYSDEC Staff is required to provide a permit applicant such as Entergy with "a decision in the form of: a permit, a permit with conditions *or a statement that the permit applied for has been denied, with an explanation for the denial*" (emphasis added). Furthermore, according to 6 NYCRR §624.4(c)(1)(ii), in the context of a proposed denial of a permit application by NYSDEC Staff, an issue is adjudicable if "it relates to *a matter cited by the department staff as a basis to deny the permit* and is contested by the applicant" (emphasis added). The purpose of these provisions is to provide adequate notice of the grounds on which NYSDEC Staff proposed to deny the application, for suitable issues to be adjudicated, and for discovery to proceed on those issues in advance of hearing.

Indeed, in applying this principle, the Commissioner has routinely denied NYSDEC Staff's attempt to support a notice of denial on bases other than those actually set forth in the notice.

For instance, *In the Matter of William Huley, Applicant*, DEC No. 1-4736-06627/00001, 2009 WL 2141501 (N.Y. Dept. Env. Conserv. June 22, 2009), involved an interim appeal of an Issues Ruling by an applicant who had initially applied for both a freshwater wetlands permit and a tidal wetlands permit. NYSDEC Staff issued a notice of denial, stating only that NYSDEC Staff had concluded that the application failed to satisfy the requirements for a freshwater wetlands permit. *Id.* The Applicant appealed, and after the Issues Conference, the ALJ advanced for adjudication *both* the issue of whether the application demonstrated compliance with the requirements for freshwater and tidal wetlands permits. *Id.* The applicant appealed the Issues Ruling to the Commissioner, arguing that it was impermissible to require the applicant to adjudicate an issue that was not set forth as a basis for denial by NYSDEC Staff in the notice.

On appeal, the Commissioner agreed with the applicant, citing to 6 NYCRR § 621.10(a)'s requirement that the notice set forth the reasons and bases for NYSDEC Staff's proposed permit denial, and held that the failure to identify deficiencies with the application for a tidal wetlands permit precluded NYSDEC Staff from attempting to support the denial of the application on that ground. In doing so, the Commissioner noted that the fact that an applicant has the burden of proof to demonstrate compliance with all applicable laws and regulations "does not relieve Department staff of the obligation to identify, in a timely fashion, those issues relating to a permit application upon which its denial is based." *Id.* Further, the Commissioner held that "[a]n applicant is entitled to know the grounds upon which its permit application is denied so that, if it seeks a hearing on the denial, it is able to prepare its case including the identification and development of witnesses, the organization of documentary evidence and the

development of legal argument.” *Id.* Finally, the Commissioner concluded:

In a notice of permit denial, Department staff is required to clearly state the substantive reasons for denial of the permit application, relate those reasons to the permitting standards, and, in situations such as this where more than one permit has been applied for, address each permit application that Department staff determines does not satisfy applicable standards. A failure to state the basis for denying a permit application or the mere suggestion that there might be an issue that warrants denial is insufficient to satisfy the regulatory standard of 6 NYCRR 621.10(a).

Id. (footnote omitted). As a result, the Commissioner granted the applicant’s appeal, and did not allow the issue of whether the applicant had demonstrated compliance with the tidal wetlands requirements to move forward to adjudication. *Id.*

The Commissioner’s reasoning is directly applicable here, and should foreclose NYSDEC Staff’s attempt to support the Notice based on statutes and regulations not cited in the Notice. As set forth above, the Notice proposed to deny the WQC based on radiological considerations for one: that the unplanned releases from Indian Point that had entered the Hudson River were “deleterious substances” that “could impair the waters for their best usage.” PFF at ¶¶ 81-83. However, in the pre-filed testimony of Mr. Kolakowski, NYSDEC Staff – for the first time – took positions other than those stated in the Notice, asserting that Indian Point’s unplanned releases are “prohibited by ECL §17-0807 and 6 NYCRR §750-1.3(a).” PFF at ¶ 90.¹⁶ As the Commissioner has held, such post-hoc justifications of NYSDEC Staff’s denial of Entergy’s Application are impermissible. *In the Matter of William Haley, Applicant*, 2009 WL 2141501. In fact, as noted above, they are not even adjudicable. *Id.* Accordingly, any ground for denial that does not appear in the Notice should be stricken from the record.

¹⁶ During his cross examination, Mr. Kolakowski readily confirmed that these bases for denial did not appear in NYSDEC Staff’s Notice. Hearing Tr. at 2729-2730 (Kolakowski); PFF at ¶ 85.

2. Mr. Kolakowski conceded that ECL §17-0807(1) and 6 NYCRR §750-1.3(a) are not proper grounds for denying Entergy's Application.

Even if this Tribunal determines that NYSDEC Staff's post hoc attempts to support the Notice are permissible, it is clear that none of the statutes or regulations identified by Mr. Kolakowski in his testimony provide any basis for denial of the WQC. To begin, ECL §17-0807(1) prohibits "the discharge of any radiological, chemical or biological warfare agent or high-level radioactive waste, as such terms are defined in the Act¹⁷ or pursuant thereto." Section 750-1.3(a) of 6 NYCRR sets forth the same prohibition on "the discharge of any radiological, chemical or biological warfare agent or high-level radioactive waste, pursuant to section 301(f) of the Act."

At hearing, Mr. Kolakowski recanted his pre-filed testimony and agreed that neither ECL §17-0807(1) nor 6 NYCRR §750-1.3(a) applies to the radiological discharges at issue in this case. In particular, Mr. Kolakowski confirmed that these materials are not "radiological warfare agents" or "high-level radioactive waste." PFF at ¶¶ 168-169. Thus, Mr. Kolakowski's testimony confirms that there is no factual basis for the Department to deny Entergy's Application on the basis of ECL §17-0807(1) and 6 NYCRR §750-1.3(a).

3. Radiological discharges from NRC-licensed facilities are not regulated under the SPDES program and, therefore, ECL §17-0807(4) cannot be a basis for denying Entergy's Application.

NYSDEC Staff's witness also claimed that ECL §17-0807(4), which prohibits the discharge of pollutants regulated under the SPDES program without first obtaining a SPDES permit, was a separate basis for denying the WQC.¹⁸ Mr. Kolakowski's belated reliance on

¹⁷ The "Act" as referenced in ECL §17-0807(1) refers to the CWA.

¹⁸ This was the Department's position, as articulated by Mr. Kolakowski:

Q: So this section, which includes 17-0807, this is the state's implementation of the SPDES program under the Clean Water Act, correct?

ECL § 17-0807(4) is incorrect as matter of law, however, because the Department has stated on many occasions that it has no authority to regulate radiological discharges from Indian Point under the SPDES program. PFF at ¶ 4. The plain language of ECL §17-0807(4) makes clear that its prohibition on unpermitted releases applies only to those releases that are subject to and regulated by New York's SPDES program. Given that radiological discharges from Indian Point are not within the regulatory scope of the CWA and therefore are outside the scope of regulated discharges under New York's SPDES program, ECL §17-0807(4)'s prohibition does not apply. Accordingly, NYSDEC Staff cannot rely on ECL §17-0807(4) to deny the Application.

However, even if NYSDEC Staff were correct that unplanned radiological releases from Indian Point were categorically prohibited by ECL §17-0807(4), the evidence adduced at hearing demonstrates that such would **still** be an improper basis on which to propose denial of the WQC. This is so because the uncontroverted evidence introduced at the hearing demonstrated that Entergy could prevent such unplanned releases from reaching the Hudson River during the license renewal term. PFF at ¶ 170. Entergy presented evidence during the hearing that sufficient extraction wells could be installed at the perimeter of the Indian Point site to reverse the hydraulic gradient at Indian Point sufficient to ensure that **no** radionuclides from the identified Indian Point groundwater plumes would reach the Hudson River via the groundwater pathway during the license renewal term. PFF at ¶ 170. Neither NYSDEC Staff nor Riverkeeper

A: Yes, it is.

Q: So, is it your position, then, that the reason the discharges at issue in this case are prohibited by section 17-0807 is because Entergy did not get a SPDES permit to authorize the releases at issue in this case?

A: That was my read of that, yes.

....

Q: And so if Entergy had a SPDES permit that authorized the discharges that are described in the GZA report 17-0807(4) would not apply.

A: I believe so, yes.

Hearing Tr. at 2740-42 (Kolakowski).

disputed the ability of Entergy to install such wells, or the ability of such wells to ensure that during license renewal term no radionuclides from the identified groundwater plumes would reach the Hudson River via the groundwater pathway. Given this uncontroverted evidence, there is no basis to conclude that there are not “reasonable assurances” that radiological releases from Indian Point during the license renewal term will comply with the purported requirements of ECL §17-0807(4).

4. Mr. Kolakowski’s insertion of an allegedly new ground for denial on the stand is simply the statutory authority for the regulatory requirement that discharges comply with applicable water quality standards.

In addition to attempting to assert new bases to support the Notice in his pre-filed testimony, for the first time when taking the stand Mr. Kolakowski inserted a reference to ECL §17-0501 as another potential basis for denial – a basis not only absent from the Notice, but also from Mr. Kolakowski’s pre-filed testimony. *See* Hearing Tr. at 2736 (Kolakowski); PFF at ¶¶ 171-172. However, on cross-examination, Mr. Kolakowski readily admitted that Section 17-0501 was merely the statutory requirement that prohibits discharges to the waters of the state in amounts that impair the best usage of the Hudson River, and therefore provided no **independent** basis for denial of Entergy’s Application.¹⁹ Thus, despite the eleventh-hour insertion of this provision into Mr. Kolakowski’s testimony, ECL §17-0501 does not provide an independent ground for denying Entergy’s Application. Furthermore, since the uncontroverted evidence at hearing demonstrated conclusively that Indian Point’s unplanned radiological releases do not,

¹⁹ Q: So, really, this new prohibition is another way of stating the opinion that exists in your testimony already, which is that the discharge of these materials could impair the waters for the best usage, correct?

A: Yes.

Q: And, as you testified earlier, that is the actual reason stated in the Notice for why the water quality certification was denied.

A: Yes, I believe that was.

Hearing Tr. at 2743 (Kolakowski); PFF at ¶ 173.

and will not, impair the best uses of the Hudson River, there is no basis to deny the Application on the grounds of ECL §17-0501.

- D. The Department did not deny Entergy's Application on the basis of groundwater concentrations, and any attempt to do so would likewise be preempted and unsupported in law and fact.

NYSDEC Staff did not purport to deny Entergy's Application on the basis of on-site or off-site groundwater concentrations of radiological materials. Nothing in the Notice or Mr. Kolakowski's testimony indicates that NYSDEC Staff proposed to deny Entergy's Application on this basis. In fact, Mr. Kolakowski confirmed during the hearing that Department Staff did not consider groundwater concentrations, in and of themselves, during his analysis of Entergy's Application. PFF at ¶ 174. In this instance, the NYSDEC Staff's approach was appropriate. As discussed below, any attempt to deny Entergy's Application due to on-site groundwater contamination is preempted by federal law, outside the scope of § 401, and otherwise improper.

1. Federal law pre-empts any state regulation of radiological groundwater concentrations beneath Indian Point.

As discussed in detail in Section I above, the federal government retains exclusive jurisdiction over all AEA-regulated radionuclides at NRC-licensed facilities. Of course, this conclusion applies with equal force to radionuclides found within the boundaries of an NRC-licensed facility. On the basis of the arguments set forth in Section I above, and in Entergy's prior briefing on this issue, any attempt by the Department to deny Entergy's Application on the basis of on-site groundwater contamination is preempted by federal law.²⁰

2. Even if the regulation of onsite groundwater was not pre-empted, § 401 of the CWA applies only to discharges to surface waters.

²⁰ There is no dispute that the groundwater beneath the Indian Point power block area flows only in the direction of the Hudson River and does not flow to adjacent properties, PFF at ¶¶ 28(b), 32(a), and that radiological materials from Indian Point have never been detected in off-site groundwater. PFF at ¶ 41(e).

NYSDEC's authority to issue certifications under § 401 of the CWA is limited to regulation of a proposed "discharge" as that term is defined in the CWA. The CWA makes clear that discharges subject to its regulatory scope are limited to discharges to **surface** waters, and not groundwater. *See* 33 U.S.C. §1362(12) ("discharge of a pollutant" means "(A) any addition of any pollutant *to navigable waters* from any point source, [and] (B) any addition of any pollutant *to the waters of the contiguous zone or the ocean* from any point source other than a vessel or other floating craft" (emphasis added)); *see also Wademan v. Condra*, 13 F.Supp.2d 295, 303-304 (N.D.N.Y. 1998) (CWA does not regulate groundwater). Accordingly, it would be improper to withhold a certification under § 401(a) of the CWA on the basis of groundwater conditions. Mr. Kolakowski confirmed that the Department's review of Entergy's Application properly focused on impacts to surface waters only. PFF at ¶ 174.

3. EPA's Safe Drinking Water Act standards do not apply to the groundwater beneath Indian Point.

The record includes testimony from various witnesses regarding certain maximum contaminant levels ("MCLs") for drinking water established by EPA under the federal Safe Drinking Water Act ("SDWA"). In particular, there was testimony that certain individual samples of groundwater beneath Indian Point contained concentrations of tritium or strontium-90 exceeding the SDWA MCLs.

The SDWA does not apply to the groundwater beneath Indian Point. The primary and secondary drinking water regulations developed pursuant to the SDWA apply to "public water systems," defined by statute to be "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals." 42 U.S.C. §§300f(1) --

(4), 300g. The groundwater beneath Indian Point is not collected and delivered to the public. PFF at ¶¶ 8-9.

Moreover, the term “maximum contaminant level” is defined by statute to be “the maximum permissible level of a contaminant in water *which is delivered to* any user of a public water system.” 42 U.S.C. §300f(3). In other words, the SDWA sets MCLs for water “at the tap,” rather than at the source. PFF at ¶ 176. Accordingly, even if the water beneath Indian Point were to be used for drinking water purposes, the MCLs for any contaminant would not apply to the concentration of that contaminant within the groundwater. *Id.*

Thus, EPA’s MCLs under the SDWA have no relevance to the issues presented in this case. It is undisputed that the groundwater beneath Indian Point is not a source of water for a “public water system,” and, even if it were, the MCLs referenced during the hearing do not apply to groundwater but, instead, would apply to any water delivered to a tap at the end of a public water system. *Id.*

Recognizing these facts, NYSDEC Staff did not at the time of the Notice, and did not in this proceeding, argue that contamination of Indian Point groundwater was a basis for denying Indian Point’s WQC. As is clear from above, there would be no basis in fact or law to do so.

REQUESTED RELIEF

For the reasons set forth above and in its prior briefs, Entergy respectfully requests that this Tribunal vacate any and all grounds alleged by NYSDEC Staff for denial of Entergy’s Application due to radiological releases, including by:

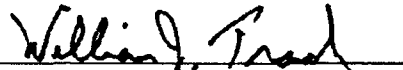
1. Finding that NYSDEC lacks authority under the CWA to regulate releases of radionuclides from Indian Point;

2. Finding that NYSDEC Staff's proposed denial of Entergy's Application on the basis of radiological releases to the environment is preempted by federal law;
3. Finding that there are reasonable assurances that radiological releases from Indian Point during the license renewal period, if any, will not impair the Hudson River for its best usages;
4. Finding that NYSDEC Staff's attempt to add bases for denial of Entergy's Application that are not included in the Notice are improper and barred from adjudication or, in the alternative, lack merit;
5. Finding that testimony adduced at hearing related to EPA's MCLs under the SDWA have no bearing on the adjudicable issues in this case; and
6. Any other relief this Tribunal deems just and proper.

Respectfully submitted,

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

By its attorneys,

A handwritten signature in black ink, appearing to read "William J. Trach", is written over a horizontal line.

John C. Englander

Elise N. Zoli

William J. Trach

Robert H. Fitzgerald

Goodwin|Procter LLP

53 State Street

Boston, Massachusetts 02109

Tel.: 617.570.1000

Fax: 617.523.1231

Signed and dated in Boston, MA this 27th day of April, 2012.

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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)

CERTIFICATE OF SERVICE

I, William J. Trach, hereby certify that, on this 27th day of April, 2012, I caused a true and accurate copy of:

1. Post Hearing Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. – Radiological Issues; and
2. Proposed Findings of Fact of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. – Radiological Issues,

to be served on all counsel of record in the above-captioned action via First Class Mail and/or e-mail as specified in the appended Service List.



William J. Trach

Dated: April 27, 2012

SERVICE LIST
(Updated 4/27/2012)

Service by E-mail and First Class Mail

Maria E. Villa
Daniel P. O'Connell
Administrative Law Judges
Office of Hearings and Mediation
Services
New York State Department of
Environmental Conservation
625 Broadway, First Floor
Albany, New York 12233-1550
518-402-9003
518-402-9037 (fax)
mevilla@gw.dec.state.ny.us
dpoconne@gw.dec.state.ny.us

Mark Lucas, Esq.
COUNSEL FOR RIVERKEEPER INC.,
SCENIC HUDSON, INC. and THE
NATURAL RESOURCES DEFENSE
COUNCIL
Riverkeeper, Inc.
20 Secor Road
Ossining, New York 10562
914-478-4501, ext. 241
914-478-4527 (fax)
rtroutman@riverkeeper.org
mlucas@riverkeeper.org

Richard L. Brodsky
2121 Saw Mill River Road
White Plains, NY 10607
Tel: 914.720.8830
richardlbrodsky@gmail.com

Mark D. Sanza, Esq.
Assistant Counsel
William G. Little, Esq.
Associate Counsel
COUNSEL FOR DEPARTMENT STAFF
New York State Department of Environmental
Conservation
Division of Legal Affairs
625 Broadway, 14th Floor
Albany, New York 12233-1500
518-402-9195
518-402-9018 (fax)
wglittle@gw.dec.state.ny.us
mdsanza@gw.dec.state.ny.us

Robert L. Sweeney, Esq.
COUNSEL FOR AFRICAN AMERICAN
ENVIRONMENTALIST ASSOCIATION
Whiteman Osterman & Hanna
One Commerce Plaza
Albany, New York 12260
518-487-7670
518-487-7777 (fax)
rsweeney@woh.com

Melissa-Jean Rotini, Esq.
Assistant County Attorney, Of Counsel
Westchester County Attorney's Office
Michaelian Office Building
148 Martine Avenue, 6th Floor
White Plains, NY 10601
914-995-3630
914-995-3132 (Fax)
Email: MJRI@westchestergov.com

Thomas F. Wood, Esq.
Town Attorney, Town of Cortlandt
Daniel Riesel, Esq.
COUNSEL FOR TOWN OF
CORTLANDT
Sive, Paget & Riesel, P.C.
460 Park Avenue, 10th Floor
New York, New York 10022
212-421-2150
212-421-1891 (fax)
driesel@sprlaw.com

Michael J. Delaney, Esq.
Director, Energy Regulatory Affairs
New York City Department of
Environmental Protection
59-17 Junction Boulevard
Flushing, NY 11373
(718) 595-3982
mdelaney@dep.nyc.gov

Daniel Riesel, Esq.
Victoria Shiah, Esq.
Adam Stolorow, Esq.
Sive, Paget & Riesel, P.C.
460 Park Avenue, 10th Floor
New York, NY 10022
driesel@sprlaw.com
vshiah@sprlaw.com
astolorow@sprlaw.com

Robert J. Glasser, Esq.
Robert J. Glasser, P.C.
COUNSEL FOR CENTRAL HUDSON GAS &
ELECTRIC CORPORATION
284 South Avenue
Poughkeepsie, New York 12601
Cellphone (preferred): 646-318-0522
845-486-5292
845-486-5782
Bob.glasser@robertjglasserpc.com

Norris McDonald
President
Center for Environment, Commerce & Energy
AFRICAN AMERICAN ENVIRONMENTALIST
ASSOCIATION
1629 K Street, N.W., Suite 300
Washington, D.C. 20006
301-265-8185 (direct)
443-569-5102
norrismcdonald@msn.com
www.aaenvironment.com/CECE.htm

Service E-mail Only

Ned Sullivan
President, Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, New York 10591
845-473-4440, ext. 224
845-452-7567 (fax)
nsullivan@scenichudson.org

Hayley Mauskapf, Esq.
Environmental Advocacy Associate
Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, NY 10591
845-473-4440, ext. 210
845-473-2649 (fax)
hmauskapf@scenichudson.org

Geoffrey H. Fettus, Esq.
Senior Project Attorney
COUNSEL FOR NATURAL
RESOURCES DEFENSE COUNCIL
1200 New York Avenue, N.W., # 400
Washington, D.C. 20005
202-289-2371
202-289-1060 (fax)
gfettus@nrdc.org

Paul Schwartzberg
Land Projects Specialist
Scenic Hudson, Inc.
One Civic Center Plaza, Suite 200
Poughkeepsie, New York 10591
845 242-2915
845 255-2827 (fax)
schwartzberg@scenichudson.org

Karl S. Coplan, Esq.
Daniel E. Estrin, Esq.
Supervising Attorney/Adjunct Professor of
Law
Pace Environmental Litigation Clinic, Inc.
Pace University School of Law
78 North Broadway
White Plains, New York 10603
914-422-4343
914-422-4661 (fax)
kcoplan@law.pace.edu
destrin@law.pace.edu

Interns:

Amber Paterson
apaterson@law.pace.edu

Kimberly Klein
kklein@law.pace.edu

Deborah Brancato, Esq.
Staff Attorney
Riverkeeper, Inc.
828 South Broadway
Tarrytown, New York 10591
914-478-4501, ext. 230
914-478-4527 (fax)
dbrancato@riverkeeper.org

Phillip H. Musegaas, Esq.
Hudson River Program Director
Riverkeeper, Inc.
828 South Broadway
Tarrytown, New York 10591
914-478-4501, ext. 224
phillip@riverkeeper.org

Steven Blow, Esq.
Assistant General Counsel
New York State Department of Public
Service
Agency Building Three
Empire State Plaza
Albany, New York 12223-1350
518-474-6955
518-486-5710 (fax)
steven.blow@dps.ny.gov

Frank V. Bifera, Esq.
COUNSEL FOR MIRANT BOWLINE
Hiscock & Barclay, LLP
50 Beaver Street
Albany, New York 12207
518-429-4224
518-427-3487 (fax)
fbifera@hblaw.com

Kelli M. Dowell, Esq.
Assistant General Counsel/Environmental
Entergy Services, Inc.
308 East Pearl Street, Suite 700
Jackson, MS 39201
601-969-2596
Cell: 601-519-6823
601-969-2696 Fax
kdowell@entergy.com

Sam M. Laniado, Esq.
David B. Johnson, Esq.
Read and Laniado, LLP
COUNSEL FOR INDEPENDENT
POWER PRODUCERS
OF NEW YORK
25 Eagle Street
Albany, New York 12207-1901
518-465-9313
518-465-9315 (fax)
sml@readlaniado.com
dbj@readlaniado.com

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of

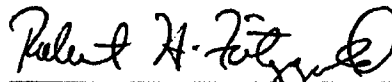
Entergy Nuclear Indian Point 2, LLC, Entergy
Nuclear Indian Point 3, LLC, and Entergy
Nuclear Operations, Inc.'s Joint Application
for CWA §401 Water Quality Certification

DEC App. Nos. 3-5522-00011/00030 (Unit 2)
3-5522-00105/00031 (Unit 3)

POST HEARING REPLY MEMORANDUM OF ENTERGY NUCLEAR
INDIAN POINT 2, LLC, ENTERGY NUCLEAR INDIAN POINT 3, LLC,
AND ENTERGY NUCLEAR OPERATIONS, INC.
RADIOLOGICAL ISSUES

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

By Their Attorneys,



John C. Englander, Esq.
Elise N. Zoli, Esq.
William J. Trach, Esq.
Robert H. Fitzgerald, Esq.
Goodwin|Procter LLP
Exchange Place
Boston, MA 02109-2881
(617) 570-1000

Dated: October 5, 2012

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INTRODUCTION

This post-hearing reply brief, submitted on behalf of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc. (collectively, "Entergy"), sets forth why the New York State Department of Environmental Conservation ("DEC" or "DEC") Staff's April 2, 2010 Notice of Denial ("Notice"), which proposed to deny Entergy a water quality certification ("WQC") based on radiological releases from Indian Point, was not supported by law or fact. For the reasons stated herein and in Entergy's opening brief, DEC Staff's attempt to use its authority under § 401 of the federal Clean Water Act ("CWA") to regulate the release of radiological materials regulated by the Nuclear Regulatory Commission ("NRC") and governed by the Atomic Energy Act of 1954, as amended (the "AEA") is federally preempted by the AEA and outside the jurisdiction granted to DEC under the CWA. Further, the evidence adduced at trial demonstrates that even if DEC had jurisdiction to regulate radiological releases from an NRC-licensed nuclear facility, the unplanned releases at issue in this proceeding fully complied with New York water quality standards ("WQS").

This reply brief is divided into two sections. The first section focuses on the settled, controlling law demonstrating that DEC is both preempted and lacks jurisdiction under the CWA to regulate releases of radiological materials governed by the AEA from an NRC-regulated nuclear facility. Either is fatal to Department Staff's Notice of Denial. In this section, Entergy also addresses DEC Staff's improper and belated efforts to introduce a non-CWA rationale for the Notice of Denial. The second section demonstrates that, even assuming that DEC had authority to regulate Indian Point's radiological releases, which it does not, the evidence adduced at hearing demonstrates conclusively that there are reasonable assurances that unplanned releases

of radiological materials from Indian Point during the license renewal term will not impair the waters of the state for their best usages, or otherwise contravene WQS.

*DEC Lacks Jurisdiction to Regulate
the Radiological Releases from Indian Point at Issue in This Proceeding*

More specifically with respect to DEC's preempted activity and lack of jurisdiction, the following facts and legal principles are undisputed:

- Indian Point is an NRC-regulated nuclear facility operating pursuant to a license granted under the terms of the AEA.
- Under settled, controlling United States Supreme Court precedent, the AEA granted *exclusive jurisdiction* to the NRC to regulate the release of radiological materials as defined in the AEA ("AEA materials"), and preempted states, and therefore DEC, from any such regulation.
- Under settled, controlling United States Supreme Court precedent, the authority granted to the states, and therefore DEC, under the federal CWA does not include the authority to regulate AEA materials.
- The radiological materials released from Indian Point at issue in this proceeding are AEA materials that are regulated by the NRC.
- The NRC has determined that the unplanned release of radiological materials from Indian Point at issue in this proceeding have never violated NRC regulations.

Given these fundamental facts and legal principles, it is plain that the Notice, which proposed to deny Entergy's WQC application based on the release of AEA materials from an NRC-regulated nuclear facility, is both preempted by the NRC's exclusive jurisdiction and outside the scope of DEC's authority under the CWA. Entergy addressed these arguments in detail in its opening post-hearing brief, and in this brief addresses DEC Staff's and Riverkeeper's attempts to argue why, despite the undisputed facts and law set forth above, this Tribunal should nevertheless find that DEC has jurisdiction to regulate AEA materials released from an NRC-regulated nuclear facility. As set forth below, those arguments have no merit.

DEC Staff fails even to mention preemption in its opening brief, despite the fact that the Issues Ruling explicitly (at DEC Staff's urging) advanced the radiological issue to adjudication,

in part on the ground that DEC Staff claimed there were factual issues necessary to decide the scope of preemption. DEC Staff's failure to address the fundamental issue of preemption or the jurisdictional limits of the CWA is telling, as it means that DEC Staff has advanced no credible legal argument that DEC has the authority to regulate the release of AEA materials from Indian Point.

Riverkeeper briefly addresses the issues of preemption and the lack of state jurisdiction to regulate the release of AEA materials from NRC-licensed facilities, but in doing so concocts an argument regarding preemption that finds no support in the case law, and is expressly rejected by relevant preemption law that Riverkeeper fails to mention in its brief.

Of course, DEC's lack of authority to regulate AEA materials under the CWA, and the broader prohibition of such regulation as a result of federal preemption, ends the inquiry, and requires the conclusion that the Notice, to the extent it is based on "radiological considerations," cannot stand.

Even if DEC Possessed Jurisdiction, the Evidence at Trial Fails to Support the Notice

Even absent the clear jurisdictional limits of the CWA and preemptive effect of the AEA, the evidence adduced at hearing demonstrates that the unplanned release of radiological materials from Indian Point has not impaired the Hudson River for its best usages and that there are reasonable assurances that no such impairment will occur during the license renewal period. Thus, the Notice's suggestion that such an impairment "could" occur, even if that were a credible finding sufficient to support the Notice (which it is not), is not borne out by the facts. On this point, the following facts are undisputed:

- Entergy's experts have established that the radiological releases at issue in this proceeding have not impaired the Hudson River for its best usages and that there are reasonable assurances that no such impairment will occur during the license renewal period.

- The NRC has investigated the radiological releases at issue in this proceeding and determined that they have not affected, and will not in the future affect, public health, safety and the environment, and also are “negligible” with respect to conservatively established NRC regulations designed to protect public health, safety, and the environment.
- DEC Staff’s actual experts in radiological releases, who have been monitoring Indian Point’s unplanned releases and Entergy’s response thereto from the outset (but who were, over Entergy’s objection, prevented from providing testimony by DEC Staff counsel), have determined and publicly stated that the unplanned releases at issue in this proceeding: (i) have never exceeded state water quality standards (“WQS”) for tritium and strontium; (ii) have had no measurable effect on Hudson River aquatic biota; and (iii) are less than 1% of NRC standards deemed protective of public health, safety, and the environment.
- DEC Staff’s lone witness in this proceeding, who conceded his lack of radiological expertise, agreed with Entergy’s witnesses regarding the lack of any evidence of an effect on the best usages of the Hudson River.

These undisputed facts compel a finding that the Notice, which proposed denying Indian Point’s WQC on the basis that the unplanned releases of radiological materials “could” impair the Hudson River for its best usages, cannot stand.

Despite the undisputed facts adduced at hearing, DEC Staff and Riverkeeper nonetheless attempt to resuscitate the Notice through various specious arguments. These include: (i) applying the wrong standard of review; (ii) arguing for the application of a “zero discharge” standard that has no basis in New York law; (iii) attempting to apply WQS absent from the Notice and inapplicable to Indian Point; and (iv) ignoring the undisputed facts regarding the absence of any environmental impact from the releases at issue in this proceeding. For these reasons, as detailed below, Entergy respectfully requests that the Tribunal, should it determine DEC possesses jurisdiction to regulate Indian Point’s radiological releases, reject DEC Staff’s and Riverkeeper’s claims and find, consistent with every competent expert to examine Indian Point’s unplanned radiological releases, that there are reasonable assurances that such releases will not impair New York waters for their best usages or otherwise contravene WQS for the duration of Indian Point’s license renewal term.

I. DEC has no legal authority to deny a WQC application on the basis of radiological releases from NRC-regulated facilities.

This section addresses three legal arguments. First, under any formulation of the federal preemption inquiry, including as described by this Tribunal in the Issues Ruling, DEC Staff's proposed denial of Entergy's WQC is preempted by the AEA. Second, even if it were not preempted, the proposed denial exceeds the jurisdictional limits of the CWA as defined by the U.S. Supreme Court. Third, Department Staff's argument that it can deny Entergy's application on the basis of state law other than WQS exceeds the jurisdictional limits of New York law as defined by the New York Court of Appeal. For these reasons, Department Staff's Notice of Denial should be rejected.

A. DEC Staff's proposed denial of Entergy's WQC Application on the basis of unplanned radiological releases is clearly preempted.

In its Post-Issues Conference Briefing, DEC Staff argued in favor of advancing the radiological issue to adjudication over Entergy's objection that DEC Staff was preempted from regulating the release of radiological materials from Indian Point. DEC Staff contended that there was a factual question as to whether the unplanned releases were regulated by the NRC or were in compliance with NRC requirements and, therefore, whether such releases were subject to the AEA's preemptive effect. *See* Initial Post-Issues Conference Brief by the Staff of the Department of Environmental Conservation at 15. As discussed in Entergy's opening post-hearing brief, this Tribunal adopted DEC Staff's reasoning and advanced the radiological issue to adjudication on the basis that there were two factual questions necessary to determine the issue of preemption: whether the radiological releases from Indian Point were (i) regulated by the NRC, and (ii) in compliance with NRC regulations. *See* Post Hearing Memorandum of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. Radiological Issues ("Entergy Br.") at 15-19; Ruling on Proposed Issues For

Adjudication and Petitions for Party Status ("Issues Ruling") at 26-27. Thus, following the Tribunal's reasoning, to avoid a finding of preemption DEC Staff and Riverkeeper had to establish that the radiological releases at issue in this Proceeding were not regulated by the NRC, and were not in compliance with NRC regulations.¹ In fact, however, both parties now concede that the radiological releases at issue in this proceeding are both regulated by the NRC and in compliance with NRC regulations. This must end the inquiry, as DEC Staff and Riverkeeper have failed to provide any basis that the radiological releases at issue are not subject to the preemptive effect of the AEA.

Specifically, Department Staff now acknowledges, as it must, that the Indian Point unplanned releases are in fact regulated by the NRC, and are in compliance with NRC requirements. *See* Brief of the Department of Environmental Conservation in Support of Denial of the Application for a Water Quality Certificate for Indian Point Unit 2 and Indian Point Unit 3; Issue: Radiological Releases to the Hudson River ("DEC Staff Br.") at 10 ("it has become abundantly clear that standard operating procedures at Indian Point [and perhaps all nuclear energy power producing facilities in the U.S.] contemplate unplanned discharges of radiological materials from the facility during normal facility operations"); 12 ("NRC's regulatory oversight for licensed nuclear power generation facilities 'normalizes' unplanned leaks.... The NRC's regulatory regime considers unplanned leaks to be 'normal operations'...."). This irrefutable conclusion is amply supported in the record because (i) Entergy's witnesses testified consistently that NRC regulated the radionuclides discharged from Indian Point, including unplanned releases of those radionuclides, and that those releases were well within NRC discharge limits;

¹ Entergy again states that it does not agree with the Issues Ruling's determination that whether the unplanned releases were in fact regulated by the NRC or in compliance with NRC's requirements were necessary or appropriate to determine the scope of federal preemption. Rather, the law is to the contrary. *Train v. Colorado Pub. Int. Research Grp.*, 426 U.S. 1, 16 n.12 ("States are precluded from playing any role in several significant areas of regulation including the setting of limitations on radioactive discharges from nuclear power plants.").

(ii) Entergy submitted into evidence multiple NRC inspection reports regarding the unplanned releases of radionuclides at issue in this proceeding which demonstrate that NRC is in fact regulating those releases and which conclude that those releases complied with all applicable NRC regulations. *See* Hoffman Prefiled at 8-9, 11-13; Barvenik Prefiled at 9, 15, 19-21; Hearing Tr. at 3092 (Hoffman), Hearing Tr. at 3920-21 (Barvenik); Entergy Ex. #31, 32, 34. Thus, the fact that NRC regulates Indian Point's radionuclide discharges, including unplanned discharges, is now undisputed and compels a finding that DEC Staff is preempted from regulating those releases.

For DEC Staff or Riverkeeper to prevail, they would have to provide this Tribunal with a credible basis for circumventing *Train*. Both have failed to do so. Rather than attempting to deal with the threshold factual questions that DEC Staff initially advanced and the Issues Ruling identifies as necessary to determine the issue of preemption, DEC Staff ignores them completely. Indeed, the word preemption shows up nowhere in DEC Staff's brief. Instead, DEC Staff attempts to advance two alternative arguments for why DEC has jurisdiction to regulate Indian Point's NRC-regulated releases. First, DEC Staff seeks to rely on the broad purpose of the CWA to protect state waters as providing the legal basis to support the regulation of radiological releases from an AEA-regulated facility. DEC Staff Br. at 17-18. This argument is unavailing. The *Train* decision anticipates and expressly refutes this very argument. Specifically, the Court held that, despite the broad authority granted to the states to protect state waters (as set forth in 33 U.S.C. § 1251, the same authority relied upon by DEC Staff in its brief), Congress did not intend that authority to apply to AEA-regulated materials, as doing so would be wholly inconsistent with the exclusive authority over such materials granted to the NRC. *See Train*, 426 U.S. at 16 & n.13. Thus, DEC Staff's reliance on the broad purpose of the CWA cannot overcome the holding in *Train* and support the proposed Notice of Denial.

DEC Staff's second argument is that NRC regulations are not strict enough, and that the state should be permitted to apply more stringent standards to the discharge of Indian Point's unplanned releases than those applied by the NRC.² DEC Staff Br. at 12. Applying more stringent state standards to the release of radiological materials from an NRC-regulated facility, however, is precisely the sort of regulation that courts repeatedly have found to be preempted. *See, e.g., Train*, 426 U.S. at 16 n.12 & 17 ("States are precluded from playing any role in several significant areas of regulation including the setting of limitations on radioactive discharges from nuclear power plants."); *Northern States Power Co. v. Minnesota*, 447 F.2d 1143, 1144, 1149 n.6, 1154 (8th Cir. 1971) (affirming that "the United States Government has the sole authority under the doctrine of pre-emption to regulate radioactive waste releases from nuclear power plants to the exclusion of the states"); *United States v. City of New York*, 463 F. Supp. 604, 614 (S.D.N.Y. 1978) (holding that city of New York's attempt to require Columbia University to obtain a license to operate nuclear reactor preempted by federal government's exclusive jurisdiction); *Entergy Nuclear Vermont Yankee, LLC v. Shumlin*, 838 F. Supp. 2d 183, 230-31 (D. Vt. 2012) (preempting state legislation intended to regulate radiological health and safety at AEA-licensed nuclear power plant). In sum, DEC Staff's argument reflects a textbook case of preempted state action.

Riverkeeper also ignores the Tribunal's directive with respect to the factual issues relevant to preemption, and attempts to advance two flawed arguments regarding DEC's regulation of AEA materials. First, Riverkeeper argues that AEA preemption only applies to

² In doing so, DEC Staff cites to the NRC's Groundwater Task Force Final Report, and argues incorrectly that in that document "NRC acknowledges that it does not have regulatory authority to actually prevent leaks of radiological materials from nuclear facilities in the first instance..." DEC Staff Br. at 12-13 n.7. To the contrary, NRC did not conclude that it lacks regulatory authority to prevent all leaks; rather, NRC stated that its regulatory framework does not require that licensees have no leaks. *See* U.S. Nuclear Regulatory Commission, Groundwater Task Force Final Report, June 2010, at 4 ("NRC's regulatory framework does not explicitly state that all activities under a licensee's control must be accomplished with no leakage.").

“*direct* state regulation of radiological hazards from nuclear facilities,” and that “application of relevant State standards under CWA § 401 in a federal licensing proceeding does not constitute *direct* regulation of nuclear facilities.” Post-Hearing Closing Brief of Intervenors Riverkeeper, Natural Resources Defense Council, and Scenic Hudson Regarding Issue for Adjudication No. 3 – Radiological Materials (“Rkp. Br.”) at 13 (emphasis added). According to Riverkeeper, preemption only applies where a state seeks “to directly enforce health and environmental regulations based on independent state authority,” but does not apply to state enforcement of such regulations pursuant to federal authority, such as the CWA. *Id.* at 14. Riverkeeper’s argument has no basis in the law. First, this argument is belied by *Train* itself, which held that Congress vested the NRC with exclusive jurisdiction over AEA materials and that neither EPA nor the states could promulgate or apply water quality standards for the discharge of AEA materials under the CWA. *See Train*, 426 U.S. at 16 n.12, 25.

Moreover, Riverkeeper’s purported distinction has been rejected by controlling New York Court of Appeals precedent. In a case interpreting DEC’s authority under § 401 the Court of Appeals held, in direct contradiction to Riverkeeper’s argument, that federal preemption applied to DEC’s attempt to regulate a federal licensee under § 401:

Settled law in New York has consistently supported the view that section 401 gives the State regulatory entity only a limited role of review, based on requirements affecting water quality, not on all State water quality provisions. Review by State agencies that would overlap or duplicate the Federal purview and prerogatives was not contemplated and would infringe on and potentially conflict with an area of the law dominated by the nationally uniform Federal statutory scheme.

Niagara Mohawk Power Corp. v. N.Y. Dept. of Env. Conserv., 82 N.Y.2d 191, 196 (1993).

Riverkeeper’s attempt to rely on a California Appeals Court decision does nothing to refute clear New York law contradicting Riverkeeper’s position. *See Karuk Tribe v. Cal. Regional Water Quality Control Board*, 183 Cal. App. 4th 330 (2010). That case (which has

nothing to do with the scope of AEA preemption or the regulation of radiological materials) stands only for the unremarkable proposition that, when Congress has preempted state action in a certain area (in that case, the regulation of hydroelectric plants), it can nonetheless through other legislation provide states with some role in the process of federal licensing, such as through the certification authority under § 401. *Id.* at 359-60. Entergy has never contended that states have no role in federal licensing proceedings through their § 401 authority; rather, the specific question before this Tribunal is whether that role includes the authority to regulate AEA materials. Indeed, the holding of *Karuk Tribe*, which Riverkeeper omits, is that “it is Congress that determines what is the extent of state input.” *Id.* at 360. As such, the question at issue in this proceeding is simple: did Congress, in passing the CWA, provide states with the authority to regulate the discharges of AEA materials by nuclear facilities? As *Train* makes clear, the answer is unequivocally no.

Riverkeeper’s second flawed argument is that DEC Staff’s purported conditioning authority under § 401(d) provides some residual state authority over radionuclides regulated by NRC that is somehow immune from preemption. Rkp. Br. at 17-18. This argument fails because the clear holding of *Train* is that in passing the CWA, which of course includes § 401(d), Congress did not intend for state or federal authority under the CWA to apply to NRC-regulated radionuclides or otherwise alter the exclusive NRC jurisdiction over such materials as set forth in the AEA. Riverkeeper’s claim is based on the unfounded assertion that a subsequent Supreme Court decision somehow altered the clear holding in *Train* and the law of federal preemption, specifically *PUD No. 1 v. Washington Dept. of Ecology*, 511 U.S. 700 (1994). In fact, nothing in *PUD* authorizes states to deny a water quality certification based on discharges that states are not authorized to regulate under § 401(a), or any other provision of the CWA, and are otherwise federally preempted from regulating by the AEA.

Accordingly, DEC Staff's purported denial of Entergy's WQC Application on the basis of unplanned releases of radiological materials at Indian Point must be rejected as preempted by federal law.

B. Department Staff and Riverkeeper ignore the jurisdictional limits of § 401 of the CWA.

Because the radionuclide discharges at issue in this proceeding are governed by the AEA, under settled, controlling United States Supreme Court precedent, those materials are outside the scope of permissible regulation under the CWA. As such, the regulation of those discharges cannot form a legal basis for the Notice of Denial. The United States Supreme Court has held that, in passing the CWA, Congress did not confer on any agency administering the CWA the authority to address radionuclides regulated by NRC. *See Train v. Colorado Public Interest Research Group*, 426 U.S. 1, 23-25 (1976). The *Train* decision, the holding of which has remained black letter law for more than thirty years, has clear, direct and incontrovertible consequences here: Department Staff's effort to ground its Notice of Denial on "radiological considerations" – specifically the unplanned release of radionuclides from Indian Point to the Hudson River – cannot stand.

Consequently, DEC's authority under the CWA does not extend to the regulation of radionuclides discharged from Indian Point, whether unplanned or not. As such, Department Staff's Notice of Denial under § 401 of that Act based on radiological considerations must be rejected as ultra vires and otherwise unlawful.

C. DEC Staff's attempt to support the proposed denial by reference to sections of the ECL that are not WQS promulgated pursuant to the CWA contradicts New York law.

DEC Staff's opening brief references, as an apparent additional and separate basis for the Notice of Denial, provisions of the ECL that are not state WQS contained in 6 NYCRR §§ 701-

704. See, e.g., DEC Staff Br. at 5-6, 15-16 (citing to ECL §§ 17-0105(5), (17), (19), 17-0301, 17-0511, 17-0807(4)). Settled New York law makes clear, however, that the state's authority under § 401(a) is limited to a determination of whether the proposed activity will comply with state WQS contained in 6 NYCRR §§ 701-704, and cannot extend to other provisions of the environmental law that are not CWA-authorized WQS:

The Clean Water Act reads simply that a certification shall issue if a determination is reached 'that any such discharge will comply with the applicable provisions of sections 301, 302, 303, 306, and 307 of this Act.'.... DEC concedes that in New York the water quality standards promulgated pursuant to section 303 are linked and found only in 6 NYCRR parts 701 to 704. Thus, there is nothing in the new language or legislative history of section 401 that would empower DEC to deny certification on the basis of broader environmental provisions of New York law or regulation, nor is there adequate support for DEC's contention that the operation and reach of section 401 has been altered in a way that requires this Court to upset its settled analysis and resolution of the interrelated questions in *Matter of de Rham v. Diamond* (32 NY2d 34, *supra*) and *Matter of Power Auth. v. Williams* (60 NY2d 315, *supra*).

See *Niagara Mohawk*, 82 N.Y.2d at 200 (1993). Accordingly, the law is clear that DEC has no authority to do what Department Staff proposes here, which is to use its certification authority under § 401(a) of the CWA to apply provisions of the ECL that are not WQS promulgated in 6 NYCRR §§ 701-704.

To the extent that DEC Staff and Riverkeeper purport to rely on the conditioning authority of § 401(d) of the CWA to apply other provisions of the ECL to Indian Point's WQC request, the law is clear that § 401(d) cannot serve as a basis to deny an application, but only permits a state to place conditions on a WQC that has been granted pursuant to § 401(a). This conclusion is required by the plain language of § 401(d), which states:

Any certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations, under section 1311 or 1312 of this title, standard of performance under section 1316 of this title, or prohibition, effluent standard, or pretreatment standard under section 1317 of this title, and with any

other appropriate requirement of State law set forth in such certification, and shall become a condition on any Federal license or permit subject to the provisions of this section.

33 U.S.C § 1341(d). Indeed, DEC made precisely this argument in the *Niagara Mohawk* case, contending that § 401(d)'s reference to "other applicable state laws" permitted DEC to review an application for a WQC for compliance with all aspects of the ECL that bear on water quality. 82 N.Y.2d at 199-200. In rejecting this argument, the New York Court of Appeals held that:

[S]ection 401 (d) does not control the analysis or outcome here. That subdivision applies only to the conditioning authority on a certificate issued by DEC. DEC's enlarged reading of 'appropriate requirement of State law' under section 401 (d) would enable DEC to impose onerous conditions that could contradict or undermine Federal licensing by superimposing unrelated conditions not within the EPA mandates and specifications. Such a strained construction would countermand the carefully worded authority of section 401(a) (1).

Id. (emphasis added). Accordingly, DEC's attempt to support the proposed denial by reference to sections of the ECL that are not state WQS passed pursuant to the CWA is contrary to settled New York law.³

In sum, the evidence set forth at trial, which is undisputed by the parties, is that the unplanned radiological releases at issue in this proceeding are governed by the AEA and regulated by the NRC pursuant to its authority under the AEA. As such, DEC is preempted from regulating the release of those materials by federal law, and possesses no jurisdiction to regulate those materials under the CWA. In addition, DEC Staff's attempt to base its Notice of Denial on state law other than WQS exceeds its jurisdiction under New York law. Thus, the Notice of Denial is contrary to law and must be rejected.

³ The Court of Appeals' decision in *Niagara Mohawk* is consistent with federal law interpreting § 401(d), including the U.S. Supreme Court's decision in *PUD*. That case upheld a state's use of its conditioning authority under § 401(d) to place conditions on a granted WQC to ensure that non-discharge related aspects of the applicant's activity would comply with state WQS passed pursuant to the CWA. *Id.* at 713-14. It did not hold that a state had authority to deny a WQC under § 401(d); indeed, nothing in the language of § 401(d) would permit such an interpretation.

II. Even if DEC had authority to regulate the radionuclide discharges from Indian Point, the only conclusion supported by the record is that Department Staff improperly proposed denial of Entergy's Application on the basis of unplanned releases of AEA materials.

Even if DEC were not preempted from regulating the radiological releases at issue in this proceeding, and even if the regulation of such releases were not outside the authority conferred on DEC through the CWA, DEC Staff's proposal to deny the WQC based on such radiological releases would still be improper under New York law. For the reasons set forth below, Entergy has more than demonstrated that prior radiological releases from Indian Point fully complied with any even arguably applicable WQS, and that there are reasonable assurances that any future releases would also comply with such standards. In short, DEC Staff and Riverkeeper failed to demonstrate any basis to support the proposed Notice of Denial.

A. Department Staff and Riverkeeper failed to meet their burden to produce evidence contrary to Entergy's position and, therefore, Department Staff's purported denial of Entergy's application is arbitrary and capricious.

While a permit applicant bears the burden of production and persuasion that its application complies with applicable law, "[o]nce an applicant produces evidence sufficient to establish a prima facie case, the burden of production may shift to other parties in the proceeding, including Department staff, to produce evidence either in rebuttal to the applicant' [sic] evidence or in support of contrary factual assertions, or both." *Matter of Karta Corp.*, Decision of the Deputy Commissioner, DEC No. 3-5512-0054/00004, 2006 WL 1111345, at *2 (N.Y. Dept. Env. Conserv. Apr. 20, 2006). Department Staff did not meet its burden here. Not only did Department Staff and Riverkeeper fail to offer any credible evidence relevant to the purportedly applicable legal standards, Department Staff also departed without explanation or support from its prior accurate conclusions that the unplanned releases of radiological materials from Indian Point have not adversely impacted water quality or aquatic biota. Department

Staff's failure to adhere to the law and to explain its contrary conclusions is the very definition of arbitrary and capricious agency action. *See Matter of Charles A. Field Delivery Serv.*, 66 N.Y.2d 516, 516-517 (1985) ("A decision of an administrative agency which neither adheres to its own prior precedent nor indicates its reasons for reaching a different result on essentially the same facts is arbitrary and capricious."). For the reasons set forth both in Entergy's opening brief and below, the evidence adduced at hearing demonstrates that the radiological releases at issue in this proceeding were in compliance with all applicable WQS, and neither DEC Staff nor Riverkeeper provided any evidence to refute Entergy's position.⁴

B. DEC Staff fails to apply properly the New York law it claims governs this issue.

Even if DEC had jurisdiction to regulate the radiological releases at issue in this proceeding, the standard to be applied to Entergy's Application is whether there are "reasonable assurances" that the operation of Indian Point during the license renewal term will comply with applicable WQS. *See* Issues Ruling at 1; *Long Lake Energy Corp. v. N.Y. Dept. of Env. Conserv.*, 164 A.D.2d 396, 402 (3rd Dept. 1990) ("reasonable assurances" standard applies to review of § 401 WQC determinations) (*quoting Matter of de Rham v. Diamond*, 32 N.Y.2d 34, 44 (1973); *Power Auth. of the State of N.Y. v. Williams*, 101 A.D.2d 659, 659 (3rd Dept. 1984) (applying "reasonable assurance" standard); *In re Erie Boulevard Hydropower L.P.*, Decision of the Deputy Commissioner, No. 4-6103-00027/00001-9, 2006 WL 2951127, at *4 (Oct. 6, 2006) (certification under § 401 is "whether a 'reasonable assurance' exists that the project will not violate applicable water quality standards"). This is not only the law, but logical: applications under § 401 of the CWA for a WQC are necessarily forward looking – *i.e.*, an evaluation of

⁴ Riverkeeper advances an argument that the radionuclides at issue in this case constitute "high-level radioactive waste." *See* Rkp. Br. at 93-94. There is no evidence in the record to support this argument, and even DEC Staff disclaimed this argument at hearing. *See* Hearing Tr. at 2734-2737 (Kolakowski). Riverkeeper's argument is with legal or factual merit.

future compliance during the federal licensing period.⁵ Therefore, reasonable assurance of future compliance is not only the best that an applicant can provide; it is also the only rational standard a regulator could enforce.

Department Staff's brief appears to acknowledge that its obligation is to apply the reasonable assurance standard. *See, e.g.*, DEC Staff Br. at 20, n.17. However, nowhere in its opening brief does Department Staff actually apply this standard to the facts of this case.⁶ Rather, and contrary to this Tribunal's clear recitation of the "reasonable assurance" standard in the Issues Ruling, *see* Issues Ruling at 1, Department Staff's brief elsewhere advocates a standard of "certainty" regarding Indian Point's future radiological releases.

Specifically, Department Staff asserts, as grounds for supporting the proposed denial, that Entergy's groundwater concentration and dose data "does not reflect with certainty the forthcoming period of the intended WQC." DEC Staff Br. at 12 (emphasis added). In addition, Department Staff concluded that Entergy's evidence provided "no predictive certainty as to when the [radiological] discharges will cease, or whether the discharges will decrease over time in the manner predicted by GZA." *Id.* at 13 (emphasis added). Department Staff states affirmatively that these conclusions "necessarily inform the Department's regulatory decision making when weighing the capacity for the Indian Point facilities to demonstrate compliance with the State's water quality standards." *Id.* at 12. Thus, to the extent Department Staff applied a heightened standard in issuing the Notice, it must be rejected as ultra vires. To the extent Department Staff

⁵ Department Staff agrees that WQC determinations are "forward looking." *See* Hearing Tr. at 2696, 2711 (Kolakowski).

⁶ Mr. Kolakowski does not mention the standard of review in his pre-filed direct testimony. Further, in his pre-filed rebuttal testimony, he acknowledges only that Entergy "must demonstrate compliance with" applicable WQS, *see* Kolakowski Pre-filed Rebuttal Testimony at 3, and, when asked on cross-examination to identify what standard should be applied to Entergy's demonstration of future compliance, Mr. Kolakowski stated that he could not do so and was unfamiliar with the "reasonable assurance" standard. *See* Hearing Tr. at 2698-2699 (Kolakowski). In other words, while DEC Staff counsel acknowledges the applicable standard to be applied to Entergy's application, DEC Staff responsible for issuing the Notice of Denial apparently have not.

asks this Tribunal to apply that heightened standard to its review of Entergy's Application, that position lacks any legal foundation.

Riverkeeper's argument that Department Staff is free to require certainty, because certainty is a "more stringent requirement" than reasonable assurances, is meritless. Riverkeeper ignores both the Issues Ruling and applicable New York law holding that the "reasonable assurance" standard is to be applied to WQC applications in New York. Instead, it relegates its discussion of the reasonable assurance standard to a footnote in which it makes a purported "plain language" argument that "merely providing a 'reasonable assurance' of compliance with water quality standards is a less stringent standard than the requirement that an applicant 'must demonstrate compliance' in order to satisfy 6 NYCRR §608.9(a)." Rkp. Br. at 20, n.87. Again, Riverkeeper's argument lacks any citation to legal authority, and fails to distinguish the directly contrary and controlling holdings of New York courts on this issue.

Moreover, the provision of the CWA that addresses states' ability to pass "more stringent" standards than federal standards—upon which Riverkeeper premises its argument—is totally irrelevant to the standard of review to be applied to WQC applications. The statutory provision authorizing states to impose more stringent standards applies in specified circumstances, none of which is present here. According to § 510 of the CWA:

Except as expressly provided in this chapter, nothing in this chapter shall ... preclude or deny the right of any State or political subdivision thereof or interstate agency to adopt or enforce (A) any standard or limitation respecting discharges of pollutants, or (B) any requirement respecting control or abatement of pollution; except that if an effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance is in effect under this chapter, such State or political subdivision or interstate agency may not adopt or enforce any effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance which is less stringent than the effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance under this chapter ...

33 U.S.C. § 1370 (emphasis added). The standard of review applied to Entergy's Application is neither a "standard or limitation respecting discharges of pollutants," nor a "requirement respecting control or abatement of pollution." Further, nothing in Section 510 of the CWA allows a state agency to require the impossible – the certain prediction of the future – from applicants for WQCs. Indeed, if Riverkeeper's position were correct, Entergy questions how any proposed project could ever obtain a WQC, as doing so would require an applicant to demonstrate that it will never experience an unplanned release. In all respects, Riverkeeper's baseless argument must be rejected.⁷

- C. In addition to applying an improper standard of review to Entergy's Application, Department Staff failed to apply the best usages standard for Class SB waters and, instead, applied a legally unsupportable "zero discharge" standard.

There is no dispute that the narrative standard applicable to the discharge of deleterious substances into Class SB waters such as the Hudson River near Indian Point is:

None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.

6 NYCRR §703.2 (emphasis added). Thus, even if it were legally permissible to apply the deleterious substance standard for Class SB waters to Indian Point's Application, the standard to be applied is not whether any deleterious substances will be discharged, but whether the amount of deleterious substances discharged will impair the waters for their best usages.⁸

⁷ This legally unfounded notion – that the State of New York has plenary power to regulate Indian Point's unplanned radiological releases under the guise of being "more stringent" than federal law – is notably advanced by Riverkeeper at the same time it argues (in its attempt to avoid the reach of federal preemption) that New York is not regulating Indian Point at all when it reaches a decision with regard to Entergy's Application. That Riverkeeper continues to pursue legally inconsistent positions underscores how untethered its arguments are to the controlling law at issue in this case.

⁸ Notably, where the Department's narrative water quality standards prohibit the discharge of *any* amount of a material, the language of the standard clearly indicates as much. See 6 NYCRR §703.2 (narrative standard for "garbage, cinders, ashes, oils, sludge and other refuse" is "None in any amounts."). Furthermore, the Department's narrative standard for radioactivity – which only applies to the more protected Class-A Special waters and not to the Class SB waters that apply to the Hudson River in the vicinity of Indian Point – is "[s]hould be kept at the lowest practical levels, and in any event should be controlled to the extent necessary to prevent harmful effects on health." 6 NYCRR § 703.2 (emphasis added). In other words, the narrative

In apparent recognition that the proper inquiry requires an analysis of whether the “amount of” Indian Point’s discharges impaired the waters for their best usages, Department Staff argues in its brief that deleterious substances discharged to the Hudson River, in any amount, will impair the water for its best usages. See DEC Staff Br. at 9 (claiming there is a “legitimate concern that any leak from Indian Point’s generating units could cause impairment of the State’s waters.”). In other words, Department Staff urges this Tribunal to apply a “zero discharge” standard to Entergy’s Application, without any analysis of whether the discharges actually impair the best usages of the Hudson River. That Department Staff applies such a standard is evident from its brief. Department Staff asserts that Entergy must “demonstrate that on-going discharges to the Hudson River would cease” during the license renewal period, DEC Staff Br. at 3, that Department Staff “cannot ignore the fact that [Monitored Natural Attenuation] will not stop the radiological discharges to the Hudson River,” *id.* at 11, that there is no indication “as to when, if ever, the releases of radiological materials into the groundwater and discharges into the Hudson River will stop” or whether they “will ever cease during the period for which Entergy seeks a WQC.” *Id.* at 9, 12. Indeed, Department Staff has simply declared the discharge of deleterious substances to be detrimental to water quality:

Discharges of deleterious substances are detrimental to the quality of the State’s waters, since the substances are additive, man-made, contributed from a known source, and in addition to the natural background of the water body.

Id. at 16. To be clear, there is no legal citation in support of this statement, nor is it consistent with the language of the best usages standard itself.⁹ Simply put, whether a particular substance

standard for radioactivity even in the State’s most protective water classification is not “none” but rather is consistent with the “as low as reasonably achievable” standard with which Entergy already complies as a matter of NRC regulation. See 10 C.F.R. § 50.36a(a). Thus, as a matter of fact, Indian Point’s radiological discharges would comply with the heightened narrative standard for radioactivity even if it applied to Indian Point’s application, which it does not.

⁹ Mr. Gundersen provided testimony that similarly assumed that the discharge of any deleterious substance would result in a *per se* impairment of the Hudson River’s best usages: “Q: And do you have an opinion about

is “detrimental to the quality of the State’s waters” is not the legal standard to be applied here. The best usages standard on which Department Staff denied Entergy’s Application requires an inquiry into the amount of deleterious substance released and whether that amount will result in an impairment of best usages. As set forth in detail below, when the proper standard is applied to Indian Point’s releases, Entergy’s evidence demonstrates that the unplanned releases at issue in this proceeding have not impaired the Hudson River for its best usages, and that there are reasonable assurances that any future releases will also not impair the Hudson River for its best usages. Neither Department Staff nor Riverkeeper provided any evidence to the contrary.

D. Entergy produced ample evidence to demonstrate that the unplanned releases of radiological materials at Indian Point comply with purportedly applicable water quality standards.

In this case, the only party to have addressed the actual best usages standard cited by Department Staff in its Notice of Denial is Entergy.¹⁰ Entergy’s witnesses documented the amount of unplanned releases to groundwater that have occurred over time, the amount entering the Hudson River over that same period, whether the amount of radionuclides entering the Hudson River over that period had impaired the best usages of the Hudson River, and whether the amount of radionuclides reasonably expected to the Hudson River during the license renewal period would be sufficient to result in an impairment of best usages.

Entergy’s witnesses’ conclusions were clear, unrebutted and unchallenged:

whether the radiological leaks at Indian Point during the license renewal term could impair the best usages of the Hudson River for swimming and recreational purposes?” Mr. Gundersen: “It appears that the radiation is moving toward the river and not laterally up river and or down river. So, what’s in the ground will either decay away or over time enter the river. And it’s a deleterious substance, so, yes, it will adversely affect swimming and fishing.” Hearing Tr. at 2816 (Gundersen) (emphasis added).

¹⁰ Indeed, Department Staff failed to present or develop any technical information on this issue. Its sole exhibit was Mr. Kolakowski’s *curriculum vitae*, which discloses that he is not qualified – as he testified – to address the human or environmental effects of radionuclides in the environment. See Hearing Tr. at 2768 (Kolakowski); DEC Staff Ex. #1.

- **the amount of** radionuclides from unplanned releases from Indian Point that have already reached the Hudson River are extremely small and have had no impact on the best usages of the Hudson River, *see* Hearing Tr. at 3104-07 (Hoffman);¹¹
- **the amount of** radionuclides reasonably expected to reach the Hudson River from unplanned releases at Indian Point will decline over time and, in any event, is reasonably likely to be less than the amount associated with groundwater conditions over the past several years, *see* Hearing Tr. at 3117 (Esselman), 3915, 3918-3920 (Barvenik), 3971 (Barvenik);
- there are reasonable assurances that unplanned releases of radionuclides to groundwater at Indian Point during the license renewal period, if any, will not impair the Hudson River for its best usages, *see* Hearing Tr. at 3107 (Hoffman).¹²

No other conclusion can be supported by the record.¹³

The record could not be more clear that both Department Staff and Riverkeeper have wholly failed to evaluate whether **the amount of** radionuclides released to the Hudson River via

¹¹ Mr. Kolakowski testified that he had no contrary evidence. *See* Hearing Tr. at 2750 (Kolakowski).

¹² Mr. Kolakowski testified that he had no contrary evidence with regard to tritium entering the Hudson River. *See* Hearing Tr. at 2759-2760 (Kolakowski) ("Q: So, I guess I am asking: Do you have any factual basis for believing that the continued operation of units 2 and 3 during license renewal will result in a leak of tritium sufficiently large to impair the waters for their narrative best usage? A: Specific to tritium and specific to surface water, I don't. There doesn't appear that there would be a best usage impact based on the data that we have in front of us now."). He provided no contrary evidence with respect to any other radionuclide.

¹³ Department Staff mischaracterize Dr. Hoffman's testimony by claiming that "an epidemiological risk is present even below the levels that can be observed or measured." DEC Staff Br. at 14. What Dr. Hoffman said was that epidemiological studies would have tremendous difficulties identifying a statistically significant excess risk at the levels of radiation at issue here. *See* Hearing Tr. at 3099-3100 (Hoffman). It is undisputed that there are no data to establish that the occurrence of cancer follows exposure to dose rates below 10,000 mrem, and people living at higher elevations and, therefore, subject to more than three times the natural background levels of radiation (*i.e.* 1,000 mrem as compared to 310 mrem) have shown no adverse effects. *See* Entergy Ex. #43. The linear-no-threshold model conservatively assumes that risk is present below the levels of epidemiological detection (*i.e.*, below 10,000 mrem) and, therefore, a nonzero risk can be calculated for very low levels of exposure to radiation – even such low levels as 0.0002 mrem associated with Indian Point's unplanned releases. *See* Hearing Tr. at 3102-3105 (Hoffman). Of course, Department Staff did not ask or address the central question – whether the amount of radionuclides released could lead to a level of risk that could reasonably be said to constitute an impairment of the waters of the Hudson River – which Dr. Hoffman answered with a resounding "no."

unplanned releases to groundwater will impair the Hudson for its best usages. On direct examination, Mr. Kolakowski testified only that the groundwater beneath Indian Point flows to the Hudson River. *See* Hearing Tr. at 2663 (Kolakowski). His direct testimony said nothing about the concentrations or quantities of materials in the groundwater or the amounts of those materials entering the Hudson River as a result, *see* Kolakowski Pre-filed Direct Testimony, and his rebuttal testimony asserted only that the relative concentrations of radionuclides in some monitoring locations “were higher at times during 2010 than in 2009,” but did not discuss the actual amount of radionuclides entering the Hudson River during any time period, or whether those amounts could reasonably be expected to result in a violation of the best usages standard for SB waters. *See* Kolakowski Pre-filed Rebuttal Testimony, at 4-5.

On cross examination, Mr. Kolakowski testified that he was well aware that a finding of impairment “depend[ed] on the concentrations of the radiological components,” Hearing Tr. at 2752 (Kolakowski). He also testified that he did not review any of Indian Point’s annual radiological effluent release reports, which document the amount of radiological releases to the environment, in connection with his analysis – despite the fact that these reports are regularly submitted to the Department. *Id.* at 2771-2772 (Kolakowski). Additionally, Mr. Kolakowski said that he had no reason to disagree with DEC’s study which concluded that the release of radionuclides to the Hudson River at Indian Point was not affecting the fish in the river. *Id.* at 2767-2768 (Kolakowski). Nor did he provide any prefiled or live testimony to dispute prior public statements by the Department confirming that the unplanned releases at Indian Point complied with WQS and applicable NRC limits or explain why the Notice of Denial contradicted these earlier Department pronouncements. Thus, there is no legitimate dispute that Department Staff failed to address whether the amount of radionuclides reasonably expected to enter the Hudson River from unplanned releases to groundwater during the license renewal period will

impair the best usages of the Hudson River. Further, Department Staff did not address this argument and, therefore, failed to provide any rationale for reaching a conclusion in this proceeding that is directly at odds with its prior assurances to the public regarding the absence of public health and environmental impacts from Indian Point's unplanned releases.

Riverkeeper also failed to address the issue of whether the amount of radionuclides at issue in this proceeding has impaired, or reasonably could impair, the best usages of the Hudson River. Mr. Gundersen's analysis of this issue was summed up succinctly in his response to the question: "What if any effect have radiological leaks from Indian Point had on the Hudson River?":

The radiological leaks introduced deleterious substances into the river. That according to BEIR, BEIR VII, any amount of radiation can cause a cancer. So, it has introduced deleterious material into the river.

Hearing Tr. at 2814-2815 (Gundersen). Aside from being entirely circular in his reasoning, Mr. Gundersen did not analyze the amount of radionuclides entering the Hudson River or whether those amounts could reasonably be said to impair the best usages of the Hudson River.¹⁴ His direct and pre-filed testimony are similarly lacking in any analysis of the amount of radionuclides entering the Hudson River from Indian Point's unplanned discharges. *See* Gundersen Pre-filed Testimony, at 12-15; Gundersen Pre-filed Rebuttal Testimony, at 13-16. Moreover, on cross examination Mr. Gundersen admitted that he did not perform an assessment of whether the amount of radionuclides entering the Hudson River could reasonably be expected to result in an increase in human cancer or impacts to aquatic biota, and that he did not even read

¹⁴ This position also underscores the failure to apply the reasonable assurances standard, as well as the failure to apply the narrative best usages standard as written. The standard is not whether any amount of a substance poses a risk of cancer. The standard is whether there is a reasonable assurance that the amount of the substance released will not impair the water for its best usages. Neither Mr. Kolakowski nor Mr. Gundersen addressed that question. Dr. Hoffman addressed it directly, and concluded that the unplanned releases have had no effect on human health (*i.e.*, via primary or secondary recreational activities) or aquatic biota – that is, no impairment of the best usages of the Hudson River. *See* Hearing Tr. at 3104-3105 (Hoffman).

or review Dr. Hoffman's testimony on that point. *See, e.g.,* Hearing Tr. at 2891-2893, 2897, 2976 (Gundersen).¹⁵ Thus, Riverkeeper equally failed to address the actual best usages standard at issue.

E. The Tribunal should reject Department Staff's attempt to add yet another legal argument found nowhere in the Notice of Denial for denying Entergy's Application.

As detailed in Entergy's initial brief, in its witnesses' pre-filed testimony, Department Staff improperly attempted to advance reasons for its denial of Entergy's Application found nowhere in its Notice of Denial. Department Staff's own witness admitted that his own testimony included grounds for denial of Entergy's Application that were not contained in and not evaluated at the time of the Notice. This is contrary to basic due process guarantees before this Tribunal and, consequently, those newly advanced theories should be stricken from the record.¹⁶

In its opening brief, Department Staff continues to advance arguments to support the Notice that are found nowhere in the Notice, and are otherwise unsupported by fact or law, and therefore should be rejected. For instance, Department Staff now argues –for the first time – that the radionuclides at issue here are “industrial waste” and, therefore, their discharge is prohibited by New York law. For a number of reasons, this late addition to Department Staff's legal

¹⁵ Riverkeeper implies that Dr. Hoffman did not consider the exposure pathway associated with swimming in the Hudson River as part of his analysis. However, Dr. Hoffman testified that all pathways are considered and excluded if not present in the area under consideration. *See* Hearing Tr. at 3278 (Hoffman). Moreover, Dr. Hoffman testified that “[f]or aquatic releases of radionuclides, such as strontium 90, the maximum exposures occur from eating fish. If you had swimming, boating, et cetera, at that same location, they would add an inconsequential amount to the exposures that you would get from fishing. So the fishing pathway gives you the maximum indication of what the exposures would be.” *Id.*

¹⁶ In *Matter of William Haley, Applicant* the Commissioner noted that: “An applicant is entitled to know the grounds upon which its permit application is denied so that, if it seeks a hearing on the denial, it is able to prepare its case including the identification and development of witnesses, the organization of documentary evidence and the development of legal argument. In addition, Department staff needs to inform an applicant of the specific grounds for denial to afford an applicant the opportunity to consider revisions to a project or related mitigation measures....” DEC No. I-4736-06627/00001, 2009 WL 2141501, at *3 (N.Y. Dept. Env. Conserv. June 22, 2009).

theories should be rejected. First, this position is found nowhere in the Notice of Denial. Accordingly, for the same reasons articulated in Entergy's opening brief, this theory should be stricken from the record. Second, characterizing the radionuclides at issue in this case as "industrial waste" is not even relevant to the narrative WQS at issue here. Department Staff's Notice of Denial says that radionuclides are "deleterious substances" and subject to the narrative standard regarding best usages quoted above. Nowhere does that standard use the words "industrial waste," a defined term in the Department's WQS regulations. Its absence is meaningful, because the term "industrial waste" does appear in other narrative standards, in particular the narrative standards for suspended, colloidal and settleable solids ("None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.") and oil and floating substances ("No residue attributable from sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease."). 6 NYCRR §703.2 (emphasis added). Thus, Department Staff is advancing yet another argument completely untethered from the Notice of Denial and the language of the WQS at issue here.

Finally, the state regulations regarding discharges of industrial waste do not contain an absolute ban; rather, the definition of industrial waste itself notes that such discharge is problematic only if it reasonably can be expected to lead to violations of WQS:

Industrial waste means any liquid, gaseous, solid or waste substance, or a combination thereof, resulting from any process of industry, manufacturing, trade, or business or from the development or recovery of any natural resources, that may cause or might reasonably be expected to cause pollution of the waters of the State in contravention of the standards adopted pursuant to [Article 17 of the ECL].

6 NYCRR §700.1(26) (emphasis added). Thus, Department Staff's position that the discharge of "industrial waste" is prohibited under New York law is false, as Department Staff routinely authorize such discharges to waters of the State. Moreover, even the definition of industrial

waste confirms that the inquiry is not whether any industrial waste is discharged but whether the discharge of such waste might “reasonably be expected” to result in a violation of WQS – *i.e.*, in quantities sufficient to violate WQS. As set forth above, the uncontroverted evidence in this case is that Entergy’s unplanned releases have not violated any even potentially applicable WQS, and there are reasonable assurances that any future releases will not violate such standards. Thus, Department Staff’s latest attempt to revise the Notice of Denial and the Department’s own regulations is both prohibited by Department precedent and lacking in merit.

F. DEC is not entitled to any deference on this issue.

Department Staff ask this Tribunal to defer to its expertise with regard to the impact of Indian Point’s radionuclides on the Hudson River. *See* DEC Staff Br. at 22 (“The Department should be accorded deference in its decision making, including weighing and balancing of the above facts, opinions, and circumstances in the context of applicable State water quality standards.”).

Department Staff’s position is legally untenable and factually absurd. First, as discussed above, Department Staff failed to apply the correct legal standards to Entergy’s Application. Second, Department Staff did not offer the expertise of those Staff members who (a) not only actually participated in and concurred with the Indian Point groundwater investigation and remediation strategy, but also issued public notices confirming the absence of impairment, (b) had expertise in radiological materials and their potential impacts on the environment, and (c) concluded that Entergy’s unplanned releases had not violated Hudson River water quality standards. Instead, Department Staff chose to rely on a witness who (i) by his own admission, is unqualified in the area of radiological health and safety or the assessment of impacts associated with radionuclides in the environment, (ii) did not participate in the Indian Point groundwater investigation, and (iii) could not and did not perform an analysis of the impacts of unplanned

releases on Hudson River fish because it was “outside [his] area of expertise.” Hearing Tr. at 2768 (Kolakowski).

“An administrative agency’s interpretation of the statute it is charged with implementing is entitled to varying degrees of judicial deference depending upon the extent to which the interpretation relies upon the special competence the agency is presumed to have developed in its administration of the statute.” *Claim of Gruber*, 89 N.Y.2d 225, 231 (1996) (emphasis added) (quoting *Matter of Rosen v. Public Employment Relations Bd.*, 72 N.Y.2d 42, 47 (1988); see also *Schneider v. Ambach*, 135 A.D.2d 284, 290 (3rd Dept. 1988) (“An administrative agency seeking to support a discriminatory regulation on the basis of considerations outside the scope of its general statutory mandate and specialized knowledge is not entitled to the deference which courts customarily give to agency determinations....”) (emphasis added). Simply put, Department Staff’s conclusions do not rely on those staff members who were directly involved and contributed to the groundwater investigation at Indian Point. Instead, Department Staff knowingly put forth testimony ungrounded in relevant expertise and flatly contradicted by the Department’s communications to the public on this issue. See *Entergy Ex. #46*, 80. As this Tribunal has already indicated, the absence of relevant expertise applied to the Department’s position is a matter of the weight to be afforded Department Staff’s testimony. Not only should Department Staff receive no deference under these circumstances, its testimony should be afforded no weight at all.¹⁷

¹⁷ Indeed, if it were not for Entergy’s inclusion in the record of the Department’s Community Fact Sheets documenting the Department’s independent findings associated with the Indian Point groundwater investigation, this Tribunal would not have been aware of them at all, since Department Staff did not disclose them to the Tribunal or the parties.

- G. Riverkeeper's argument that Department Staff should have proposed to deny the WQC based on impacts to groundwater has no basis in law or fact, and should be rejected.

Riverkeeper argues that, although Department Staff did not propose to deny the WQC based on impacts to groundwater and is on record stating that the CWA does not permit considerations of impacts to groundwater, the Tribunal should recommend denial of Entergy's Application on the basis of radiological contamination of the groundwater beneath Indian Point. For multiple reasons, Riverkeeper's arguments are both legally and factually flawed.¹⁸

1. *The CWA, including Section 401, applies only to discharges to surface waters.*

Section 401 of the CWA requires applicants for federal licenses to provide a certification from the State in which its "discharge" originates that "any such discharge will comply with the applicable provisions of sections [301, 302, 303, 306 and 307] of [the CWA]." 33 U.S.C. § 1341(a)(1). The CWA defines the term "discharge" to include a "discharge of a pollutant, and a discharge of pollutants." 33 U.S.C. § 1362(16). In turn, the phrases "discharge of a pollutant" and "discharges of pollutants" are defined to be:

any addition of any pollutant to navigable waters from any point source, [and] any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft.

33 U.S.C. § 1362(12) (emphasis added). Thus, the certification required under § 401(a) of the CWA is limited to a certification that releases of pollutants to navigable waters or waters of the contiguous zone or ocean comply with the relevant sections of the CWA. The impacts to

¹⁸ Most fundamentally, Riverkeeper's arguments go beyond the issue for adjudication: "whether Department Staff properly denied the WQC application based upon radiological considerations." See Issues Ruling at 25-27, 40. Department Staff did not, in fact, deny Entergy's application on the basis of the concentration of radionuclides in groundwater. The Notice of Denial does not address this topic, and Mr. Kolakowski confirmed during cross examination that the scope of Department Staff's inquiry was on the effect of unplanned releases of radiological materials to groundwater on surface waters – *i.e.*, the Hudson River. See Hearing Tr. at 2759-2763 (Kolakowski). Thus, Riverkeeper's arguments should be rejected as beyond the scope of this hearing.

groundwater of a release from a facility are completely outside the scope of § 401's certification requirement.¹⁹ Accordingly, Riverkeeper's argument falls under the plain language of § 401(a), a fact that Department Staff plainly acknowledged in this proceeding. *See* DEC Staff Br. at 15, 17.

2. *Riverkeeper's argument that § 401(d) permits the denial of Entergy's application on the basis of radiological contamination of groundwater is equally misplaced.*

As discussed above, § 401(d) of the CWA does not provide authority to states to deny a WQC application. At most, § 401(d) authorizes states to condition a WQC to the extent necessary to comply with, among other things, "any other appropriate requirement of State law." Thus, Riverkeeper's reliance on § 401(d) as a basis for the denial of Entergy's Application finds no support in § 401(d).

Riverkeeper further argues that the U.S. Supreme Court decision in *PUD* authorizes states to circumvent the limitations of the CWA, as established in *Train*, and the pre-emptive effect of the AEA, and to regulate the unplanned releases of NRC-regulated materials into groundwater pursuant to the state's groundwater quality standards. What Riverkeeper fails to mention is that *PUD* neither (a) addressed the discharge of pollutants to groundwater, nor (b) addressed the release of NRC-regulated materials into groundwater. Thus, *PUD* is not a license to ignore the jurisdictional limits of the CWA to surface waters or to ignore the exclusive authority of the NRC to regulate radionuclides under the AEA. Riverkeeper cites no relevant authority to support its position that state groundwater quality standards can be applied to NRC-regulated materials found in groundwater beneath NRC-regulated facilities.

¹⁹ Moreover, the U.S. Supreme Court held in *Train* that the definition of "pollutant" under the CWA does not include materials regulated by the NRC under the AEA. This argument applies with equal force here, as the phrase "discharge of a pollutant" necessarily is limited by the same definition of "pollutant" provided by the U.S. Supreme Court. Thus, even if the § 401(a) applied to groundwater – which it plainly does not – the discharge of AEA materials to groundwater is also beyond the reach of the CWA pursuant to *Train*.

3. *The evidence presented by Riverkeeper demonstrates that the groundwater beneath Indian Point meets the best use standard.*

Even if the limits of the CWA did not preclude Riverkeeper's argument, the evidence adduced at trial provides no support for Riverkeeper's position. Entergy's groundwater monitoring network consists of more than 250 different monitoring points. *See* Hearing Tr. at 3917-3918 (Barvenik), Barvenik Prefiled at 5. Water samples collected from the substantial majority of these locations contain radionuclides well below the maximum contaminant levels ("MCLs") that Riverkeeper purports apply here (*i.e.*, 20,000 pCi/l for tritium and 8.0 pCi/l for strontium). *See* Riverkeeper Ex. #14, 19, 22. Thus, even if the MCLs applied to the groundwater, there are multiple locations that groundwater could be removed from beneath Indian Point with concentrations below the MCLs.²⁰

However, as discussed in Entergy's initial brief, the MCLs do not apply to groundwater. The MCLs established by EPA under the federal Safe Drinking Water Act ("SDWA") apply to "public water systems" at the point at which water "is delivered to" any user of that public water system (*i.e.*, at the tap). *See* Entergy Br. at pp. 44-45. The groundwater beneath Indian Point is neither itself a public water system, nor is it delivered to any drinking water user and, therefore, the MCLs do not apply to the groundwater as it resides beneath Indian Point. Thus, Riverkeeper's arguments fail as a matter of fact as well as law.²¹

²⁰ Riverkeeper repeatedly alleges that Entergy has "refused" to employ groundwater extraction wells at Indian Point. *See, e.g.*, Rkp. Br. at 83, 88. This is simply not true – neither the NRC nor DEC have required extraction wells. In collaboration with both DEC and NRC, Entergy has employed a remedial strategy of monitored natural attenuation. There is no public health or environmental protection basis for requiring more, as Dr. Hoffman testified that there are "zero" impacts associated with the unplanned releases at issue. *See* Hearing Tr. 3104-3107 (Hoffman). To the extent extraction wells were required at Indian Point, no one has contested Entergy's conceptual plan to implement that remedial strategy.

²¹ It is disputed that unplanned releases of radionuclides from Indian Point have not contaminated any drinking water sources or any off-site groundwater. *See* Entergy Ex. #33, at viii, 114; Entergy Ex. #34, at v-vi; Entergy Ex. #38 at 1-1, Entergy Ex. #40 at 1-1; Entergy Ex. #46; Hearing Tr. at 3925-26 (Barvenik).

CONCLUSION

In sum, both Congress's decision to preclude the regulation of NRC-regulated radiological materials from the scope of the CWA and the preemptive effect of the AEA clearly prohibit Department Staff's attempt to deny Entergy's Application based upon the unplanned releases of AEA-governed radiological materials. Further, even if DEC possessed authority to regulate Indian Point's radiological releases, which it does not, the evidence adduced at trial demonstrates that Department Staff have repeatedly advanced rationales for its denial of Entergy's Application found nowhere in the Notice of Denial, in direct violation of applicable precedent and fundamental notions of due process. Both Department Staff and Riverkeeper claim that Entergy must predict the future with certainty in order to obtain a WQC, another position directly contradicted by controlling precedent which both parties neglected to cite to this Tribunal. They then argue that the discharge of any amount of deleterious substance to the waters of the State is prohibited by New York law – a position flatly refuted by the Department's own regulations authorizing concentrations of these substances in State waters and its routine authorization of such discharges around the state – even though the narrative WQS cited in the Notice of Denial expressly requires an evaluation of whether the amount of deleterious substances will impair the waters for its best usages. And to top it off, Department Staff demands that this Tribunal defer to its decision making despite its multiple failures to apply the law or the expertise of Staff with knowledge and experience in radiological matters, including the Indian Point groundwater investigation.

The record demonstrates uncontrovertibly that the unplanned releases from Indian Point have not posed a threat to public health, the environment or the best usages of the Hudson River, and that there are reasonable assurances that any future unplanned releases will not impair such

usages. Entergy respectfully requests that the Tribunal rule conclusively and completely in Entergy's favor.