LBP-13-13

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

Lawrence G. McDade, Chairman
Dr. Michael F. Kennedy
Dr. Richard E. Wardwell

| | |
|---|---|
| In the Matter of | Docket Nos. 50-247-LR and 50-286-LR |
| ENTERGY NUCLEAR OPERATIONS, INC. | ASLBP No. 07-858-03-LR-BD01 |
| (Indian Point Nuclear Generating Units 2 and 3) | November 27, 2013 |

Partial Initial Decision
(Ruling on Track 1 Contentions)

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APPENDIX A ..... A1

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ACE | Accuracy and Coverage Evaluation |
| ACRS | Advisory Committee on Reactor Safety |
| AEA | Atomic Energy Act |
| AFW | Auxiliary Feedwater System |
| AMP | Aging Management Program |
| APA | Administrative Procedures Act |
| APEC | Area Potential Earth Current |
| API | American Petroleum Institute |
| AWWA | American Water Works Association |
| BPTIMP | Buried Pipes and Tanks Inspection and Monitoring Program |
| BPTIP | Buried Pipes and Tanks Inspection Program |
| BWR | Boiling Water Reactor |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CIS | Close Interval Survey |
| CLB | Current Licensing Basis |
| CP | Cathodic Protection |
| CR | Condition Report |
| CST | Condensate Storage Tank |
| DSEIS | Draft Supplemental Environmental Impact Statement |
| EIS | Environmental Impact Statement |
| EJ | Environmental Justice |
| EPA | Environmental Protection Agency |
| EPRI | Electric Power Research Institute |
| EPU | Extended Power Uprate |
| FAC | Flow Accelerated Corrosion |
| FEIS | Final Environmental Impact Statement |
| FSAR | Final Safety Analysis Report |
| FSEIS | Final Supplemental Environmental Impact Statement |
| FSER | Final Safety Evaluation Report |
| GALL-1 | Generic Aging Lessons Learned, Revision 1 |
| GALL-2 | Generic Aging Lessons Learned, Revision 2 |
| GEIS | Generic Environmental Impact Statement |
| GWT | Guided Wave Ultrasonic Testing |
| IP1 | Indian Point Unit 1 |
| IP2 | Indian Point Unit 2 |
| IP3 | Indian Point Unit 3 |
| IPA | Integrated Plant Assessment |

| | |
|---|---|
| IPEC | Indian Point Energy Center |
| LOCA | Loss of Coolant Accident |
| LRA | License Renewal Application |
| LWR | Light Water Reactor |
| NACE | National Association of Corrosion Engineers |
| NEI | Nuclear Energy Institute |
| NEPA | National Environmental Policy Act |
| NL | Nuclear Licensing |
| Non-EQ | Non-Environmentally Qualified |
| NPP | Nuclear Power Plant |
| NRC | U.S. Nuclear Regulatory Commission |
| NSAC | Nuclear Safety Analysis Center |
| PCA | PCA Engineering, Inc. |
| PEO | Period of Extended Operation |
| RAI | Request for Additional Information |
| SAMA | Severe Accident Mitigation Alternatives |
| SAR | Safety Analysis Report |
| SBO | Station Blackout |
| SER | Safety Evaluation Report |
| SIA | Structural Integrity Associates |
| SPU | Stretch Power Uprate |
| SRP-LR | Standard Review Plan – License Renewal |
| SSC | System, Structure, and Component |
| SSER | Supplemental Safety Evaluation Report |
| TC | Technical Contention |
| TLAA | Time-Limited Aging Analysis |
| UFSAR | Updated Final Safety Analysis Report |
| UPTIMP | Underground Piping and Tanks Inspection and Monitoring Program |
| UT | Ultrasonic Testing |

Partial Initial Decision
(Ruling on Track 1 Contentions)[1]

This proceeding arises out of the April 23, 2007, application of Entergy Nuclear Operations, Inc. (Entergy or Applicant) to renew its 10 C.F.R. Part 50 operating licenses for Indian Point Nuclear Generating Units 2 and 3 (IP2 and IP3) which are located at its Indian Point Energy Center (IPEC) in Buchanan, New York.[2] Currently pending before this Atomic Safety and Licensing Board (the Board) are nine contentions,[3] each asserting specific grounds for denial of license renewal. If granted renewed licenses, Entergy would be permitted to operate IP2 and IP3 for an additional twenty-year period beyond the period specified in the current operating licenses,[4] which expired on September 28, 2013, for IP2, and will expire on December 12, 2015, for IP3.[5] Nevertheless, pursuant to 10 C.F.R. § 2.109(b), IP2 and IP3 may continue to operate until this adjudication is completed.[6]

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[1] The nine contentions that are the subject of this partial initial decision (the "Track 1" contentions) went to hearing in October, November, and December 2012. As will be explained below, an additional six contentions (the "Track 2" contentions) will not be heard until the NRC Staff completes its safety and environmental review.

[2] 72 Fed. Reg. 26,850 (May 11, 2007).

[3] A tenth contention, RK-EC-3/CW-EC-1, concerning impacts from spent fuel pool leaks was scheduled to be heard during the October 2012 session but settled shortly before the hearing was to begin. See Licensing Board Consent Order (Approving Settlement of Consolidated Contention Riverkeeper EC-3A and Clearwater EC-1 (Oct. 17, 2012) (unpublished).

[4] 72 Fed. Reg. 26,850.

[5] Id. We note that the second *Federal Register* Notice concerning this case stated the expiration for IP2 license is September 9, 2013. Both September 9, 2013, and September 28, 2013, appear in various documents as the license expiration date for IP2. See 72 Fed. Reg. 42,134, 42,134 (Aug. 1, 2007); but see License Renewal Application Indian Point Energy Center at 1-1 (Apr. 23, 2007) (Ex. ENT00015A) [hereinafter License Renewal Application].

[6] See 10 C.F.R. § 2.109(b) (2012).

On June 8, 2012, the Board issued a hearing notice, listing the previously-admitted contentions on which the Board would take oral testimony during October and December, 2012.[7] The Track 1 hearing contentions, in brief, are as follows:

1. Contention RK-TC-2:[8] Challenges the adequacy of Entergy's aging management program (AMP) for flow accelerated corrosion.

2. Contention NYS-5:[9] Challenges the adequacy of Entergy's AMP for the inspection and monitoring for corrosion or leaks in all buried systems, structures, and components (SSCs) that convey or contain radioactive material.

3. Contention NYS-6/7: Challenges the adequacy of Entergy's AMP for non-environmentally-qualified inaccessible medium-voltage and low-voltage cables and wiring.

4. Contention NYS-8: Challenges Entergy's omission of an AMP for safety-related electrical transformers.

5. Contention NYS-12C: Challenges the Nuclear Regulatory Commission's (NRC Staff or Staff) compliance with the National Environmental Policy Act (NEPA) concerning its severe accident mitigation alternatives (SAMA) analysis of the decontamination and clean-up costs of a severe accident in the New York Metropolitan area.[10]

6. Contention NYS-16B: Challenges the Staff's compliance with NEPA concerning its SAMA analysis of the cost of human exposure in the case of a severe accident.

7. Contention NYS-17B: Challenges the Staff's compliance with NEPA relating to an analysis of the impacts of license renewal on property values for real property near the IPEC.

8. Contention NYS-37: Challenges the Staff's compliance with NEPA concerning the adequacy of its no-action alternative analysis.

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[7] 77 Fed. Reg. 36,015, 36,016 (June 15, 2012). Due to circumstances that arose after the time of the publication of the hearing notice, the Board also conducted a brief session on November 28, 2012. Licensing Board Order (Scheduling the Continuation of the Hearing on Contention NYS-37) (Nov. 14, 2012) (unpublished).

[8] Contentions beginning with letters "RK" were submitted by Riverkeeper. The letters "TC" indicated that it was proffered as a technical contention, as opposed to an environmental contention (EC).

[9] Contentions beginning with the letters "NYS" were submitted by New York.

[10] An explanation of SAMA analyses begins at page 262 below.

9. Contention CW-EC-3A:[11] Challenges the Staff's compliance with NEPA concerning its environmental justice analysis.

In this partial initial decision, we address the merits of these nine contentions. We note that this decision does not resolve all pending issues in this proceeding, as six additional contentions (Track 2 Contentions) have not yet gone to hearing, and there still remains the potential for the filing of new and/or amended contentions.[12]

[11] Contentions beginning with the letters "CW" were submitted by Clearwater.

[12] The not-yet litigated contentions are NYS-25, NYS-26B/RK-TC-1B, NYS-38/RK-TC-5, RK-EC-8, NYS-39/RK-EC-9/CW-EC-10, and CW-SC-4. See 77 Fed. Reg. at 36,016 (discussing the posture of NYS-38/RK-TC-5 and RK-EC-8); id. at n.14 (discussing the posture of NYS-25, NYS-26B/RK-TC-1B, NYS-38/RK-TC-5, and RK-EC-8); Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished). An amended contention arose from the NRC Staff's supplements to the Final Environmental Impact Statement and/or may arise from the Final Safety Evaluation Report, as well as Entergy changes to its LRA. See Riverkeeper, Inc. Consolidated Motion for Leave to File Amended Contention RK-EC-8A and Amended Contention RK-EC-8A (Aug. 20, 2013); see also Licensing Board Order (Memorializing Items Discussed During the July 9, 2012 Status Conference) (July 12, 2012) at 2–3 (unpublished); Licensing Board Order (Granting State of New York Motion for Extension of Time to File New Contentions) (Aug. 31, 2012) at 1 (unpublished); NRC Staff's 21st Status Report in Response to the Atomic Safety and Licensing Board's Order of February 16, 2012 (Nov. 1, 2013) at 2–3 (indicating that the Staff expects to issue the SER Supplement in "early- to mid-2014," which affects Track 2 contentions NYS-25 and NYS-38/RK-TC-5); Licensing Board Order (Establishing Deadline for Motions for New and Amended Contentions) (July 9, 2013) at 2 (unpublished) (setting August 20, 2013 deadline to file new or amended contentions based on the FSEIS Supplement, Vol. 4, published on June 21, 2013 which affects RK-EC-8).

## I. GENERAL BACKGROUND

On April 23, 2007, Entergy filed a license renewal application (LRA) pursuant to 10 C.F.R. Part 54[13] requesting an additional twenty-year term for its operating licenses for IP2 and IP3 (Operating Licenses Nos. DPR-26 and DPR-64) that have been issued under Section 104(b) of the Atomic Energy Act (AEA) of 1954 as amended.[14]

Entergy's renewal application encompasses the facility operating licenses for both IP2 and IP3, and renewal of those NRC source materials, special nuclear material, and by-product material licenses that are subsumed or combined with the facility operating licenses.[15]

### A. Contention Admissibility and the Parties to the Proceeding

After the Commission published in the *Federal Register* a notice of opportunity for hearing,[16] sixteen parties filed requests for hearing and petitions to intervene: the State of New York (New York);[17] the State of Connecticut (Connecticut);[18] Westchester County, New York (Westchester);[19] the Town of Cortlandt, New York (Cortlandt);[20] the Village of Buchanan, New

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[13] See License Renewal Application (Exs. ENT00015A–B).

[14] Id. at 1-4. The Nuclear Regulatory Commission (NRC) issued construction permits in 1966 and 1969 and operating licenses in 1973 and 1975 for IP2 and IP3, respectively. IP2 and IP3 employ a pressurized water reactor design with a dry ambient containment. Each unit is licensed for a power output of 3216 megawatts thermal with a gross electrical output of approximately 1080 megawatts electric.

[15] Id. at 1-4.

[16] 72 Fed. Reg. at 42,134 (Aug. 1, 2007). See also 72 Fed. Reg. 55,834 (Oct. 1, 2007) (extending the deadline for filing requests for hearing or petitions to intervene in this case).

[17] New York State Notice of Intention to Participate and Petition to Intervene (Nov. 30, 2007) [hereinafter New York Petition].

[18] Petition for Leave to Intervene, Request for Hearing and Contentions of Richard Blumenthal, Attorney General of Connecticut, for the License Renewal Proceeding for Indian Point Nuclear Generating Unit Nos. 2 and 3, DPR-26 and DPR-64 (Nov. 30, 2007).

[19] Westchester County's Notice of Intention to Participate and Petition to Intervene (Dec. 7, 2007).

[20] Town of Cortlandt Request for Hearing and Petition to Intervene (Nov. 29, 2008).

York (Buchanan);[21] the City of New York (New York City);[22] the New York Affordable Reliable Electricity Alliance (New York AREA);[23] Friends United for Sustainable Energy (FUSE);[24] Hudson River Sloop Clearwater (Clearwater);[25] Connecticut Residents Opposed to Relicensing Indian Point (CRORIP);[26] Westchester Citizen Awareness Network (WestCAN); Rockland County Conservation Association; Sierra Club – Atlantic Chapter; Assemblyman Richard Brodsky; Public Health and Sustainable Energy;[27] and Riverkeeper, Inc. (Riverkeeper).[28] On October 18, 2007, this Board was established to adjudicate the issues raised by the sixteen petitioners.[29]

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[21] Village of Buchanan Hearing Request and Petition to Intervene (Nov. 15, 2007).

[22] Amended Petition for Leave to Intervene and Statement of Interest of the City of New York (Nov. 29, 2007).

[23] New York Affordable Reliable Electricity Alliance's Petition to Intervene (Nov. 28, 2007). Petitioner is an agency of the City of New York.

[24] Friends United for Sustainable Energy Superceding Request for Hearing and Petition to Intervene (Dec. 24, 2007).

[25] Hudson River Sloop Clearwater Inc.'s Petition to Intervene and Request for Hearing (Dec. 10, 2007) [hereinafter Clearwater Petition].

[26] Connecticut Residents Opposed to Relicensing of Indian Point and Its Designated Representatives Petition to Intervene and Request for Hearing (Dec. 11, 2007).

[27] Westchester Citizen Awareness Network; Rockland County Conservation Association; Sierra Club – Atlantic Chapter; Assemblyman Richard Brodsky; and Public Health and Sustainable Energy filed their petition jointly. See WestCAN Petition for Leave to Intervene with Contentions and Request for Hearing (Dec. 10, 2007).

[28] Riverkeeper, Inc.'s Request for Hearing and Petition to Intervene in the License Renewal Proceeding for the Indian Point Nuclear Power Plant (Nov. 30, 2007) [hereinafter Riverkeeper Petition].

[29] See 72 Fed. Reg. 60,394 (Oct. 24, 2007). On April 9, 2012, the Board was reconstituted, substituting Judge Michael F. Kennedy for Judge Kaye D. Lathrop. 77 Fed. Reg. 22,361 (Apr. 13, 2012).

Early in the proceeding, the petitions for leave to intervene of Buchanan, New York City, and the New York AREA were denied.[30] Although Buchanan and New York City failed to raise admissible contentions, each was eligible to participate in the proceeding as an interested governmental entity pursuant to 10 C.F.R. § 2.315(c), and on December 18, 2008, both were granted this status.[31] On February 1, 2008, the Board struck with prejudice the petition of FUSE for failing to comply with the NRC Rules of Practice and Board orders.[32] On July 31, 2008, the Board struck the joint petition for leave to intervene of WestCAN; Rockland County Conservation Association; Sierra Club – Atlantic Chapter; Assemblyman Richard Brodsky; and Public Health and Sustainable Energy for filing multiple "materially false" certificates of service and making several false representations to the Board and other parties.[33]

Also on July 31, 2008, the Board issued a memorandum and order that (1) granted the requests for hearing and petitions to intervene of New York, Riverkeeper, and Clearwater (collectively, the Intervenors); (2) denied the requests for hearing of CRORIP, Cortlandt, Connecticut, and Westchester; and (3) granted interested governmental entity status pursuant

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[30] Memorandum and Order (Denying the Village of Buchanan's Hearing Request and Petition to Intervene) (Dec. 5, 2007) (unpublished) [hereinafter Buchanan Order]; Memorandum and Order (Denying the City of New York's Petition for Leave to Intervene) (Dec. 12, 2007) (unpublished) [hereinafter New York City Order]; Memorandum and Order (Denying the New York Affordable Reliable Electricity Alliance's Petition to Intervene) (Dec. 12, 2007) (unpublished).

[31] Buchanan Order at 9–10; New York City Order at 8–9; Licensing Board Order (Authorizing Interested Governmental Entities to Participate in this Proceeding) (Granting in Part Riverkeeper's Motion for Clarification and Reconsideration of the Board's Ruling in LBP-08-13 Related to the Admissibility of Riverkeeper Contention EC-2) (Denying Riverkeeper's Request to Admit Amended Contention EC-2 and New Contentions EC-4 and EC-5) (Denying Entergy's Motion for Reconsideration of the Board's Decision to Admit Riverkeeper EC-3 and Clearwater Contention EC-1) (Dec. 18, 2008) at 2 (unpublished).

[32] Licensing Board Order (Granting the NRC Staff's Motion to Strike FUSE's Superceding Request for Hearing) (Feb. 1, 2008) at 5–6 (unpublished).

[33] Licensing Board Order (Striking WestCAN's Request for Hearing) (July 31, 2008) (unpublished), aff'd, CLI-08-29, 68 NRC 899 (2008).

to 10 C.F.R. § 2.315(c) to Cortlandt, Connecticut, and Westchester.[34] The Board admitted fifteen contentions proffered by New York, Riverkeeper, and Clearwater. In addition to the nine contentions discussed in this decision, the Board also admitted:

1. Contention NYS-24: Challenged the adequacy of Entergy's AMP for containment structural integrity.

2. Contention NYS-25: Challenged the adequacy of Entergy's AMP for embrittlement of the reactor pressure vessel and associated internals.

3. Contention NYS-26A: Challenged the adequacy of Entergy's AMP for managing age-related metal fatigue on key reactor components. (Consolidated with Contention RK-TC-1A).

4. Contention RK-TC-1A: Challenged the adequacy of Entergy's AMP for managing age-related metal fatigue on key reactor components. (Consolidated with Contention NYS-26A).

5. Contention RK-EC-3: Challenged the adequacy of Entergy's assessment of the environmental impacts of radionuclide leaks from spent fuel pools. (Consolidated with Contention CW-EC-1).

6. Contention CW-EC-1: Challenged the adequacy of Entergy's assessment of the environmental impacts of radionuclide leaks from spent fuel pools. (Consolidated with Contention RK-EC-3).[35]

In addition to these fifteen contentions that were admitted in the July 31, 2008, order, as we describe below, the Board subsequently admitted four additional contentions based on new information that arose during the course of this proceeding.

On June 30, 2010, the Board admitted, in part, contentions NYS-35 and NYS-36.[36] NYS-35 was admitted as a contention of omission calling for completion of the analyses to

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[34] LBP-08-13, 68 NRC 43, 59 (2008). See also Licensing Board Order (Authorizing Interested Governmental Entities to Participate in this Proceeding) (Granting in Part Riverkeeper's Motion for Clarification and Reconsideration of the Board's Ruling in LBP-08-13 Related to the Admissibility of Riverkeeper Contention EC-2) (Denying Riverkeeper's Request to Admit Amended Contention EC-2 and New Contentions EC-4 and EC-5) (Denying Entergy's Motion for Reconsideration of the Board's Decision to Admit Riverkeeper EC-3 and Clearwater Contention EC-1) (Dec. 18, 2008) at 2 (unpublished).

[35] LBP-08-13, 68 NRC at 218–19. These descriptions are of the initially admitted contentions, which in some cases were amended at a later date.

[36] LBP-10-13, 71 NRC 673, 676 (2010).

determine whether the proposed SAMAs were cost beneficial.[37] NYS-36 addressed SAMAs that were initially deemed cost beneficial, but appeared dramatically more cost beneficial in updated analyses.[38] NYS-36 was admitted based on the rationale that the Staff failed to require implementation of the plainly cost-beneficial SAMAs or to explain why no such implementation was required.[39] These contentions were consolidated as NYS-35/36.[40] Entergy and the NRC Staff filed for interlocutory review of the Board's decision admitting NYS-35/36. The Commission denied the petitions because the filings did not meet the established standards for interlocutory review.[41]

On July 6, 2011, the Board admitted RK-EC-8, which alleged that the Staff had failed to consult with the National Marine Fisheries Service as required by the Endangered Species Act and failed to consider the outcome of the consultation process in the issuance of its final supplemental environmental impact statement (FSEIS).[42]

On November 10, 2011, the Board admitted and consolidated NYS-38/RK-TC-5, which challenged the adequacy of various of Entergy's AMPs with regard to several critical components and systems, including, for example, the AMP for managing metal fatigue and the AMP for managing the effects of aging on the reactor vessel internals.[43]

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[37] Id. at 698, 702.

[38] Id.

[39] Id. at 702.

[40] Id.

[41] CLI-10-30, 72 NRC 564, 565 (2010).

[42] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 61, 71 (unpublished).

[43] Licensing Board Memorandum and Order (Admitting New Contention NYS-38/RK-TC-5) (Nov. 10, 2011) at 2, 12 (unpublished).

For the convenience of the parties, Appendix A to this partial initial decision is a list of all admitted contentions including their current status, *i.e.*, settled and dismissed, summary disposition granted, resolved in this partial initial decision, or pending.

**B. Pre-Hearing Disposition of Admitted Contentions[44]**

Several admitted contentions were disposed of prior to the evidentiary hearing. On January 26, 2012, the Board approved a settlement agreement between New York and Entergy concerning NYS-24.[45] Finding that the proposed resolution of NYS-24 would avoid unnecessary litigation and would serve the public interest, the Board approved the parties' agreement and dismissed NYS-24.[46] RK-EC-3/CW-EC-1 was also settled by agreement among Riverkeeper, Clearwater, and Entergy.[47] Finding that the resolution of RK-EC-3/CW-EC-1 would enhance the NRC's oversight of Entergy's Radiological Environmental Monitoring Program and would serve the public interest, the Board approved the agreement and dismissed RK-EC-3/CW-EC-1 on October 17, 2012.[48]

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[44] Other proffered contentions were disposed of by the Board as inadmissible. See, e.g., LBP-08-13, 68 NRC at 71, 73, 163, 181, 196, 209, 217 (rejecting contentions proffered by New York, Riverkeeper, Connecticut, Clearwater, Cortlandt, and Connecticut Residents Opposed to Relicensing Indian Pont); Licensing Board Memorandum and Order (Denying Riverkeeper's and Clearwater's Motion for Leave to File New Environmental Contention Regarding NRC's Near-Term Task Force on Fukushima) (Mar. 30, 2012) at 1 (unpublished).

[45] Licensing Board Order (Approving Settlement of Contention NYS-24) (Jan. 26, 2012) at 1–2 (unpublished).

[46] Id. at 2.

[47] Joint Motion for Approval of Settlement Agreement and Dismissal of Consolidated Contention Riverkeeper EC-3 and Clearwater EC-1 (Spent Fuel Pool Leaks) (Oct. 12, 2012). Cortlandt did not object to the settlement. See Email from Victoria Shiah Treanor, Sive Paget & Riesel, P.C., to Anne Siarnacki, Atomic Safety and Licensing Board Law Clerk (Oct. 16, 2012) (Ex. BRD000003).

[48] Licensing Board Consent Order (Approving Settlement of Consolidated Contention Riverkeeper EC-3 and Clearwater EC-1) (Oct. 17, 2012) (unpublished).

On July 14, 2011, the Board ruled on cross-motions for summary disposition concerning Contention NYS-35/36.[49] In granting summary disposition in favor of New York, the Board held that:

> under NRC Regulations, the [Administrative Procedure Act] APA, and NEPA, Entergy's licenses cannot be renewed unless and until the NRC Staff reviews Entergy's completed SAMA analyses and either incorporates the results of these reviews into the FSEIS or, in the alternative, modifies its FSEIS to provide a valid reason for recommending the renewal of the licenses before the analysis of potentially cost-effective SAMAs is complete and for not requiring the implementation of cost-beneficial SAMAs.[50]

Entergy appealed the Board's decision to the Commission.[51] The Commission declined to review the Board's ruling at that time because it was not final, and Entergy had not met the requirements for interlocutory review.[52] On May 6, 2013, Entergy submitted to the NRC Staff the results of engineering cost estimates for SAMAs that it had previously identified as potentially cost beneficial.[53] However, to date, the Staff stated that it has not decided whether to revise its FSEIS to elaborate on this analysis.[54] Given the state of the record, unless the Board's July 2011 Order granting summary disposition is vacated, Entergy cannot be issued a renewed license unless and until admissible contentions regarding that analysis have been resolved.[55]

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[49] LBP-11-17, 74 NRC 11 (2011).

[50] Id. at 27.

[51] Applicant's Petition for Review of LBP-11-17 Granting Summary Disposition of Consolidated Contention NYS-35/36 (July 29, 2011).

[52] CLI-11-14, 74 NRC 801, 813–14 (2011).

[53] NL-13-075, Letter from F. Dacimo, Vice President, Indian Point Energy Center, to NRC Document Control Desk, License Renewal Application – Completed Engineering Project Cost Estimates for SAMAs Previously Identified as Potentially Cost-Beneficial (May 6, 2013).

[54] See NRC Staff's 21st Status Report in Response to the Atomic Safety and Licensing Board's Order of February 16, 2012 (Nov 1, 2013) at 2–3.

[55] LBP-11-17, 74 NRC at 27.

### C. Questions Relating to the Waste Confidence Rule (10 C.F.R. § 51.23)

In November 2009, Clearwater moved for leave to file new contentions relating to the potential environmental and safety impacts of the long-term storage of spent fuel at IPEC.[56] In response, the Board certified to the Commission questions raised by Clearwater's proposed contentions that addressed significant legal and policy issues and challenged the continued viability of the Waste Confidence Rule (10 C.F.R. § 51.23).[57] More specifically, in 2010, the Board requested that the Commission explain how recent developments affecting the proposed Yucca Mountain nuclear waste repository affect the application of Section 51.23.[58] In response to our request for guidance, in July 2010, the Commission ordered the Board to deny admission of Clearwater's contentions, stating that the issue was being addressed through generic rulemaking.[59]

Subsequently, a 2012 ruling from the United States Court of Appeals for the District of Columbia Circuit[60] vacated the Commission's Waste Confidence Rule concerning the storage and disposal of high level waste (10 C.F.R. § 51.23(a)), and remanded the issue to the Commission to generate either a generic analysis that is "forward looking" and has "enough breadth to the support the Commission's conclusions"[61] or a site-specific environmental impact

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[56] See Hudson River Sloop Clearwater, Inc.'s Motion for Leave to Add a New Contention Based Upon New Information (corrected version Nov. 6, 2009).

[57] Licensing Board Memorandum and Order (Certification to the Commission of a Question Relating to the Continued Viability of 10 C.F.R. § 51.23(b) Arising from Clearwater's Motion for Leave to Admit New Contentions) (Feb. 12, 2010) at 1 (unpublished).

[58] Id. at 2.

[59] CLI-10-19, 72 NRC 98, 100 (2010). As directed, the Board denied Clearwater's motion. See Licensing Board Order (July 14, 2010) at 1 (unpublished).

[60] New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012).

[61] Id. at 483.

statement in all relevant proceedings.[62] New York, Riverkeeper, and Clearwater promptly filed contentions challenging the Staff's reliance on the Waste Confidence Rule in this proceeding.[63] The Commission preemptively responded to these filings, and similar filings in other proceedings, by directing "that these contentions – and any related contentions that may be filed in the near term – be held in abeyance pending . . . further order [of the Commission]."[64] The Commission also held that the NRC "will not issue licenses dependent upon the Waste Confidence Decision or the Temporary Storage Rule until the [D.C. Circuit's] remand is appropriately addressed."[65] Therefore, the Applicant will not be granted renewed licenses until the Commission has reissued its analysis on the storage of nuclear waste – either in a site-specific or generic way.[66]

**D. NRC Staff Review**

License renewal requires two concurrent actions by the NRC Staff, an environmental analysis as required by NEPA, and a technical review of safety issues as required by the AEA. These actions are primarily governed by NRC regulations in 10 C.F.R. Parts 51 and 54, which respectively set forth the requirements for the environmental review and safety analysis.[67]

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[62] Id. at 478.

[63] See State of New York, Riverkeeper, and Clearwater's Joint Motion for Leave to File a New Contention Concerning the On-Site Storage of Nuclear Waste at Indian Point (July 8, 2012).

[64] Calvert Cliffs Nuclear Project, L.L.C. (Calvert Cliffs Nuclear Power Plant, Unit 3), et al., CLI-12-16, 76 NRC 63, 68–69 (2012). See also Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished).

[65] Calvert Cliffs, CLI-12-16, 76 NRC at 67.

[66] In response to this remand, on September 13, 2013, the NRC Staff published a proposed rule and notice of availability of a draft EIS on waste confidence issues. Comments on the proposed rule and draft EIS are due to be filed by November 27, 2013. 78 Fed. Reg. 56,776 (Sept. 13, 2013) Proposed Rule; 78 Fed. Reg. 56,621 (Sept. 13, 2013) Draft Waste Confidence GEIS.

[67] It should be noted that the Commission has stated that, in the context of license renewal, "[t]he Commission's AEA review under Part 54 does not compromise or limit NEPA." Fla. Power & Light Co. (Turkey Point Nuclear Plant, Units 3 and 4), CLI-01-17, 54 NRC 3, 13 (2001).

### 1. Safety Evaluation Report and Supplements

The Safety Evaluation Report (SER) for this license renewal proceeding "summarizes the results of the Staff's safety review of the LRA and describes the technical details considered in evaluating the safety aspects of the units' proposed operation for an additional 20 years beyond the term of the current operating licenses."[68] The SER was "based on the applicant's LRA, amendments to the LRA, and on its responses to the staff's requests for additional information."[69] A draft SER with twenty open items was issued in January 2009.[70] After resolution of those open items,[71] the SER issued in November 2009.[72] In August 2011, the Staff issued a supplement to the SER (SSER, Vol. 1), which encompassed additional information provided by Entergy after the release of the SER and discussed the issues associated with several admitted contentions, including NYS-5 and NYS-6/7.[73]

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[68] Office of Nuclear Reactor Regulation (NRR), Nuclear Regulatory Commission (NRC), Safety Evaluation Report (SER) Related to the License Renewal of Indian Point Nuclear Generating Units Nos. 2 and 3 (Nov. 2009) at 1-2 (Ex. NYS00326A) [hereinafter SER].

[69] Id.

[70] NRR, NRC, SER with Open Items Related to the License Renewal of Indian Point Nuclear Generating Unit Nos. 2 and 3 (Jan. 2009) at iii (ADAMS Accession No. ML090150571) [hereinafter DSER].

[71] SER at iii (Ex. NYS00326A).

[72] See SER (Exs. NYS00326A–F).

[73] NRR, NRC, SER Related to the License Renewal of Indian Point Nuclear Generating Units Nos. 2 and 3, Supp. 1 at 1-1, 3-1 to -5, 3-5 to -9 (Aug. 2011) (Ex. NYS000160). The Staff informed the Board that the SSER, Vol. 1 would not be issued with open items and that any other SSER supplements likewise would be issued in their finalized form. Tr. at 1006–07 (Mr. Turk for the NRC Staff). At this juncture, the first citation to the proceeding's transcript, we note a transcript pagination error that occurred in 2009. On January 14, 2009, the Board conducted a telephone conference, which was transcribed on pages 748 through 833. On August 24, 2009, we conducted another telephone conference, which was transcribed on pages 748 to 794. Because two sets of pages were labeled 748 to 794, all transcripts originating after January 14, 2009 contain a 46-page mispagination. Rather than create additional confusion attempting to repaginate the transcript of this proceeding, we simply note the error here for clarity.

In January 2012, the Staff first informed the Board of a recent development that it considered relevant to and which the Staff believed could affect litigation of Contention NYS-25.[74] Based on responses to Requests for Additional Information (RAIs), the Staff indicated that its "review of this matter may be the subject of a [second] . . . SER for the Indian Point license renewal application."[75] Confirmation that the Staff expected to issue a second supplemental SER came in July 2012 – when the Staff informed the Board that it expected to complete its review of Entergy's Reactor Vessel Internals Program, and to issue a second Supplement to the SER in December 2012.[76] That estimated release date was extended several times. At the time of this decision's issuance, the NRC Staff indicated that it expects to issue the SER Supplement in "early- to mid-2014."[77]

**2. Supplemental Environmental Impact Statement**

NEPA requires "federal agencies such as the [Nuclear Regulatory] Commission to examine and report on the environmental consequences of their actions."[78] Under NEPA, federal agencies must prepare an Environmental Impact Statement (EIS) before taking a "major

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[74] Letter from Sherwin E. Turk, Counsel for the NRC Staff, to Lawrence G. McDade, Chair, Dr. Kaye Lathrop, and Dr. Richard Wardwell, Atomic Safety and Licensing Board (Jan. 27, 2012) at 1.

[75] Id.

[76] NRC Staff's Fifth Status Report in Response to the Atomic Safety and Licensing Board's Order of February 16, 2012 (July 2, 2012) at 2.

[77] As noted above in note 12, the most recent estimate proffered by the Staff for the publication of the SER supplement is "early- to mid-2014."

[78] New York v. NRC, 681 F.3d at 476.

Federal action . . . significantly affecting the quality of the human environment."[79] The reissuance of a reactor license is a major federal action, requiring such a review.[80]

To meet this responsibility under NEPA, the Staff considered the environmental impacts of renewing a nuclear operating license for an additional twenty years in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS).[81] The GEIS covers a generic review of sixty-nine issues that apply to license renewal at all plants.[82] The Commission also identified twenty-three issues that must be evaluated in a site-specific manner through a supplement to the GEIS – to the extent that each issue is relevant to the plant applying for the license.[83] In December 2008, the Staff released the Draft Supplemental Environmental Impact Statement (DSEIS), which preliminarily recommended preserving the option of license renewal for energy planning decisionmakers.[84] The document also provided an opportunity for public comment on the Staff's findings.[85] In December 2010, the Staff published its FSEIS for License Renewal of Nuclear Plants, which recommended "that the Commission determine that the adverse environmental impacts of license renewals for IP2 and

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[79] 42 U.S.C. § 4332(2)(C). In the alternative, the agency can conduct an environmental assessment and make a finding of no significant impact. New York v. NRC, 681 F.3d at 476 (citing Sierra Club. v. Dep't of Transp., 753 F.2d 120, 127 (D.C. Cir. 1985)).

[80] New York v. NRC, 589 F.3d 551, 553 (2d Cir. 2009).

[81] See Office of Nuclear Regulatory Research (RES), NRC, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NUREG-1437) (May 1996) (Exs. NYS00131A–I) [hereinafter GEIS].

[82] NRR, NRC, GEIS, Supp. 38, Regarding Indian Point Nuclear Generating Units Nos. 2 and 3, Draft Report for Comment (NUREG-1437) at iii (Dec. 2008) (Ex. NYS00132A).

[83] Id.

[84] Id. at iv.

[85] Id. at ii.

IP3 are not so great that not preserving the option of license renewal for energy planning decision makers would be unreasonable."[86]

In late 2011, the Staff announced that it would be releasing an additional supplement to the GEIS – specifically to address the issues raised by Contention RK-EC-8.[87] The Board held in abeyance the submissions of evidence concerning that contention.[88] On June 26, 2012, the Staff released the draft version of this additional supplement.[89] The final version, released on June 20, 2013, affirmed the Staff's initial assessment that adverse environmental impacts should not foreclose consideration of the renewal of the operating licenses for IP2 and IP3.[90] On August 20, 2013, Riverkeeper filed a motion for leave to file an amended contention RK-EC-8.[91] On October 1, 2013, Entergy and NRC Staff filed their answers to this motion.[92] On

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[86] NRR, NRC, GEIS, Supp. 38, Regarding Indian Point Nuclear Generating Units Nos. 2 and 3, Final Report (NUREG-1437) at xix (Dec. 2010) (Ex. NYS00133A) [hereinafter FSEIS].

[87] Tr. at 1011 (Mr. Turk for the NRC Staff).

[88] Licensing Board Order (Dec. 14, 2011) at 2 (unpublished).

[89] NRR, NRC, GEIS, Supp. 38, Vol. 4 Regarding Indian Point Nuclear Generating Units Nos. 2 and 3, Draft Report for Comment (NUREG-1437) (June 2012) (ADAMS Accession No. ML12178A662).

[90] NRR, NRC, GEIS, Supp. 38, Vol. 4 Regarding Indian Point Nuclear Generating Units Nos. 2 and 3, Final Report (NUREG-1437) at xix (June 2013) (ADAMS Accession No. ML13162A616). The Board gave the parties until August 20, 2013 to file new or amended contentions based on this FSEIS Supplement. See Licensing Board Order (Establishing Deadline for Motions for New and Amended Contentions) (July 9, 2013) at 2 (unpublished).

[91] Riverkeeper, Inc. Consolidated Motion for Leave to File Amended Contention RK-EC-8A and Amended Contention RK-EC-8A (Aug. 20, 2013).

[92] Entergy's Answer to Riverkeeper, Inc.'s Consolidated Motion for Leave to File Amended Contention RK-EC-8A and Amended Contention RK-EC-8A (Endangered Aquatic Species) (Oct. 1, 2013); NRC Staff's Answer to Riverkeeper, Inc.'s Consolidated Motion for Leave to File Amended Contention RK-EC-8A, and Amended Contention RK-EC-8A (Oct. 1, 2013).

October 8, 2013, Riverkeeper filed a combined reply to the NRC Staff and Entergy's answers.[93] Riverkeeper's motion is currently pending before the Board.

## E. Other Prehearing Rulings and Activities

### 1. Site Visit

On May 8, 2012, the Board conducted a site visit at IPEC, where we viewed areas of IPEC that appeared to be relevant to the admitted contentions.[94] The purpose of the visit was for the Board "to gain an appreciation for the physical configuration of the key plant components and to focus on specific elements discussed in the contentions that are external to the reactors at Indian Point."[95]

### 2. Written Limited Appearance Statements

As provided for in 10 C.F.R. § 2.315(a), the Board permitted any person who was not a party to the proceeding to submit written limited appearance statements concerning the issues in this proceeding.[96] The Board cautioned that "[t]hese statements do not constitute evidence but may assist the Board and/or parties in defining the issues being considered."[97] The Board received over 700 written limited appearance statements via mail, fax, and e-mail. The extraordinary volume of these letters, both in favor of and against the relicensing of IP2 and IP3, demonstrates the significant interest of the surrounding communities in this proceeding and

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[93] Riverkeeper Inc. Combined Reply to NRC Staff and Entergy Answers to Riverkeeper's Motion for Leave to File Amended Contention RK-EC-8A and Amended Contention RK-EC-8A (Oct. 8, 2013).

[94] Licensing Board Notice (Scheduling Site Visit and Pre-Hearing Conference Call) (Apr. 5, 2012) at 1 (unpublished).

[95] Id. at 2; see also Licensing Board Order (Memorializing Items Discussed at April 16, 2012 Pre-Hearing Conference) (Apr. 18, 2012) at 4–6 (unpublished).

[96] 77 Fed. Reg. at 36,016. See also 10 C.F.R. § 2.315(a).

[97] 77 Fed. Reg. at 36,016.

citizen concerns with relicensing on issues as diverse as taxes, education, livelihood, safety, and air quality.[98]

## F. The Evidentiary Hearing

### 1. Scheduling the Hearing

As written testimony and evidence began to be offered on most of the contentions in late 2011, and early 2012, the Board considered the best means to conduct the evidentiary hearing in light of the Staff's supplemental reviews and evolving information on some contentions. Of particular concern was 10 C.F.R. § 2.332(d), which requires that a presiding officer "take into consideration the NRC staff's projected schedule for completion of its safety and environmental evaluations to ensure that the hearing schedule does not adversely impact the staff's ability to complete its reviews in a timely manner."[99] The regulation continues:

> [h]earings on safety issues may be commenced before publication of the NRC staff's safety evaluation upon a finding . . . that commencing the hearings at that time would expedite the proceeding. Where an environmental impact statement (EIS) is involved, hearings on environmental issues addressed in the EIS may not commence before the issuance of the final EIS.[100]

In light of this regulation and the Staff's ongoing supplemental reviews, the Board first "directed any participant objecting [to the Board's suggested order of addressing the contentions at hearing] pursuant to 10 C.F.R. § 2.332(d) or otherwise to file a motion stating and explaining its objection no later than May 1, 2012."[101] After receiving no objections from the parties, the Board asked the NRC Staff to address the appropriate method for conducting a hearing where

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[98] Copies of these letters can be viewed in the NRC's Electronic Hearing Docket, by opening the Indian_PT_2&3_50-247&50-286-LR folder, followed by Indian PT Pleadings sub-folder, and then the Limited Appearance Statements sub-folder. See Electronic Hearing Docket, http://ehd1.nrc.gov/ehd/ (last visited July 9, 2013).

[99] 10 C.F.R. § 2.332(d).

[100] Id.

[101] Licensing Board Order (Memorializing Items Discussed at April 16, 2012 Pre-Hearing Conference) (Apr. 18, 2012) at 3–4 (unpublished).

some contentions are clearly ripe for resolution, while others are not.[102] The Staff asserted that § 2.332(d) "does not bar the commencement of evidentiary hearings, at least with respect to issues that will not be addressed in the Supplement, since the Staff's evaluation of those issues [was] 'final.'"[103] Riverkeeper objected to the Staff's interpretation of § 2.332(d),[104] while New York stated that final federal agency action is precluded until the EIS process is complete.[105] The Board ultimately determined that, despite the NRC Staff's ongoing safety and environmental reviews, it was efficient to proceed to the evidentiary hearing prior to the issuance of the Staff's additional environmental and safety review documents. In reaching this conclusion, the Board found that the continued Staff reviews would not implicate any of the Track 1 contentions.[106]

In June 2012, the Board issued a Notice of Hearing which announced that the Board would begin taking oral testimony on October 15, 2012, in Westchester County, New York.[107] The notice selected ten contentions to be heard on October 15, 16, 17, 18, 22, 23, and 24, 2012.[108] The Board also noted that it planned to reconvene hearings on December 10 through

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[102] Licensing Board Order (Ordering the NRC Staff to Address Board Questions) (June 7, 2012) (unpublished).

[103] NRC Staff's Statement in Response to the Atomic Safety and Licensing Board's Order of June 7, 2012 (June 18, 2012) at 9.

[104] Riverkeeper Responses to NRC Staff Answers to ASLB Questions (July 6, 2012) at 8–10.

[105] Letter from Janice A. Dean, Assistant Attorney General, to Lawrence G. McDade, Richard E. Wardwell, and Michael F. Kennedy, Atomic Safety and Licensing Board (July 6, 2012) at 2. New York's concern has been addressed by the Commission in CLI-12-16, where the Commission stated that the NRC would not issue final licenses dependent on the Waste Confidence Decision or the Temporary Storage Rule until the District of Columbia Circuit's remand was addressed. See Calvert Cliffs, CLI-12-16, 76 NRC at 67. As a result, the Commission urged all licensing reviews and proceedings to move forward on all other issues. Id.

[106] 77 Fed. Reg. at 36,016.

[107] Id.

[108] Id.

14, 2012, as needed.[109] In late July, 2012, the Board notified the parties that a venue had been selected and that the October and December sessions would be conducted at the DoubleTree Hotel in Tarrytown, New York.[110]

**2. Pre-hearing Filings and Hearing Procedures**

The Board's Initial Scheduling Order set out the basic framework for the filing of written testimony and evidentiary exhibits.[111] Pursuant to the Scheduling Order, the Intervenors timely filed their initial written statements of position, written testimony, and exhibits on a contention-by-contention basis by late 2011.[112] After a brief extension, the NRC Staff and Entergy filed their statements of position, testimony, and exhibits in March 2012.[113] The Intervenors followed with rebuttal testimony and exhibits.[114] The Board also received a submission by Connecticut,

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[109] Id.

[110] Licensing Board Notice (Evidentiary Hearing Venue) (July 27, 2012) at 1 (unpublished).

[111] See Licensing Board Scheduling Order (July 1, 2010) at 13–16 (unpublished) [hereinafter Scheduling Order]. This order has occasionally been modified. See, e.g., Licensing Board Order (Granting Unopposed Motion by the State of New York and Riverkeeper, Inc. to Amend the Scheduling Order) (Nov. 17, 2011) at 1 (unpublished); Licensing Board Amended Scheduling Order (June 7, 2011) at 1–3 (unpublished); Licensing Board Order (Granting Unopposed Extension of Time) (May 16, 2012) at 1 (unpublished); Licensing Board Order (Granting NRC Staff's Unopposed Time Extension Motion and Directing Filing of Status Updates) (Feb. 16, 2012) at 1 (unpublished).

[112] Scheduling Order at 13.

[113] Prior to granting the Staff's request for an extension, the Board required the Staff to identify the contentions on which it intended to participate as a party to this proceeding, and to state which party's position the Staff intended to support on any such contention. Licensing Board Order (Requesting Information from the NRC Staff and All Participants) (Feb. 3, 2012) at 1 (unpublished). The Staff responded that "it intends to participate as a party in this adjudicatory proceeding with respect to all admitted contentions." NRC Staff's Statement in Response to the Atomic Safety and Licensing Board's Order of February 3, 2012 (Feb. 8, 2012) at 1. The Staff also stated that "the Staff's position is likely to support Entergy's positions on the admitted contentions." Id. The Board then granted the Staff's request for an extension of time to file its evidentiary submissions. Licensing Board Order (Granting NRC Staff's Unopposed Time Extension Motion and Directing Filing of Status Updates) (Feb. 16, 2012) at 1 (unpublished).

[114] Scheduling Order at 13.

which filed a statement of position as an interested governmental entity.[115] On each round of filings, the parties submitted motions in limine within thirty days of the submittal of new or revised exhibits and testimony.[116] Ultimately, the Board received, admitted, and reviewed over a thousand exhibits, containing tens of thousands of pages, which addressed the admitted contentions in this proceeding.[117]

The parties also timely filed proposed questions for the Board to ask at the evidentiary hearing, pursuant to 10 C.F.R. § 2.1207(a)(3).[118] On August 8, 2012,[119] New York filed a motion for cross-examination pursuant to Section 274(l) of the AEA, 42 U.S.C. § 2021(l).[120] Only New York moved for cross-examination.

On September 21, 2012, the Board granted, in part, New York's motion for cross-examination holding that New York would have a reasonable opportunity to examine witnesses

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[115] See id. at 14–15; see also Statement of Position of the Attorney General of Connecticut (June 28, 2012).

[116] Scheduling Order at 15. Most motions in limine were denied in whole or in part. For a complete review of these motions see the Electronic Hearing Docket for this proceeding.

[117] Due to the volume of exhibits, and frequent revisions of filings from all parties, the Board noted several corrections to the parties' exhibit lists throughout the proceeding. See, e.g., Licensing Board Order (Concerning Evidentiary Submission) (Oct. 4, 2012) at 2–3 (unpublished). Appendix B to this Initial Decision is a list of the admitted exhibits that the Board viewed as relevant to the Track 1 contentions, which is being issued in conjunction with this Partial Initial Decision but will not be published as part of this document. Appendix B will, however, be available on the NRC's Electronic Hearing Docket and also on ADAMS (The NRC's Agencywide Documents Access and Management System).

[118] Pursuant to 10 C.F.R. § 2.1207(a)(3)(iii), the proposed questions filed by all parties will be publicly released by Order of this Board 30 days after this partial initial decision. These questions will be available on the NRC's Electronic Hearing Docket and also on ADAMS.

[119] The deadline for filing motions for cross-examination, requests for a Subpart G proceeding, and proposed questions for the Board to ask on all contentions scheduled to be heard in October or December was August 29, 2012. See Licensing Board Order (Memorializing Items Discussed During the July 9, 2012, Status Conference) (July 12, 2012) at 2 (unpublished).

[120] State of New York Motion to Implement Statutorily-Granted Cross-Examination Rights Under Atomic Entergy Act § 274(l) (Aug. 8, 2012).

pursuant to NRC regulations.[121] Entergy filed an "emergency petition for interlocutory review" of that order.[122]

The Commission denied Entergy's request for interlocutory review and emphasized that it expected the Board to provide all parties with "a full and fair opportunity to request cross-examination, and . . . [expected] that the Board will act on any such requests fairly and evenhandedly . . . ."[123] The Commission emphasized that cross-examination "should be reserved for cases where the Board determines that it is truly necessary to develop a sound record."[124] Consistent with the Commission's guidance, the Board gave all parties the opportunity to conduct brief, pointed examination of witnesses at the evidentiary hearing, as necessary to develop a sound record.[125]

The parties were permitted to request that specific contentions be handled pursuant to Subpart G procedures pursuant to 10 C.F.R. § 2.310(d).[126] No such requests were filed, and the evidentiary hearing on all admitted contentions was governed by the procedures set forth in 10 C.F.R. Part 2, Subpart L, 10 C.F.R. §§ 2.1200–2.1213.

### G. Track 1 and Track 2 Contentions

For clarity, we repeat that this partial initial decision resolves only "Track 1" contentions. Track 1 contentions are RK-TC-2, NYS-5, NYS-6/7, NYS-8, NYS-12C, NYS-16B, NYS-17B,

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[121] Licensing Board Order (Order Granting, in part, New York's Motion for Cross Examination) (Sept. 21, 2012) at 5–6 (unpublished). See also Licensing Board Errata (Regarding Order Granting, in part, New York's Motion for Cross Examination) (Sept. 25, 2012) (unpublished).

[122] Entergy's Emergency Petition for Interlocutory Review of Board Order Granting Cross-Examination to New York State and Request for Expedited Briefing (Sept. 28, 2012).

[123] CLI-12-18, 76 NRC 371, 372, 375 (2012).

[124] Id. at 376.

[125] See, e.g., Tr. at 1843–92.

[126] Scheduling Order at 17.

NYS-37, and CW-EC-3A. This partial initial decision does not address "Track 2" contentions, which are NYS-25, NYS-26/RK-TC-1B, NYS-38/RK-TC-5, and RK-EC-8.[127]

As noted above, the evidentiary hearing on the Track 2 contentions was deferred pending the publication of a forthcoming SER Supplement and the recently released FSEIS Supplement.[128] Regarding the forthcoming SER Supplement, which affects contentions NYS-25 and NYS-38/RK-TC-5, the Staff is currently unable to provide an exact date for its issuance.[129] Regarding the recently released FSEIS Supplement, which is limited to the subject area addressed in RK-EC-8, as noted at page 16 above, Riverkeeper filed a timely motion to amend RK-EC-8, which is pending before the Board.[130] Additionally, at the request of the NRC Staff, NYS-26/RK-TC-1B was delayed to coincide with the other Track 2 contentions because of witness availability issues.[131]

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[127] See Tr. at 4539–45 (Judge McDade discussing Track 2 contentions); 77 Fed. Reg. at 36,016 at n.14 (discussing posture of NYS-25, NYS-26B/RK-TC-1B, NYS-38/RK-TC-5, and RK-EC-8).

[128] See NRC Staff's 17th Status Report in Response to the Atomic Safety and Licensing Board's Order of February 16, 2012 (July 1, 2013) at 1–3.

[129] NRC Staff's 21st Status Report in Response to the Atomic Safety and Licensing Board's Order of February 16, 2012 (Nov. 1, 2013).

[130] See Riverkeeper, Inc. Consolidated Motion for Leave to File Amended Contention RK-EC-8A and Amended Contention RK-EC-8A (Aug. 20, 2013).

[131] See Licensing Board Order (Evidentiary Hearing Administrative Matters) (Sept. 14, 2012) at 1 (unpublished) (stating that "due to this witness unavailability, the Board will not address NYS-26 . . . during the Track 1 Evidentiary Hearing.")

## II. GENERAL LEGAL STANDARDS APPLICABLE TO LICENSE RENEWAL

### A. Burden of Proof

Generally, an applicant has the burden of proof in a licensing proceeding.[132] However, while "[i]t is well established that the Applicant carries the burden of proof on safety issues,"[133] in the environmental context, the burden is slightly different, as the NRC, and not the applicant, has the overall burden of complying with NEPA.[134] Despite the ability of both the Staff and applicant to present evidence and witnesses on environmental issues, "the ultimate issue in determining NEPA compliance is the adequacy of the Staff's environmental review, not the applicant's Environmental Report."[135]

### B. The License Renewal Process: Safety Issues

Forty-year operating licenses, like Entergy's for IP2 and IP3, can be renewed for an additional twenty years, pursuant to the AEA.[136] However, "[t]he issues and concerns involved in an extended 20 years of operation are not identical to the issues reviewed when a reactor facility is first built and licensed."[137] Part 54 of the NRC's regulations define the safety issues that can be raised in a license renewal proceeding and limits them to "the most significant overall safety concern posed by extended reactor operation – the detrimental effects of

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[132] 10 C.F.R. § 2.325.

[133] Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041 (1983) (citing Consumers Power Co. (Midland Plant, Units 1 and 2), ALAB-283, 2 NRC 11, 17 (1975)).

[134] Id. at 1049.

[135] Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), CLI-12-1, 75 NRC 39, 61 (Feb. 9, 2012).

[136] 42 U.S.C. § 2133 (2012).

[137] Turkey Point, CLI-01-17, 54 NRC at 7; see also Entergy Nuclear Vt. Yankee, L.L.C. & Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763, 785–89 (2008) (providing an explanation of the general legal standards applicable to license renewal).

aging."[138] Accordingly, Part 54 requires that applicants demonstrate that they have programs in place that will effectively manage the effects of aging for specific types of structures and components during the period of extended operation (PEO).[139] To this end, Section 54.21(a) requires that each application contain an integrated plant assessment (IPA) that according to the Commission, "is a detailed assessment, conducted at 'a component and structure level,' rather than at a more generalized 'system level.'"[140] The IPA requires that applicants demonstrate that systems, structures, and components (SSCs) will continue to perform their intended functions during the PEO.[141] This aging management review, however, only covers SSCs, which "perform their intended function without moving parts or without a change in configuration or properties."[142] The Commission has referred to these as "passive"[143] SSCs, adding that the passive SSCs are subject to an aging management review only if they are "long-lived" – that is, not subject to replacement based on a qualified life or specified time period.[144] Thus, the aging management review consists of identifying the aging effects, and the AMPs which will manage aging effects and demonstrate that passive, long-lived SSCs will perform their intended functions during the PEO.[145]

10 C.F.R. Part 54 also requires applicants to reassess any time-limited aging analyses (TLAAs) that were "based upon a particular time period, such as, an assumed service life of a

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[138] Id.

[139] 10 C.F.R. §§ 54.21(a), 54.29.

[140] Turkey Point, CLI-01-17, 54 NRC at 8.

[141] See 10 C.F.R. § 54.21(a)(3).

[142] Id. § 54.21(a)(1)(i).

[143] Amergen Energy Co., L.L.C. (Oyster Creek Nuclear Generating Station) et al., CLI-08-23, 68 NRC 461, 466 (2008).

[144] Id.

[145] 10 C.F.R. § 54.21(a); Turkey Point, CLI-01-17, 54 NRC at 8.

specific number of years or some period of operation defined by the original" forty-year license term.[146] The reassessment of TLAAs must: "(1) show that the earlier analysis will remain valid for the extended operation period; or (2) modify and extend the analysis to apply to a longer term, such as 60 years; or (3) otherwise demonstrate that the effects of aging will be adequately managed in the renewal term."[147]

License renewal safety reviews are generally limited to these issues because the NRC recognizes that it "has the ongoing responsibility to oversee the safety and security of operating nuclear reactors," and "maintains an aggressive and ongoing program to oversee plant operation."[148] Therefore, for active SSCs, the Commission chose to exempt from license renewal challenges to a plant's operational activities covered by its current licensing basis (CLB). The CLB encompasses "the various Commission requirements applicable to a specific plant that are in effect at the time of the license renewal application,"[149] as well as the regulatory requirements of Parts 2, 19, 20, 21, 30, 40, 50, 55, 72, 73, and 100 with which the applicant must comply.[150]

In establishing its license renewal process, "the Commission did not believe it necessary or appropriate to throw open the full gamut of provisions" in a plant's CLB to re-analysis because those are "effectively addressed and maintained by ongoing agency oversight, review, and enforcement."[151] While the CLB is thus not evaluated in the license renewal process, its

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[146] Turkey Point, CLI-01-17, 54 NRC at 8.

[147] Id.; see also 10 C.F.R. § 54.21(c).

[148] Turkey Point, CLI-01-17, 54 NRC at 8.

[149] Id. at 9. The CLB consists of license requirements, including license conditions and technical specifications. It also includes plant-specific design basis information and any orders, exemptions, and licensee commitments that are part of the docket for the plant's license. Id.; see also 10 C.F.R. § 54.3.

[150] 10 C.F.R. § 54.3.

[151] Turkey Point, CLI-01-17, 54 NRC at 9.

provisions and protections remain in effect, complementing and supplementing any additional measures added due to the aging management requirements of 10 C.F.R. § 54.21(a) and (c).

After an applicant has met the requirements of 10 C.F.R. § 54.21(a) and (c), Section 54.29 states that a renewed license may be issued if the Commission finds that:

> (a) Actions have been identified and have been or will be taken with respect to the matters identified in paragraphs (a)(1) and (a)(2) of this section, such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and that any changes made to the plant's CLB in order to comply with this paragraph are in accord with the Act and the Commission's regulations. These matters are:
>
> (1) managing the effects of aging during the period of extended operation on the functionality of structures and components that have been identified to require review under § 54.21(a)(1); and
>
> (2) time-limited aging analyses that have been identified to require review under § 54.21(c).
>
> (b) Any applicable requirements of subpart A of 10 C.F.R. part 51 have been satisfied.
>
> (c) Any matters raised under § 2.335 have been addressed.[152]

The Commission has cautioned that "'[r]easonable assurance' is not quantified as equivalent to a 95% (or any other percent) confidence level, but is based on sound technical judgment of the particulars of a case and on compliance with our regulations."[153] To meet this reasonable assurance standard, the applicant "must make a showing that meets the 'preponderance of the evidence' threshold of compliance with the applicable regulations . . . ."[154]

The Staff's safety review for license renewal applications is guided by two documents: NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," (SRP-LR) and NUREG-1801, "Generic Aging Lessons Learned Report,"

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[152] 10 C.F.R. § 54.29.

[153] Oyster Creek, CLI-09-07, 69 NRC at 263.

[154] Id.

(GALL)."[155] NUREG-1800 (SRP-LR) provides the NRC Staff with guidance on how to conduct safety reviews of license renewal applications.[156] The SRP-LR seeks "to ensure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the period of extended operation."[157] GALL is a technical basis document for the SRP-LR, providing guidance to the Staff in its review.[158] According to GALL, in choosing its AMP for any given SSC, an applicant may either use an AMP that is consistent with GALL, or prepare a plant-specific AMP.[159]

According to the Commission, the approach taken by the applicant impacts the license renewal requirements:

> An applicant for license renewal "may reference [GALL] . . . to demonstrate that the programs at the applicant's facility correspond to those reviewed and approved" therein, and the applicant must ensure and certify that its programs correspond to those reviewed in [GALL]. In other words, the license renewal applicant's use of an aging management program identified in [GALL] constitutes reasonable assurance that it will manage the targeted aging effect during the renewal period. If the applicant uses a different method for managing the effects of aging for particular SSCs at its plant, then the applicant should demonstrate to the Staff reviewers that its program includes the ten elements cited in [GALL] and will likewise be effective. In addition, many plants will have plant-specific aging management programs for which there is no corresponding program in [GALL]. For each aging management program, the application gives a brief description of the licensee's operating experience in implementing that program.[160]

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[155] See Oyster Creek, CLI-08-23, 68 NRC at 466. Revision 1 of the SRP-LR and revision 1 of GALL (GALL-1) are exhibits NYS000195 and NYS00146A–C, respectively.

[156] NRR, NRC, Standard Review Plan for Review of License Renewal Application for Nuclear Power Plants (NUREG-1800) at iii (Sept. 2005) [hereinafter SRP-LR Rev. 1] (Ex. NYS000195).

[157] Id.

[158] Id. at 3.0-1.

[159] Id. at 3.0-3.

[160] Oyster Creek, CLI-08-23, 68 NRC at 468 (citations omitted).

Though a commitment to implement an AMP consistent with GALL is an "acceptable method for compliance with 10 C.F.R. § 54.21(c)(1)(iii),"[161] the Commission has emphasized that "such a commitment does not absolve the applicant from demonstrating, *prior* to issuance of a renewed license, that its AMP is indeed consistent with the GALL Report."[162] The Commission has emphasized that the NRC does "not simply take the applicant at its word" and that the Staff must "draw its own independent conclusion as to whether the applicant's programs are in fact consistent with the GALL Report."[163] Moreover, the Staff's independent finding of consistency with GALL does not prevent the Board from reviewing the substance of the applicant's commitments, and exploring deficiencies alleged by intervenors in our proceedings.[164] This includes any specific allegations that a reference to GALL lacks the specificity to demonstrate an adequate AMP.[165]

In December 2010, the Staff issued Revision 2 of GALL (GALL-2), which modified the prior version "based on further lessons learned from the reviews of LRAs, operating experience obtained after Revision 1 was issued, and other public input including industry comments."[166] Because Revision 2 was released after Entergy's LRA was submitted and after the Staff

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[161] Entergy Nuclear Vt. Yankee, L.L.C. & Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station), CLI-10-17, 72 NRC 1, 36 (2010).

[162] Id. at 37 (emphasis in the original).

[163] Id.

[164] Id. at 38.

[165] Id.; see also NextEra Energy Seabrook, L.L.C. (Seabrook Station, Unit 1), CLI-12-05, 75 NRC 301, 315 (2012) (stating that a reference to "an AMP in the GALL Report does not insulate that program from challenge in litigation.").

[166] NRR, NRC, Generic Aging Lessons Learned (GALL) Report Rev. 2 (NUREG-1801) at 3 (Dec. 2010) (Ex. NYS00147A) [hereinafter GALL-2].

conducted its initial review, the basis of both the LRA and Staff's initial SER was GALL-1.[167] The use of the older version appears acceptable for the following two reasons: (1) GALL is a nonbinding guidance document which (in the case of either revision) does not have the force of the law;[168] and (2) the Commission has generally deemed acceptable later revisions to the LRA that bring the plant into compliance with the GALL-2.[169] Thus, the Applicant's and Staff's use of GALL is not required by the regulations, and each AMP that Intervenors allege deficient must be evaluated in the context of the larger evidentiary record of this proceeding, which includes both GALL-1 and GALL-2.

### C. The License Renewal Process: Environmental/NEPA Issues

In the license renewal context, the scope of the Staff's NEPA review is substantially different from, and broader than the scope of the Staff's review of Part 54 safety issues. The Commission has clearly stated that its "AEA review under Part 54 does not compromise or limit NEPA."[170] Although the Part 54 review focuses on the management of aging on a limited set of "passive" systems, structures, and components, the NEPA review is not so restricted. As the Commission has noted, "the two inquiries are analytically separate: one examines radiological health and safety, while the other examines environmental effects of all kinds. Our aging-based safety review does not in any sense 'restrict NEPA' or 'drastically narrow[] the scope of

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[167] See, e.g., NRC Staff's Statement of Position on Contention NYS-5 (Buried Pipes and Tanks) (Dec. 7, 2012) at 7, n.5 (Ex. NRCR20015); Entergy's Statement of Position Regarding Contention NYS-5 (Buried Piping and Tanks) (Dec. 7, 2012) at 9–10 (Ex. ENTR20372).

[168] Oyster Creek, LBP-06-11, 63 NRC at 399; see also Natural Res. Def. Council v. Envtl. Prot. Agency, 643 F.3d 311 (D.C. Cir. 2011); Duke Energy Corp. (Catawba Nuclear Station, Units 1 and 2), CLI-04-29, 60 NRC 417, 424 (2004) (stating that "[g]uidance documents are, by nature, only advisory. They need not apply in all situations and do not themselves impose legal requirements on licensees."); The Curators of the Univ. of Mo., CLI-95-8, 41 NRC 71, 98 (1995) (stating "it is well established . . . that NUREGs and Regulatory Guides, by their very nature, serve merely as guidance and cannot prescribe requirements.").

[169] Pilgrim, CLI-12-10, 75 NRC at 497; Seabrook, CLI-12-05, 75 NRC at 309–11.

[170] Turkey Point, CLI-01-17, 54 NRC at 13.

NEPA."[171] In short, the NEPA review in license renewal proceedings is not limited to aging-related issues and not barred by the fact that an environmental impact may be caused by activities associated with the CLB.

NEPA "declares a broad national commitment to protecting and promoting environmental quality."[172] As such, NEPA § 102(2)(C) requires that federal agencies, to the fullest extent possible:

> include in every recommendation or report on proposals for . . . major Federal actions significantly affecting the quality of the human environment; a detailed statement . . . on: (i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action, (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.[173]

As noted earlier, the granting of an operating license is a major federal action for which the NRC must conduct a NEPA review.[174] At its heart, the NEPA process is designed to ensure that the decisionmaker has adequate and thorough information from which to make a decision.

> It is absolutely essential to the NEPA process that the decisionmaker be provided with detailed and careful analysis of the relative environmental merits and demerits of the proposed action and possible alternatives, a requirement that we have characterized as the linchpin of the entire impact statement. Indeed the development and discussion of a wide range of alternatives to any proposed federal action is so important that it is mandated by NEPA when any proposal involves unresolved conflicts concerning alternative uses of available resources. This requirement is independent of and of wider scope than the duty to file the EIS.[175]

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[171] Id.

[172] Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 348 (1989).

[173] 42 U.S.C. § 4332(2)(C) (2012).

[174] New York v. NRC, 589 F.3d at 553.

[175] Natural Res. Def. Council v. Callaway, 524 F.2d 79, 92–93 (2d Cir. 1975) (citation and internal quotations omitted); see also La. Energy Servs., L.P. (Claiborne Enrichment Center), LBP-96-25, 44 NRC 331, 341 (1996) (stating that the EIS "serves as an environmental full disclosure law providing agency decisionmakers, as well as the President, the Congress, the

As explained above, to meet this burden in license renewal cases, the Staff developed the GEIS, which contains generic findings that apply to all nuclear power plants and are codified in Appendix B of Subpart A of 10 C.F.R. Part 51.[176] In accordance with 10 C.F.R. § 51.53(c), an applicant can adopt the generic findings of the GEIS (designated as Category 1 issues in Table B-1 of Appendix B to Subpart A of Part 51),[177] but must also include site-specific analyses of certain environmental impacts in its ER (designated as Category 2 issues in the same table).[178] These plant-specific reviews are evaluated by the Staff and are to be included in a site-specific supplement to the GEIS.[179]

NEPA's requirements, like the publication of the EIS, "implement [NEPA's] sweeping policy goals by ensuring that agencies will take a 'hard look' at environmental consequences."[180] NEPA's "hard look requirement" does not allow sweeping generalities about possible effects and risk without a justification as to why more definitive information was not provided.[181] On the other hand, the Supreme Court has held that NEPA does not require a "worst case" inquiry.[182] Rather, NEPA analyses are assessed by the "rule of reason." Under the NEPA "rule of reason," "the agency's environmental analysis need only consider environmental impacts that are

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CEQ, and the public the environmental cost-benefit information that Congress thought they should have about each qualifying federal action.").

[176] See Turkey Point, CLI-01-17, 54 NRC at 11 (conducting an extensive discussion of regulatory divide between the GEIS and plant-specific review).

[177] 10 C.F.R. § 51.53(c)(i).

[178] Id. § 51.53(c)(ii).

[179] FSEIS at iii (Ex. NYS00133A).

[180] Robertson, 490 U.S. at 333.

[181] Pa'ina Haw., L.L.C. (Materials License Application), CLI-10-18, 72 NRC 56, 74 (2010) (citing Blue Mountains Biodiversity Project v. Blackwood, 161 F.3d 1208, 1213 (9th Cir. 1998); Neighbors of Cuddy Mountain v. U.S. Forest Serv., 137 F.3d 1372, 1380 (9th Cir. 1998)).

[182] Robertson, 490 U.S. at 354–56.

reasonably foreseeable, and need not consider remote and speculative scenarios."[183] To be successful, intervenors must demonstrate with adequate support that the Staff failed to take a "hard look" at important environmental questions or failed to provide a reasonable analysis.[184]

Several of the contentions in this case address a relatively nuanced area of NEPA law as applied in NRC license renewal proceedings – the Severe Accident Mitigation Alternatives (SAMA) analysis, required by 10 C.F.R. § 51.53(c)(3)(ii)(L). This analysis evaluates the degree to which specific additional mitigation measures may reduce the risk of various accident scenarios on a site-specific basis.[185] The SAMA analysis is a quantitative cost-benefit analysis, comparing the costs of a mitigation measure against its benefits.[186] The analysis also takes into account the probabilities of accident scenarios, so that the analysis ultimately "assesses whether and to what extent the probability-weighted consequences of the analyzed severe accident sequences would decrease if a specific mitigation alternative were implemented."[187]

As a NEPA analysis, "the SAMA analysis is not based on either the best-case or the worst-case accident scenarios, but on mean accident consequence values, averaged over the many hypothetical several accident scenarios."[188] When a board is called upon to assess a SAMA analysis, the Commission has instructed that "the question is not whether more or

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[183] Exelon Nuclear Tex. Holdings, L.L.C. (Victoria County Station Site), LBP-11-15, 73 NRC 645, 690–91 (2011). See also Duke Energy Corp. (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-03-17, 58 NRC 419, 431 (2003) (stating that "NRC adjudicatory hearings are not EIS editing sessions. [We] do not sit to parse and fine-tune EISs.").

[184] See id.; Seabrook, CLI-12-05, 75 NRC at 341. While the agency must take a "hard look" under NEPA, "it is now well settled that NEPA itself does not mandate particular results." Robertson, 490 U.S. at 350.

[185] Pilgrim, CLI-12-15, 75 NRC at 706; McGuire & Catawba, CLI-02-17, 56 NRC at 4.

[186] Pilgrim, CLI-12-15, 75 NRC at 707.

[187] Id. (internal quotations omitted).

[188] Id. at 708.

different analysis can be done."[189] Contentions challenging a SAMA analysis "must identify a deficiency that plausibly could alter the overall result of the analysis in a material way."[190] The question of material impacts "hinges upon whether [a SAMA alternative] may be cost-beneficial to implement."[191] However, like other NEPA evaluations, a SAMA analysis is governed by the rule of reason and "alternatives must be bounded by some notion of feasibility."[192] In short, "the proper question is not whether there are plausible alternative choices for use in the analysis, but whether the analysis that was done is reasonable under NEPA."[193]

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[189] Id. at 714.

[190] Id.

[191] McGuire & Catawba, CLI-02-17, 56 NRC at 12.

[192] Pilgrim, CLI-12-15, 75 NRC at 724 (citations omitted).

[193] Seabrook, CLI-12-05, 75 NRC at 323. See also Town of Winthrop v. Fed. Aviation Admin., 535 F.3d 1, 13 (1st Cir. 2008) (stating that NEPA allows agencies "to select their own methodology as long as that methodology is reasonable.").

## III. SAFETY CONTENTION RK-TC-2 (Flow Accelerated Corrosion)

### A. Statement of Contention RK-TC-2

RK-TC-2, a safety contention that challenges the aging management of flow accelerated corrosion, as litigated on October 15, 16, and 17, 2012, reads as follows:

> (1) Entergy's AMP for components affected by FAC is deficient because it does not provide sufficient details (*e.g.*, inspection method and frequency, criteria for component repair or replacement) to demonstrate that the intended functions of the applicable components will be maintained during the extended period of operation; and (2) Entergy's program relies on the results from CHECWORKS without benchmarking or a track record of performance at IPEC's power uprate levels.[194]

### B. RK-TC-2 Background

#### 1. RK-TC-2 Procedural History

As filed by Riverkeeper on November 30, 2007,[195] RK-TC-2 contended that Entergy's program for the management of flow-accelerated corrosion (FAC) failed to demonstrate that the effects of aging will be adequately managed for the PEO, and thus failed to satisfy the requirements of 10 C.F.R. § 54.21(a)(3).[196] More specifically, in RK-TC-2, Riverkeeper alleged that Entergy's FAC AMP failed to demonstrate that the intended functions of the FAC-vulnerable plant components will be adequately maintained during the proposed license renewal term because it did not specify the method and frequency of inspections, and the criteria for component repair or replacement.[197] In addition, Riverkeeper took issue with Entergy's reliance on the computer code CHECWORKS without sufficient benchmarking of the code under Indian

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[194] LBP-08-13, 68 NRC at 177.

[195] Riverkeeper Petition at 15.

[196] Id. at 15–16.

[197] Id.

Point operating parameters.[198] Riverkeeper argued that benchmarking is necessary because CHECWORKS is an empirical program that requires plant-specific calibrations.[199]

**2. Applicant's Aging Management Program for Flow-Accelerated Corrosion**

Appendix A, Section A.2.1.14 (Flow-Accelerated Corrosion Program) of Entergy's LRA contains the supplement to the UFSAR, which presents a summary description of the program for managing the effects of aging due to FAC during the PEO.[200] Appendix A states that this information will be incorporated into the UFSAR following issuance of the renewed operating license.[201] In Appendix B, Section B.1.15 (Flow-Accelerated Corrosion), Entergy describes the FAC program credited for managing aging effects during the PEO.[202] Section B.1.15 contains a "Program Description," which states that the FAC program "is an existing program that applies to safety-related and nonsafety-related carbon and low alloy steel components in systems containing high-energy fluids carrying two-phase or single-phase high- energy fluid ≥ 2 percent of plant operating time."[203] This section further represents that the FAC program is consistent with the program described in GALL-1,[204] with no exceptions and no enhancements (GALL Section XI.M17).[205] Additionally, Section B.1.15 states that the AMP "predicts, detects, and

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[198] Id.

[199] Id. at 16, 20, 21.

[200] See License Renewal Application at App. A (Ex. ENT00015B).

[201] Id.

[202] Id. at B-54 to -55.

[203] Id. at B-54.

[204] NRR, Generic Aging Lessons Learned (GALL) Report Rev. 1 (NUREG-1801) Rev. 1 (Sept. 2005) (Ex. NYS00146C) [hereinafter GALL-1].

[205] License Renewal Application at B-54 (Ex. ENT00015B). The NRC Staff reviewed Entergy's LRA for consistency with GALL-1. Tr. at 1683 (Mr. Yoder for the NRC Staff). However, the NRC Staff also deemed the Applicant's LRA to be consistent with GALL-2. Tr. at 1680 (Mr. Yoder for the NRC Staff). GALL-1 and GALL-2 is discussed beginning at page 41 below.

monitors FAC in plant piping and other pressure-retaining components," and is "based on EPRI guidelines in the Nuclear Safety Analysis Center (NSAC)-202L-R2 [Report] for an effective flow-accelerated corrosion program . . . ."[206] Finally, operating experience relevant to the FAC AMP is also discussed in Section B.1.15 of Entergy's LRA.[207]

Based on the guidelines in NSAC-202L, GALL-1 stated that an effective FAC aging management program should include (a) an analysis to determine critical locations; (b) limited baseline inspections to determine the extent of thinning at these locations; and (c) follow-up inspections to confirm the predictions or to identify components needing repairs or replacements.[208] GALL-1 further provided an applicant with guidance regarding how an AMP can satisfy the ten separate program elements identified in GALL and the SRP-LR.[209] Following each of the ten program elements, GALL-1 provided a brief description of the applicability of each program element and a description of how an applicant can implement the program element.[210] The GALL-1 AMP for FAC stated that the program should include the use of a predictive code such as CHECWORKS.[211]

While Entergy's LRA states that its FAC program is based on NSAC-202L-R2, Entergy subsequently amended this program to incorporate guidance in the more recent NSAC-202L-

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[206] License Renewal Application at B-54 (Ex. ENT00015B).

[207] Id. at B-54 to -55.

[208] GALL-1 at XI M-61 (Ex. NYS00146C).

[209] Id. at XI M-62. The ten program elements identified in GALL and the SRP-LR are 1) scope of program, 2) preventative actions, 3) parameters monitored / inspected, 4) detection of aging effects, 5) monitoring and trending, 6) acceptance criteria, 7) corrective action, 8) confirmation process, 9) administrative controls, and 10) operating experience.

[210] Id. at XI M-61 to -62.

[211] Id. at XI M-61.

R3.[212] NSAC-202L-R3 states that it incorporates lessons learned following the publication of Revision 2 of NSAC-202L.[213]

### 3. Legal Standards and Issues Related to RK-TC-2

As explained in detail at pages 24–34 above, the applicable legal standards for Indian Point's FAC management AMP are contained in 10 C.F.R. §§ 54.21(a)(3) and 54.29(a) and stand as a condition precedent to relicensing. In order to secure license renewal, Entergy must demonstrate, to the point of providing "reasonable assurance" (as discussed in Section II(B) above), that the intended functions will be maintained in accordance with the CLB for the PEO.[214]

In determining whether an applicant's LRA provides the requisite "reasonable assurance," the Staff conducts a safety review of the applicant's LRA.[215] The Staff's review is intended to verify that the applicant has "properly scoped the aging management review; that the existing or planned aging management programs conform to the descriptions in the license renewal application; and that the documentation used to support the application is auditable, retrievable, and in fact does support the application."[216]

As noted beginning at page 27 above, the Staff's safety review pursuant to 10 C.F.R. Part 54 is principally guided by two documents: GALL and the SRP-LR,[217] and that an

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[212] See License Renewal Application at B-54 (Ex. ENT00015B); see also NL-07-153, Letter from Fred Dacimo, Entergy, to NRC, Amendment 1 to License Renewal Application (LRA), Attach. 1 at 46–48 (Dec. 18, 2007) (Ex. NYSR00159)).

[213] Electric Power Research Institute (EPRI), Recommendations for an Effective Flow-Accelerated Corrosion Program (NSAC-202L-R3) (May 2006) at 5 (Ex. RIV000012) [hereinafter NSAC-202L-R3].

[214] 10 C.F.R. §§ 54.21(a)(3), 54.29(a).

[215] See generally 10 C.F.R. pt. 54.

[216] Oyster Creek, CLI-08-23, 68 NRC at 468.

[217] Id. at 466.

applicant's "'use of an aging management program identified in the GALL Report constitutes reasonable assurance that it will manage the targeted aging effect during the renewal period.'"[218] However, "such a commitment does not absolve the applicant from demonstrating . . . that its AMP is indeed consistent with the GALL Report."[219] We cannot simply take the applicant at its word, we must examine whether the applicant's programs are in fact consistent with GALL.[220]

### 4. Evidentiary Record Related to RK-TC-2

#### a. Identification of Witnesses Who Provided Testimony Relevant to RK-TC-2

Entergy presented five witnesses on RK-TC-2 – Ian D. Mew,[221] Alan B. Cox,[222] Nelson F. Azevedo,[223] Dr. Jeffrey S. Horowitz,[224] and Robert M. Aleksick.[225] On October 12, 2012, Entergy filed the written direct testimony of these five witnesses,[226] which was admitted into evidence on October 15, 2012.[227]

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[218] Entergy Nuclear Vt. Yankee, L.L.C. & Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station), CLI-10-17, 72 NRC 1, 36 (2010) (quoting Oyster Creek, CLI-08-23, 68 NRC at 468).

[219] Id. at 37.

[220] Id.

[221] Curriculum Vitae of Ian D. Mew (Ex. ENT000030).

[222] Curriculum Vitae of Alan B. Cox (Ex. ENT000031).

[223] Curriculum Vitae of Nelson F. Azevedo (Ex. ENTR00032).

[224] Curriculum Vitae of Jeffrey S. Horowitz (Ex. ENT000033).

[225] Curriculum Vitae of Robert M. Aleksick (Ex. ENTR00037).

[226] See Testimony of Entergy Witnesses Ian D. Mew, Alan B. Cox, Nelson F. Azevedo, Jeffrey S. Horowitz, and Robert M. Aleksick Regarding Contention RK-TC-2 (Flow-Accelerated Corrosion) (Ex. ENTR00029) [Entergy RK-TC-2 Testimony]. The testimony submitted by Entergy on October 12, 2012, is Entergy's revised written testimony for RK-TC-2. Entergy's revised testimony replaces Entergy's original testimony for RK-TC-2, which was filed on March 28, 2012. Written testimony is generally attributed to several witnesses. Rather than repeatedly listing all of the witnesses' names for each reference to written testimony, statements from

The NRC Staff presented two witnesses on RK-TC-2 – Matthew G. Yoder[228] and Dr. Allen L. Hiser.[229] On March 31, 2012, the NRC Staff filed the written direct testimony of these two witnesses,[230] which was admitted into evidence on October 15, 2012.[231]

Riverkeeper presented one witness on RK-TC-2 – Dr. Joram Hopenfeld.[232] On December 22, 2011, Riverkeeper filed the written direct testimony of this witness.[233] On June 29, 2012, Riverkeeper submitted written rebuttal testimony of this witness.[234] Both of these submissions were admitted into evidence on October 15, 2012.[235]

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written testimony will be attributed to "Entergy's witnesses," "NRC Staff witnesses," "Staff witnesses," etc. When reference is made to the transcript the witness speaking will be identified.

[227] Tr. at 1269 (Judge McDade).

[228] Matthew Yoder Statement of Professional Qualifications (Ex. NRCR00122).

[229] Allen Hiser Statement of Professional Qualifications (Ex. NRCR00103).

[230] See NRC Staff Testimony of Matthew G. Yoder and Allen L. Hiser, Jr. Concerning Riverkeeper Technical Contention RK-TC-2 Flow-Accelerated Corrosion (Mar. 31, 2012) (Ex. NRC000121) [hereinafter NRC Staff RK-TC-2 Testimony].

[231] Tr. at 1269 (Judge McDade).

[232] Curriculum Vitae of Joram Hopenfeld (Ex. RIV000004).

[233] See Prefiled Written Testimony of Dr. Joram Hopenfeld Regarding Riverkeeper Contention TC-2 – Flow Accelerated Corrosion (Dec. 22, 2011) (Ex. RIV000003) [hereinafter Riverkeeper RK-TC-2 Testimony].

[234] See Prefiled Rebuttal Testimony of Dr. Joram Hopenfeld Regarding Riverkeeper Contention TC-2 – Flow Accelerated Corrosion (June 29, 2012) (Ex. RIV000108) [hereinafter Riverkeeper RK-TC-2 Rebuttal Testimony].

[235] Tr. at 1269 (Judge McDade).

### b. Identification of Admitted Exhibits Relevant to RK-TC-2

Relevant to RK-TC-2, Entergy submitted 66 exhibits, the NRC Staff submitted 12 exhibits, and Riverkeeper submitted 47 exhibits.[236] These exhibits were admitted into the record on October 15, 2012, and January 15, 2013.[237] As noted in footnote 117 above, all admitted exhibits that the Board viewed as relevant to the resolution of the Track 1 contentions are listed in Appendix B to this Partial Initial Decision.

### c. Relevant NRC Staff Guidance Documents, Industry Guidance Documents, and Corporate Procedures

1. NUREG-1800, Rev. 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (Dec. 2010) (SRP-LR) (Ex. NYS00161). The purpose of the SRP-LR is to ensure the quality and uniformity of Staff review and to present a well-defined base from which to evaluate applicant programs and activities for the PEO.[238] Each of the individual sections in the SRP-LR addresses (1) who should perform the review; (2) the matters that are to be reviewed; (3) the basis for review; (4) how the review is to be accomplished; and (5) the conclusions to be made.[239]

2. NUREG-1801, Rev.1, "Generic Aging Lessons Learned (GALL) Report" (Sept. 2005) (GALL-1) (Exs. NYS00146A–C). GALL-1 is referenced as a technical basis document in the SRP-LR.[240] GALL-1 identifies AMPs the NRC has determined to be acceptable for managing

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[236] See Licensing Board Order (Issuing Appendix B to the Partial Initial Decision) (Nov. 27, 2013) (unpublished) [hereinafter Appendix B – Partial Initial Decision].

[237] Tr. at 1269 (Judge McDade); Order (Scheduling Post-Hearing Matters and Ruling on Motions to File Additional Exhibits) (Jan. 15, 2013) (unpublished).

[238] NRR, Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants, NUREG-1800, Rev. 2 (Dec. 2010) at iii (Ex. NYS000161) [hereinafter SRP-LR Rev. 2].

[239] Id.

[240] GALL-1 at iii (Ex. NYS00146A).

the aging effects of systems, structures, and components in the scope of license renewal, as required by 10 C.F.R. Part 54.[241]

3. NUREG-1801, Rev.2, "Generic Aging Lessons Learned (GALL) Report" (Dec. 2010) (GALL-2) (Exs. NYS00147A–D). GALL-2 reflects changes to GALL-1 based on lessons learned from the reviews of LRAs, operating experience obtained after GALL-1 was issued, and other public input including industry comments.[242]

4. Electric Power Research Institute (EPRI), "Recommendations for an Effective Flow-Accelerated Corrosion Program," NSAC-202L-R3 (May 2006) (NSAC-202L-R3) (Ex. RIV000012).[243] NSAC-202L-R3 presents a set of EPRI recommendations for nuclear power plants to detect and mitigate FAC.[244] These recommendations are represented to be based on FAC inspection program implementation and nuclear power plant operating experience.[245] This document states that it presents the key elements for an effective FAC program and presents the steps that should be followed to minimize the chances of experiencing a consequential FAC-induced leak or rupture.[246]

5. EN-DC-315, Revision 6, Flow-Accelerated Corrosion Program (October 26, 2011) (EN-DC-315) (Ex. ENT000038). EN-DC-315 is a corporate fleet-wide procedure that Entergy

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[241] Id.

[242] NRR, NRC, Generic Aging Lessons Learned (GALL) Report, NUREG-1801 Rev. 2 (Dec. 2010) at 3. (Ex. NYS00147A) [hereinafter GALL-2].

[243] Revision 3 of NSAC-202L contains recommendations updated with the worldwide experience of members of the CHECWORKS Users Group, plus recent developments in detection, modeling, and mitigation technology. NSAC-202L-R3 at 5 (Ex. RIV000012). Despite referencing Revision 2 of NSAC-202L, Entergy relies upon NSAC-202L-R3 in its FAC Program. See Entergy RK-TC-2 Testimony at 26 (Ex. ENTR00029); EN-DC-315, Rev. 6, Flow Accelerated Corrosion Program at 16 (Oct. 26, 2011) (Ex. ENT000038) [hereinafter EN-DC-315].

[244] NSAC-202L-R3 at 5, 7 (Ex. RIV000012).

[245] Id.

[246] Id.

developed to deal with FAC at all of its nuclear power plants in the United States.[247] The stated purpose of EN-DC-315 is to implement a common approach to establish standardized programmatic control, updating, and documenting for FAC programs at Entergy's nuclear plants.[248] EN-DC-315 provides criteria and methodology for implementing Entergy's FAC program.[249]

### C. Issues Raised in RK-TC-2

The Board admitted RK-TC-2 upon concluding that Riverkeeper had raised a genuine issue as to the adequacy of Entergy's FAC AMP, alleging that program was deficient because it did not provide sufficient details (as focused on the methods and frequency of inspections and criteria for component repair or replacement) to demonstrate that the aging effects of FAC will be adequately managed throughout the PEO.[250] Additionally, the Board concluded that Riverkeeper had raised a genuine issue whether Entergy's program relied on the results from CHECWORKS without adequate benchmarking, or a sufficient track record of performance at IPEC's power uprate levels.[251] Further, Riverkeeper raised a genuine issue regarding Entergy's definition of FAC, its wall thinning management of steam generator components, and its prediction of wall thinning by means other than CHECWORKS.[252]

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[247] Tr. at 1352 (Mr. Azevedo for Entergy).

[248] EN-DC-315 at 3 (Ex. ENT000038).

[249] Id.

[250] LBP-08-13, 68 NRC at 177.

[251] Id.

[252] See, e.g., Riverkeeper RK-TC-2 Rebuttal Testimony at 14, 19, 43 (Ex. RIV000108).

## D. RK-TC-2 Findings

### 1. Adequacy of Entergy's Flow Accelerated Corrosion Aging Management Program

Riverkeeper witness Dr. Hopenfeld stated that "Entergy lacks a sufficiently detailed AMP to demonstrate that the aging effects of FAC will be adequately managed throughout the proposed PEO,"[253] specifically asserting that to comply with GALL and the SRP-LR, Entergy must provide sufficient details to address all relevant program elements, including the method for determining component inspections, frequency of such inspections, and attendant criteria for component repair and replacement.[254] As explained below, based on the preponderance of the evidence before us, we disagree with Dr. Hopenfeld's conclusion that Entergy's AMP addressing FAC is inadequate.

#### a. Entergy's License Renewal Application

At the hearing, the Board examined the documentation of Entergy's FAC AMP and inquired into whether the program description in Entergy's FAC AMP provides sufficient information focused towards the Applicant's FAC inspections (frequency and methods) and criteria for component repair and replacement.[255] In response to questions from the Board, Entergy witness Mr. Cox testified that both Appendices A and B of the LRA contain a description of the program.[256] He further testified that Appendix A contains the supplement to the UFSAR, which presents a summary description of the FAC AMP,[257] while Appendix B contains a more detailed description of the FAC AMP, as well as operating experience relevant to the

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[253] Report of Dr. Joram Hopenfeld in Support of Contention Riverkeeper TC-2 – Flow Accelerated Corrosion (Sept. 7, 2012) at 25 (Ex. RIVR00005) [hereinafter Hopenfeld Report].

[254] Id.

[255] See, e.g., Tr. at 1340 (Judge Kennedy).

[256] Tr. at 1342 (Mr. Cox for Entergy).

[257] Id.; see also LRA at A-24 (Ex. ENT00015B). Entergy has since supplemented and amended its application several times.

program.[258] Section B.1.15 of Appendix B states that the FAC AMP "is an existing program" and that the FAC AMP is consistent with the program described in GALL.[259] We agree with this representation.

As presented in the LRA, Entergy's FAC AMP is "based on . . . NSAC-202L-R2 . . . ."[260] Finally, Entergy's LRA states that the "FAC Program has been effective at managing aging effects. The FAC Program assures the effects of aging are managed such that applicable components will continue to perform intended functions consistent with the current licensing basis through the period of extended operation."[261] We also agree with this statement.

While Entergy's FAC AMP, as it appears in its LRA, consists primarily of the Appendix B description and the summary description in Appendix A, Entergy's FAC AMP does not stop there.[262] As discussed immediately below, Entergy's FAC program was updated based on NSAC-202L-R3,[263] which is to be implemented via EN-DC-315.[264]

**b. Entergy's Corporate Procedure**

Entergy witness Mr. Cox stated that GALL-1 is incorporated by reference into Appendix B of IPEC's LRA.[265] He added that GALL, in turn, references NSAC-202L as the guidance

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[258] LRA at B-54 to -55 (Ex. ENT00015B).

[259] Id.

[260] Id. at B-54. In addition to the LRA's reference to NSAC-202L-R2, GALL states that a FAC program relies on implementation of the guidelines in NSAC-202L-R2 for an effective FAC program. GALL-1 at XI M-61 (Ex. NYS00146C).

[261] LRA at B-55 (Ex. ENT00015B).

[262] Tr. at 1342 (Mr. Cox for Entergy).

[263] Tr. at 1342, 1483 (Mr. Cox for Entergy).

[264] Entergy RK-TC-2 Testimony at 31 (Ex. ENTR00029).

[265] Tr. at 1344 (Mr. Cox for Entergy).

document that describes an acceptable program to manage aging due to FAC.[266] He further testified that Entergy used the guidance in NSAC-202L as the basis for its FAC program[267] and developed EN-DC-315, its fleet-wide corporate procedure governing Entergy's FAC AMP[268] which delineates the details of Entergy's proposed FAC AMP.[269] Accordingly, as Mr. Cox testified, EN-DC-315 is the document Entergy will use to guide its day-to-day FAC practices to ensure compliance with the actions described in the NSAC document.[270] EN-DC-315 describes how inspections will be conducted and inspection data will be evaluated, as well as outlining the acceptance criteria for inspection components, the criteria for the disposition of components failing to meet acceptance criteria, the sample expansion criteria,[271] and the instructions for incorporating inspection data into the CHECWORKS model.[272] After reviewing this document, we find that it contains sufficient detail for us to evaluate the effectiveness of Entergy's FAC program.

As an example of the level of specificity contained in the Applicant's FAC AMP, Entergy's witnesses testified that inspection locations and the extent and schedule of inspections are to be selected in accordance with NSAC-202L to assure detection of wall

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[266] Tr. at 1346 (Mr. Cox for Entergy).

[267] Tr. at 1342 (Mr. Cox for Entergy). Entergy testified that NSAC-202L is a "fairly detailed description of an effective FAC [aging] management program." According to NSAC-202L, an effective FAC program includes the following six elements: (1) corporate commitment; (2) analysis; (3) operating experience; (4) inspections; (5) training and engineering judgment; and (6) long-term strategy. NSAC-202L addresses each of these elements in more detail and makes recommendations for implementation of each element in an effective AMP.

[268] See Entergy RK-TC-2 Testimony at 37 (Ex. ENTR00029).

[269] See generally EN-DC-315 (Ex. ENT000038); see also Tr. at 1355 (Mr. Cox for Entergy).

[270] Tr. at 1356 (Mr. Cox for Entergy).

[271] Sample expansion criteria are parameters that if exceeded would result in additional inspections to be conducted. For example, if the measured wall thickness is less than the minimum acceptable wall thickness than additional inspections of identical or similar piping components would be performed. See EN-DC-315 at 26–27 (Ex. ENT000038).

[272] See id.

thinning before the loss of intended function.[273] According to NSAC-202L-R3, the inspection locations shall be chosen to select the components with the greatest susceptibility to FAC.[274]

Using EN-DC-315 as the guide, Entergy's witnesses testified that inspection locations will be selected differently for pipes that are modeled with CHECWORKS than those selected for non-modeled pipes.[275] These witnesses further testified that Entergy's criteria for component selection for modeled piping at IPEC, consistent with NSAC-202L-R3,[276] are based on several factors including: (1) the trending of pipe wall thickness measurements from past outages; (2) predictive evaluations performed using the CHECWORKS code; (3) industry and IPEC-specific operating experience related to FAC; (4) results from other plant inspection programs; and (5) engineering judgment.[277] We find these procedures to be adequate.

Entergy witnesses additionally testified that the susceptible non-modeled piping will be evaluated for inspection using a similar set of criteria, except that criterion (2) above, the predictive evaluations from CHECWORKS, will not be used.[278] Instead, according to Entergy witnesses Mr. Mew and Mr. Aleksick, a separate set of susceptible non-modeled piping rankings (based on operating conditions, consequence of failure, maintenance history, and industry experience) will be employed.[279] According to Mr. Mew and Mr. Aleksick, each criterion can be

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[273] Id. at 43–44. GALL FAC programs rely on the inspection program delineated in NSAC-202L, which consists of identification of susceptible locations as indicated by operating conditions or special considerations. GALL-1 at XI-M61 (Ex. NYS00146C).

[274] NSAC-202L-R3 at 2-2 (Ex. RIV000012). The piping locations at IPEC that are most susceptible to FAC are locations with two-phase flow and high moisture content, lines which contain saturated liquid that flashes to steam due to changes in pressure, and certain areas with high flow velocity and high turbulence. Entergy RK-TC-2 Testimony at 44 (Ex. ENTR00029).

[275] Entergy RK-TC-2 Testimony at 43 (Ex. ENTR00029).

[276] Id. at 45 (citing EN-DC-315 at 15–19 (Ex. ENT000038)).

[277] Id. at 45–46 (citing NSAC-202L-R3 at 2-3 to -4, 3-2 (Ex. RIV000012)).

[278] Id. at 46.

[279] Id.

the basis for a decision to select a particular component for inspection,[280] because "experience has shown that this approach has led to effective FAC programs throughout the industry."[281] They also stated that the actual measured and CHECWORKS-predicted margins between nominal wall thickness and minimum required wall thickness, along with the consequence of failure of a particular component with respect to personnel safety and plant availability will be considered in selecting the location of future IPEC inspections.[282]

Referring to the earlier discussion in this section, we find that Entergy's FAC AMP is based on three documents, GALL, NSAC-202L, and EN-DC-315, each in order containing progressively more site-specific detail than its predecessor, and note that together these documents specify the activities to be conducted under Entergy's FAC AMP.

With the Commission's Oyster Creek decision in mind, and given the level of detail in NSAC-202L and EN-DC-315, we find that Riverkeeper's assertion that Entergy's FAC AMP lacks sufficient detail to provide the NRC Staff with the requisite reasonable assurance lacks adequate evidentiary support. Based on the information in Entergy's LRA and subsequent testimony, we find that Entergy's FAC AMP implements the recommendations of GALL, as well as the more detailed guidelines provided in NSAC-202L. For the reasons stated above, we find that Entergy has demonstrated with sufficient specificity that IPEC's AMP for FAC meets the industry guidelines relating to the methods and frequency of inspections and for the repair or replacement of components. Consequently, we find that Entergy's FAC AMP is consistent with GALL and provides sufficient detail to demonstrate that the intended functions of the applicable components will be managed during the PEO.

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[280] Id.

[281] Id. at 44.

[282] Id. at 46 (citing EN-DC-315 at 15–19 (Ex. ENT000038)).

### 2. Definition of Flow Accelerated Corrosion

In support of contention RK-TC-2, Riverkeeper witness Dr. Hopenfeld testified that, "FAC is a pipe wall thinning phenomenon in which the thinning rate is accelerated by flow velocity,"[283] and that wall thinning is highly dependent on flow velocity.[284] He stated that, "[g]enerally, two different mechanisms could lead to such wall thinning: (1) physical removal of metal by mechanical forces (shear or impact), and (2) chemical or electrochemical dissolution of the metal."[285] He further stated that "[i]n many instances both mechanisms occur simultaneously."[286] Dr. Hopenfeld also testified that Entergy "improperly excludes wall thinning by cavitation, wet steam, galvanic corrosion, and jet impingement/erosion even though all are [a]ffected by flow velocities,"[287] and that Entergy's use of CHECWORKS is deficient because it "does not predict wall thinning by these other mechanisms, including cavitation or droplet impingement."[288]

Taking exception to Dr. Hopenfeld's view, Entergy witnesses defined FAC as the "[d]egradation and consequent wall thinning of a component by a dissolution phenomenon, which is affected by variables such as temperature, steam quality, steam/fluid velocity, water

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[283] Hopenfeld Report at 2 (Ex. RIVR00005).

[284] Riverkeeper RK-TC-2 Rebuttal Testimony at 29 (Ex. RIV000108).

[285] Hopenfeld Report at 2 (Ex. RIVR00005).

[286] Id.

[287] Riverkeeper RK-TC-2 Rebuttal Testimony at 29 (Ex. RIV000108) (citing Entergy RK-TC-2 Testimony at 32). To support his definition of FAC, Dr. Hopenfeld cites examples of observed non-linear wear. See, e.g., Tr. at 1547, 1579–81, 1583, 1585–86 (Dr. Hopenfeld for Riverkeeper). He testified that this non-linear wear is the result of localized effects related to the erosion contribution to FAC. Tr. at 1545–46 (Dr. Hopenfeld for Riverkeeper). Dr. Hopenfeld testified that because the Entergy FAC AMP does not account for this localized effect, the ability of the Indian Point FAC program to detect FAC is inhibited. Tr. at 1493 (Dr. Hopenfeld for Riverkeeper).

[288] Riverkeeper RK-TC-2 Rebuttal Testimony at 29 (Ex. RIV000108).

chemistry, component material composition and component geometry."[289] Acknowledging that in the past FAC has been referred to as "erosion/corrosion,"[290] Entergy's witnesses nonetheless testified that "FAC is a chemical corrosion phenomenon that is distinct from mechanical or erosive phenomena that may cause pipe wall thinning, such as cavitation, liquid droplet impingement, and solid particle erosion."[291] They testified that FAC is defined throughout the industry as a chemical corrosion process and not an erosive phenomenon.[292]

Entergy's witnesses further testified that FAC and other degradation mechanisms do not occur simultaneously,[293] in that wall thinning in FAC-susceptible systems is caused "either by a chemical process (*i.e.*, FAC) or an erosive process, but not both" and "[c]ombinations of mechanisms in FAC-susceptible systems are rare."[294] Their claim is based on the supposition

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[289] Entergy RK-TC-2 Testimony at 29 (Ex. ENTR00029) (citing EN-DC-315, at 6 (Ex. ENT000038)); see also NSAC-202L-R3 at v, 1–2 (Ex. RIV000012); Tr. at 1438 (Mr. Aleksick for Entergy) ("Flow-accelerated corrosion is a pure corrosion process."). The NRC Staff's witnesses agreed with this definition. See NRC Staff RK-TC-2 Testimony at 7–8 (Ex. NRCR00121).

[290] Entergy RK-TC-2 Testimony at 29 (Ex. ENTR00029).

[291] Id.

[292] Id. at 29–32. This definition is consistent with NSAC-202L-R3 and Entergy's corporate FAC Program, EN-DC-315. Id. at 29. As stated above, NSAC-202L is the industry guidance document for developing a FAC AMP. NSAC-202L-R3 at 5, 7 (Ex. RIV000012).

[293] Entergy RK-TC-2 Testimony at 32 (Ex. ENTR00029) (stating that "[b]ased on our more than 45 years of experience with FAC, this statement [that erosion and corrosion occur simultaneously] is incorrect.").

[294] Id. Despite maintaining that erosion in combination with FAC does not occur in carbon steel piping, Entergy's witnesses testified that "[o]nce cavitation is identified, the situation is normally corrected as part of ongoing operations and maintenance activities." Id. They testified that "mechanical or erosive damage to piping surfaces can occur by various means, but . . . the FAC Program addresses wall-thinning, whether caused by FAC or not." Id. at 31. They explained that "the CHECWORKS model is based on empirical data from many plants" and that "CHECWORKS is calibrated at individual plants through the PASS-2 analysis, which compares predicted and measured wear rates from UT data." Id. at 61. "To the extent that plant-specific UT [ultrasonic testing] data reflects the effects of degradation mechanisms other than FAC, then after calibration the effects of those mechanisms are accounted for in subsequent wear rate predictions. For modeled lines, however, mechanisms other than FAC are usually negligible." Id. Entergy's witness Mr. Aleksick explained that "the FAC Program is in a sense a wall-thinning

that "erosion in combination with FAC does not occur in carbon steel piping because the oxide layer that is necessary for FAC cannot form if erosion is occurring."[295] According to Entergy's witnesses, in a FAC-susceptible system wall thinning due to erosion is "treated as a design issue, not an aging mechanism."[296]

We find that Entergy appropriately defined FAC as a chemical corrosion process and not an erosive phenomenon. We find no compelling support for Riverkeeper's position that Entergy's FAC program is deficient for failing to include wall thinning due to physical processes with the chemical process degradation generally associated with FAC. The Board addresses, in turn, Riverkeeper's main arguments regarding the definition of FAC.

First, Dr. Hopenfeld in his testimony referenced a paper authored by Dr. Digby Macdonald for the proposition that "erosion/corrosion . . . is not a mass transfer controlled process."[297] Dr. Hopenfeld further testified that:

> when the flow is fairly low, the level of turbulence is low. The whole process is controlled basically by metal dissolution.
>
> When you go beyond that . . . you go through very, very high turbulence and at that point you have a situation that part of that outside layer is weakened. . . . It's easier for the flow shear to remove part of the outside layer.
>
> At this point, you get in the situation that you have both, erosion and corrosion.[298]

Although this statement is consistent with the erosion/corrosion discussion in the Macdonald paper, Dr. Hopenfeld's testimony and his reference to the Macdonald paper does

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program. And so through the use particularly of operating experience as well as engineering judgment, those other degradation mechanisms are addressed." Tr. at 1439 (Mr. Aleksick for Entergy).

[295] Entergy RK-TC-2 Testimony at 32 (Ex. ENTR00029).

[296] Id.

[297] Tr. at 1323 (Dr. Hopenfeld for Riverkeeper) (referencing Digby D. Macdonald, The Point Defect Model for the Passive State, 139 J. of the Electrochemical Society (Issue No. 12 Dec. 1992) (Ex. RIV000127) [hereinafter Macdonald Paper]).

[298] Tr. at 1442 (Dr. Hopenfeld for Riverkeeper).

not convince the Board that FAC includes wall thinning due to chemical corrosion and mechanical erosion. Entergy witness Dr. Horowitz stated that the assumption in the Macdonald paper is that a critical velocity is reached,[299] and testified that this critical flow velocity condition is not reached at Nuclear Power Plants (NPPs) as evident from all the data and experiments related to FAC.[300] The Board agrees and finds that the Macdonald paper does not support Riverkeeper's position that FAC includes wall thinning due to physical, mechanical processes at IPEC because the requisite critical velocity conditions do not occur under actual plant conditions.

Second, Dr. Hopenfeld referenced the BRT-CICERO software[301] in support of his hypothesis that FAC occurs at a "non-linear rate" which indicates that FAC is not limited to chemical corrosion.[302] We find that Riverkeeper's reference to the BRT-CICERO software lends little support to its position. As Entergy witness Dr. Horowitz testified, "[t]he CICERO code is clearly based on [a] linear assumption. The assumption is exactly the same as CHECWORKS."[303] Therefore, because the CICERO code is based on the same linear assumption as CHECWORKS, the Board finds that the BRT-CICERO paper does not support

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[299] Tr. at 1444 (Dr. Horowitz for Entergy). The term "critical velocity" was introduced by Dr. Horowitz to describe a flow velocity in the Macdonald paper in which the wall-thinning is represented more by erosion/corrosion than corrosion. See Macdonald Paper at 12, fig. 17 (Ex. RIV000127).

[300] Tr. at 1444 (Dr. Horowitz for Entergy).

[301] Tr. at 1549 (Dr. Hopenfeld for Riverkeeper) (referencing the BRT-CICERO paper, Ex. RIV000110). The BRT-CICERO paper describes the French BRT-CICERO software, which is based on laboratory data aimed at showing that FAC progresses at a constant rate under constant operating conditions. See Entergy RK-TC-2 Testimony at 32 (Ex. ENTR00029) (citing Stephane Trevin and Marie-Pierre Moutrille, Optimization of EDF's NPPs Maintenance Due to Flow Accelerated Corrosion and BRT-CICERO improvement by NDT Results Analysis (Apr. 2012) (Ex. RIV000110)).

[302] Hopenfeld Report at 2 (Ex. RIVR00005); Tr. at 1421 (Dr. Hopenfeld for Riverkeeper) (stating that he has not seen "any data" suggesting that the rate of FAC is linear with time).

[303] Tr. at 1882 (Dr. Horowitz for Entergy).

Dr. Hopenfeld's hypothesis that CHECWORKS and the FAC program are deficient because both BRT-CICERO and CHECWORKS assume a linear rate of FAC.

Additionally, to further refute Dr. Hopenfeld's "non-linear rate" thesis, Entergy witness Mr. Aleksick, testified that "through experience of 23 years in this field the wear rates are linear and you can plot a measurement that at 1992 and then inspect the same component in 2002 and in 2012 and you will see a linear progression of wear."[304] Mr. Aleksick additionally testified that "one could go back to the data set of 3,700 historical inspections. Some of the components in that data set have been inspected multiple times, two, three, four times over a period of many years. And plot those, and I think demonstrate the linear nature of FAC."[305] Based on this evidence, the Board is not persuaded by Dr. Hopenfeld's argument that FAC occurs at a "non-linear rate" and deduction from this non-linearity that FAC is not limited to chemical corrosion.

Third, Dr. Hopenfeld referenced two Entergy FAC inspection reports as examples that "nonlinear wear exists at Indian Point" and that the definition of FAC should include erosion.[306] Although Dr. Hopenfeld pointed to an exhibit from each report,[307] he provided no further explanation in support for his non-linearity hypothesis.[308] The Board finds that these two examples fail to support Dr. Hopenfeld's position that nonlinear wear exists at IPEC and that the definition of FAC should include erosion. The referenced exhibits provide no indication of nonlinear wear. To the contrary, the FAC Inspection Report for IP3 conducted in 2005 shows

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[304] Tr. at 1431 (Mr. Aleksick for Entergy).

[305] Tr. at 1766 (Mr. Aleksick for Entergy).

[306] Tr. at 1845 (Dr. Hopenfeld for Riverkeeper) (referring to Exs. RIV000132 and RIV000133).

[307] Id.

[308] See Tr. at 1847 (Dr. Hopenfeld for Riverkeeper) (stating that his conclusions regarding the two Entergy FAC inspection reports were based on "some averages" and on a "gut feeling"); Tr. at 1848 (Dr. Hopenfeld for Riverkeeper) (stating that in reviewing the inspection report data, he simply "looked at this and said, '[l]ook, there is a significant change here.'"). But Dr. Hopenfeld provided no explanation and even stated that "[he] ha[dn't] analyzed" the data. Id.

an elbow component, where the variations in wall thickness were due to how the component was manufactured, not FAC or any other degradation mechanism.[309] Similarly, the FAC Inspection Report for IP3 conducted in 2005 shows a pipe reducer, where again the thickness variations were due to the design of the component, not any wall thinning mechanism.[310] Even if there were no evidence regarding the cause of the thickness variations, it would be difficult for Dr. Hopenfeld's references to provide support for his position given that his conclusions were "based on a gut feeling"[311] and his acknowledgment that he "ha[dn't] analyzed . . . these steep changes."[312]

Lastly, to back his argument regarding the definition of FAC and to demonstrate the presence of non-linear localized wear, Dr. Hopenfeld discussed "instances of undetected FAC [that] ha[s] previously resulted in catastrophic events" at other nuclear power plants, *i.e.*, Surry, San Onofre, Fort Calhoun, and Mihama.[313] Although these might be examples of undetected FAC, we find that Riverkeeper's reliance on operating experience with undetected FAC at other nuclear power plants and Dr. Hopenfeld's discussion of these occurrences provides no support for its position that the wear is non-linear. In regard to selected examples that provided some discussion of wear rate (*i.e.*, Surry, Fort Calhoun and Mihama), the Board does not find this evidence convincing for the reasons summarized below.

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[309] See Tr. at 1887–89 (Mr. Aleksick for Entergy) (explaining the variations in wall thickness).

[310] See Tr. at 1878–79 (Mr. Aleksick for Entergy (explaining the variations in wall thickness).

[311] Tr. at 1846 (Dr. Hopenfeld for Riverkeeper).

[312] Tr. at 1848 (Dr. Hopenfeld for Riverkeeper).

[313] Hopenfeld Report at 3 (Ex. RIVR00005); see also Tr. at 1514–17, 1530–31 (Dr. Hopenfeld for Riverkeeper). Dr. Hopenfeld references (1) a feed water pipe elbow rupture at the Surry nuclear power plant in 1986; (2) FAC resulted in failures of feed ring and J-tube components at the San Onofre steam generators in 1993; (3) extraction steam piping ruptured at the Fort Calhoun Station in 1997; and (4) FAC in the secondary loop at the Mihama nuclear power plant in 2004. Hopenfeld Report at 3 (Ex. RIVR00005).

In regard to the pipe rupture at Surry, Dr. Hopenfeld testified that according to published reports the FAC-related failure involved uneven corrosion that occurred in an elbow component.[314] He went on to assert that the Surry incident supports his conclusion that non-linear localized wear occurs because "20% of the wall thickness was lost in less than 18 months."[315] In contrast, Dr. Horowitz testified for Entergy that "[t]he 20 percent wall loss turns out to be an erroneous conclusion made at the inspection of the outage after the rupture."[316] He asserted that although it appears that the "process was non-linear, . . . that turns out not to be the case at all."[317] According to Dr. Horowitz, the wear actually occurred over the operational life of the Surry elbow, which was roughly 10 years.[318] Additionally, as Entergy's witnesses, Dr. Horowitz and Mr. Aleksick, noted, Surry had no FAC program when the pipe rupture event occurred.[319] In fact, as Dr. Horowitz accurately testified, the Surry accident resulted in the development of CHEC, the first EPRI computer program used to predict FAC.[320]

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[314] Tr. at 1514–15 (Dr. Hopenfeld for Riverkeeper).

[315] Riverkeeper RK-TC-2 Rebuttal Testimony at 40 (Ex. RIV000108); Tr. at 1515 (Dr. Hopenfeld for Riverkeeper) (responding to Judge Wardwell's question asking for "evidence that supports your contention that this local type failure does result in non-linear rates."). It is also noted that Dr. Hopenfeld appears to cite these examples of operating experience at other facilities as general criticism of CHECWORKS and IPEC's FAC program.

[316] Tr. at 1520–21 (Dr. Horowitz for Entergy).

[317] Tr. at 1521 (Dr. Horowitz for Entergy). It is noted that Dr. Hopenfeld appeared to concede to Dr. Horowitz's conclusion. See Tr. at 1523 (Dr. Hopenfeld for Riverkeeper) ("With respect to Dr. Horowitz' comments, I'm sure he's right. He's done much more detailed analysis of it than I did. I just go as to what -- I talked to various people at the time. I visited the plant at the time and I saw literature following the accident and that's what I reported here. If he has done additional analysis, I wish he had shared it with us.").

[318] Tr. at 1521 (Dr. Horowitz for Entergy).

[319] Entergy RK-TC-2 Testimony at 9, 100 (Ex. ENTR00029).

[320] Id. at 100.

At Fort Calhoun,[321] as Entergy's witnesses testified, the underlying failure to detect the FAC was due to an error in data input causing a failure location to be omitted from inspection.[322] Lastly, in regard to the Mihama example, Dr. Hopenfeld for Riverkeeper maintained that this FAC event "was very, very local" and "completely unpredicted."[323] Dr. Hopenfeld stated that a close review of these events showed a "clear indication" of "how local the phenomenon" was, with the data in particular showing "that there [was] no linearity between time and corrosion."[324] Dr. Horowitz for Entergy countered that he "would hardly characterize it as local. If you look at the pictures you can see the large amount of thinning evolves downstream of an orifice."[325] Additionally, according to Dr. Horowitz, no computer code or predictive method was used to select the inspection locations at Mihama and the plant operators (using their non-predictive approach) just missed it.[326] So as Dr. Horowitz testified, for roughly 15 years nobody thought to inspect the piping downstream of that orifice.[327] We find Dr. Horowitz's conclusions compelling. Because of the significant amount of time that the plant operated without inspecting this piping location downstream of the orifice, we find no support was presented for Dr. Hopenfeld's conclusion that the Mihama failure indicated non-linear wear.

Accordingly, we find that the examples cited by Dr. Hopenfeld do not provide a technical basis for defining and managing FAC as both a chemical corrosion and erosive process. The

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[321] Dr. Hopenfeld appears to cite Fort Calhoun only as an example that "undetected FAC at nuclear power plants have . . . resulted in catastrophic events." Hopenfeld Report at 3 (Ex. RIVR00005). The example does not appear to the Board to be cited in support of Dr. Hopenfeld's definitional argument.

[322] Entergy RK-TC-2 Testimony at 100 (Ex. ENTR00029).

[323] Tr. at 1517 (Dr. Hopenfeld for Riverkeeper).

[324] Tr. at 1530–31 (Dr. Hopenfeld for Riverkeeper).

[325] Tr. at 1518 (Dr. Horowitz for Entergy).

[326] Id.

[327] Tr. at 1519 (Dr. Horowitz for Entergy).

Board concludes that Entergy, for purposes of its FAC program, has appropriately defined flow accelerated corrosion as a chemical corrosion process, that FAC is not an erosive phenomenon, and that all evidence in the record before us points to a linear rate of FAC wear. We thus find that FAC is degradation and consequent wall thinning of a component by chemical dissolution, which is affected by variables such as temperature, steam quality, steam/fluid velocity, water chemistry, component material composition and component geometry.

**3. Adequacy of CHECWORKS Benchmarking at IPEC**

IP2 underwent a Stretch Power Uprate (SPU) of 3.26 percent in 2004, and IP3 underwent a SPU of 4.85 percent in 2005.[328] Riverkeeper alleges that, following the 2004, and 2005 SPUs at IPEC, ten to fifteen years of post-uprate "benchmarking" should be required before CHECWORKS can be used as part of the FAC Program.[329] We find no evidentiary support for Riverkeeper's claim that extended post-uprate benchmarking must occur before CHECWORKS can be useful.[330]

First, we find that the validity of CHECWORKS results does not depend on post-uprate benchmarking, extended or otherwise. Entergy's witnesses convincingly testified that CHECWORKS appropriately accounts for the change in FAC wear rates that occur due to power uprates[331] and that Entergy updated the IP2 and IP3 CHECWORKS models in 2005 to include the new SPU operating parameter changes, such as flow rates and operating temperatures.[332] According to Entergy's witnesses, "CHECKWORKS was designed, and has

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[328] See id. at 62; Approved Applications for Power Uprates (Oct. 28, 2009) (Ex. ENT000083).

[329] Riverkeeper Petition at 21–22; Hopenfeld Report at 3–4 (Ex. RIVR00005).

[330] Hopenfeld Report at 4 (Ex. RIVR00005).

[331] Entergy RK-TC-2 Testimony at 86–87 (Ex. ENTR00029).

[332] See id. at 62; NRC Staff RK-TC-2 Testimony at 29 (Ex. NRCR00121).

been shown, to accommodate changes in chemistry, flow rate, and other operating conditions that may be associated with power uprates, without inspection data from multiple outages."[333]

As further support, Entergy's witnesses cited a recent study that examined the impact of SPUs and Extended Power Uprates (EPUs) of up to twenty percent on the FAC programs at twenty-two U.S. nuclear units.[334] This study concluded that CHECWORKS predictions reasonably matched inspection conditions after the power uprates.[335] Additionally, Entergy's witnesses testified that "comparison of the measured wear and CHECWORKS model-predicted wear indicates a level of correlation following SPU implementation that is consistent with the level of correlation at IPEC before uprates."[336]

Additionally, in correspondence submitted to the NRC in response to an NRC Staff RAI, Entergy explained that the validity of the CHECWORKS model does not depend on benchmarking against plant-specific measured wear rates of components operating under SPU conditions,[337] and that the uprated conditions (*e.g.*, flow rate and operating temperatures) are generally bracketed by historical data.[338] Entergy indicated that:

> [i]n its use throughout the industry, the CHECWORKS model has been benchmarked against measurements of wall thinning for components operating over a wide range of flow rates. Consequently, the validity of the model does not depend on benchmarking against plant-specific measured wear rates of components operating under SPU conditions. . . . The accuracy of the model is not expected to change significantly due to the SPU.[339]

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[333] Entergy RK-TC-2 Testimony at 86 (Ex. ENTR00029).

[334] Id.

[335] See EPRI, Plant Engineering: Impact of Electric Power Uprates on Flow-Accelerated Corrosion (July 2011) (Ex. ENT000081).

[336] Entergy RK-TC-2 Testimony at 87 (Ex. ENTR00029).

[337] See NL-08-004, Letter from Fred R. Dacimo, Entergy, to NRC, Reply to Request for Additional Information Regarding License Renewal Application (Steam Generator Tube Integrity and Chemistry), Attach. 1 at 3 (Jan. 4, 2008) (Ex. ENT000082).

[338] Id.

[339] Id.

And the NRC Staff agreed with Entergy's RAI response, concluding in the Indian Point SER that CHECKWORKS is a "self-benchmarking" computer code.[340] In this regard, the NRC Staff witnesses Dr. Hiser and Mr. Yoder testified that:

> CHECWORKS is "calibrated" for the plant by adding plant-specific data from actual physical inspection data from components, developed over the course of several inspections. This calibration process is sometimes called "self-benchmarking." The calibration evaluates a line correction factor for a given line, which is used to adjust wear rate predictions in a given line to account for plant operating conditions that may vary with time. The line correction factor is determined by comparing the predicted wear to the measured wear at locations in the line which have been inspected. . . . Self-benchmarking of CHECWORKS improves the accuracy of wear predictions from the plant-specific model to account for the actual wear that is occurring in the plant. The self-benchmarking improves the estimates of FAC and helps to indicate the locations for future inspections.[341]

Based on Entergy's and the NRC Staff's convincing testimony, the Board finds that the validity of CHECWORKS results does not depend on post-uprate benchmarking because CHECWORKS (1) accounts for the change in FAC wear rates that occur due to power uprates; and (2) is a "self-benchmarking" computer code.

Second, we conclude that extended benchmarking is not required because, as Entergy witnesses Dr. Horowitz and Mr. Aleksick testified, CHECWORKS is properly performing its intended function by providing a screening and ranking function for the FAC engineer to identify inspection locations.[342] They clarified that CHECWORKS is not used to determine corrective action, but is a predictive software tool, based on algorithms developed from test data that is only used with other plant information and site experience to assist the FAC engineer in

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[340] SER at 3-28 (Ex. NYS00326B).

[341] NRC Staff RK-TC-2 Testimony at 15–16 (Ex. NRCR00121).

[342] Entergy RK-TC-2 Testimony at 77 (Ex. ENTR00029).

identifying locations for inspection.[343] According to Entergy's witnesses, CHECWORKS predictions focus the attention of the FAC Program on those components that may either be experiencing wear *or* on locations where CHECWORKS is not well-calibrated or where there are other indicia of uncertainty in CHECWORKS predictions.[344] Then, as those witnesses stated, appropriate corrective action is taken based on actual, measured data, not on the results from CHECWORKS modeling.[345]

Entergy's witnesses Dr. Horowitz and Mr. Aleksick testified that, for those IPEC FAC Program components modeled by CHECWORKS, the software adequately performs its intended purpose of assisting the FAC engineer in identifying locations in need of inspection.[346] Based on that testimony, we find that CHECWORKS results at IPEC are sufficiently accurate to serve its purpose of providing one of several sources of information for the FAC program engineer to use in selecting inspection locations.

Dr. Horowitz and Mr. Aleksick also testified that, based on the recent IPEC CHECWORKS reports, an average of approximately fifty-five percent of the analysis lines across both plants are calibrated[347] and the line correction factors[348] are in range approximately

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[343] Tr. at 1294–95 (Mr. Aleksick for Entergy); Entergy RK-TC-2 Testimony at 57 (Ex. ENTR00029). The software is designed to provide a best estimate of wear due to FAC. Entergy RK-TC-2 Testimony at 76–77 (Ex. ENTR00029).

[344] Entergy RK-TC-2 Testimony 59–61, 81 (Ex. ENTR00029) (citing NSAC-202L-R3 at 4-1, 4-7 (Ex. RIV000012)); Tr. at 1604 (Mr. Aleksick for Entergy).

[345] Id. at 77.

[346] Id.

[347] Generally, a calibrated line in this context refers to an analysis line that meets a number of criteria. For this contention the most relevant criteria is that the analysis line should have a line correction factor (see below) between 0.5 and 2.5. An analysis line is one or more physical lines of piping that have been analyzed together. See NSAC-202L-R3 at 4-1 (Ex. RIV000012).

[348] In the context of the CHECWORKS code, line correction factor is defined as the median value of the ratios of measured wear for a given component divided by its predicted wear for a particular set of piping lines (referred to as an analysis line). A line correction factor of 1.0 is considered ideal as the measured wear equals the predicted wear (median value). See id.

seventy percent of the time.[349] These results, according to Entergy's witnesses, are typical of FAC Programs they have reviewed throughout their careers, and are sufficient for CHECWORKS to serve its intended function as one of several screening tools used to focus the attention of the FAC engineer on lines that may be experiencing wear and on lines where the wear rate is not being accurately predicted.[350] In understanding these results, Entergy witness Mr. Aleksick pointed out that a primary reason analysis lines are not calibrated is related to the very low wear rate that is often lower than the measurement uncertainty.[351]

Entergy's witnesses concluded, and we agree based on the unrebutted information they provided, that CHECWORKS is providing useful information to the IPEC FAC Program engineer.[352] We find that extended benchmarking is not required because CHECWORKS is sufficiently self-calibrating to properly perform its intended screening and ranking function.

**4. Wall Thinning Management of Steam Generator Components**

Dr. Hopenfeld on behalf of Riverkeeper testified that "[c]omponents inside the steam generators, as well as valves and blow down lines, are important safety/risk-significant components that are highly vulnerable to FAC and fall within the license renewal rule, and yet are not monitored at all by CHECWORKS."[353] For the following reasons, however, we find no deficiency in Entergy's management of potential FAC in steam generator components or steam generator blow down lines.

Using the steam generator feedwater ring as an example, Dr. Hopenfeld testified that this component "is subjected to very high turbulence especially at the flow stagnation area, yet

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[349] Id. at 63–64.

[350] Id. at 64; Tr. at 1641–42 (Mr. Aleksick for Entergy), 1670–71 (Mr. Azevedo for Entergy).

[351] Tr. at 1753 (Mr. Aleksick for Entergy).

[352] Entergy RK-TC-2 Testimony at 64 (Ex. ENTR00029).

[353] Riverkeeper RK-TC-2 Rebuttal Testimony at 28, 16–18 (Ex. RIV000108).

is not monitored by CHECWORKS to determine inspection intervals."[354] He found this problematic, noting that the lack of CHECWORKS monitoring "fails to ensure that the steam generator will maintain its integrity, in particular, during design basis accidents such as main steam-line breaks and station blackouts."[355] He further testified that EPRI's guidance in NSAC-202L "does not recommend the use of tools other than a quantitative predictive model such as CHECWORKS."[356]

Entergy witnesses agreed that the "FAC Program does not cover components inside the steam generators, such as the feedwater distribution ring"[357] but, "[i]nstead, those components are inspected under the Steam Generator Integrity Program . . . ."[358] Mr. Azevedo testified that "early during the original steam generator design, there were issues with FAC and the feed rings in the J-tubes. However, both Indian Point Units 2 and 3 have replacement steam generators."[359] Mr. Azevedo went on to state that, based on inspections that have been completed, "the current Indian Point 2 and 3 steam generators are not susceptible to feed ring wear."[360] Responding to a question about whether any steam generator components are susceptible to FAC, Mr. Azevedo testified that "they could have been because of the original design, but the current steam generators, no."[361] Dr. Hopenfeld responded to Entergy's

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[354] Id. at 28.

[355] Id.

[356] Id. (citing NSAC-202L-R3 (Ex. (Ex. RIV000012)).

[357] Entergy RK-TC-2 Testimony at 40 (Ex. ENTR00029).

[358] Id. The efficacy of the Steam Generator Integrity Program is not challenged in this contention.

[359] Tr. at 1521 (Mr. Azevedo for Entergy).

[360] Id.

[361] Tr. at 1522 (Mr. Azevedo for Entergy).

testimony by stating that he had based his conclusions on San Onofre prior to the installation of the replacement steam generators at Indian Point.[362]

Based on the record before us, the Board finds that not managing the steam generator components for FAC with CHECWORKS is of no consequence at IPEC. First, the relevant aging effects are being managed under the steam generators' own AMP – the IPEC Steam Generator Integrity Program, which is not being challenged in this contention. Second, consistent with Mr. Azevedo's testimony, we conclude that the replacement steam generators have reduced the potential for the feedwater distribution ring in the steam generators to be susceptible to FAC. Accordingly, the Board finds no deficiency in Entergy's FAC AMP for not managing FAC in steam generator components or steam generator blow down lines.

**5. Wall Thinning Prediction by Means Other Than CHECWORKS**

Lastly, we address Riverkeeper's argument challenging the adequacy of the "other tools" Entergy indicated it used to select inspection locations as part of Entergy's FAC AMP.[363] Riverkeeper witness Dr. Hopenfeld, testified that these "other tools" were not "described in sufficient detail to allow a thorough assessment of their effectiveness for managing FAC or to draw meaningful conclusions about the validity of their performance."[364] Focusing on Entergy's use of other specifically identified tools, Dr. Hopenfeld's concern was directed at the trending of

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[362] Tr. at 1522–23 (Dr. Hopenfeld for Riverkeeper) (referencing testimony by Entergy witness Mr. Azevedo).

[363] Riverkeeper RK-TC-2 Rebuttal Testimony at 9 (Ex. RIV000108).

[364] Id. at 16. Dr. Hopenfeld testified that in his opinion because these "other tools" account for 75 percent of Entergy's FAC inspection program, it should provide a quantitative description of the predictive methodology employed for these techniques. Id. Dr. Hopenfeld testified that Entergy should be required to (1) describe how many components per outage are inspected by each method; (2) provide a ranking of components' safety significance; (3) identify the size of the inspection areas relative to all FAC susceptible locations; (4) specify what percentage of the total FAC susceptible area in the plant is addressed with these other tools; and (5) outline how often the components are inspected, how the frequency of inspections is established, how the validity of the measurements is verified, what is the accuracy of the "other tool" predictions in relation to actual measurements, and what is the validity of each method relative to schedule inspection intervals. Id.

actual pipe wall thickness measurements from past outages, operating experience, information from other inspection programs, and engineering judgment.[365]

In assessing Dr. Hopenfeld's concerns, it bears repeating that Entergy does not use the various FAC AMP tools as "stand-alone"[366] methods. Instead, the various FAC inspection selection tools are used in concert.[367]

Turning then to the specifics of Dr. Hopenfeld's concerns, he first testified that actual pipe wall thickness measurements are only useful when used in combination with a predictive tool.[368] However, such trending does not "stand alone." As Entergy's witnesses testified, inspection locations that were selected based on trending may have originally been selected based on CHECWORKS.[369] Additionally, as Entergy's witnesses explained, trending of wear based on measured thicknesses is a reliable process because FAC wear rates under constant operating conditions are generally constant with time.[370]

Regarding the usefulness of operating experience, according to Dr. Hopenfeld, the validity of this "other tool" rests, at least in part, on how the CHECWORKS model processes the inputs.[371] In response, Entergy's witnesses testified that while operating experience is used

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[365] Hopenfeld Report at 21–23 (Ex. RIVR00005); Riverkeeper RK-TC-2 Rebuttal Testimony at 9–17 (Ex. RIV000108).

[366] Hopenfeld Report at 21 (Ex. RIVR00005).

[367] See Tr. at 1610 (Mr. Aleksick for Entergy) (explaining that a "variety of techniques" are used in a "complementary manner"); see also infra Section III(D)(5).

[368] Riverkeeper RK-TC-2 Testimony at 13 (Ex. RIV000003); Hopenfeld Report at 21 (Ex. RIVR00005); Riverkeeper RK-TC-2 Rebuttal Testimony at 11–14 (Ex. RIV000108).

[369] See, e.g., Entergy RK-TC-2 Testimony at 54–55 (Ex. ENTR00029).

[370] Id. at 32. Additionally, operating experience has shown trending to be reliable. Entergy RK-TC-2 Testimony at 69–79. Dr. Hopenfeld acknowledged at the hearing that if the rate of FAC is constant with time, then trending would be an effective tool to manage FAC. Tr. at 1493 (Dr. Hopenfeld for Riverkeeper).

[371] Riverkeeper RK-TC-2 Testimony at 13 (Ex. RIV000003).

directly to select some of the inspection locations,[372] it is not used in any numerical calculations of predicted wear rates.[373] We agree with Entergy's approach regarding this "other tool" and note that the use of operating experience in the selection of inspection locations is documented in detail in Attachment A of the IPEC System Susceptibility Evaluation Reports.[374]

Lastly, Dr. Hopenfeld testified that Entergy's FAC AMP does not define "engineering judgment" in relation to FAC inspections and the role that this "other tool" plays in inspection scope selection.[375] Engineering judgment, however, is intrinsically subjective.[376] Moreover, given the other more quantitative, analytical tools in the program, we find that the subjectivity of engineering judgment does not create a deficiency in Entergy's FAC AMP.[377]

In sum, we find that Entergy uses the "other" FAC inspection selection tools in concert with CHECWORKS. Furthermore, the Applicant has provided sufficient details to assess the effectiveness of these "other tools" for managing FAC.

**E. Conclusions of Law**

The preponderance of the evidence fully supports the conclusion that Entergy has demonstrated that the effects of aging from FAC on the intended functions of the piping and components susceptible to FAC will be adequately managed for the PEO as required by 10 C.F.R. § 54.21(a)(3). The issues regarding the adequacy of Entergy's AMP for the

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[372] Entergy RK-TC-2 Testimony at 47 (Ex. ENTR00029).

[373] Id. at 47, 53–54.

[374] See IP2 SSE Report, Attach. A (Ex. ENT000048); IP3 SSE Report, Attach. A (Ex. ENT000049). A table of important industry events and their applicability to IPEC was compiled into Industry FAC Experience Tables.

[375] Riverkeeper RK-TC-2 Testimony at 14 (Ex. RIV000003); Hopenfeld Report at 22 (Ex. RIVR00005).

[376] Riverkeeper RK-TC-2 Testimony at 14 (Ex. RIV000003); Entergy RK-TC-2 Testimony at 48 Ex. ENTR00029).

[377] As Entergy's witnesses testified, engineering judgment, moreover, is only used to select a relatively small percentage of the inspection scope in any given refueling outage. Entergy RK-TC-2 Testimony at 53–54 (Ex. ENTR00029).

management of flow accelerated corrosion raised by RK-TC-2 have been resolved in favor of the Applicant and do not prevent the NRC from issuing the requested license renewal.

# IV. SAFETY CONTENTION NYS-5 (Buried Pipes)

## A. Statement of Contention NYS-5

NYS-5, a safety contention that challenges the aging management of buried pipes, as litigated on December 10 and 11, 2012, reads as follows:

> The LRA does not provide [an] adequate AMP for buried pipes, tanks, and transfer canals that contain radioactive fluid that meet 10 C.F.R. § 54.4(a) criteria. In addition, the LRA is not clear whether an AMP for IP1 buried SSCs that are being used by IP2 and IP3 exists, and whether the LRA is adequate if it does exist.[378]

## B. NYS-5 Background

### 1. NYS-5 Procedural History

#### a. Contention Admissibility

NYS-5 challenges the adequacy of the AMP for IP2 and IP3 to manage the effects of aging during the PEO on buried pipes and tanks that may contain radioactive fluids. More specifically, New York alleges that the LRA does not satisfy 10 C.F.R. §§ 54.21 and 54.29(a) because the LRA does not mandate adequate inspection and monitoring for corrosion or leaks in all buried SSCs that may contain radioactively contaminated water or other fluids and therefore it does not demonstrate that the effects of aging will be adequately managed for the PEO.[379]

In admitting NYS-5, we stated that the questions to be addressed at hearing will include, inter alia, "whether, and to what extent, inspections of buried SSCs containing radioactive fluids, a leak prevention program, and monitoring to detect future excursions, are needed as part of Entergy's AMP for these components."[380] We further stated that "proposed inspection and monitoring details will come before this Board" to provide assurances that the intended function

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[378] LBP-08-13, 68 NRC at 218.

[379] Id.

[380] Id. at 81.

of relevant SSCs "will be maintained for the license renewal period, and specifically, to detect, prevent, or mitigate the effects of future inadvertent radiological releases as they might affect the safety function of the buried SSCs and potentially impact health."[381]

**b. The Aging Management Program in the License Renewal Application**

On April 23, 2007, Entergy filed its LRA for IP2 and IP3.[382] In Appendix A, Sections A.2.1.5 (Buried Piping and Tanks Inspection Program – IP2) and A.3.1.5 (Buried Piping and Tanks Inspection Program – IP3), Entergy described the IP2 and IP3 AMPs for buried pipes and tanks.[383] In Appendix B, Section B.1.6, Entergy described these programs in slightly more detail.[384] The "Program Description" contained in Section B.1.6 stated that the "Buried Piping and Tanks Inspection Program (BPTIP) is a new program that includes (a) preventative measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, gray cast iron, and stainless steel components."[385] Section B.1.6 identified the components to which the program applies, stated that the program will be implemented prior to the PEO, provided a description of inspection practice, and further confirmed that the preventive measures will be in accordance with industry practice.[386]

Entergy's LRA as originally filed stated that the BPTIP will be consistent with program attributes (based on industry operating experience) described in NUREG-1801 (GALL-1) with no

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[381] Id.

[382] LRA at B-27 to -28 (Ex. ENT00015B).

[383] Id. at A-19, A-46.

[384] Id. at B-27 to -28.

[385] Id. at B-27.

[386] Id.

exceptions and no enhancements.[387] As expressed in the original LRA, in Entergy's judgment, "[t]he [BPTIP] will be effective for managing aging effects since it will incorporate proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls."[388] The entirety of Entergy's AMP, absent the GALL-1 reference, was contained on one-and-a-half pages.

The sections of GALL-1 provide detail concerning the implementation and requirements of each program. For example, the "Program Description" in GALL-1 stated that "preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings, buried piping and tanks will be inspected when they are excavated during maintenance and when a pipe is dug up and inspected for any reason."[389] Additionally, Section XI.M34 of GALL-1 presented topics including preventive actions, monitoring and inspection parameters, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.[390] The referenced sections also provided that, as part of this program, plant and industry operating experience would be considered prior to, and during, program implementation.[391]

#### c. Subsequent Amendments and Submittals to Applicant's Aging Management Program

Following the submission of its LRA in 2007, Entergy amended its LRA for buried pipes and tanks. In July of 2009, Entergy modified its AMP as a result of an evaluation of recent site operating experience at Indian Point and other industry plants, related industry and Entergy fleet

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[387] Id. at B-27 to -28.

[388] Id.

[389] GALL-1 at XI M-111 to -112 (Ex. NYS00146C).

[390] Id.

[391] Id.; NL-09-106, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Questions Regarding Buried Piping Inspections, Attach. 1 at 3 (July 27, 2009) (Ex. NYS000203) [hereinafter NL-09-106].

initiatives, and the NRC Staff license renewal RAIs.[392] As of July 2009, the AMP for buried piping and tanks, with deletions and additions noted from the original program in the LRA, was documented in a letter from Entergy's Nuclear Licensing (NL) Department numbered NL-09-106.[393]

Entergy again revised its AMP for buried pipes and tanks in March 2011 in response to NRC Staff RAIs to add details on its buried piping inspections, including the number of total inspections planned for each unit before and during the PEO, the number of excavated direct visual inspections of external surfaces, the piping length to be excavated for direct visual inspections, the type of material to be inspected, and the piping category to be inspected.[394] Thereafter, on July 14, 2011, (as amended by a letter dated July 27, 2011) Entergy revised LRA Sections A.2.1.5 and A.3.1.5 (the parts of the UFSAR Supplement dealing with buried pipes for IP2 and IP3, respectively) to reflect an increased number and frequency of piping inspections as well as additional soil testing so as to be consistent with Entergy's RAI responses.[395] In these revisions, Entergy specified that 34 direct inspections of buried pipe will be performed during the 10-year period prior to the PEO and that 30 direct inspections will be performed during each 10-

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[392] Testimony of Entergy Witnesses Alan Cox, Ted Ivey, Nelson Azevedo, Robert Lee, Stephen Biagiotti, and Jon Cavallo Concerning Contention NYS-5 (Buried Pipes and Tanks) (Dec. 6, 2012) at 52, 58 (Ex. ENTR30373) [hereinafter Entergy NYS-5 Testimony]; see also NL-09-106, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Questions Regarding Buried Piping Inspections, Attach. 1 at 3 (July 27, 2009) (Ex. NYS000203) [hereinafter NL-09-106].

[393] See NL-09-106 (Ex. NYS000203).

[394] NL-11-032, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 3–9 (Mar. 28, 2011) (Ex. NYS000151) [hereinafter NL-11-032].

[395] NL-11-074, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 2–3 (July 14, 2011) (Ex. NYS000152) [hereinafter NL-11-074]; NL-11-090, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Response to Request for Additional Information (RAI), at Attach. 1 at 203 (July 27, 2011) (Ex. NYS000153) [hereinafter NL-11-090]. NL-13-037, Letter from Fred Dacimo, Entergy, to NRC, Revision to the Response to Request for Additional information (RAI), Attach. 1 (Mar. 5, 2013) (Ex. ENT000606) [hereinafter NL-13-037].

year period of the PEO (for a total of 60 direct inspections during the PEO). Entergy's inspection program for buried pipes is also outlined beginning at page 127, in our discussion of the need for cathodic protection for buried piping at IPEC.

The Final Safety Evaluation Report (FSER) issued by the NRC Staff in August of 2011 states that, after completing its review, the Staff concluded that Entergy's AMP was consistent with GALL-1 and that, based on its review of Entergy's response to NRC Staff RAIs 3.0.3.1.2-1[396] and 3.0.3.1.2-2,[397] aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO, as required by 10 C.F.R. § 54.21(a)(3).[398] In its review of the July 14, 2011 and July 27, 2011 supplements for Entergy's AMP[399] (UFSAR) the Staff concluded that they provided an adequate summary description of the programs as required by 10 C.F.R. 54.21(d).[400]

**2. Legal Standards and Issues Related to NYS-5**

As discussed above, 10 C.F.R. §§ 54.21(a)(3) and 54.29(a) provide the applicable legal standards for the evaluation of Indian Point's AMP for buried pipes and tanks. These regulations require that Entergy must demonstrate, to the point of providing "reasonable assurance," that the intended functions of these components will be maintained in accordance with the CLB for the PEO, as previously discussed in Section II(B) above.[401]

As explained in more detail in our discussion of RK-TC-2 beginning at page 38, in determining whether an applicant's LRA provides the requisite "reasonable assurance," the Staff

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[396] NL-11-032 (Ex. NYS000151).

[397] NL-11-074 (Ex. NYS000152).

[398] NRR, SER Related to the License Renewal of Indian Point Nuclear Generating Unit Nos. 2 and 3, NUREG-1930, Supp. 1, at 3-5 (Aug. 2011) (Ex. NYS000160) [hereinafter SER Supp. 1].

[399] See NL-11-074 (Ex. NYS000152); NL-11-090 (Ex. NYS000153).

[400] SER Supp. 1 at 3-5 (Ex. NYS000160).

[401] 10 C.F.R. §§ 54.21(a)(3), 54.29(a).

conducts a safety review of the application, governed by 10 C.F.R. Part 54 and principally guided by two documents, GALL and the SRP-LR.[402]

### 3. Evidentiary Record Related to NYS-5

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-5

Entergy presented six witnesses on NYS-5 – Alan B. Cox,[403] Ted Ivy,[404] Nelson F. Azevedo,[405] Robert Lee,[406] Stephen Biagiotti,[407] and Jon Cavallo.[408] On December 6, 2012, Entergy filed revised written direct testimony of these five witnesses[409] and on January 15, 2013, this revised testimony was admitted as evidence.[410]

The NRC Staff presented two witnesses to provide testimony on NYS-5 – Kimberly J. Green[411] and William C. Holston.[412] On December 7, 2012, the Staff filed the revised written

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[402] See supra Section II(B).

[403] Curriculum Vitae of Alan B. Cox (Ex. ENT000031).

[404] Curriculum Vitae of Ted Ivy (Ex. ENT000374).

[405] Curriculum Vitae of Nelson F. Azevedo (Ex. ENT000032).

[406] Curriculum Vitae of Robert C. Lee (Ex. ENT000375).

[407] Curriculum Vitae of Stephen F. Biagiotti, Jr. (Ex. ENT000376).

[408] Curriculum Vitae of Jon R. Cavallo (Ex. ENTR00377).

[409] See Entergy NYS-5 Testimony (Ex. ENTR30373).

[410] See Memorandum and Order (Admitting Entergy's Exhibits, Granting New York's Motion, and Admitting NRC's Exhibits) (Jan. 15, 2013) (Unpublished).

[411] Kimberly J. Green, Statement of Professional Qualifications (Mar. 29, 2012) (Ex. NRC000017).

[412] William C. Holston, Statement of Professional Qualifications (Mar. 29, 2012) (Ex. NRC000018).

direct testimony of these two witnesses.[413] This testimony was admitted on January 15, 2013.[414]

New York presented one witness to provide testimony on NYS-5 – Dr. David J. Duquette.[415] On December 16, 2011, New York filed the written direct testimony of Dr. Duquette in support of its position on NYS-5.[416] On October 5, 2012, New York filed the written rebuttal testimony of Dr. Duquette.[417] These two submissions were admitted by the Board on October 15, 2012.[418]

**b. Identification of Admitted Exhibits Relevant to NYS-5**

Relevant to NYS-5, Entergy submitted 97 exhibits, the Staff submitted 17 exhibits, and New York submitted 63 exhibits.[419] These exhibits were admitted into the record on October 15, 2012, January 15, 2013, and August 20, 2013.[420]

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[413] See NRC Staff's Testimony of Kimberly J. Green and William C. Holston Concerning Contention NYS-5 (Buried Pipes and Tanks) (Dec. 7, 2012) (Ex. NRCR20016) [hereinafter NRC Staff NYS-5 Testimony].

[414] See Memorandum and Order (Admitting Entergy's Exhibits, Granting New York's Motion, and Admitting NRC's Exhibits) (Jan. 15, 2013) (unpublished).

[415] Curriculum Vitae of David J. Duquette (Ex. NYS000166).

[416] See Pre-Filed Written Testimony of Dr. David J. Duquette, Ph.D. Regarding Contention NYS-5 (Dec. 16, 2011) (Ex. NYS000164) [hereinafter New York NYS-5 Testimony].

[417] See Pre-Filed Written Rebuttal Testimony of Dr. David J. Duquette Regarding Contention NYS-5 (Oct. 5, 2012) (Ex. NYSR20399) [hereinafter New York NYS-5 Rebuttal Testimony].

[418] Tr. at 1269 (Judge McDade).

[419] See Appendix B - Partial Initial Decision.

[420] Tr. at 1269 (Judge McDade); Licensing Board Order (Scheduling Post-Hearing Matters and Ruling on Motions to File Additional Exhibits) (Jan. 15, 2013) (unpublished); Licensing Board Order (Admitting Entergy's Exhibits) (Aug. 20, 2013) (unpublished).

#### c. Relevant NRC Staff Guidance Documents

1. NUREG-1800, Rev. 1, "Standard Review Plan for Review of License Renewal Application for Nuclear Power Plants" (Sept. 2005) (SRP-LR) (Ex. NYS000195). A description of this document was provided at page 41 above as it also pertains to RK-TC-2.

2. NUREG-1801, Rev.1, "Generic Aging Lessons Learned (GALL) Report" (Sept. 2005) (GALL-1) (Exs. NYS00146A–C). A description of this document was provided at page 41 above as it also pertains to RK-TC-2.

3. NUREG-1801, Rev. 2, "Generic Aging Lessons Learned (GALL) Report" (Dec. 2010) (GALL-2) (Exs. NYS00147A–D). A description of this document was provided at page 42 above as it also pertains to RK-TC-2.

## C. Issues Raised in NYS-5

NYS-5 raises numerous issues related to the proper assessment of the adequacy of Entergy's AMP for buried pipes and tanks that contain radioactivity. These related issues are: (1) the scope of the contention; (2) the intended functions of buried pipes; (3) the adequacy of Entergy's AMP as submitted with its LRA; (4) amendments to the Applicant's AMP for buried pipes; (5) IPEC's corrosion potential, soil corrosivity, historic leaks, corrective actions, inspections, cathodic protection, and proposed soil testing and inspection program for Entergy's amended AMP; (6) the Applicant's adherence to license commitments and specified procedures; and (7) the Staff's conclusions relating to Entergy's AMP for buried pipes. The evidence for each of these issues and the findings of fact are discussed in the subsequent subsections. This is followed by a summary of these findings of fact and the Board's conclusions of law.

## D. Scope of NYS-5

### 1. Evidence Related to the Scope of NYS-5

Evidence presented by New York was more narrowly focused than the contention was written and admitted. Accordingly, for the reasons explained below, only the adequacy of

Entergy's AMP for buried piping that conveys, or may contain, radioactive fluids is within the scope of NYS-5.

NYS-5 as submitted alleged that Entergy's AMP for buried pipes did not meet regulatory standards because "it does not provide adequate inspection and monitoring for corrosion or leaks in all buried systems, structures, and components that may convey or contain radioactively contaminated water or other fluids and/or may be important for plant safety."[421] At issue here is whether the scope of this contention was limited by the evidence presented.

Initially, in outlining the scope of this contention, it is important to note the difference between buried and underground piping. Buried piping is piping that is below grade that is exposed on its external surfaces to soil or concrete.[422] In contrast, underground pipes are below grade, but are contained within a tunnel or vault such that they are in contact with air but are located where access for inspection is restricted.[423] This definition is consistent with the current description of the Buried Piping and Tanks Program presented in GALL-2.[424] NYS-5 does not challenge the aging management of underground piping.[425]

Entergy's LRA includes a Buried Piping and Tanks Inspection Program (BPTIP), which lists the systems that are covered by Entergy's aging management review, including: service water, fuel, city water, safety injection, fire protection, security generator, plant drains, river-

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[421] LBP-08-13, 68 NRC 43, 78 (2008). Initially, NYS-5 challenged the degree to which IP1 piping was included in Entergy's AMP for buried pipes. However, New York's testimony made no reference to IP1, and its expert witness, Dr. Duquette, confirmed that whatever IP1 piping that is within scope is covered by the AMP and is no longer an issue. See Tr. at 3494 (Dr. Duquette for New York).

[422] Tr. at 3572–73 (Mr. Holston for the NRC Staff).

[423] NL-11-032, Attach. 1 at 8 (Ex. NYS000151).

[424] GALL-2 at XI M41-1 (Ex. NYS00147D).

[425] LBP-08-13, 68 NRC at 218.

water and auxiliary feedwater (AFW) systems.[426] Mr. Holston, testifying for the Staff, stated that of these systems, safety injection and AFW systems have the potential to contain radioactivity during normal operations, while service water, plant drains, and city water system have the potential to contain radioactivity during abnormal operations.[427]

As noted by the Staff, the buried piping and tanks within this AMP contain both radioactive and non-radioactive fluids, but, according to Mr. Cox for Entergy, the percentage of in-scope piping and tanks containing radionuclides is less than the percentage of in-scope SSCs with no radioactivity.[428] Furthermore, Entergy witnesses testified that all in-scope buried pipes are to be monitored under its program whether or not they contain radioactivity.[429] Although Entergy's witnesses testified that tanks are also part of license renewal,[430] New York raised no technical criticisms of Entergy's program for these tanks,[431] and New York's testimony did not allege that buried tanks are within the scope of NYS-5.

**2. Findings Related to the Scope of NYS-5**

The Board admitted NYS-5 to the extent that it challenged the adequacy of Entergy's AMP for those buried pipes, tanks, and transfer canals that contain radioactive fluid so as to fall within 10 C.F.R. § 54.4(a) criteria.[432] This contention, however, evolved during the lengthy prehearing period, and now challenges only Entergy's AMP for buried piping that conveys or may contain radioactive fluids. As noted above, while six buried tanks at IPEC are part of

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[426] LRA at B-27 (Ex. ENT00015B); Tr. at 3308–09 (Mr. Holston for the NRC Staff).

[427] NRC Staff NYS-5 Testimony at 18–19 (Ex. NRCR20016); Tr. at 3697–98 (Mr. Holston for the NRC Staff).

[428] See Tr. at 3580–81 (Mr. Cox for Entergy).

[429] Entergy NYS-5 Testimony at 57 (Ex. ENTR30373).

[430] Id. at 31.

[431] Tr. at 3584 (Dr. Duquette for New York).

[432] LBP-08-13, 68 NRC at 78.

Entergy's BPTIP and fall under license renewal,[433] New York did not contest the adequacy of Entergy's program for these tanks, and, as a result, these components are not addressed further in this decision.

New York's contention does not encompass the entirety of the Applicant's AMP for buried pipes but challenges only a limited class of SSCs that may contain radioactive fluids.[434] We believe, however, that this distinction has little import in that a ruling on the adequacy of Entergy's AMP, as it pertains to buried pipes falling under license renewal that contain radioactivity will necessarily address all buried pipes within the scope of license renewal. New York submitted no evidence or testimony concerning tanks and underground pipes.[435]

## E. Intended Functions of Buried Pipes

### 1. Evidence Related to the Intended Functions of Buried Pipes

The purpose of an AMP is to insure that structures and components perform their intended functions during the PEO. Accordingly, to assess the adequacy of an AMP we must understand the intended function of the buried pipes.

Table 2.0-1 of Entergy's LRA states that the function of buried pipes is to provide "pressure boundary integrity such that adequate flow and pressure can be delivered. This includes maintaining structural integrity and preventing leakage or spray."[436] Suggesting that this definition of pressure boundary is consistent with the Staff's definition in its SRP-LR[437] and

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[433] Entergy NYS-5 Testimony at 31 (Ex. ENTR30373).

[434] The piping and tanks within the scope of Part 54 are defined by 10 C.F.R. § 54.4, and, as pointed out in this decision, is consistent with GALL-2 that includes both buried and underground SSCs.

[435] For simplicity, the rest of this decision will only refer to Entergy's "buried pipe" program, recognizing that the AMP also covers buried tanks and underground pipes that are not part of this contention.

[436] LRA at 2.0-2, tbl. 2.0-1 (Ex. ENT00015A).

[437] SRP-LR Rev. 1 at 2.1-17, tbl. 2.1-4(b) (Ex. NYS000195).

10 C.F.R. § 54.4(a)(2), Ms. Green and Mr. Holston testified for the NRC Staff that potential leakage is not a safety consideration for license renewal so long as any leakage or spray from the system does not impact the ability of the SSC to deliver flow at an adequate pressure.[438]

Dr. Duquette, testifying on behalf of New York, stated that he considers leaks in a pipe to constitute failure.[439] In his opinion, "a piping system is . . . supposed to contain a fluid . . . , and if it can't contain that fluid, then it's at failure."[440] Specifically, he posited that a small leak, if left undetected could grow into a larger leak, which could compromise the function of a pipe and compromise its ability to maintain a pressure boundary.[441]

Dr. Duquette further testified that the leaking of radioactive fluids constitutes failure of the system that, like all safety-related pipes carrying radioactive fluid, was not supposed to fail.[442] Accordingly, in Dr. Duquette's opinion, "if a failure has already occurred, independent of the root cause of that failure, absent a comprehensive inspection or protection of the system, there can be no guarantee that future unpredictable failures will not occur in other safety related piping."[443] While recognizing that a leak would not necessarily make a difference in the flow rate through a pipe surrounded by soil, Dr. Duquette testified that controlling environmental impacts are part of aging management functions, even if the change in flow rate with the leakage may not be discernible and the pipeline is still achieving its primary function of moving fluid from one

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[438] NRC Staff NYS-5 Testimony at 25–26 (Ex. NRCR20016).

[439] Id. at 15.

[440] Tr. at 3554 (Dr. Duquette for New York).

[441] Tr. at 3965 (Dr. Duquette for New York).

[442] Id.

[443] New York NYS-5 Rebuttal Testimony at 6 (Ex. NYSR20399).

place to another.[444] Nevertheless, he also conceded that zero radioactive release is an unreasonable criterion.[445]

Controlling releases of radioactivity from leaks as an intended function of piping was addressed by both the NRC Staff and Entergy. Mr. Holston, testifying on behalf of the NRC Staff, stated that "controlling the releases of radioactivity is a safety related function" when it occurs as a result of an accident.[446] He testified that, in his opinion, the goal is "to control off-site dose that relates to health and safety, but as long as that piping system can deliver the required flow, it mitigates those releases and you won't see any change in release whether that pipe is leaking or not leaking."[447]

According to Mr. Holston, one of the premises of license renewal is that the current licensing basis (CLB) will continue into the PEO, and that the CLB already addresses the control of radioactive effluents.[448] But, Mr. Holston conceded that the mere fact that an SSC is to be maintained under the CLB does not exclude it from consideration for AMR as there are many AMPs that are covered under the maintenance rule.[449]

Mr. Cox testifying for Entergy echoed the position of the NRC Staff that the intended function of a pipe is to provide a pressure boundary to maintain flow,[450] but added that, in his experience, if the leaks from a pipe are controlled sufficiently to maintain its pressure boundary and flow, then the liquid release will not be sufficient to exceed the dose limits referenced in 10

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[444] Tr. at 3557–59, 3561 (Dr. Duquette for New York).

[445] Tr. at 3565 (Dr. Duquette for New York).

[446] Tr. at 3572 (Mr. Holston for the NRC Staff).

[447] Id.

[448] Tr. at 3570 (Mr. Holston for the NRC Staff).

[449] Tr. at 3574 (Mr. Holston for the NRC Staff).

[450] Tr. at 3576–77 (Mr. Cox for Entergy).

C.F.R. Part 54.[451] He stated that it was his understanding that the focus is on the need to maintain the flow necessary to mitigate the effects of an accident by keeping the core cooled, and "[i]t's not directed at making sure you don't have leakage from the pipe . . . . [U]ltimately you're concerned about dose limits, but you're more concerned about making [sure] the systems that are there to mitigate the consequences of the accident" are operational because radiation levels from an accident far exceed those from holes in buried piping.[452] Mr. Cox concluded that the release of radioactivity from leaky pipes would result in very low dose exposure that, in his judgment, would not challenge the regulatory limits.[453]

**2. Findings Related to the Intended Functions of Buried Pipes**

The scope of license renewal, including buried piping, addresses two categories of SSCs. In accordance with 10 C.F.R. § 54.4(a)(1), the first category consists of all safety-related SSCs that are relied upon to remain functional to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down and maintain the safe shutdown of the reactor, or the capability to prevent or mitigate the consequences of accidents which could result in potential offsite radiation exposures. The second category described in 10 C.F.R. § 54.4(a)(2) consists of all nonsafety-related SSCs, whose failure could prevent satisfactory accomplishment of any of the safety functions identified above, including the control of excessive dose exposures.

As discussed above, the witnesses for the NRC Staff and Entergy testified that the intended safety function of buried pipes that fall within the purview of license renewal is only to establish a pressure boundary for maintaining the flow or containing the storage of fluid during

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[451] Tr. at 3578 (Mr. Cox for Entergy); see also 10 C.F.R. § 54.35 (referencing 10 C.F.R. pts. 20, 50, 100).

[452] Tr. at 3579–80 (Mr. Cox for Entergy).

[453] Id.

the PEO.[454] They asserted that mere leaks in a pipe would not significantly jeopardize the performance of a buried pipe to convey fluid given the restrictions to flow provided by the soil surrounding a buried pipe.[455] But these witnesses conceded that NRC regulations relating to license renewal are also concerned with the control of unlicensed releases of radioactivity and resulting dose exposures from these releases.[456] We agree.

We note that there is some evidence to support the proposition that the control of inadvertent releases of radioactivity (to assure that dose exposure limits are not exceeded) by maintaining a pressure boundary is also an intended function of buried piping. In addressing this, we find that in his testimony on behalf of Entergy, Mr. Cox was correct in his conclusion that liquid released from a leaky pipe at IPEC where the pressure boundary is maintained would not be sufficient to exceed the dose limits specified in 10 C.F.R. Part 54.[457] Based on this, we also find that there is no evidence to dispute Entergy's premise that, if its AMP for buried pipes at IPEC maintains the pressure boundary for the in-scope buried pipes at IPEC, it will also necessarily control radiological releases sufficiently to provide reasonable assurance that dose exposure limits are not exceeded.

## F. Adequacy of the Applicant's Initial AMP Presented in its LRA

### 1. Evidence Related to the Adequacy of the Applicant's Initial AMP as Presented in its LRA

The AMP for buried pipes presented in Entergy's LRA referenced the 10-program elements required by GALL-1, the version of NUREG-1801 applicable at the time Entergy's application was submitted in 2007. More specifically, Entergy stated that "[t]he Buried Piping

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[454] Tr. at 3576–77 (Mr. Cox for Entergy), 3572 (Mr. Holston for the NRC Staff).

[455] Tr. at 3578 (Mr. Cox for Entergy), 3572 (Mr. Holston for the NRC Staff).

[456] Tr. at 3580 (Mr. Cox for Entergy), 3571 (Mr. Holston for the NRC Staff).

[457] Tr. at 3578, 3580 (Mr. Cox for Entergy). See 10 C.F.R. § 54.35 (referencing 10 C.F.R. pts. 20, 50, 100).

and Tanks Inspection Program [BPTIP] will be consistent with program attributes described in NUREG-1801, Section XI.M34, Buried Piping and Tanks Inspection" with no exceptions.[458]

Dr. Duquette, for New York, took exception to the Staff's positions, stating that Entergy's AMP for buried pipes "contains very few actual commitments and "is conceptual and aspirational in nature."[459] He concluded that "these bare statements are insufficient to provide an understanding of what exactly Entergy would be doing to manage aging of buried pipes."[460]

Entergy and the NRC Staff maintained that merely committing to the future development of a program that is consistent with GALL was sufficient to demonstrate that the effects of aging will be adequately managed during the PEO.[461] Consistent with its SRP-LR, the NRC Staff witnesses opined that an applicant can take credit for a program described in GALL such that its AMP would be found acceptable in one of three ways: (1) establishing a program that is consistent with all the recommendations in GALL without exception, (2) establishing a program consistent with GALL with exceptions that expand, but not reduce, the scope of GALL, or (3) developing a completely plant-specific aging management program.[462] Staff witness, Mr. Holston, stated that, if an applicant commits to develop a program consistent with GALL, the demonstration of its consistency would not be achieved by details within the application, but through the NRC audit performed as part of the review of the LRA.[463]

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[458] LRA at B-27 to -28 (Ex. ENT00015B).

[459] New York NYS-5 Testimony at 18 (Ex. NYS000164).

[460] Id. at 16.

[461] Entergy's Statement of Position Regarding Contention NYS-5 (Buried Piping and Tanks) (Dec. 7, 2012) at 9 (Ex. ENTR20372); NRC Staff's Statement of Position on Contention NYS-5 (Buried Pipes and Tanks) (Dec. 7, 2012) at 7–8 (Ex. NRCR20015).

[462] NRC Staff NYS-5 Testimony at 12–13 (Ex. NRCR20016); Tr. at 3389 (Mr. Holston for the NRC Staff).

[463] Tr. at 3323–24 (Mr. Holston for the NRC Staff).

As to why the NRC Staff does not require that an applicant provide a general description of the detailed procedures that the applicant will use to show how the 10 elements of GALL are specifically applied to IPEC, Mr. Holston responded "that's the way we built the process" requiring only that the applicant list the exceptions to the program in its LRA and provide enhancements to compensate for these exceptions.[464] According to Mr. Holston, the NRC Staff then would confirm consistency with GALL, including the exceptions and enhancements during its AMP audit.[465] Mr. Holston testified that, if the NRC Staff required an applicant to provide the details in its application, the LRA would be a huge document (noting that an AMP audit of one program includes review of many hundreds of pages of procedures and reports).[466] But, Mr. Holston went on to concede that there is no technical reason why a summary of the details that eventually end up in the audited reports could not be included with, or amended to, the LRA to provide a more definitive demonstration of how an applicant's AMP is consistent with the attributes of GALL.[467]

As an example of what he viewed a fatal lack of detail, Dr. Duquette testified on behalf of New York that Entergy's AMP did not explain "what factors Entergy would take into account in performing a risk assessment or to classify its pipe, or how frequently Entergy would inspect pipes according to their priority."[468]

In response to Dr. Duquette, the NRC Staff witnesses testified that, in their view, "that level of detail is not required in an aging management program. Rather such details are contained in a licensee's inspection plans or procedures for implementation of its aging

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[464] Tr. at 3324–25 (Mr. Holston for the NRC Staff).

[465] Id.

[466] Tr. at 3325 (Mr. Holston for the NRC Staff).

[467] Tr. at 3325–26 (Mr. Holston for the NRC Staff).

[468] New York NYS-5 Testimony at 17 (Ex. NYS000164).

management programs."[469] Accordingly, they stated that such details "would not be subject to NRC review and approval prior to license renewal; rather, an applicant would be required to have such details available for the Staff verification during an onsite inspection prior to, or subsequent to, license renewal (pursuant to Inspection Procedure 71003 or Temporary Instruction (TI) 2516/001)."[470]

Testifying on behalf of the NRC Staff, Ms. Green conceded that the regulations and GALL do not expressly reject the level of detail suggested by Dr. Duquette.[471] She opined, however, that the requirement in 10 C.F.R. § 54.33 that "all the information that Applicant uses to support its License Renewal Application has to be maintained in an auditable and retrievable form"[472] supports the Staff's position that "such details are not subject to NRC review and approval prior to license renewal."[473] According to Ms. Green, "that is why the NRC conducts audits and later on inspections."[474]

### 2. Findings Related to the Adequacy of the Applicant's Initial AMP as Presented in its LRA

Entergy's initial AMP consisted solely of statements promising to develop and to implement an AMP that would be consistent with the NRC guidance document applicable at the

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[469] NRC Staff NYS-5 Testimony at 46 (Ex. NRCR20016). Entergy and NRC Staff often use the term "implementation" when referring to the development of the program (see Tr. at 3327–28 (Mr. Holston for the NRC Staff)), while the Board is more familiar with using this term to describe the actual performance of the plant-specific elements described in the already-developed program.

[470] NRC Staff NYS-5 Testimony at 45 (Ex. NRCR20016) (referring to NRC Inspection Manual, Temporary Instruction 2516/001, "Review of License Renewal Activities (Program Applicability: This temporary instruction (TI) applies to Indian Point Nuclear Generating Unit 2 and Pilgrim Nuclear Power Station only)" (March 30, 2011) (Ex. NRC000029)).

[471] Tr. at 3409 (Ms. Green for the NRC Staff).

[472] Id.

[473] NRC Staff NYS-5 Testimony at 45 (Ex. NRCR20016).

[474] Tr. at 3409 (Ms. Green for the NRC Staff).

time the application was submitted, *i.e.*, GALL-1.[475] As explained below, we find that this was insufficient to satisfy the requirements of 10 C.F.R. § 54.21(a)(3).

GALL-1 contained a two-page description of the 10 general attributes that applicants need to address in their AMP for buried pipes. Consistent with the Commission's ruling in Vermont Yankee, and initially noted herein at page 28 above, an applicant must demonstrate, not just promise, consistency with GALL,[476] because simply promising to develop a program that would be consistent with GALL-1 does not demonstrate that the effects of aging are being adequately managed during the license renewal period. An applicant must present an AMP with sufficient information that the NRC will be able to "draw its own independent conclusion as to whether the applicant's programs are in fact consistent with GALL."[477]

To meet this mandate, we find that an applicant must provide a general description of the corporate-wide and plant-specific procedures sufficient to show that the 10 elemental attributes of GALL have been addressed so as to demonstrate that the effects of aging on buried pipes will be adequately managed throughout the PEO.[478] Entergy's effort in its initial LRA fell well short of that mark.

If this was the end of the story, we would conclude that Entergy has not adequately demonstrated that its AMP for buried piping would manage the effects of aging in these components as required by the regulations. But, since the LRA was submitted, much activity has taken place that augments Entergy's initially deficient program description. That activity is discussed below.

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[475] LRA at B-27 to -28 (Ex. ENT00015B) (referencing GALL-1 (Exs. NYS00146A–C)).

[476] See Vt. Yankee, CLI-10-17, 72 NRC at 37.

[477] Id.

[478] 10 C.F.R. § 54.21(a)(3).

## G. Adequacy of the Applicant's Amended AMP for Buried Pipes

### 1. Evidence Related to the Adequacy of the Applicant's Amended AMP for Buried Pipes

The adequacy of Entergy's current AMP for buried pipes, as amended by this new information, is reviewed in this section, and includes a discussion of the updated BPTIP, recent corporate programs and IPEC procedures, acceptance criteria, and corrective actions.

#### a. The BPTIP

Entergy's witnesses testified that "[t]he [updated] BPTIP manages loss of material due to external corrosion of buried piping and tanks to provide reasonable assurance that the associated systems can perform their intended functions."[479] Section B.1.6 of Entergy's LRA states that "the updated BPTIP includes two key elements: (1) reliance on preventive measures (*e.g.*, protective coatings) to mitigate external corrosion and (2) inspections to manage the effects of corrosion on the pressure retaining capability of buried carbon steel, gray cast iron, and stainless steel components."[480] According to Entergy's witnesses, such inspections are conducted to assess the condition of coatings and to detect and quantify the potential loss of material due to corrosion.[481]

Entergy's witnesses testified that in NL-09-106 (July 27, 2009),[482] the Applicant submitted to the NRC its revised BPTIP to modify the program in response to the operating experience and industry initiatives, and that this revised BPTIP increased the number of planned inspections of buried piping and tanks over those initially presented in its LRA.[483]

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[479] Entergy NYS-5 Testimony at 45–46 (Ex. ENTR30373).

[480] Id. at 46.

[481] Id.

[482] NL-09-106 (Ex. NYS000203).

[483] Entergy NYS-5 Testimony at 61 (Ex. ENTR30373); see also NL-09-106, Attach. 1 at 3 (Ex. NYS000203).

Entergy witnesses also stated that through NL-09-111 (August 6, 2009),[484] Entergy committed "to perform periodic (instead of opportunistic) inspections and to establish the inspection priorities and frequencies based, in part, on the results of the inspections performed before the period of extended operation and other applicable industry and plant-specific operating experience."[485]

Through these two letters, Entergy expanded the commitment described in LRA Section B.1.6 to include, inter alia: (1) a risk assessment of in-scope buried piping and tanks that includes consideration of the impacts of buried piping or tank leakage and of conditions affecting the risk for corrosion; (2) classification of pipe segments and tanks as having a high, medium, or low impact of leakage, based on the safety class, the hazard posed by fluid contained in the piping, and the impact of leakage on reliable plant-operation; (3) determination of corrosion risk through consideration of piping or tank material, soil resistivity, drainage, the presence of cathodic protection, and the type of coating; (4) establishment of inspection priority and frequency for periodic inspections of the in-scope piping and tanks based on the results of the risk assessment; and (5) performance of inspections using qualified inspection techniques with demonstrated effectiveness.[486]

Entergy further revised the BPTIP through responses to additional RAI's (*i.e.*, 3.0.3.1.2-2, and 3.0.3.1.2-3),[487] as contained in three NL letters in 2011: NL-11-032 (March 28), NL-11-074 (July 14), and NL-11-090 (July 27).[488]

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[484] NL-09-111, Letter from Fred Dacimo, Vice President, IPEC, to NRC Document Control Desk, Additional Information Regarding License Renewal Application – IPEC RAI 2.3A.3.11-1 and Buried Piping and Tanks Inspection Clarifications (Aug. 6, 2009) (Ex. NYS000171) [hereinafter NL-09-111].

[485] Entergy NYS-5 Testimony at 60 (Ex. ENTR30373); see also NL-09-111, Attach. 1 at 1 (Ex. NYS000171).

[486] NL-09-106, Attach. 1 at 3, 6 (Ex. NYS000203); NL-09-111, Attach. 1 at 1, Attach. 2 (Ex. NYS000171).

[487] SER Supp. 1 at 3-5 (Ex. NYS000160).

Entergy witnesses testified that in the March 2011 letter (NL-11-032), Entergy sought to modify its BPTIP in response to RAI 3.0.3.1.2-1

> to include additional details on its buried piping inspections, including the number of total inspections planned for each unit before and during the period of extended operation, the number of excavated direct visual inspections of external surfaces, the piping length to be excavated for direct visual inspections, the type of material to be inspected (*i.e.*, carbon or stainless steel), and the piping category to be inspected.[489]

NL-11-032 also stated that Entergy committed that:

> [s]oil samples will be taken prior to the period of extended operation and at least once every 10 years thereafter to confirm the initial sample results. According to this commitment, soil samples will be taken at a minimum of two locations at least three feet below the surface near the in-scope piping to obtain representative soil conditions for each system.[490]

According to Entergy's witnesses, the BPTIP, as revised by NL-11-032, is the version that the NRC Staff approved as Entergy's AMP for buried pipes.[491] It is Entergy's position that this BPTIP satisfies Dr. Duquette's (New York's witness) recommendations for an adequate AMP because it:

> (1) adopts NEI [NEI-09-14] and EPRI [EPRI-1016456] recommendations, (2) follows the dictates of NUREG-1801, Rev. 2, Section XI.M41 [GALL-2]; (3) identifies acceptance criteria for inspections of buried pipes; and (4) states the repair and remediation procedures to be followed if the corrosion damage exceeds the acceptance criteria.[492]

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[488] See Tr. at 3390–91 (Mr. Holston for the NRC Staff); see also NL-11-074 (Ex. NYS000152); NL-11-090, Attach. 2 at 1 (Ex. NYS000153).

[489] Entergy NYS-5 Testimony at 61 (Ex. ENTR30373).

[490] NL-11-032, Attach. 1 at 9 (Ex. NYS000151).

[491] Entergy NYS-5 Testimony at 61 (Ex. ENTR30373) (citing NL-11-032, Attach. 1 at 6, 9 (Ex. NYS000151) and SER Supp. 1 at 3-3 (Ex. NYS000160)).

[492] Id. at 19. See also Nuclear Energy Institute, Guideline for the Management of Underground Piping and Tank Integrity (NEI 09-14) (Dec. 2010) (Ex. NYS000168) [hereinafter NEI 09-14, Rev. 1]; EPRI, Recommendations for an Effective Program to Control the Degradation of Buried Pipe, Report 1016456 (Ex. NYS000167) [hereinafter EPRI-1016456].

During the Staff's review and approval of Entergy's March 2011 BPTIP, Entergy continued to modify its AMP. In response to Staff RAIs 3.0.3.1.2-2 and 3.0.3.1.2-3, Entergy submitted NL-11-074 and NL-11-090 in July 2011, which, among other things, committed to increase the number and frequency of piping inspections, add additional soil testing,[493] and modify its obligation to perform inspections using inspection techniques with demonstrated effectiveness equivalent to "using direct visual inspection.[494] In addition, NL-12-174 (November 29, 2012), which is part of the latest version of the BPTIP, includes: underground components of IP3 service water, IP3 city water, and the IP2 and IP3 fuel oil systems; visual inspections of the piping prior to the PEO and every two years thereafter in accordance with GALL-2; and non-destructive testing if there are indications of significant material loss during the inspections.[495]

According to Mr. Holston, the most concise locations to find a description of the components of Entergy's updated BPTIP that comprise its AMP for buried pipes are: (1) the summary presented in the Staff's SSER, and (2) the responses to RAIs, 3.0.3.1.2-1, 3.0.3.1.2-2, and 3.0.3.1.2-3,[496] as presented in Entergy's three 2011 NL letters (NL-11-032, NL-11-074, and NL-11-090).[497] Mr. Holston stated that the original LRA (as modified by the changes IPEC proffered in its 2009 and 2011 responses to RAIs) and the description of the Staff's review represented in the original SER (as amended by the SSER) summarizes the "evaluation of that

[493] NL-11-074, Attach. 1 at 3–4, 4–5, Attach. 2 at 1 (Ex. NYS000152); NL-11-090, Attach. 1 at 2, 2–3, Attach. 2 at 1 (Ex. NYS000153).

[494] NL-11-074, Attach. 2 at 1 (Ex. NYS000152).

[495] NL-12-174, Attach. 2 at 3–4 (Ex. ENT000597).

[496] SER Supp. 1 at 3-5 (Ex. NYS000160).

[497] Tr. at 3390–91 (Mr. Holston for the NRC Staff); see also NL-11-032 (Ex. NYS000151); NL-11-074 (Ex. NYS000152); NL-11-090 (Ex. NYS000153).

program as it went from being consistent with AMP XI.M34 to the greatly enhanced AMP it is nowadays."[498]

**b. Other Corporate and Plant-Specific Procedures**

Entergy witness Mr. Cox testified that after the industry's new guidelines were published in 2010,[499] and GALL-2 was issued by the NRC in 2011 to include additional details defining the 10 program elements of GALL,[500] Entergy developed numerous corporate-wide[501] and plant-specific[502] procedural documents relating to the management of aging for buried piping and tanks including the 2011 fleet program documents EN-DC-343 (May 16) and CEP-UPT-0100 (October 31), and the plant procedural document SEP-UIP-IPEC (April 29).[503] He went on to testify that these procedures serve to document programs, and procedures that implement its updated BPTIP for buried piping and tanks at IPEC as described in § B.1.6 of the LRA.[504]

Entergy witnesses testified that its fleet procedure EN-DC-343 describes the program that governs the development of the Underground Piping and Tanks Inspection and Monitoring

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[498] Tr. at 3392 (Mr. Holston for the NRC Staff).

[499] EPRI-1016456 (Ex. NYS000167); NEI 09-14, Rev. 1 (Ex. NYS000168).

[500] GALL-2 at XI M-1 to -41 (EX. NYS00147D).

[501] Entergy, EN-EP-S-002-MULTI, Rev. 0, Buried Piping and Tanks General Visual Inspection (Oct. 30, 2009) (Ex. ENT000408) [hereinafter EN-EP-S-002-MULTI, Rev. 0]; Entergy, EN-DC-343, Underground Piping Tanks Inspection and Monitoring Program (May 16, 2011) (Ex. NYS000172) [hereinafter EN-DC-343]; Entergy, Underground Piping and Tanks Inspection and Monitoring, Program Section No. CEP-UPT-0100, Rev. 0 (Oct. 31, 2011) (Ex. NYS000173) [hereinafter CEP-UPT-0100].

[502] Entergy, Underground Components Inspection Plan, Program Section No. SEP-UIP-IPEC, Rev.0 (Apr. 29, 2011) (Ex. NYS000174) [hereinafter SEP-UIP-IPEC].

[503] Tr. at 3596 (Mr. Cox for Entergy).

[504] Tr. at 3595–97 (Mr. Cox for Entergy).

Program (UPTIMP) to meet the industry piping initiative presented in "Guideline for the Management of Buried Piping Integrity."[505] The UPTIMP states that it

> includes all buried and underground SSCs, including those that are not subject to AMR for license renewal in accordance with 10 C.F.R. Part 54. The BPTIP, in contrast, includes only buried components that are in scope and subject to AMR under Part 54—a discrete subset of those buried and underground components covered by the UPTIMP.[506]

Entergy witness Mr. Azevedo testified that all the provisions of the corporate fleet procedure, EN-DC-343, are applicable to IPEC.[507] He stated that CEP-UPT-0100 provides the procedures needed to implement the fleet-wide program described in EN-DC-343.[508] SEP-UIP-IPEC is the Underground Components Inspection Plan specifically developed for IPEC, which, inter alia, summarizes the risk ranking process for the plant.[509] It includes a database of all buried piping at the plant, a listing of observed leaks, and the schedule for inspections with a summary of the inspection findings as they are completed.[510] In addition to the three documents, Entergy also issued "Buried Piping and Tanks General Visual Inspection (EN-EP-S-002-MULTI, October 30, 2009)," which specifies the requirements for visual inspections of buried piping.[511] Mr. Azevedo testified that Entergy's procedures, identified above, are being

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[505] Entergy NYS-5 Testimony at 56 (Ex. ENTR30373) (citing NEI 09-14, Rev. 1 (Ex. NYS000168)).

[506] Id. at 59.

[507] Tr. at 3465 (Mr. Azevedo for Entergy).

[508] Entergy NYS-5 Testimony at 58 (Ex. ENTR30373).

[509] Id. at 67.

[510] Tr. at 3620–21 (Mr. Azevedo for Entergy).

[511] Entergy NYS-5 Testimony at 56 (Ex. ENTR30373) (referring to EN-EP-S-002-MULTI, Rev. 0 (Ex. ENT000408)).

used to implement the UPTIMP at IPEC and to address the various technical procedures recommended in EPRI-1016456.[512]

Dr. Duquette, testifying for New York, acknowledges that Entergy has submitted additional documents describing its corporate programs and plant-specific procedures,[513] but testified that he still believes "there is nothing in the AMP at all to determine what Entergy is committing to doing except a conceptual framework [which in his opinion] is wholly deficient."[514] Furthermore, Dr. Duquette noted that while "Entergy has offered more detail in corporate documents, . . . these internal documents are not included in the commitment from Entergy or made a part of the LRA."[515]

Dr. Duquette criticized what he viewed as a lack of detail in Entergy's commitment because, in his opinion, "no information is provided concerning what factors Entergy will take into account in performing a risk assessment or to classify its pipes, or how frequently Entergy will inspect pipes according to their priority. Moreover, Entergy makes no commitment to taking any mitigative measures if problems are found."[516]

In an effort to rebut Dr. Duquette's testimony, Entergy's witnesses stated that they used "risk ranking" as an example of one aspect of Entergy's detailed AMP for buried pipes. Specifically, Entergy's witness, Mr. Lee, testified that the corporate program, CEP-UPT-0100, provides the methodology for performing the risk ranking, while the plant's specific procedures in SEP-UIP-IPEC provide the results of the risk ranking that was performed, and the end result, *i.e.*, the establishment of an inspection priority of either high, medium, or low with its

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[512] Id. at 57.

[513] New York NYS-5 Testimony at 17 (Ex. NYS000164).

[514] Id. at 18.

[515] Id. at 19 (referring to EN-DC-343 (Ex. NYS000172), CEP-UPT-0100 (Ex. NYS000173), and SEP-UIP-IPEC (Ex. NYS000174)).

[516] New York NYS-5 Testimony at 17 (Ex. NYS000164).

corresponding inspection interval.[517] Mr. Lee pointed to Entergy's corporate document CEP-UPT-0100 as a source of its detailed guidance on the risk ranking of buried piping systems, including inspection priority guidance for radioactive systems, an impact assessment chart to assign risk factors based on the impact of piping leakage, detailed corrosion rating factors, and inspection priority guidance for non-radioactive systems.[518]

In response, Dr. Duquette testified that, while CEP-UPT-0100 presents risk factors, it does not say what you do with those risk factors. According to Dr. Duquette, there is no follow-on relative to the risk factors and, as a result, he still did not know what is going to happen once the risk has been identified.[519]

While Dr. Duquette stated that he did not believe that Entergy had prepared plant or site-specific procedures for monitoring buried pipes,[520] SEP-UIP-IPEC describes applicable inspection and examination methods for buried pipes and tanks, including in-line pipeline examinations using instrumented vehicles, guided wave indirect inspections, local pipe direct examination, and direct visual inspections of excavated piping. It also describes the pipe line grouping process based on attributes such as pipe material, coating type, soil/backfill, age, operating parameters, size, process fluid, and cathodic protection.[521] In addition, the appendices to SEP-UIP-IPEC provide additional piping inspection information alleged by Dr. Duquette to be unavailable.[522] This includes, among other things, risk ranking information and a list of pipes in order of inspection priority (Appendix A); an Integrated Inspection Schedule that

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[517] Tr. at 3457 (Mr. Lee for Entergy).

[518] CEP-UPT-0100 at 21–25 (Ex. NYS000173).

[519] Tr. at 3423 (Dr. Duquette for New York).

[520] Tr. at 3411–12 (Dr. Duquette for Entergy).

[521] Entergy NYS-5 Testimony at 71 (Ex. ENTR30373).

[522] See SEP-UIP-IPEC at 19–69 (Ex. NYS000174).

identifies the specific excavated direct visual inspections to be performed through the third quarter of 2013 (Appendix G); and program drawings of the piping systems and the exact locations of the inspection points (Appendix H).[523]

Dr. Duquette provided no convincing counter-point to the adequacy of the program details provided by these corporate and plant-specific documents that were generated by Entergy after the industry piping initiative presented in NEI 09-14 was issued in 2010 and GALL-2 was issued in 2011. His alleged deficiencies in the acceptance criteria for inspections and corrective actions are discussed in the followings section.

**c. Acceptance Criteria for Inspections and Corrective Action**

Mr. Azevedo for Entergy stated that Entergy "has specified appropriate acceptance criteria for inspections of buried piping coatings and buried piping surfaces"[524] in Section 5.5 of CEP-UPT-0100[525] and in Entergy's procedural document EN-EP-S-002-MULTI. These documents record the requirements to perform visual inspections of buried piping, including a checklist of visual indications of corrosion.[526] According to Mr. Ivy,

> the acceptance criteria . . . for these procedures is such that if you find any of the listed defects, that's unacceptable . . . . If you find any blistering of the coating, any flaking, peeling, delamination, that's considered unacceptable, and you write a condition report that goes into the corrective action system.[527]

Mr. Ivy further testified that these acceptance criteria are based on an industry standard as incorporated into EPRI-1016456.[528]

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[523] Entergy NYS-5 Testimony at 71 (Ex. ENTR30373).

[524] Id. at 84.

[525] Tr. at 3515 (Mr. Azevedo for Entergy).

[526] Tr. at 3514, 3496 (Mr. Ivy for Entergy); EN-EP-S-002-MULTI, Rev. 0 at 4, 11 (Ex. ENT000408).

[527] Tr. at 3497–98 (Mr. Ivy for Entergy).

[528] Tr. at 3498 (Mr. Ivy for Entergy); see also EPRI-1016456, App. G (Ex. NYS000167).

Mr. Holston of the NRC Staff stated that GALL-2 established two mechanisms to demonstrate the effectiveness of an AMP for buried pipes: direct visual inspections and ultrasonic testing of 25 percent of the piping. While there are other effective tools for screening piping to rank it according to corrosion susceptibility, he stated that the NRC Staff only recognizes direct inspection and ultrasound testing as the methods that have been demonstrated to be effective.[529] As previously mentioned, in July 2011, Entergy modified its requirement to perform inspections from "using inspection techniques with demonstrated effectiveness"[530] to "using direct visual inspection."[531]

Mr. Azevedo for Entergy testified that, pursuant to Entergy's procedures, if any coating damage or degradation is discovered upon pipe inspection, a condition report must be prepared, and the remaining wall thickness measured.[532] He further stated that if less than 87.5 percent of the nominal wall thickness remains, Entergy must perform a location-specific evaluation that depends upon the loads at that location, and the actual area of the pipe impacted by corrosion.[533] He added that if the measured wall thickness is less than the required wall thickness to carry the design loads for that specific pipe, including future corrosion during its remaining life, then that pipe is replaced prior to that component being returned to service.[534] In Mr. Azevedo's opinion, this is an acceptable response and that developing any more detailed

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[529] Tr. at 3405 (Mr. Holston for the NRC Staff).

[530] NL-11-032, Attach. 2 at 2 (Ex. NYS000151).

[531] NL-11-074, Attach. 2 at 1 (Ex. NYS000152).

[532] Tr. at 3504 (Mr. Azevedo for Entergy).

[533] Id.

[534] Tr. at 3505 (Mr. Azevedo for Entergy).

acceptance criteria would not be reasonable given the variables that influence pipe performance.[535]

Dr. Duquette for New York criticized Entergy's acceptance criteria in several respects. First, he stated that performing a linear extrapolation of existing wear to predict future corrosion is not accurate because there is no way of determining when the corrosion started. Second, he stated that he has not been informed as to what Entergy plans to do with a condition report once it is prepared. Third, Dr. Duquette testified that he believes that while Entergy has a program to address spot corrosion when encountered, it has not developed corrective actions that identify the problems for the remaining length of a piping system. Fourth, he testified that only a small portion of the total linear footage of piping is being addressed with the proposed number of inspections. And, lastly, he stated that Entergy has not clarified what level of coating damage would need to be present before it is considered unacceptable.[536]

Irrespective of the Applicant's prediction algorithms, Entergy's witness stated that any degradation detected during buried piping inspections is unacceptable and "entered into the IPEC Corrective Action Program and evaluated for extent of condition,"[537] with any repair and replacement of safety-related systems having to be performed in accordance with ASME industry standards.[538] Mr. Azevedo for Entergy testified that, whenever coating damage is detected during an inspection, regardless of whether there is any loss in the pipe wall thickness, the pipe will be recoated before returning it to service.[539] He went on to state that, with regard to looking at other portions of a pipeline system where corrosion is detected, as part of Entergy's

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[535] Tr. at 3504 (Mr. Azevedo for Entergy).

[536] Tr. at 3506 (Dr. Duquette for New York).

[537] Tr. at 3497–98 (Mr. Ivy for Entergy); Entergy NYS-5 Testimony at 82 (Ex. ENTR30373).

[538] Tr. at 3516 (Mr. Azevedo for Entergy), 3603 (Mr. Ivy for Entergy); see also ASME Code, Sec. XI, Art. IWA-2000, "Examination and Inspection" (2001) (Ex. ENT000531).

[539] Tr. at 3509 (Mr. Azevedo for Entergy).

corrective action program, the condition report requires Entergy to determine if there are other locations that are susceptible to the same corrosion mechanisms and to investigate these areas before the issue can be closed.[540]

Mr. Holston testified for the Staff that, because all aspects of the licensee's CLB for IP2 and IP3 will remain in effect during the PEO, in the event that renewed licenses are issued, "the provisions of 10 C.F.R. Part 50, Appendix B, Criterion XVI, Corrective Actions, will apply – which require that conditions adverse to quality (*e.g.*, coating damage, external corrosion of buried piping) are corrected."[541]

Mr. Ivy and Mr. Lee, on behalf of Entergy, testified that, in accordance with Entergy's procedures, if any coating degradation was noted, a Condition Report (CR) would be written and entered into the corrective action process.[542] According to Mr. Azevedo, the CRs are screened by Indian Point management to determine what level of evaluation is required (A through C),[543] which, in turn, dictates the level of investigation that IPEC needs to implement – either an apparent cause or a more detailed root cause evaluation.[544] He also stated that with this information, the corrective actions are defined to make sure the condition is bounded and that it does not occur again.[545] He added that once completed, the CR goes back to the

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[540] Id.

[541] NRC Staff NYS-5 Testimony at 53 (Ex. NRCR20016); see also Tr. at 3522 (Mr. Holston for the NRC Staff).

[542] Tr. at 3485 (Mr. Lee for Entergy), 3497–98 (Mr. Ivy for Entergy).

[543] Level A evaluation encompasses very significant issues that might result in a plant shutdown or a violation of a requirement. Tr. at 3552 (Mr. Azevedo for Entergy). Level B evaluation is for items with a lesser albeit still substantial impact. Id. Level C evaluation covers impacts that are at an even lower level and only requires that the plant evaluate and correct the conditions. Id.

[544] Id.

[545] Id.

management team (for A and B reports) or to the CR department (for C reports) for a review of the response to determine whether it was appropriate and correctly addressed the issue.[546]

Mr. Azevedo for Entergy testified that, as part of the corrective action process, two questions that have to be answered are: (1) where else might an identical problem exist, and (2) what other systems might be affected by the observed corrosion. Further, he stated that these questions would have to be answered not just for the plant where it was initially detected, but for the rest of the Entergy fleet.[547] He stated that if it were concluded that there are other potential locations affected by this corrosion mechanism, then Entergy would have to establish corrective actions to deal with that issue. He asserted that if conditions in one part of the plant impact other systems within the Entergy fleet, the SEP will be updated to reflect the operating experience. Further, Mr. Azevedo stated that, if needed, the procedures will be revised to reflect, among other things what locations get inspected, and how frequently those inspections are conducted.[548]

According to the Mr. Ivy, this corrective action process is a fleet-wide procedure required by 10 C.F.R. § 50 Appendix B and documented in Entergy's procedures EN-LI-102.[549] Staff witness Mr. Holston testified that the Staff reviews the Applicant's corrective actions when evaluating each AMP.[550] Thus, in Mr. Holston's opinion, program element seven of GALL, entitled "corrective actions," is addressed for every program submitted by a license renewal applicant.[551] In addition, according to Mr. Holston, the NRC Staff personnel in the four NRC

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[546] Tr. at 3693 (Mr. Azevedo for Entergy).

[547] Tr. at 3553 (Mr. Azevedo for Entergy).

[548] Tr. at 3691 (Mr. Azevedo for Entergy).

[549] Tr. at 3694 (Mr. Ivy for Entergy).

[550] Tr. at 3383 (Mr. Holston for the NRC Staff).

[551] NRC Staff NYS-5 Testimony at 53–54 (Ex. NRCR20016).

regional offices periodically conduct "Problem Identification and Resolution" inspections at all nuclear plants that look for gaps in corrective action program performance.[552]

### 2. Findings Related to the Adequacy of the Applicant's Amended AMP for Buried Pipes

Section XI.M41 of GALL-2 contains significantly more program details and recommendations than Section XI.M34 of GALL-1. Nevertheless, GALL-2, like GALL-1, is only a description of program attributes that an applicant must address in its corporate and plant-specific AMP for buried pipes to demonstrate that the effects of aging will be adequately addressed during the PEO. And as the Commission has stated, a mere commitment by an applicant to prepare a plan falls well short of demonstrating that aging management of these components will be achieved.[553]

But, with the clarifying documents noted below, we find that the current updated BPTIP provides sufficient detail to allow us to find that it is consistent with GALL-2, and that Entergy has provided reasonable assurance by demonstrating that the effects of aging on buried piping will be adequately managed during the PEO.

More specifically, we find that the AMP, as currently presented in NL-11-032 and as augmented by (1) the Applicant's Commitment 3 presented in the UFSAR Supplement, (2) implementing procedures (*i.e.*, CEP-UPT-0100, EN-DC-343, SEP-UIP-IPEC, EN-EP-S-002-MULTI), and (3) responses to the Staff's RAIs (*i.e.*, NL-11-074 and NL-11-090) provides sufficient detail to determine that the current BPTIP provides reasonable assurance that the effects of aging will be managed adequately during the PEO.

Following the submittal of its LRA, Entergy has: (1) performed a risk assessment of in-scope buried piping and tanks; (2) classified pipe segments and tanks as having a high, medium, or low impact of leakage; (3) determined corrosion risk through consideration of piping

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[552] Id. at 54.

[553] Vt. Yankee, CLI-10-17, 72 NRC at 37.

or tank material, soil resistivity, drainage, the presence of cathodic protection and the type of coating, (4) established inspection priority and frequency for periodic inspections based on the results of the risk assessment, and (5) performed inspections using qualified inspection techniques with demonstrated effectiveness.[554] We find that these items, combined with the facts testified to by Mr. Holston that: (1) the buried pipes at IPEC are coated, and (2) the Applicant has committed to conduct soil sampling and augmenting their inspection program based upon those soil sampling results. These activities give us confidence that Entergy's AMP for buried pipes will provide reasonable assurance that their intended function will be maintained during the PEO.[555]

Industry guidance, as presented in EPRI-1016456, recommends that "[w]here the risk of failure is unacceptable, preventive and mitigative options should be implemented."[556] Mr. Holston testifying for the Staff stated that the risk of failure means that the system could not perform its intended function during the period of extended operation as, for instance, indicated by repeated findings of degradation in the piping systems.[557] We agree with Mr. Holston. While New York witness Dr. Duquette testified that he believes any leak in a buried pipe is failure, we see nothing in the record supporting New York's overly conservative position and find the Staff's opinion is supported by a preponderance of the evidence before us.

Dr. Duquette also criticizes Entergy's acceptance criteria for, inter alia, not providing evidence to explain what Entergy will do with a condition report once it is written, not developing corrective actions that identify the problems for the remaining length of a piping system when

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[554] NL-09-111, Attach. 1 at 1, Attach. 2 at 2 (Ex. NYS000171).

[555] See Tr. at 3972–73 (Mr. Holston for the NRC Staff).

[556] EPRI-1016456 at 6-1 (Ex. NYS000167).

[557] Tr. at 3975–76 (Mr. Holston for the NRC Staff).

spot corrosion is encountered, and not clarifying what level of coating damage would need to be present before it is considered unacceptable.[558]

We disagree with Dr. Duquette's criticism of Entergy's acceptance criteria. Under the updated BPTIP to which Entergy has committed, the Board finds that: (1) a CR must be written and entered into the corrective action process for any noted coating degradation, (2) CRs must be screened by IPEC management to determine the level of investigation that IPEC needs to implement to bound the condition, (3) corrective actions must be formulated from this investigation to correct the condition and to assure it does not occur again, (4) any coating damage must be repaired, and (5) at the conclusion of the process, the CR must go back for a management review of the response to determine whether it was appropriate and correctly addresses the issue. Entergy has developed, and committed to, an inspection program to increase the number of inspections if corrosion conditions are encountered.[559] Accordingly, based on the preponderance of the evidence before us, we find that this process addresses New York's concerns and demonstrates that Entergy has developed and committed to an acceptable corrective action program.

Finally, in conformity with Part 50, Appendix B, as part of this corrective action process, Entergy must address the question as to where else this problem might exist and what other systems are affected by the observed corrosion – and not just at IPEC, but with all of the Entergy nuclear fleet. If conditions in one part of the plant impact other systems within the fleet, the SEP-UIP-IPEC must be updated to reflect this operating experience. Furthermore, we find that Entergy is committed to implement corrective actions if there are potential locations at IPEC affected by corrosion mechanisms observed at other plants.[560]

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[558] Tr. at 3506 (Dr. Duquette for New York).

[559] See NL-09-106, Attach. 1 at 3 (Ex. NYS000203).

[560] Tr. at 3691 (Mr. Azevedo for Entergy).

As discussed above, the NRC Staff has conducted reviews at IPEC to look for gaps in corrective action program performance, and concluded that there is reasonable assurance that adverse buried piping and tank inspection results will be corrected.[561] We agree with the Staff and find that if the "external surfaces of the piping, coatings, and backfill quality are found to not meet the standards imposed by the plants' CLB, there is reasonable assurance that they will be restored to meet existing license requirements."[562]

Based on our review of the Applicant's current BPTIP (it's AMP for buried pipes that includes enhanced commitments) as augmented by recent corporate programs, IPEC procedures, and responses to Staff's RAIs (covering, inter alia, enhanced inspection programs, acceptance criteria and corrective actions), we find that Entergy's program provides reasonable assurance that the effects of aging on buried piping will be adequately managed through the PEO.

## H. Need for Cathodic Protection at IPEC[563]

### 1. Evidence Related to the Need for Cathodic Protection at IPEC

In addition to its argument that Entergy's AMP for buried pipes was inadequate because it lacked sufficient detail, New York also argued that regardless of the level of detail supplied, the absence of additional cathodic protection for buried piping at IPEC rendered Entergy's AMP inadequate. As explained below, we disagree.

In his testimony, Dr. Duquette for New York expressed concerns that Entergy has not committed to installing cathodic protection (CP) at Indian Point despite NEI and EPRI

[561] NRC Staff NYS-5 Testimony at 53–54 (Ex. NRCR20016).

[562] Id. at 51–52.

[563] Cathodic protection is a technique used to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

documents, as well as Entergy's own corporate guidance documents and consultants' reports, and the NRC Staff's GALL-2, that all stress the importance of cathodic protection.[564]

Attempting to address these concerns, Entergy's witness Mr. Biagiotti testified that the goal for corrosion protection is not to arrest corrosion, but control it to a manageable level of less than one mil/year (*i.e.*, 0.001-inch/year).[565] Mr. Holston for the Staff added that the primary defense for this control is provided by the coating applied to the buried pipes at IPEC and that cathodic protection, where needed, is installed to protect a pipe against any breaks (*i.e.*, holidays) that might form in the coating.[566]

Dr. Duquette for New York agreed with these statements, but testified that the main purpose of cathodic protection for pipelines is to protect against pinholes and cracks. Specifically, he stated that he believes that the goal when using CP is not to protect the entire uncoated pipe, but rather, to protect those areas that are not protected by coatings.[567]

The need for cathodic protection at IPEC is discussed in this section. It includes a summary of site characterizations to quantify corrosion potential at the site, a history of leaks, corrective actions, inspections, and cathodic protection at IPEC; and steps incorporated into Entergy's updated AMP to enhance its program to address the lack of site-wide CP.

#### a. Corrosion Potential at IPEC

Corrosion is an electrochemical process by which steel and other metals attempt to return to their natural ore condition. In this process, the metal is corroded by discharges of

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[564] New York NYS-5 Testimony at 18–22 (Ex. NYS000164). According to Dr. Duquette, issues regarding the level of detail in Entergy's AMP, risk ranking of the piping, and the number and frequency of inspections all lead him to conclude that cathodic protection needs to be implemented on a plant-wide basis at the IPEC site. Id. at 22.

[565] Tr. at 3877 (Mr. Biagiotti for Entergy).

[566] Tr. at 3858–59 (Mr. Holston for the NRC Staff).

[567] Tr. at 3884–85 (Dr. Duquette for New York).

metallic ions to earth.[568] As Entergy witness Mr. Biagiotti explained during the hearing, corrosion needs four conditions to occur: (1) an anode as a source of electrons, *e.g.*, pipe where the metal wastage occurs; (2) a cathode as the consumer of the metal electrons, *e.g.*, other sites on a bare metal pipe or a dissimilar metal from the anode; (3) a metallic path between the anode and cathode; and (4) an electrolyte, often water with oxygen to aid the electrochemical reaction at the cathode site.[569] According to Mr. Biagiotti, corrosion terminates if any one of these four characteristics is removed.[570]

Entergy witness Mr. Biagiotti testified that IPEC consists of a congested underground environment that includes multiple piping systems in the presence of an extensive grounding network of bare copper wire.[571] He stated that these are conditions conducive to corrosion from dissimilar metals that are detrimental to the ferrous piping materials in the presence of copper.[572] Mr. Biagiotti stated that Entergy attempts to control corrosion at IPEC through the use of coatings to break the current path.[573] He added that while coated, any breaks or holidays in the pipe coating provide an opportunity for corrosion and can lead to accelerated rates of corrosion in steel and ferrous materials, particularly if soil resistivity is low , *i.e.*, indicating a high corrosivity soil.[574]

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[568] PCA Engineering, Inc., "Corrosion/Cathodic Protection Field Survey and Assessment of Underground Structures at Indian Point Energy Center Unit Nos. 2 and 3 during October 2008" (Nov. 10, 2008; revised Dec. 2, 2008) at 5 (Ex. NYS000178) [hereinafter PCA Report].

[569] Tr. at 3771 (Mr. Biagiotti for Entergy).

[570] Tr. at 3772 (Mr. Biagiotti for Entergy).

[571] Tr. at 3749 (Mr. Biagiotti for Entergy).

[572] Report of Dr. David J. Duquette, Ph.D. in Support of Contention NYS-5 (Dec. 16, 2011) at 21 (Ex. NYS000165) [hereinafter Duquette Report].

[573] Tr. at 3772 (Mr. Biagiotti for Entergy).

[574] See PCA Report at 6 (Ex. NYS000178).

According to Entergy's witnesses, two commonly used methods for assessing soil corrosivity of buried pipes are: (1) testing for resistivity using direct soil tests and indirect resistivity surveys, and (2) performing an analysis to estimate corrosivity in accordance with the American Water Works Association C105 (AWWA C105) assessment process.[575] Regarding the former, "[b]ased on soil resistivity alone, a resistivity >20,000 ohm-cm is considered non-corrosive."[576] Concerning the latter, according to exhibits received in evidence, "AWWA C105 soil corrosivity assessment utilizes a point system, using five soil parameters: soil resistivity, pH, redox potential, sulfides, and moisture (drainage).[577] Accordingly, soils scoring more than ten points are considered corrosive."[578] These witnesses stated that Entergy uses both of these analyses to determine soil corrosivity.[579]

According to Mr. Biagiotti for Entergy, the most efficient approach to detect corrosion potential is to directly test the soil for its propensity to resist current flow, which is an indication of the lack of anode/cathode units present in an area.[580] These soil resistivity measurements indicate the relative ability of the earth to restrict the flow of electrical currents, *i.e.*, lower resistivity soils are generally considered to be more corrosive than soils of higher resistivity.[581] NACE reference documents relied on by Entergy state that soil resistivity of up to 1,000 ohm-cm is generally considered to be corrosive to very corrosive, between 1,000 to 2,000 ohm-cm

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[575] Entergy NYS-5 Testimony at 39–40 (Ex. ENTR30373); see also S.F. Biagiotti, Jr., *et al.*, *Using Soil Analysis and Corrosion Rate Modeling to Support ECDA and Integrity Management of Pipelines and Buried Plant Piping*, NACE Corrosion/2010, Paper 10059 (Mar. 2010) (Ex. ENT000389).

[576] NL-11-032, Attach. 1 at 9 (Ex. NYS000151).

[577] Id.

[578] Id.

[579] Id.; Entergy NYS-5 Testimony at 61, 98–105, 116–17 (Ex. ENTR30373).

[580] Tr. at 3773 (Mr. Biagiotti for Entergy).

[581] PCA Report at 7 (Ex. NYS000178).

moderately corrosive, between 2,000 to 10,000 ohm-cm mildly corrosive, and above 10,000 ohm-cm is considered negligibly corrosive.[582]

As testified to by Mr. Biagiotti, two other techniques used to measure soil resistivity at a site include the close interval survey (CIS) technique that measures potential, *i.e.*, voltage that's moving around the pipe, and direct current voltage gradient (DCVG) that is designed to look where the current pickup and discharge points are to reveal information about the location of holidays in the pipe coating.[583] As testified to by Mr. Biagiotti, these are well-established techniques that are referenced in the American Petroleum Institute (API) and EPRI documents.[584]

**b. Soil Corrosivity at IPEC**

Entergy's UFSAR states that an initial corrosivity survey and soil tests were performed for plant construction of IP2 and IP3 to assess the need for cathodic protection for these units.[585] Electrical resistivity measurements and a visual inspection of the area away from the river (where the turbine generator building, reactor building, primary auxiliary building and associated facilities for IP2 and IP3 are located), indicated that the environment is mostly rock with areas of dry sandy clay.[586] On this basis, Entergy determined that cathodic protection was not required on underground facilities in these areas.[587]

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[582] Entergy NYS-5 Testimony at 115 (Ex. ENTR30373) (citing A.W. Peabody, Peabody's Control of Pipeline Corrosion 8 (Ronald L. Bianchetti, 2d ed. 2001) (Ex. ENT000390)).

[583] Tr. at 3775–76 (Mr. Biagiotti for Entergy).

[584] Tr. at 3776 (Mr. Biagiotti for Entergy) (referencing API 570, Piping Inspection Code: In-Service Inspection, Rating, Repair, Alteration of Piping Systems, American Petroleum Institute (2d ed. Oct. 1998) (Ex. ENT000447) and EPRI-1016456 (Ex. NYS000167).

[585] UFSAR, Rev. 20, Indian Point Unit 3, Excerpted: Chapter 8 - Electrical Systems (2007) at 59 (Ex. NYSR0013K) [hereinafter IP3 UFSAR, Rev. 20]; see also UFSAR, Rev. 20, Indian Point Unit 2 (2007) at 38 (Ex. NYSR0014D) [hereinafter IP2 UFSAR, Rev. 20].

[586] IP3 UFSAR, Rev. 20 at 59 (Ex. NYSR0013K); IP2 UFSAR, Rev. 20 at 38 (Ex. NYSR0014D).

[587] IP3 UFSAR, Rev. 20 at 59 (Ex. NYSR0013K); IP2 UFSAR, Rev. 20 at 38 (Ex. NYSR0014D).

In October 2008, PCA Engineering, Inc. (PCA) performed a corrosion/cathodic protection field survey and assessment of the underground structures (both within and outside the scope of the license renewal rule) at IP2 and IP3 using field survey procedures consisting of soil resistivity measurements, as well as structure-to-soil potential measurements, electrical isolation testing, and temporary impressed current testing.[588] PCA characterized the site[589] and recorded soil resistivity data for the areas above the buried piping running between the IP2 condensate storage tank (CST) and the auxiliary feed water (AFW) pump building, and the IP2 city water storage tank to the IP2 pipe tunnel.[590] Soil resistivities that were measured at depths of 5, 10, and 15 feet below ground surface ranged from 8,043 ohm-cm to 63,195 ohm-cm with an average value of 28,589 ohm-cm and all values but one were higher than 10,000 ohm-cm.[591]

As a result of their survey, PCA made three recommendations: (1) install corrective measures to eliminate/minimize stray current to the city water piping at the location that it crosses the Algonquin gas pipeline, (2) provide a progressive evaluation of cathodic protection needs for high priority piping services on a zone basis, and (3) implement an inspection program using industry standard API-570 to identify high priority zones.[592] In addressing these recommendations, Mr. Azevedo testified that Entergy provided cathodic protection for the stray currents around the city water line where it crosses the Algonquin gas pipeline and have progressively evaluated the need for additional cathodic protection using, inter alia, the results of the Area Potential Earth Current (APEC) survey described below that resulted in: (1) the installation of a CP system on the IP2 and IP3 CST lines, (2) placement of sacrificial anodes on

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[588] PCA Report at 1 (Ex. NYS000178).

[589] Tr. at 3788 (Mr. Biagiotti for Entergy).

[590] Entergy NYS-5 Testimony at 114 (Ex. ENTR30373) (citing PCA Report at 14 & tbls. I–IV (Ex. NYS000178)).

[591] Id.

[592] PCA Report at 16–18 (Ex. NYS000178).

the IP3 sewage line, and (3) development of plans to install cathodic protection on IP2 service water lines in 2013.[593]

Dr. Duquette testified for New York that "[i]mplementing the recommendations of the PCA report would have brought IPEC into reasonable agreement with [GALL-2] for buried and underground pipes."[594] While Dr. Duquette testified that he agreed that cathodic protection has been provided to address the stray current around the city water piping and that Entergy has implemented an inspection program, he testified that he has not seen any progressive evaluation of cathodic protection for all the piping within the scope of license renewal – a deficiency he views as problematic.[595]

Mr. Azevedo asserted that Entergy has implemented the third recommendation by inspecting a variety of pipes in many locations.[596] In addition, he stated that the program has been augmented with a system engineer (*i.e.*, the cathodic protection engineer[597]) who performs an annual inspection of the cathodic protection system, and monitors rectifier outputs.[598]

In response to a leak observed in February 2009,[599] Entergy's witnesses testified the Applicant contracted in September 2009 with Structural Integrity Associates (SIA) to perform indirect guided wave ultrasonic testing (GWT) on the IP2 CST and condensate return line

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[593] Tr. at 3846–48 (Mr. Azevedo for Entergy). Sections IV(H)(1)(d) beginning at page 120, and IV(H)(1)(f) beginning at page 127 of this decision detail the installation of CP systems and the proposed pipeline inspection and soil testing program.

[594] Duquette Report at 21 (Ex. NYS000165).

[595] Tr. at 3952–54 (Dr. Duquette for New York).

[596] Tr. at 3716 (Mr. Azevedo for Entergy).

[597] Tr. at 3963 (Mr. Azevedo for Entergy).

[598] Tr. at 3954–55 (Mr. Azevedo for Entergy).

[599] See infra Section IV(H)(1)(c) beginning at page 114.

piping.[600] The testing results indicated that the 8-inch condensate return line and 12-inch CST supply lines might have moderate corrosion on the outside pipe surface at lower plant elevations to the west of the site near the river where the moisture content of the soil is greater than on the higher ground to the east.[601] Entergy witnesses testified that "[o]n that basis, cathodic protection was installed to protect this piping at the lower plant elevations."[602]

In 2010, Entergy commissioned SIA to conduct the aforementioned site-wide APEC survey within the protected area at IPEC.[603] APEC is an indirect survey technique that investigates a broad area to help focus attention towards areas of higher potential for corrosion activity.[604] As Mr. Biagiotti testified, this technique is used to avoid random excavations by providing data to concentrate on the most likely locations for potential corrosion problems.[605] SIA completed the APEC survey in November 2010 with the final technical report issued in September 2011.[606]

Entergy records reflect that a total of 335 locations were tested throughout the protected area of the plant, and that data acquisition and analysis included the integration of 341,700 measurements.[607] According to Mr. Biagiotti, this survey covered more than 54 percent of the

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[600] Entergy NYS-5 Testimony at 94 (Ex. ENTR30373).

[601] Id.

[602] Id. at 91–92. Sections IV(H)(1)(d) beginning at page 120, and IV(H)(1)(f) beginning at page 127 of this decision detail the installation of CP systems and the proposed pipeline inspection and soil testing program.

[603] Entergy NYS-5 Testimony at 100 (Ex. ENTR30373).

[604] See generally id.

[605] Tr. at 3790 (Mr. Biagiotti for Entergy).

[606] Entergy NYS-5 Testimony at 100 (Ex. ENTR30373).

[607] 2010 APEC Survey at 1-1 (Ex. ENT000445).

license renewal piping, 79 percent of the 24-inch service water lines, and 89 percent of the service water system that has the potential to contain radiological fluid.[608]

Several APEC indications display trends associated with coating degradation.[609] While an existing CP system at IPEC was designed to provide protective current to the docks and discharge canal,[610] the APEC survey demonstrated that the existing CP systems are also influencing some portions of the buried piping located in the western bench adjacent to the Hudson River.[611] But, because only 16 percent of the inspected areas are receiving adequate CP to ensure corrosion control,[612] SIA opined that it is still necessary to add supplemental current to improve the distribution and polarization levels to cathodically protect the remaining buried piping in the area.[613]

Based on its APEC survey, SIA recommended that the extent of the coating degradation be assessed through direct pipe examinations, and that the plant augment its CP system to provide complete site coverage.[614] Accepting this recommendation, and in order to validate and calibrate the APEC interpretations, Entergy selected four plant locations with the most adverse indications of potential variability and directional current change based on the APEC survey for excavation and inspection.[615] In order of priority, the areas designated by APEC and selected

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[608] Tr. at 3782–83 (Mr. Biagiotti for Entergy).

[609] 2010 APEC Survey at 1-1 (Ex. ENT000445).

[610] Id.

[611] Id. at 3-8.

[612] Id. at 1-1; see also id. at 3-11, fig. 3-8.

[613] Id. at 4-1.

[614] Id. at 1-1 to -2, 4-1.

[615] Entergy NYS-5 Testimony at 103 (Ex. ENTR30373).

by Entergy for inspection were: (1) IP2 Transformer Yard, (2) IP3 Transformer Yard, (3) West of IP3 Heater Bay, and (4) South of Cafeteria.[616]

It was SIA's expressed opinion that: "[t]he design, installation and use of additional cathodic protection systems for the buried piping is in the best interest of plant reliability and that "[t]he installation of a fully functional CP system will minimize the threat of continued external corrosion on the buried piping and tanks."[617] In contrast, Mr. Biagiotti, Senior Associate for SIA and Entergy witness, testified that, in his opinion, none of the testing results rose to the level of a severe indication that would prompt immediate corrective measure.[618] As he stated, this is a process and the next step following the APEC survey is to do the strategic, prioritized direct examinations of the piping at the highlighted areas to quantify what the APEC survey results signify.[619]

Dr. Duquette, testifying for New York, responded that he agrees with Entergy that this survey is a good technique for prioritizing where to look for potential corrosion by providing some information that helps locate potentially critical areas.[620] But he was nevertheless surprised that the current levels are as high as they are, because, in his opinion, if the coatings were sound, there would be no current at all.[621] Dr. Duquette also indicated that his conceptual model of the piping conditions at IPEC is not one of large areas of bonding problems or large holidays in the coating.[622] Rather, according to Dr. Duquette, "if there's going to be any kind of a problem with these kinds of coatings, it's going to be at pinholes or at small cracks in the

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[616] Id. (citing 2010 APEC Survey at 1-1 (Ex. ENT000445)).

[618] Tr. at 3789 (Mr. Biagiotti for Entergy).

[619] Id.

[620] Tr. at 3819, 3821 (Dr. Duquette for New York).

[621] Tr. at 3791–92 (Dr. Duquette for New York).

[622] See Tr. at 3792 (Dr. Duquette for New York).

coating, because of the coating aging,"[623] and the widespread presence of elevated current levels in the survey results indicates that "there's a lot of activity, a lot more than I would have expected."[624]

Mr. Biagiotti responded that, while that was a valid observation, what needs consideration is the fact that there are many buried items at IPEC providing conduits for current flow.[625] That is why, in his opinion, the next appropriate step is to preform direct visual examinations for the areas with the largest current flows in order to compare the results to observed conditions.[626] As discussed in more detail in the next section, Entergy has already completed the inspections for the first two locations identified during the APEC survey (*i.e.*, IP2 and IP3 transformer yards, with no coating degradation detected at one location and some coating degradation with only minor surface corrosion detected in the other).[627] In addition, Entergy was excavating at third location in 2013, and planned to investigate the fourth location at a future date.[628]

We received testimony that additional soil testing was performed after the APEC survey. Specifically, Mr. Lee for Entergy stated that in late 2011, Entergy took grab soil samples at the anode locations associated with the installation of cathodic protection for the IP2 and IP3 CST lines and during the excavation of 24-inch service water lines for the IP2 service water.[629]

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[623] Id.

[624] Tr. at 3792–93 (Dr. Duquette for New York).

[625] Tr. at 3793 (Dr. Duquette for New York).

[626] Tr. at 3793–95 (Dr. Duquette for New York).

[627] Tr. at 3799 (Mr. Azevedo and Mr. Lee for Entergy).

[628] Id. (Mr. Azevedo for Entergy).

[629] Tr. at 3811 (Mr. Lee for Entergy).

According to these test results, all of samples had resistivities exceeding 10,000 ohm-cm, indicating negligible corrosive potential.[630]

Based on historic soil testing and resistivity surveys, Entergy witnesses opined that "available data do not indicate that soil surrounding in-scope buried piping at IPEC is corrosive,"[631] while Dr. Duquette for New York claimed that "Entergy's own studies show that the soils at Indian Point are mildly to moderately corrosive."[632] Dr. Duquette testified that "[c]orrosive is corrosive; soil conditions either are or are not corrosive. To say that moderately corrosive soil is not corrosive is inaccurate and misleading."[633] While he has no dispute with the soil measurements that have been made, he is concerned that the soil in immediate contact with the pipe has not been characterized, pointing out that the soil was corrosive enough to have caused some leaks at the site.[634] Along these lines, Dr. Duquette testified that he considered even mildly corrosive soil to be problematic given the length of exposure time.[635] Dr. Duquette concluded that he does not think very aggressive soil is necessary to have active corrosion given the very long time for corrosion to develop to where corrosion can become serious enough to be of concern.[636] While Entergy witness Mr. Cox testified that he believes the

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[630] GZA/Theielsch Engineering Soil Resistivity Data for IP2 & IP3 AFW Bldg., IP2 SW Line 408 (June 2012) at 2 (Ex. ENT000582).

[631] Entergy NYS-5 Testimony at 61 (Ex. ENTR30373).

[632] New York NYS-5 Testimony at 22 (Ex. NYS000164); New York NYS-5 Rebuttal Testimony at 15 (Ex. NYSR20399).

[633] New York NYS-5 Rebuttal Testimony at 15–16 (Ex. NYSR20399).

[634] Tr. at 3814–15 (Dr. Duquette for New York).

[635] Tr. at 3826–27 (Dr. Duquette for New York).

[636] Tr. at 3827 (Dr. Duquette for New York).

site conditions are not conducive to widespread corrosion, the Applicant has, nevertheless, instituted the AMP for buried pipes to address possible corrosion.[637]

**c. Historic Leaks, Corrective Actions, Inspections at IPEC**

GALL-2 discusses six examples of industry-wide leaks detected in buried pipes.[638] Because this industry's operating experience shows that buried pipes are subject to corrosion, GALL-2 states that it is necessary for a license renewal applicant to evaluate both plant-specific and nuclear industry operating experience and to modify its aging management program for buried pipes accordingly.[639]

In this vein, regarding historic leaks, the NRC Staff testified that:

> [t]he Staff's review of the plant-specific operating experience at Indian Point as it pertains to in-scope buried pipes and tanks revealed the following:
>
> - In 2007, a buried auxiliary steam line leaked . . . ;
> - In 2008, three ten foot segments of IP2 condensate storage tank piping were excavated and the piping was inspected. There were two areas which required coating repairs and two areas where there were minor coating defects . . . ;
> - In 2009, an IP2 8-in. condensate storage tank return line developed a leak of under 15 gallons per minute . . . .[640]

The 2007 and 2009 leaks were discussed in Entergy's July 27, 2009, response to the Staff's RAIs.[641] The 2007 leak, detected by Entergy in a buried 8-inch auxiliary steam line, which is not within the scope of license renewal, was attributed "to the use of inappropriate insulation material for buried steam piping that allowed moisture intrusion resulting in corrosion

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[637] See Tr. at 3830 (Mr. Cox for Entergy).

[638] GALL-2 at XI M41-13 (Ex. NYS00147D).

[639] Id.; see also Entergy NYS-5 Testimony at 88–89 (Ex. ENTR30373).

[640] NRC Staff NYS-5 Testimony at 32–33 (Ex. NRCR20016).

[641] NL-09-106, Attach. 1 at 2 (Ex. NYS000203).

of the piping causing the subsequent leak. The affected piping was replaced and reinsulated with a suitable material."[642]

Relative to the 2009 leak, on February 19 of that year, IPEC personnel observed water in a pipe sleeve in the floor of the AFW pump building.[643] After excavating a portion of the IP2 8-inch diameter CST return line in the area of the observed leakage, Entergy identified a hole in the pipe where a small area of protective coating was missing and detected two other areas of thinned piping.[644] This pipe was one of the lines inspected in 2008, albeit at different locations.[645] Entergy replaced a section of the pipe containing the leak, performed weld repairs on the nearby areas exhibiting shallow corrosion, and recoated the affected piping sections in accordance with Entergy procedures.[646]

Two other leaks were detected in mid-2012. According to Entergy witness Mr. Lee, during an opportunistic inspection, a leak was identified in a 1-inch city water line that provides makeup water to a tank in a non-code portion of the system.[647] A second leak was detected in an axial crack that had developed in a sanitary sewer line.[648] Neither of these leaks was associated with in-scope piping.[649]

With regard to pipe inspections, Mr. Lee testified that the first direct visual inspections of buried piping began in 2008 when Entergy inspected portions of the pipes from the IP2 CST to

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[642] Id. at 3.

[643] Entergy NYS-5 Testimony at 91 (Ex. ENTR30373).

[644] Id.

[645] Entergy, Root Cause Analysis Report, CST Underground Recirc. Line Leak, CR-IP2-2009-00666, Rev. 0 (May 14, 2009) at 17 (Ex. NYS000179).

[646] Id. at 3–6.

[647] Tr. at 3932 (Mr. Lee for Entergy).

[648] Tr. at 3932–33 (Mr. Lee for Entergy).

[649] Tr. at 3942 (Mr. Lee for Entergy).

the AFW pump building.[650] Entergy selected these specific lines for inspection based on an assessment of the piping's safety significance, the potential radiological and operational impacts of piping failure, and the piping's corrosion risk.[651] The soil was excavated from around these pipes at two locations, exposing the roughly parallel lines that ran between these structures.[652] One location was in the horizontal run of the pipe near the base of the CST, and the other location was at the approximate "one-third point" along the sloped length of the piping, approximately 100 feet down the hill.[653] Inspections identified five small areas that required coating repairs.[654] Entergy corrected these conditions by cleaning up the affected area and removing the upper layers down to sound coating.[655]

According to Entergy's witnesses, the Applicant attributed the pipe defects to the introduction of rocks in the backfill material used when covering the piping during initial construction, and also hypothesized that the coating damage possibly occurred during the excavation process.[656] Entergy also performed ultrasonic testing (UT) thickness measurements on those areas where the base metal was exposed.[657] These inspections confirmed that the pipe thickness remained at its nominal thickness and found no evidence of measureable wall

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[650] Tr. at 3607 (Mr. Lee for Entergy).

[651] Id.

[652] Id.

[653] Entergy NYS-5 Testimony at 90 (Ex. ENTR30373).

[654] Id.

[655] Tr. at 3607 (Mr. Lee for Entergy); Entergy NYS-5 Testimony at 88 (Ex. ENTR30373).

[656] Entergy NYS-5 Testimony at 91 (Ex. ENTR30373).

[657] Id. at 90.

loss due to corrosion.[658] Entergy witness Mr. Lee testified that the Applicant concluded, even with the degraded coating, the soil was not corrosive enough to cause significant metal loss.[659]

The next inspection occurred in February 2009 during the investigation and repairs to the observed leak in the IP2 CST return line that was described above.[660] As part of its root cause evaluation, Entergy recorded that the damage to the external protective pipe coating was due to presence of large rocks in the backfill at the time of original construction – the same conclusion that was reached with the degraded coatings observed during the 2008 inspections.[661] In the report of that evaluation, Entergy posits that high moisture in the soil surrounding the pipe, likely caused by the close proximity of the pipe depth to the water table, contributed to the observed corrosion.[662] Based on an evaluation of the findings from this event, according to Entergy witnesses, the Applicant undertook numerous corrective actions, including the use of improved backfill specifications for pipe cover.[663]

The NRC Staff witnesses testified that, even though the 2009 inspection revealed that the condensate return line developed a leak, the line did not experience a through-wall failure and that "subsequent evaluations determined that its current licensing basis function could be met despite the leak; [and] therefore . . . the term 'failure' is not appropriate."[664] Entergy witness

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[658] Id.

[659] Tr. at 3608 (Mr. Lee for Entergy).

[660] Entergy NYS-5 Testimony at 88 (Ex. ENTR30373).

[661] Entergy, Root Cause Analysis Report, CST Underground Recirc. Line Leak, CR-IP2-2009-00666, Rev. 0 (May 14, 2009) at 19 (Ex. NYS000179).

[662] Id.

[663] Id. at 34–35; Tr. at 3614 (Mr. Azevedo for Entergy). Mr. Azevedo testified that the original backfill specification did not have a lot of controls on the size of rocks, while the current specification limits the maximum particle size to approximately 2 to 2½ inches. Tr. at 3614 (Mr. Azevedo for Entergy).

[664] NRC Staff NYS-5 Testimony at 68 (Ex. NRCR20016).

Mr. Lee testified that the lesson learned by Entergy from the 2008 and 2009 inspections of the IP2 CST lines is that selection of pipe sections must focus on those areas most susceptible to corrosion, in that situation at the lower plant elevations where pipelines are likely closer to the water table.[665]

In regards to further inspections, the record shows that: subsequent inspections were performed in 2009 and 2011 on the city water lines,[666] fire protection system,[667] the IP2 service water piping,[668] and two IP3 lines from the CST to the AFW piping.[669] City water lines were inspected in 2009, while fire protection lines and service water piping were inspected in 2011. Specifically, "[i]n August 2011, Entergy performed opportunistic inspections of sections of IP3 8-

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[665] Tr. at 3609 (Mr. Lee for Entergy).

[666] See General Visual Inspection Report for 10-inch City Water Line from Catskill Water Supply (Oct. 2009) (Ex. ENT000434); General Visual Inspection Report for 16-inch City Water Line from CWST (Oct. 2009) (Ex. ENT000435).

[667] See General Visual Inspection Report for 10-inch City Water/Fire Water Line at Maintenance Training Facility (MTF) (Nov. 2009) (Ex. ENT000436); see also General Visual Inspection Report for IP3 8-inch Fire Protection Line (N/S) at N/W corner of the WHUT Pit (Aug. 2011) (Ex. ENT000437); General Visual Inspection Report for IP3 6-inch Fire Protection Line (N/S) corner of the WHUT Pit (Aug. 2011) (Ex. ENT000438).

[668] See UT Erosion/Corrosion Examination Report No. IP2-UT-12-002 (Service Water 24-inch Line 409) (Jan. 2012) (Ex. ENT000442); Condition Report CR-IP2-2011-06248 (Dec. 8, 2011) (Ex. ENT000443); Condition Report CR-IP2-2011-06250 (Dec. 8, 2011) (Ex. ENT000444); see also General Visual Inspection Report for IP2 Service Water 24-inch Line 408 (WO #279576-02) (Nov. 2011) (Ex. ENT000439); General Visual Inspection Report for IP2 Service Water 24-inch Line 409 (WO #279576-02) (Nov. 2011) (Ex. ENT000440); UT Erosion/Corrosion Examination Report No. IP2-UT-11-048 (Service Water 24-inch Line 408) (Dec. 2011) (Ex. ENT000441); UT Erosion/ Corrosion Examination Report No. IP2-UT-11-050 (Service Water 24-inch Line 409) (Dec. 2011) (Ex. ENT000448).

[669] See General Visual Inspection Report for IP3 AFW/Cond Return Line to CST (8-inch Line 1080) (Ref. WO # 279578-03) (Dec. 2011) (Ex. ENT000430); General Visual Inspection Report IP3 CST supply to AFW Pumps (12-inch Line 1070) (Ref. WO # 279578-03) (Dec. 2011) (Ex. ENT000431). See also UT Erosion/Corrosion Examination Report No. IP3-UT-11-076 (8-inch Line #1080, CST return line) (Dec. 2011) (Ex. ENT000432); UT Erosion/Corrosion Examination Report No. IP3-UT-11-077 (12-inch Line #1070, CST supply to the AFW pump section) (Dec. 2011) (Ex. ENT000433).

inch and 6-inch fire protection lines running north-south under the dry cask travel pad."[670] In November and December 2011, IPEC performed direct visual inspections of sections of the IP2 service water piping (24-inch lines 408 and 409),[671] and on the IP3 pipe lines running from the CST to the AFW building.[672]

Entergy records indicate that visual inspections have not identified coating failures, and that each inspection found the condition of the coating and piping to be acceptable in accordance with the criteria contained in EN-EP-S-002-MULTI.[673] Other than the soil encountered in 2009 around the area of the leak in CST lines, Entergy witnesses have testified that visual observation of the backfill has not identified rocks or foreign material that could damage external coatings.[674] In addition to those inspection results, Entergy documents reflect that the data, acquired from future excavations and direct inspections, will be assessed to determine the need for additional inspections or for adjusted inspection frequencies.[675]

On behalf of New York, Dr. Duquette stated that the 2009 leak in the CST return line "provides a cautionary tale about the condition of all of the buried piping at Indian Point," and that IPEC's proposed inspection program would not have been sufficient to have identified the possibility of a leak in this buried pipe.[676] Entergy's witnesses, however, testified that the use of the inspection data to assess the potential need for cathodic protection for the 2009 leak is

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[670] Entergy NYS-5 Testimony at 98 (Ex. ENTR30373).

[671] Id. at 99.

[672] Id. at 96.

[673] EN-EP-S-002-MULTI, Rev. 0 (Ex. ENT000408).

[674] Entergy NYS-5 Testimony at 96–99 (Ex. ENTR30373).

[675] NL-11-032, Attach. 1 at 7 (Ex. NYS000151).

[676] Duquette Report at 9–10 (Ex. NYS000165).

consistent with the industry guidelines.[677] Those witnesses further testified that, if the 2009 CST piping leak had been indicative of a widespread pipe coating degradation at the site, then subsequent indirect assessments that were performed at IPEC would have verified this condition.[678] Subsequent assessments have not, however, indicated extensive coating degradation.[679]

In comparing Entergy's response to leaks detected at IPEC, observations made at the plant during pipe inspections, and subsequent attributes of its AMP for buried pipes with that of the other plants he has reviewed, Staff witness Mr. Holston testified that: (1) there had been evidence of only one leak in the in-scope buried piping at IPEC, (2) all of IPEC's follow-up inspections revealed good backfill with no severe coating damage, (3) IPEC has proposed the most inspections of the plant's programs that he has seen, (4) IPEC has proposed soil sampling during pipe inspection (putting them in the mainstream of the other plants) and, if it detects corrosive soil, Entergy proposes to increase their inspections significantly more than those at other plants, and (5) through their Corrective Action process and consistent with the Staff's observations during follow-up inspections, Entergy has implemented cathodic protection at the plant based upon its operating experience.[680]

#### d. Historic and Existing Cathodic Protection at IPEC

Witnesses for both the NRC Staff and New York agree that the primary way to control corrosion is to coat the buried pipes at IPEC, and that cathodic protection, where needed, is installed to protect a pipe against any gaps or holidays that might form in that protective layer.[681]

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[677] Entergy NYS-5 Testimony at 110 (Ex. ENTR30373).

[678] Id.

[679] Id.

[680] Tr. at 3922 (Mr. Holston for the NRC Staff).

[681] Tr. at 3858–59 (Mr. Holston for the NRC Staff), 3884–85 (Dr. Duquette for New York).

Dr. Duquette for New York further testified that he agrees with both Entergy and their consultants that coatings are in place at IPEC and that they are "very good coatings . . . ."[682] But, based on his long term experience, he opined that most coatings can be damaged, and they are not always constructed correctly – there are faults in the coatings where they have failed either on installation, or else due to something that's happened in the field. Dr. Duquette testified that cathodic protection systems are installed to protect those breached areas.[683]

According to its records, prior to plant construction, Entergy determined that cathodic protection was not required for buried pipes in areas away from the river based on the high resistivities of the visually identified subgrade material which consisted mostly of bedrock with areas overlain with relatively dry sandy clay.[684] But along the Hudson River, corrosion protection systems were initially installed to protect the shore structures from corrosive saline water.[685]

Mr. Azevedo testified that IPEC's licensing basis reflects the evaluation of the CP systems installed during plant construction.[686] Specifically, when the need for these systems was re-evaluated, the SSCs were found to be capable of performing their safety function without cathodic protection. As a result, those systems were turned off and abandoned in place.[687]

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[682] Tr. at 3886 (Dr. Duquette for New York).

[683] Id.

[684] IP3 UFSAR, Rev. 20 at 59 (Ex. NYSR0013K); IP2 UFSAR, Rev. 20 at 38 (Ex. NYSR0014D).

[685] IP3 UFSAR, Rev. 20 at 59 (Ex. NYSR0013K); IP2 UFSAR, Rev. 20 at 38 (Ex. NYSR0014D).

[686] Tr. at 3843–44 (Mr. Azevedo for Entergy).

[687] Id.

In 2000 a new CP system was designed and installed to protect the bearing piles and sheet pilings in this area.[688] While the original systems had been abandoned, this new system replaced CP systems for these selected riverfront structures.[689]

In addition, according to Mr. Azevedo, three other CP systems were installed and are functioning at IPEC.[690] As previously mentioned, Entergy records indicate that one impressed-current system was placed on the city water line located on the higher ground to the east of the plant where the pipe crosses over the Algonquin natural gas line.[691] Mr. Lee for Entergy estimates that approximately 200 feet of the city water line, centered on the crossing point with the gas pipeline, is now cathodically protected.[692] Another impressed-current system was installed in the area of the IP2 CST lines where a leak was detected in 2009. According to Mr. Azevedo, this system was installed at the lower elevation of the bedrock bench along the western portion of the site to protect approximately 50 to 70 feet of the piping in this area.[693] A third system was placed on the IP3 sewage line.[694]

In addition to these systems, Entergy witnesses also testified that the Applicant has been installing a fourth system on portions of the IP3 AFW/CST buried pipe lines at the lower elevation and in the same relative locations as was previously done for IP2.[695] And according to Mr. Lee, by December of 2012, the physical elements had been installed along more than 100

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[688] Tr. at 3963–64 (Mr. Azevedo for Entergy).

[689] Id.

[690] Tr. at 3846 (Mr. Azevedo for Entergy).

[691] Entergy NYS-5 Testimony at 101 (Ex. ENTR30373).

[692] Tr. at 3846–47 (Mr. Lee for Entergy).

[693] Tr. at 3847–48 (Mr. Azevedo for Entergy).

[694] Id.

[695] Entergy NYS-5 Testimony at 96 (Ex. ENTR30373).

feet of coverage and Entergy was adjusting the system to assure that current levels meet industry standards.[696] According to Mr. Azevedo, Entergy also presented plans to install a fifth system along approximately 550 feet of IP2 service water system during 2013.[697] Other identified candidates for future installation of new CP systems are the IP2 service water supply headers and the IP3 dock sheet piling just south of the intake structure.[698]

**e. Preemptive Need for Cathodic Protection at IPEC**

Dr. Duquette for New York testified that he believes cathodic protection should be provided for all the buried piping at IPEC, noting that "Entergy's own studies show that the soils at Indian Point are mildly to moderately corrosive, warranting cathodic protection as an objective matter."[699] In support of his position, he stated that "[b]oth the NEI and EPRI documents recommend cathodic protection for critical piping systems."[700] Further, he testified that in his opinion, EPRI-1016456 requires that "[w]here the risk of failure is unacceptable, preventive and mitigative options should be implemented" and the group of measures to prevent buried pipe corrosion include "coating, cathodic protection, and special trench fill."[701] While Dr. Duquette stated that he agrees these measures only need implementing when the risk of failure is unacceptable, he went on to express his belief that any leak is an unacceptable failure.[702]

NRC Staff witness Mr. Holston testified that he disagrees with Dr. Duquette, stating that risk of failure is unacceptable only when the affected piping's intended function cannot be

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[696] Tr. at 3849 (Mr. Lee for Entergy).

[697] Tr. at 3848–49 (Mr. Azevedo for Entergy).

[698] Entergy NYS-5 Testimony at 110 (Ex. ENTR30373).

[699] New York NYS-5 Testimony at 22 (Ex. NYS000164).

[700] Id. at 15; Tr. at 3878 (Dr. Duquette for New York).

[701] NEI 09-14, Rev. 1 at 6-1 (Ex. NYS000168); Tr. at 3879 (Dr. Duquette for New York).

[702] Tr. at 3881 (Dr. Duquette for New York).

met.[703] It is his expressed opinion that, if the soil conditions are corrosive enough or the backfill is of such poor quality and there have been multiple examples of coating failures, then there is a risk that an intended function of critical systems (*e.g.*, fire protection, AFW, steam generator, or safety injection) might not be met.[704] He stated, however, that pipe coatings are the primary means of protecting the piping and that cathodic protection is only needed to protect the pipe in the event that holidays form in the coating.[705]

Entergy witnesses testified that they believe Dr. Duquette mischaracterized the statements in these industry guidance documents, stating that "neither document dictates that cathodic protection be newly installed.[706] Both the NEI 09-14 and EPRI-1016456 documents acknowledge that CP systems may or may not be installed at a site and provide guidelines for a program that manages buried piping with or without cathodic protection."[707] Mr. Holston stated that NEI 09-14 and EPRI-1016456 only recommend that "if a CP system exists, then it should be properly tested and maintained."[708] Mr. Biagiotti testifying for Entergy opined that the measures presented in Section 6 of EPRI-1016456 are not a list of required corrective measures, but are options that should be considered when risk of failure is unacceptable.[709] He also maintained that there is no mandate in either EPRI-1016456 or NEI 09-14 requiring that any specific corrective measure, including CP, be implemented.[710]

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[703] Tr. at 3889 (Mr. Holston for the Staff).

[704] Id.

[705] Tr. at 3858–59 (Mr. Holston for the Staff).

[706] Entergy NYS-5 Testimony at 107 (Ex. ENTR30373).

[707] Id.

[708] Tr. at 3382 (Mr. Holston for the Staff) (citing EPRI-1016456 at 2-8 (Ex. NYS000167)); see also Entergy NYS-5 Testimony at 107 (Ex. ENTR30373).

[709] Tr. at 3883 (Mr. Biagiotti for Entergy).

[710] Id.

Dr. Duquette states that, in his opinion, GALL-2 is predicated on the premise that plants have installed cathodic protection, and that the NRC Staff's ISG "makes clear that, contrary to NRC and Entergy's expert testimony, failure to provide cathodic protection must be justified, which has not been done by Entergy for Indian Point."[711] He stated that Entergy has not demonstrated that cathodic protection of IPEC's buried piping is not required, nor, in his view, have they provided evidence that installation, operation, or surveillance are not practical.[712]

While acknowledging that the GALL-2 recommendations for pipe inspections are predicated on the presence of cathodic protection,[713] Staff witness Mr. Holston testified that the ISG had been developed, in part, to address those facilities that do not have cathodic protection in order to help assure that the intended functions of buried piping will be met in such instances.[714] Mr. Holston, who was the author of the staff guidance, stated that the ISG was written as a GALL-2 revision for plants without cathodic protection to specifically incorporate recommendations that included soil sampling, additional inspections, and operating experience.[715]

But the ISG also states that "an exception must be stated and justified if the basis for not providing cathodic protection is other than demonstrating that external corrosion control (*i.e.,* cathodic protection and coatings) is not required, or demonstrating that installation, operation, or surveillance of a cathodic protection system is not practical."[716] Specifically,

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[711] New York NYS-5 Rebuttal Testimony at 7 (Ex. NYSR20399).

[712] Tr. at 3394 (Dr. Duquette for New York).

[713] Id. (Mr. Holston for the NRC Staff) (referring to GALL-2 (Exs. NYS00147A–D)).

[714] Tr. at 3735, 3966 (Mr. Holston for the NRC Staff); see also Final License Renewal Interim Staff Guidance (ISG), Changes to the Generic Aging Lessons Learned Report Rev. 2 Aging Management Program XI.M41, Buried and Underground Piping and Tanks (LR-LSG-2011-03) (Aug. 2012) (Ex. NRC000162) [hereinafter ISG].

[715] Tr. at 3725–26 (Mr. Holston for the NRC Staff).

[716] ISG at 2 (Ex. NRC000162).

> the justification should include sufficient detail (*e.g.*, soil sample locations, soil sample results, the methodology and results of how the overall soil corrosivity was determined, pipe-to-soil potential measurements) for the staff to independently reach the same conclusion as the Applicant.[717]

When asked at the hearing how the Staff justified not requiring the cathodic protection that was recommended in its ISG prior to concluding that Entergy's AMP meets GALL-2, Mr. Holston testified that the Applicant addressed this specific issue in its March 28, 2011, RAI Response (NL-11-032).[718] Mr. Holston then outlined enhancements to Entergy's AMP to compensate for the lack of a site-wide CP system that included: (1) a summary of the coatings that were placed around in-scope piping, (2) inspections that have been performed demonstrating no piping degradation, (3) soil resistivity measurements, (4) risk ranking performed to identify piping segments for the establishment of inspection priorities, and (5) future soil sampling and increased number of inspections.[719] Mr. Holston further stated that the Staff accepted that approach as a justification for not implementing plant-wide cathodic protection, adding that it recognized the difficulties with installing cathodic protection for the plant that is built into bedrock and noting that the Applicant had installed cathodic protection in discrete areas recommended by its consultants.[720]

For his part Dr. Duquette criticized Entergy for submitting, and the NRC Staff for approving, what he called a limited process that takes some corrective measures when leaks are detected, but does not manage the site to assure that corrosion will not occur in the future.[721] Specifically, he testified that he believes it is feasible, reasonable, and economical to

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[717] Id. at A-3.

[718] NL-11-032, Attach. 1 at 6 (Ex. NYS000151).

[719] Tr. at 3855–56 (Mr. Holston for the NRC Staff).

[720] Tr. at 3856 (Mr. Holston for the NRC Staff).

[721] Tr. at 3893–94 (Dr. Duquette for New York).

require plant-wide cathodic protection, using multiple systems, possibly with a variety of components as a means to reduce the likelihood of leakage from buried pipes at the site.[722]

**f. Proposed Soil Testing and Pipe Inspections at IPEC**

In response to the Staff's stated reliance on, inter alia, additional inspections and soil testing to compensate for the lack of site-wide cathodic protection, Dr. Duquette for New York testified that he believes Entergy's inspection and soil testing program is not well defined.[723] He then provided numerous examples as to why, in his opinion, the program is inadequate including, among others, disconnect between the risk assessment and the location and procedures for inspections, lack of sampling specifications, and absence of contingencies for unexpected results.[724]

In contrast, Entergy attempted to provide the requisite assurance that the piping will remain capable of performing its intended function by proposing that testing of soil samples and direct visual inspections of piping be made prior to the PEO and repeated periodically during the extended operations in accordance with the details provided in its March 2011 response to the Staff's RAIs.[725] Entergy documents state that it will sample soil to determine its corrosivity prior to the PEO and at least once every 10 years during the PEO to confirm that the soil conditions are not aggressive,[726] and that soil samples will be taken at a minimum of two locations at least three feet below the surface near in-scope piping to obtain representative soil conditions.[727] Moreover, according to Entergy witness, Mr. Biagiotti, soil analyses will include tests relating to

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[722] Tr. at 3893–98 (Dr. Duquette for New York).

[723] Tr. at 3424 (Dr. Duquette for New York).

[724] Tr. at 3424–25, 3428, 3431–39, 3446–50 (Dr. Duquette for New York).

[725] NL-11-032, Attach. 1 at 9 (Ex. NYS000151).

[726] Id. at 6.

[727] Id.

corrosivity (*e.g.*, resistivity, anions, cations, pH, and moisture content) that are used along with site drainage conditions to rank locations for corrosion risk.[728]

Additionally, as explained beginning at page 69 above, prior to entering the PEO, Entergy committed to performing 20 direct visual inspections of IP2 piping and 14 direct inspections for IP3 piping for a total of 34 direct inspections.[729] According to Entergy's commitments, these inspections will be performed on both code/safety-related piping and piping containing hazardous materials (*i.e.*, hazmat piping).[730] The six direct (visual and direct UT) inspections that Entergy performed on certain in-scope IP2 buried piping in October 2008 were the first inspections credited under the BPTIP.[731]

Further, records submitted by the Applicant stated that as of April 22, 2013, Entergy had completed all 20 inspections for IP2 and 4 of the 14 for IP3.[732] At the time of the Staff's TI2516 audit in February 2011, according to Mr. Holston, Entergy had inspected approximately 136 feet of the 18,300 feet of total buried in-scope piping at IPEC – with the recent completion of additional inspections covering even more footage.[733] Mr. Holston testified for the Staff that he has evaluated four other nuclear power plants that do not have cathodic protection and that the amount of piping being inspected at IPEC is on the high end of those plants.[734] Mr. Azevedo for

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[728] Tr. at 3719–21 (Mr. Biagiotti for Entergy).

[729] NL-13-037, Attach. 1 at 1 (EX. ENT000606).

[730] Declaration of William C. Holston Updating NRC Staff's Testimony on Contention NYS-5 (Buried Piping and Tanks) to Address New Information Submitted by Applicant Entergy Nuclear Operations, Inc. (Apr. 22, 1013) at 3 (Ex. NRC000167); NL-13-037, Attach. 1 at 1 (Ex. ENT000606).

[731] Entergy NYS-5 Testimony at 60 (Ex. ENTR30373).

[732] Joint Declaration of Nelson Azevedo, Alan Cox, and Ted Ivy Concerning Entergy Letter NL-13-037 and Related Updates to Entergy's Testimony on Contention NYS-5 (Buried Piping) (Mar. 20, 2013) at 6 (Ex. ENT000607).

[733] Tr. at 3867 (Mr. Holston for the NRC Staff).

[734] Tr. at 3872 (Mr. Holston for the NRC Staff).

Entergy testified that, aside from the 2009 leak, the inspections performed to date have not detected any significant issues, but instead found suitable soil with coatings in good condition. He concluded that the conditions encountered in the inspections to date "have given me assurance that the buried pipes at Indian Point are in good condition and will perform their intended function."[735]

More specifically, Entergy has committed to perform 14 direct visual inspections on IP2 piping and 16 direct visual inspections on IP3 piping every 10 years during the PEO, for a total of 60 inspections during the extended operations.[736] If soils encountered are determined to be corrosive, *i.e.*, "[i]f the soil resistivity is < 20,000 ohm-cm and the soil scores higher than 10 points using AWWA C105,"[737] then "the number of inspections will be increased . . . to ensure the piping can perform its design function during the PEO. The additional inspections will be in locations with aggressive soil condition."[738]

These Entergy commitments provide for a total of 94 inspections of in-scope piping to occur prior to and through the PEO, with the provisions for additional inspections should the conditions encountered during the scheduled program indicate the need.[739] Also, Mr. Azevedo for Entergy added that IPEC's piping program is much broader than that, providing for inspections of out-of-scope piping that have not be factored into this total.[740] Mr. Holston for the NRC Staff confirmed that the results of the inspections for both in-scope and out-of-scope piping

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[735] Id.

[736] NL-13-037, Attach. 1 at 2 (EX. ENT000606).

[737] NL-11-032, Attach. 1 at 9 (Ex. NYS000151).

[738] Id.

[739] Tr. at 3936–37 (Mr. Azevedo for Entergy).

[740] Tr. at 3863 (Mr. Azevedo for Entergy).

will be reviewed to develop the most complete picture of site conditions relating to corrosion potential.[741]

Also proffered by Entergy to demonstrate the efficacy of its efforts to manage corrosion are corporate procedures (EN-EP-S-002-MULTI), which include checklists of steps to be followed in performing these inspections, such as, inter alia, the need to look at the backfill for rocks or foreign objects.[742] According to Mr. Azevedo for Entergy, if these inspections discover undesirable backfill material (*e.g.*, containing rocks) that wouldn't meet today's standards, Entergy would be required to write a Condition Report and enter that occurrence into its Corrective Action Program.[743] And as part of the evaluation conducted for its Corrective Action Program, Mr. Azevedo maintained that Entergy is required to determine whether this circumstance constitutes more than an isolated instance and, if so, determine where else this condition can occur.[744]

Mr. Holston for the Staff testified that throughout the entire PEO, if the soil is proven to be corrosive, Entergy will have dug up approximately seven percent of the piping at the site.[745] Dr. Duquette, however, testified that he does not believe that the inspection program will be very successful; stating that inspecting roughly 1,300 feet of pipe out of 17,000 total feet of piping isn't going to tell very much.[746] He went on to testify that in his judgment Entergy should inspect at least double the proposed pipe footage.[747]

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[741] Tr. at 3865 (Mr. Holston for the NRC Staff).

[742] Entergy, Underground Piping and Tanks General Visual Inspection, Rev. 1 (EN-EP-S-002-MULTI) (Nov. 30, 2012) at 14 (Ex. ENT000600).

[743] Tr. at 3835 (Mr. Azevedo for Entergy).

[744] Tr. at 3848 (Mr. Azevedo for Entergy).

[745] Tr. at 3631 (Mr. Holston for the NRC Staff).

[746] Tr. at 3918 (Dr. Duquette for New York).

[747] Id.

Entergy witness Mr. Azevedo disagreed stating that based on the results of surveys, inspections, and testing, he believes the site is not conducive for corrosion because the backfill, for the most part, does not contain large rocks and the soils are not corrosive.[748] While the total length of pipe that will be inspected is small compared to the total length of buried pipe at the site, he testified that Entergy's plan calls for excavating at the locations with the highest indications of potential corrosion issues.[749] According to Mr. Azevedo, this, along with the results of the site surveys, demonstrates to his satisfaction that there are not widespread corrosion conditions at IPEC.[750]

Finally, as an illustration of what he views as the inadequacy of the Applicant's inspection program, Dr. Duquette for New York testified that the 2009 leak occurred in a pipeline that was inspected just the previous year, arguing that Entergy chose a bad location for the excavation.[751] Recognizing that Entergy's plan to prioritize inspection to those locations with the highest potential for corrosion, Dr. Duquette testified that, in his opinion, it still is not failsafe and he remains concerned that spot inspections will not necessarily detect a potential problem.[752] When asked whether the standard of care should be the prevention of all leaks or a reasonable assurance that the intended function of the pipe is maintained, Dr. Duquette testified that he believes a nuclear power plant should be held to a higher standard than other industries so that there are "procedures to prevent all leaks," but nonetheless did not feel qualified to define what should be the standard in this case.[753]

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[748] Tr. at 3615 (Mr. Azevedo for Entergy).

[749] Id.

[750] Tr. at 3614–15 (Mr. Azevedo for Entergy).

[751] Tr. at 3634 (Dr. Duquette for New York).

[752] Tr. at 3634–35 (Dr. Duquette for New York).

[753] Tr. at 3636–37 (Dr. Duquette for New York).

### 2. Findings Related to Corrosion Potential, Cathodic Protection, Inspections, and Soil Testing at IPEC

Based on the preponderance of the evidence before us, we make the following findings relative to IPEC corrosion potential, cathodic protection, and corrosion-related piping inspections and soil testing.

We find that on several different occasions (*i.e.*, 2007, 2008, 2009, and 2012), Entergy detected leaks in buried pipes at IPEC,[754] although there is evidence of only one leak in the in-scope buried piping at IPEC.[755] Entergy's follow-up inspections generally revealed good backfill with no severe coating damage[756] – observations that we find are consistent with test results indicating that the soils in the vicinity of the relevant piping are generally non-corrosive,[757] *i.e.*, with resistivity values usually above 10,000 ohm-cm or scoring 10 or less points using AWWA C105.[758] Thus, while the soils at IPEC are not highly corrosive, site conditions at some locations are conducive for external corrosion of buried pipes so as to warrant Applicant and Staff consideration of appropriate measures to address the risk associated with potential corrosion situations.

We find that Entergy has implemented the recommendations from the 2008 PCA study by taking several remedial steps including: minimizing stray currents around the city water piping where it crosses the Algonquin gas pipeline, providing a progressive evaluation of cathodic protection needs for high priority piping services on a zonal basis, and developing an

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[754] NL-09-106, Attach. 1 at 2 (Ex. NYS000203).

[755] Tr. at 3922 (Mr. Holston for the NRC Staff).

[756] Id.

[757] Entergy NYS-5 Testimony at 115 (Ex. ENTR30373) (citing A.W. Peabody, Peabody's Control of Pipeline Corrosion 88 (Ronald L. Bianchetti, 2d ed. 2001) (Ex. ENT000390)).

[758] IP3 UFSAR, Rev. 20 at 59 (Ex. NYSR0013K), IP2 UFSAR, Rev. 20 at 38 (Ex. NYSR0014D); Entergy NYS-5 Testimony at 114 (Ex. ENTR30373) (citing PCA Report at 14 & tbls. I–IV (Ex. NYS000178)).

inspection program focused on high priority zones.[759] In this regard, in 2010, Entergy performed an APEC survey to help (1) define the high priority zones by identifying areas of adequate cathodic protection levels; (2) identify localized changes in the measured potentials indicative of areas possibly containing corrosion cells; and (3) measure localized variations in earth currents that relate to possible coating degradation.[760] Additionally, Entergy has installed cathodic protection for the stray currents around the city water line where it crosses the Algonquin gas pipeline, and performed the progressive evaluation of cathodic protection by installing an impressed-current system on the IP2 and IP3 CST lines, and by adding sacrificial anodes to the IP3 sewage line.[761] Also, the Applicant will install cathodic protection for the IP2 service water lines in 2013.[762]

The Board further finds that, in accordance with its March 2011 response to the Staff's RAIs, Entergy used site surveys, inspections, and data to augment its AMP for buried pipes by: (1) classifying its pipes according to their safety class, fluid hazards, and leakage impacts; (2) quantifying the corrosion risk that considers piping material, subsurface conditions, coating, and cathodic protection; and (3) establishing inspection priority based on risk assessment.[763] We conclude that, with these additions, Entergy has met the PCA recommendations, and that implementing PCA's suggestions has brought IPEC's program for buried and underground pipes into reasonable agreement with GALL-2.[764]

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[759] PCA Report at 16–18 (Ex. NYS000178).

[760] Tr. at 3606 (Mr. Lee for Entergy).

[761] Tr. at 3846–48 (Mr. Azevedo for Entergy).

[762] Id.

[763] NL-11-032, Attach. 2 at 2 (Ex. NYS000151).

[764] Duquette Report at 21 (Ex. NYS000165).

There is no disagreement among the parties that, while coating buried pipes at IPEC is a primary means to protect against corrosion, cathodic protection systems are also needed in areas of elevated corrosion potential to protect breaches in the coatings that inevitably occur due to construction defects or inadvertent damage.[765] Rather than limiting cathodic protection to areas of higher corrosion risk, however, New York witness Dr. Duquette urges that CP should be required "as an objective matter" or, at a minimum, be seriously considered for all buried SSCs at Indian Point because "Entergy's own studies show that the soils at Indian Point are mildly to moderately corrosive, warranting cathodic protection."[766] Dr. Duquette pointed to the 2009 leak in the CST return line as evidence that IPEC's current proposed inspection program is not sufficient to identify the possibility of future problems with buried pipes at IPEC.[767]

Countering this assertion, Entergy witnesses stated that all the measured soil resistivities taken at multiple depths at numerous locations indicate a negligible potential for corrosivity.[768] They testified that these measurements were consistent with subsequent surveys,[769] and match with the fact that there is only limited evidence of corrosion observed at the site after 40 years of service.[770] We agree and find that the inspections and testing Entergy has performed to date support other evidence of no widespread, highly corrosive conditions, or extensive coating degradation at the site. Based on these results, we find that there is negligible potential corrosivity at most of the IPEC site and that wholesale installation of cathodic protection for buried piping at IPEC is not warranted.

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[765] Tr. at 3850–51 (Dr. Duquette for New York), 3858–59 (Mr. Holston for the NRC Staff).

[766] New York NYS-5 Testimony at 22 (Ex. NYS000164).

[767] Id.

[768] Entergy NYS-5 Testimony at 116 (Ex. ENTR30373).

[769] Id. at 91–92.

[770] Id. at 115.

But we also find that there is evidence of underground corrosive conditions and observed degradation of protective coatings around certain buried pipes so as to justify further attention. With the discussion of the details following, we find that the Applicant has provided that attention and reduced corrosion risk at IPEC by installing CP where needed and developing an augmented inspection and testing program that is prioritized by corrosion risk.

While New York argues that Entergy has not provided sufficient details regarding the pipe inspections and soil testing, we find that those programs are adequately defined by the corporate and plant-specific programs, in conjunction with the Applicant's response to the NRC Staff's RAIs. The details that Entergy has provided in its existing fleet and plant-specific documents, recited in Sections IV(H)(1)(c), beginning at page 114 above, and IV(H)(1(f), beginning at page 127 above, are sufficient to assure that this aspect of Entergy's AMP is adequate relative to this aspect of its overall demonstration that the effects of aging of buried pipes will be managed through the PEO.

Recognizing that the prevention of each and every leak is an unrealistic standard, the Board agrees with the NRC Staff that the risk of failure is unacceptable when a buried pipe has the potential to degrade to the point that its intended function cannot be met. We find, however, that there is no reasonable basis to conclude that site conditions at IPEC are sufficiently corrosive to create this critical condition. Accordingly, we find that the installation of site-wide cathodic protection at IPEC is not justified.

Neither NEI 09-104 nor EPRI-1016456 guidance recommend that site-wide cathodic protection be installed as a matter of course, but instead recommend that existing CP systems should be properly tested and maintained.[771] We note that both organizations (NEI and EPRI) recognized that the absence of cathodic protection may be addressed by other means, such as risk-ranking and the selection of locations to be inspected based on the consequences of

[771] EPRI-1016456 at 2-8 (Ex. NYS000167).

failure.[772] For example, EPRI-1016456 suggests other alternatives to CP installation not discussed by Dr. Duquette, including: (1) measures to prevent pipe degradation including pipe replacement with a different material; (2) measures to mitigate failure including prompt leak detection, leak source location and repair; and (3) prevention and mitigation techniques and leak detection as described in the appendices of that guidance. In lieu of site-wide installation of cathodic protection, we find that Entergy has acted within the scope of this guidance by installing cathodic systems at reasonably-selected locations, while initiating risk-ranking to assist with the selection of additional inspections – actions consistent with this industry guidance.

As to the implications of GALL-2, while we agree it is predicated on the premise that plants have installed cathodic protection, we find that the Staff's ISG was written as a GALL-2 revision to specifically include recommendations for plants without cathodic protection.[773] The Board notes that, lacking site-wide CP at IPEC, Entergy must justify its basis for not providing cathodic protection, including sufficient detail regarding site characteristics relating to the corrosion potential of buried pipes, for the NRC Staff to independently reach the same conclusion in accordance with ISG recommendations.[774]

We agree with the NRC Staff that in its March 28, 2011, RAI response (NL-11-032), Entergy provided adequate justification for not utilizing additional cathodic protection throughout the facility.[775] Therein, the Applicant described five enhancements in its AMP to compensate for the lack of site-wide CP system recited at page 126 above. We agree with the Staff that this is an acceptable justification for not implementing plant-wide cathodic protection, and also

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[772] NRC Staff NYS-5 Testimony at 72 (Ex. NRCR20016).

[773] Tr. at 3725–26 (Mr. Holston for the NRC Staff).

[774] ISG at A-3 (Ex. NRC000162).

[775] NL-11-032, Attach. 1 at 6 (Ex. NYS000151).

recognize that, as testified to by Mr. Holston, the Applicant has followed its consultant's recommendations and installed CP systems in discrete areas indicative of elevated corrosion potential.[776]

New York witness Dr. Duquette testified further that he believes Entergy's inspection and soil testing program, allegedly enhanced by the Applicant to compensate for the lack of site-wide cathodic protection, is not well defined. We disagree.

Finding that, by responses to the Staff's RAIs which are outlined beginning at page 127 above, Entergy has specified procedures to: (1) sample and test soil for its corrosivity both prior to and during the PEO to confirm that the soil conditions are not aggressive; (2) obtain soil samples at a minimum of two locations at least three feet below the surface near in-scope piping;[777] (3) analyze samples for numerous corrosivity parameters that are used along with site drainage conditions to rank locations for corrosion risk;[778] (4) perform a total of 34 inspections at IP2 and IP3 prior to the PEO,[779] and 30 direct visual inspections every 10 years for a total of 60 inspections during the PEO;[780] (5) consistent with the NRC Staff's ISG, increase the number of direct visual inspections to 42 every 10 years if soils encountered are determined to be corrosive (*i.e.*, soil resistivity is < 20,000 ohm-cm and the soil scores higher than 10 points using AWWA C105);[781] (6) perform the inspections in accordance with the checklists presented in corporate procedure EN-EP-S-002-MULTI that includes the need to look at the backfill for rocks or foreign objects; (7) write condition reports for adverse observations and entering them into its

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[776] See Tr. at 3856 (Mr. Holston for the NRC Staff).

[777] NL-11-032, Attach. 1 at 6 (Ex. NYS000151).

[778] Tr. at 3719–21 (Mr. Lee for Entergy).

[779] NL-13-037, Attach. 1 at 1 (Ex. ENT000606).

[780] Id. at 2.

[781] Id.; NL-11-074, Attach. 1 at 3–4 (Ex. NYS000152). See also ISG at 2 (Ex. NRC000162).

Corrective Action Program that, inter alia, requires Entergy to determine other site locations in which this condition can occur; and (8) investigate other locations if this condition could occur elsewhere.[782] We find that this degree of specificity reasonably outlines the soil sampling, inspections, and corrective actions needed to provide the information necessary to determine whether there is reasonable assurance that the intended functions of buried pipes will be maintained during the PEO.

Dr. Duquette expressed his doubts about the success of an inspection program that only is looking at less than eight percent of the total length of buried lines, and stated his belief that Entergy should be inspecting at least double that percentage.[783] We do not share these doubts or support his suggestion.

We find that Entergy's inspection plan is sufficiently intensive based on the inspection reports to date that generally indicate suitable soil with pipe coating in acceptable condition. We also note that Staff witness Mr. Holston testified that the piping being inspected at IPEC is on the high end of the amount that is being reviewed at four other plants that do not have cathodic protection.[784] Furthermore, we find that, while the length of pipe that will be inspected is small compared to the total length of buried pipe at the site, Entergy is excavating at the locations that have the greatest potential for corrosion issues.[785] It is clear to us from Entergy's and the Staff's uncontested testimony that Entergy's corrective action program will be implemented if any adverse conditions that generally lead to corrosion, such as poor backfill, high soil moisture contents, or damaged coatings, are detected.[786] Accordingly, we find that the length of buried

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[782] Tr. at 3835 (Mr. Azevedo for Entergy).

[783] Tr. at 3918 (Dr. Duquette for New York).

[784] Tr. at 3872 (Mr. Holston for the NRC Staff).

[785] Tr. at 3614–15 (Mr. Azevedo for Entergy).

[786] Id.

piping to be inspected during the PEO is adequate to identify highly corrosive zones and sufficient to provide data as might be necessary to refocus aging management monitoring to high priority locations.

Finally, the Board finds that the use of CP has been considered by Entergy, that some systems have been installed at IPEC, that Entergy has established a CP operations and maintenance program under the direction of a designated cathodic protection system engineer, and that this program is being conducted by qualified inspectors.[787] We note that the IPEC program provides for focused inspections of buried piping based on a risk assessment of that piping and the Applicant has performed additional inspections and site evaluations that resulted in the installation of three CP systems at the site. Also, the site has been progressively evaluated for additional systems including one currently being installed and another to start this year.[788] These activities convince us that Entergy has adequately considered cathodic protection for the buried pipes at IPEC.

## I. Applicant's Obligation to Adhere to Specified Procedures

### 1. Evidence Related to the Applicant's Obligation to Adhere to Specified Procedures

During the hearing on NYS-5, the Board raised several questions relating to the enforceability of Entergy's commitments detailed in the supplemental documents (*e.g.*, industry guidance, corporate programs, plant-specific procedures, and responses to RAIs) that augment GALL-2 and that Entergy offered to demonstrate that the aging of buried pipes will be managed during the PEO.[789] As it relates to its AMP for buried pipes and the associated leakage risk assessment and piping inspection process, the Applicant's witnesses stated that "Entergy

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[787] Entergy NYS-5 Testimony at 107 (Ex. ENTR30373).

[788] Tr. at 3846–49 (Mr. Azevedo for Entergy).

[789] See, e.g., Tr. at 3464–76, 3546–50, 3640–81.

license renewal Commitment 3 makes explicit Entergy's obligation to implement the BPTIP."[790] In addition, Staff witness Mr. Holston stated that critical aspects of the AMP such as Commitment 3 for buried pipes are captured in UFSAR Supplement pursuant to 10 C.F.R. § 54.21(d).[791]

As defined in 10 C.F.R. § 54.3, the CLB for the PEO includes Commitment 3 through the incorporation of the Applicant's UFSAR Supplement. As Ms. Green summarized for the Staff, once the license is renewed, Entergy must submit updates to their UFSAR, which would become part of their CLB.[792] She also accurately noted that Entergy's commitments are documented in Appendix A of the Staff's SER which, in turn, is included in the Applicant's CLB.[793]

Also in that regard, Staff witness Mr. Holston testified that the UFSAR Supplement is a far more important document than the LRA, which "doesn't live" after the Staff has issued its

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[790] Entergy NYS-5 Testimony at 17 (Ex. ENTR30373).

[791] Tr. at 3530–31 (Mr. Holston for the NRC Staff). As stated in NL-11-032 and SER Supp. 1, Commitment 3 reads as follows:

> Implement the Buried Piping and Tanks Inspection Program for IP2 and IP3 as described in LRA Section B.1.6. This new program will be implemented consistent with the corresponding program described in NUREG-1801 Section XI.M34, Buried Piping and Tanks Inspection. Include in the Buried Piping and Tanks Inspection Program described in LRA Section B.1.6 a risk assessment of in-scope buried piping and tanks that includes consideration of the impacts of buried piping or tank leakage and of conditions affecting the risk for corrosion. Classify pipe segments and tanks as having a high, medium or low impact of leakage based on the safety class, the hazard posed by fluid contained in the piping and the impact of leakage on reliable plant operation. Determine corrosion risk through consideration of piping or tank material, soil resistivity, drainage, the presence of cathodic protection and the type of coating. Establish inspection priority and frequency for periodic inspections of the in-scope piping and tanks based on the results of the risk assessment. Perform inspections using inspection techniques with demonstrated effectiveness. NL-11-032, Attach. 2 at 2 (Ex. NYS000151); SER Supp. 1 at A-2 (Ex. NYS000160).

[792] Tr. at 3966 (Ms. Green for the NRC Staff).

[793] Tr. at 3641 (Ms. Green for the NRC Staff).

SER.[794] We agree with Mr. Holston. He stated that the UFSAR Supplement, as presented in modifications to Appendix A of the LRA, is a reference document that the Staff uses, along with its SER, to judge the key aspects of an AMP and to determine what an Applicant must do to address program changes.[795]

Mr. Holston and Ms. Green also testified that a commitment in the UFSAR cannot be changed without the NRC Staff oversight and, specifically, evaluation of the eight criteria listed in 10 C.F.R. § 50.59.[796] As an example, at the hearing Mr. Holston and Ms. Green stated that because inspections are a critical aspect of Entergy's AMP, the specific number of these inspections proffered by Entergy have been incorporated into the IP2 and IP3 UFSAR and presented in the modified commitment tables included by Entergy in NL-11-090.[797] Ms. Green confirmed that this commitment has been tabulated and issued as part of the SER, which will make it a part of IPEC's CLB if the Applicant receives its renewed license.[798] While Commitment 3 is listed in both documents, Ms. Green testified that she gives more weight to what is included in the UFSAR Supplement, because the supplement is incorporated into the UFSAR, and any changes made to Entergy's UFSAR must go through the 10 C.F.R. § 50.59 process.[799]

Mr. Holston noted that it was the Staff's position that, in contrast to the UFSAR, corporate policies adopted by Entergy, including corporate programs (*e.g.*, EN-DC-343, CEP-UPT-0100, EN-EP-S-002-MULTI) and plant-specific procedures (*e.g.*, SEP-UIP-IPEC), "are not

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[794] Tr. at 3542 (Mr. Holston for the NRC Staff).

[795] Id.

[796] Tr. at 3530–31 (Mr. Holston for the NRC Staff), 3968 (Ms. Green for the NRC Staff).

[797] Tr. at 3641–43 (Mr. Holston and Ms. Green for the NRC Staff); see also NL-11-090, Attach. 1 at 2 (Ex.NYS000153).

[798] Tr. at 3645 (Ms. Green for the NRC Staff); SER Supp. 1 at 3-1 (Ex. NYS000160).

[799] Tr. at 3645 (Ms. Green for the NRC Staff).

binding on the licensee, for NRC regulatory purposes," and "would not be enforced by the NRC unless they are incorporated in the current or renewed license or otherwise become NRC requirements."[800]

Nevertheless, Energy has responded to numerous RAIs issued by the NRC Staff that define the detailed steps and procedures of its AMP and provided commitments in order to assure the effects of aging for buried pipes are managed through the PEO.[801] Mr. Cox for Entergy stated that, while ultimately the description of the AMP is still in Appendix B of the LRA, Entergy's Responses to RAIs often contain changes "to the SER supplement or Appendix A of the Application," and that Entergy "would make corresponding changes to Appendix B, and it would also be reflected in a RAI response."[802]

Staff witness Mr. Holston testified that "[t]he UFSAR supplement represents the capturing of the critical aspects of the program, as required 10 C.F.R. § 54.21(d), into the Applicant's current licensing basis."[803] Regardless of the details provided in the LRA, the details provided in the UFSAR Supplement that is generated as a result of the NRC Staff's review of the LRA is placed into the final SAR, providing the regulatory basis for assuring implementation of the AMP procedures by reason of their incorporation into the CLB for the plant so as to remain in effect for the remainder of IPEC's operational life.[804]

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[800] NRC Staff NYS-5 Testimony at 43 (Ex. NRCR20016); Tr. at 3919 (Mr. Holston for the NRC Staff).

[801] Tr. at 3390 (Mr. Holston for the NRC Staff); see also NL-09-106 (Ex. NYS000203); NL-09-111 (Ex. NYS000171); NL-11-032 (Ex. NYS000151); NL-11-074 (Ex. NYS000152); NL-11-090 (Ex. NYS000153); NL-12-174 (Ex. ENT000597); SER Supp. 1 (Ex. NYS000160).

[802] Tr. at 3463 (Mr. Cox for Entergy).

[803] Tr. at 3530–31 (Mr. Holston for the NRC Staff). With regard to the record of this proceeding, Mr. Holston testified that the July 27, 2011 UFSAR Supplement is presented in NL-11-090 (Ex. NYS000153) and that Entergy's exhibit ENT000597 is the most recent UFSAR dated November 29, 2012. Tr. at 3528 (Mr. Holston for the NRC Staff).

[804] Tr. at 3541(Mr. Holston for the NRC Staff).

Dr. Duquette, testifying on behalf of New York, criticized Entergy's AMP for buried pipes as lacking specificity in outlining its program.[805] While he testified that he agreed that "Entergy has offered more detail in corporate documents it disclosed (of primary relevance EN-DC-343 (Rev. 4), CEP-UPT-0100, and SEP-UIP-IPEC)," he expressed his concern that "these internal documents are not included in the commitment from Entergy or made a part of the LRA" and are "presumably subject to modification by Entergy without NRC approval and would not be obligations imposed on Entergy by a renewed license."[806]

As was detailed above, if a procedure is not specifically called out in the UFSAR, Entergy may change it without using the license amendment process described in 10 C.F.R. § 50.59(c)(1). Nonetheless, as Staff witness Ms. Green testified, proposed changes must first go through a screening to determine whether there is a significant safety question associated with making the change.[807] Staff witness Mr. Holston concurred with the description of the Section 50.59 review process, adding that an applicant can only make a change in its procedures if screening demonstrates that the Section 50.59 regulations do not apply, or if the Section 50.59 review demonstrates that there are no remaining un-reviewed safety questions.[808]

Entergy witness Mr. Cox likewise concurred, stating that any change to any procedure would be screened by Entergy to determine if the provisions of 10 C.F.R. § 50.59 apply.[809] Entergy witness Mr. Azevedo added that this screening asks whether there is any adverse impact associated with the change, and, if so, requires that the eight criteria of Section 50.59

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[805] New York NYS-5 Testimony at 18 (Ex. NYS000164).

[806] Id. at 19.

[807] Tr. at 3969 (Ms. Green for the NRC Staff).

[808] Tr. at 3403, 3472–73 (Mr. Holston for the NRC Staff).

[809] Tr. at 3402–03 (Mr. Cox for Entergy).

are evaluated to determine if the impact is more than minimal.[810] If it is, these changes require Entergy to obtain a license amendment in accordance with 10 C.F.R. § 50.59(c)(1).

At the hearing, Mr. Azevedo for Entergy stated that the results of the screening process are documented and maintained at the site by the company so as to be available for Staff review. Furthermore, the Staff audits the Applicant's Section 50.59 process on an annual basis.[811] The Staff supported this position,[812] and, regarding oversight of Entergy's Section 50.59 screening process, Mr. Holston testified that the Staff performs specific inspections that look at a wide range of the screening that the Applicant has conducted to ensure that the process is being followed properly.[813]

### 2. Findings Related to Applicant's Obligation to Adhere to Specified Procedures

Based on the preponderance of the evidence before us, we find that Entergy's BPTIP will be implemented as the AMP for the buried pipes at IPEC through Commitment 3 as documented in the Applicant's UFSAR Supplement and in the Staff's SER Supplement. Moreover, pursuant to 10 C.F.R. § 54.3(a), the commitments in these documents are legally binding as part of the CLB throughout the PEO and can only be changed through the Section 50.59 process.

We find that the BPTIP, as updated to meet the major aspects of GALL-2 and the Staff's ISG, is reflected in Entergy's Commitment 3 for buried pipes. Furthermore, implementing procedures for Entergy's BPTIP at IPEC have been developed through the use of fleet-wide programs and plant-specific documents. And because the obligations specified in Commitment 3 are binding, Entergy would be operating outside its CLB if it did not follow the corporate

[810] Tr. at 3663–64 (Mr. Azevedo for Entergy).

[811] Tr. at 3943 (Mr. Azevedo for Entergy).

[812] Tr. at 3968 (Ms. Green for the NRC Staff).

[813] Tr. at 3404 (Mr. Holston for the NRC Staff).

programs defined by EN-DC-343 (Rev. 4), CEP-UPT-0100, and EN-EP-S-002-MULTI, plant-specific procedures in SEP-UIP-IPEC, and the commitments made in responses to the Staff's RAIs including those specifically expressed in NL-11-032, NL-11-074, and NL-11-090.

To be sure, procedures not incorporated into the Applicant's UFSAR Supplement and the Staff's SER Supplement are not legally binding in the sense that proposed changes to these plans would necessitate license amendments. Nonetheless the Applicant is still required to screen changes to all procedures to ascertain if the proposed modification could have any adverse impact, and, if so, to evaluate the eight criteria of Section 50.59 to determine whether the level of impact would necessitate a license amendment for this change. Given that this entire process is documented, and is audited by the Staff, we find that even for those procedures that have not been incorporated into formal commitments made in the UFSAR Supplement and specifically added to the CLB for the PEO, there is a suitable process in place to ensure that any proposed change to those procedures will be appropriately reviewed to determine whether the change is subject to the Section 50.59 license amendment regime.

### J. Summary of Findings Relating to the Adequacy of Entergy's AMP for Buried Pipes at IPEC

Based on the preponderance of the evidence before it, the Board finds that the BPTIP has been an evolving program that has been measurably enhanced with the publication of GALL-2, the ISG, the Applicant's response to RAIs, and Entergy programs and procedural documents covering the steps that must be taken to implement the AMP for buried piping at IPEC. Based on the current state of this program as well as the amendments to Entergy's LRA that include responses to the Staff's RAIs,[814] Commitment 3 made by Entergy (and its incorporation into the Applicant's UFSAR), and the corporate documents and site-specific

[814] See NL-11-032 (Ex. NYS000151); NL-11-074 (Ex. NYS000152); NL-11-090 (Ex. NYS000153).

program description,[815] the Board finds that the Applicant's AMP for buried piping provides reasonable assurance that Entergy will be capable of managing the effects of the aging on these components so that their intended functions will be maintained throughout the PEO.[816]

NYS-5 only challenges Entergy's AMP for buried piping within the scope of license renewal that conveys or otherwise contains radioactive fluids. Consequently, this contention's challenge is not coextensive with the Applicant's AMP for piping in that this contention does not encompass either IPEC underground piping or buried tanks. In its initial LRA, Entergy's stated that its AMP for buried pipes is a new program that is consistent with the NRC guidance document applicable at the time the application was submitted, *i.e.*, GALL-1.[817]

Since the LRA was submitted, however, Entergy's initial program has been significantly augmented.[818] The industry published new guidelines,[819] the buried piping program in GALL-1 was significantly revised in GALL-2 to include a wealth of details defining the 10 program

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[815] See EN-DC-343 (Ex. NYS000172), CEP-UPT-0100 (Ex. NYS000173), and EN-EP-S-002-MULTI, Rev. 0 (Ex. ENT000408); see also SEP-UIP-IPEC (Ex. NYS000174).

[816] Similar to our conclusion that the AMP submitted with the original LRA was deficient, we also conclude that, absent the clarifying documents noted above, the current AMP would be deficient. Certainly, the mere mention of GALL-2 is not sufficient to demonstrate that the required attributes of the program will be achieved during the PEO, at least not without the clarifying procedures presented in the supplemental documents. Furthermore, we can discern no technical reason why documents such as these could not be submitted with or at least summarized in the LRA in the future.

[817] LRA at B-27 to -28 (Ex. ENT00015B).

[818] The initial AMP submitted by Entergy with its LRA consisted of statements promising to develop and implement a program that is consistent with GALL-1, a two-page generic description of the general 10 attributes that need to be addressed in managing aging for buried pipes. Entergy and the Staff maintained that merely committing to the future development of a program, consistent with GALL, would be sufficient to demonstrate that the effects of aging are being adequately managed during the PEO. Consistent with the Commission's ruling in Vermont Yankee, the Applicant must, however, demonstrate consistency with GALL. Accordingly, committing to develop sometime in the future a program that will be consistent with GALL is not sufficient demonstration, by itself, that the effects of aging will be managed throughout the PEO in accordance with 10 C.F.R. § 54.21(a)(3).

[819] EPRI-1016456 (Ex. NYS000167); NEI 09-14, Rev. 1 (Ex. NYS000168).

elements,[820] Entergy developed numerous corporate-wide[821] and plant-specific[822] procedural documents relating to the management of aging for buried piping, the Applicant prepared responses to the NRC Staff's RAIs that define the detail of the steps and procedures of its AMP,[823] and Entergy made numerous commitments to assure that the intended functions of its buried piping will be adequately managed through the PEO.[824] We find that with these commitments and the description of the program procedures now contained in Entergy's corporate documents and site-specific procedures, its AMP is consistent with industry guidelines and with the program attributes presented in GALL-2 and that the AMP satisfies the requirements of 10 C.F.R. § 54.21(a)(3).

In responding to the challenges raised in this contention, the Applicant and the NRC Staff witnesses stated that the only safety-related function for buried piping is to provide a pressure boundary necessary to maintain flow or storage.[825] In accordance with 10 C.F.R. § 54.4(b) and (a)(1)(iii), we find that buried SSCs must also control inadvertent radiological releases to assure that dose exposures are below the regulatory limits. Be that as it may, a showing that radiological releases are controlled to acceptable levels will likely be a low hurdle to clear because maintaining the necessary pressure boundary will, in the process, limit the mass of radiological releases to values that will not increase the dose exposures to any

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[820] GALL-1 at XI M41-1 to -41 (Ex. NYS00146D).

[821] EN-EP-S-002-MULTI, Rev. 0 (Ex. ENT000408); EN-DC-343 (Ex. NYS000172); CEP-UPT-0100 (Ex. NYS000173).

[822] See SEP-UIP-IPEC (Ex. NYS000174).

[823] Tr. at 3390 (Mr. Holston for the NRC Staff); NL-11-032 (Ex. NYS000151); NL-11-074 (Ex. NYS000152); NL-11-090 (Ex. NYS000153).

[824] NL-11-090 (Ex. NYS000153); SER Supp. 1 (NYS000160).

[825] NRC Staff NYS-5 Testimony at 25 (Ex. NRCR20016); Entergy NYS-5 Testimony at 76 (Ex. ENTR30373).

measurable level. In any event, we find that there is no evidence that the leaks at IPEC have contributed sufficient radioactivity to create any meaningful dose exposure impact.

As compared with other nuclear power plants (NPPs), the NRC Staff concluded that IPEC's buried pipe program is equal to or superior to other NPP programs by proposing a number of inspections, sampling soil for corrosion potential, and significantly increasing the number of inspections if corrosive soil is encountered. We find that Entergy's AMP for buried pipes incorporates provisions to address adverse corrosive field conditions if encountered during its inspection program, and includes Entergy's Corrective Action process to correct any adverse conditions.

Leaks in buried pipes have been detected at IPEC. We find, however, that the operating experience at IPEC is consistent with the experience at other NPPs,[826] and note, as detailed below, that, as dictated by its operational experience, Entergy has provided additional corrosion protection (*i.e.*, beyond coatings) by installing CP systems in critical areas for in-scope buried pipes to assure that the effects of aging are managed through the PEO. The Board further finds that Entergy has taken action to manage this aging affect through the PEO in accordance with GALL-2 and the NRC Staff's ISG. As part of this, Entergy has evaluated both plant-specific and nuclear industry operating experience with subsurface corrosion as it developed its AMP for buried pipes.

The Board also finds that Entergy has looked at the root causes of leaks and applied that (and other factors) in defining those pipe locations at IPEC that are most at risk for corrosion. From this, Entergy has developed a program that establishes inspection priorities for those critical areas, evaluates the need for corrosion protection, and implements CP systems when warranted. For instance, the Applicant has installed selected cathodic protection systems at the plant based upon operating experience and relative corrosion risk, giving us confidence

[826] GALL-2 at XI M41-13 (Ex. NYS00147D); see also Entergy NYS-5 Testimony at 88–89 (Ex. ENTR30373).

that it will continue to do so for high risk piping. Nor does the Applicant appear to be reluctant to install new systems, although we would anticipate that capital expense and power demands may limit Entergy's activities to installing systems only where the conditions and inspections show that it will provide a reasonable benefit given the risk involved.[827]

Nonetheless, to compensate for this lack of plant-wide cathodic protection, we find that Entergy has adequately augmented its program in accordance with the Staff's ISG by: (1) developing a summary of the coatings that have been placed around the in-scope piping, (2) performing inspections which have demonstrated limited piping degradation, (3) surveying the site for soil resistivity measurements to characterize the subsurface conditions for corrosion potential, (4) ranking the piping by the risk for corrosion to identify critical piping segments for the establishment of inspection priorities, and (5) proposing to further increase the number of inspections and soil sampling if corrosive conditions are encountered during future inspections.[828] We thus agree with the Staff that this is an acceptable justification for not implementing plant-wide cathodic protection, particularly given the Applicant's efforts to install cathodic protection in those areas in which, based on its risk evaluation efforts, elevated corrosion potential is extant.[829]

At the same time, as a part of its review, the NRC Staff concluded that: (1) an applicant can develop an AMP that is consistent with GALL without providing cathodic protection; (2) IPEC's inspection program in its AMP is consistent with the NRC Staff's ISG recommendations for a site without cathodic protection; and (3) no significant failures of in-scope piping systems have occurred at Indian Point that warrant installing site-wide cathodic protection.[830] Instead,

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[827] Tr. at 3862–63 (Mr. Azevedo for Entergy).

[828] Tr. at 3855–56 (Mr. Holston for the NRC Staff).

[829] Tr. at 3856 (Mr. Holston for the NRC Staff).

[830] NRC Staff NYS-5 Testimony at 55–60 (Ex. NRCR20016).

the Staff concluded that additional soil sampling and inspections constitute an acceptable alternative to installing cathodic protection.[831] We agree with the Staff's conclusions and find that Entergy's program is a reasonable approach for IPEC by focusing attention on the critical areas that are prone to buried piping corrosion rather than requiring blanket, site-wide installation of cathodic protection.

A central New York claim with this contention is that cathodic protection should be provided, or at least seriously considered, for all buried SSCs at IPEC because "Entergy's own studies show that the soils at Indian Point are mildly to moderately corrosive, warranting cathodic protection as an objective matter."[832] Conversely, Entergy argues that all the recent measured soil resistivities indicate negligible potential for corrosivity,[833] and is consistent with the fact that there is only limited evidence of corrosion observed at the site after 40-years of service.[834] Furthermore, Entergy stated that if additional tests indicate that the soils are corrosive, the number of piping inspections will be increased by approximately 30 percent during each 10-year period,[835] which is consistent with the Staff's ISG.[836] We find, based on the preponderance of the evidence, that the need for cathodic protection has been seriously considered but that the site tests indicate the soils are generally noncorrosive so that wholesale installation of cathodic protection for buried piping is not warranted.

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[831] Id. at 59.

[832] New York NYS-5 Testimony at 22 (Ex. NYS000164).

[833] Entergy NYS-5 Testimony at 92–93 (Ex. ENTR30373).

[834] Id. at 115, 117.

[835] NL-11-074, Attach. 1 at 3–4 (Ex. NYS000152).

[836] ISG at 2 (Ex. NRC000162).

New York also claims that industry guidelines recommend cathodic protection for critical piping systems[837] and that Entergy's own consultant, when recommending reinstallation of the original cathodic protection systems that were abandoned,[838] opined that "[i]t should not be a major exercise to expand the existing cathodic protection system to the piping under consideration in Contention NYS-5."[839] Countering New York's testimony, the NRC Staff clarified that neither NEI nor EPRI recommended the use of cathodic protection for all critical piping systems, but only recommended cathodic protection for situations where the risk of failure is unacceptably high. The NRC Staff recognized that the absence of cathodic protection may be addressed by other means, such as risk-ranking and the selection of locations to be inspected based on the consequences of failure.[840] Moreover, the Applicant's consultant, PCA, ultimately recommended that only the city water line be cathodically protected and that the site be progressively evaluated to determine the need for any further cathodic protection at the site.[841] Entergy subsequently adhered to both these recommendations, which we find to be an acceptable response to addressing the question of the need for cathodic protection. Thus, in lieu of site-wide installation of cathodic protection, Entergy has constructed appropriately selected cathodic protection systems, and initiated risk-ranking to assist with the selection of additional inspections for possible future CP installations.

Also relevant in this regard is the NRC Staff's conclusions, as a part of its review of the IPEC AMP, that (1) an applicant can develop an AMP that is consistent with GALL without providing cathodic protection; that (2) Indian Point's inspection program in its AMP is consistent

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[837] New York NYS-5 Testimony at 15 (Ex. NYS000164).

[838] Id.

[839] New York NYS-5 Rebuttal Testimony at 13 (Ex. NYSR20399).

[840] NRC Staff NYS-5 Testimony at 70 (Ex. NRCR20016).

[841] Tr. at 3715–16 (Mr. Azevedo for Entergy).

with the Staff's ISG recommendations for a site without cathodic protection; and (3) no significant failures of in-scope piping systems that might mandate installing cathodic protection have occurred at Indian Point.[842] The NRC Staff concluded that additional soil sampling and inspections constitute an acceptable alternative to installing cathodic protection.[843] Based on the preponderance of the evidence, we agree.

Specifically, the Board finds that the use of cathodic protection has been seriously considered by Entergy, resulting in an operations and maintenance program being established under the direction of a designated cathodic protection system engineer and a risk assessment program being conducted by qualified inspectors.[844] Under these programs, the Applicant has performed additional inspections and site evaluations that resulted in the installation of three cathodic protection systems at the site, with the site also being progressively evaluated for additional systems including one currently being installed and another slated to start in 2013.[845]

Based on this, the Board finds that the amendments to the LRA and the commitments made by Entergy, along with the corporate documents and site-specific program descriptions, demonstrate that the Applicant's AMP for buried piping assures that the aging of these components will be managed so that their intended functions will be maintained through the PEO.

### K. Conclusions of Law

By a preponderance of the evidence, Entergy has provided reasonable assurance that the effects of aging on buried pipes at IPEC that contain or may contain radioactive fluids can be adequately managed during the PEO as required by 10 C.F.R. § 54.21(a)(3). Entergy's

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[842] NRC Staff NYS-5 Testimony at 58 (Ex. NRCR20016).

[843] Id. at 59.

[844] Entergy NYS-5 Testimony at 109 (Ex. ENTR30373).

[845] Tr. at 3846–49 (Mr. Azevedo for Entergy).

current program, submitted as an addendum to its LRA to address all attributes of GALL-2, documents that buried piping will be monitored and remediated, as necessary, to assure that its intended functions will be maintained during the PEO. The issues regarding the adequacy of Entergy's AMP for buried pipes raised by NYS-5 have been resolved in favor of the Applicant and do not prevent the NRC from issuing the requested renewal licenses.

## V. SAFETY CONTENTION NYS-6/7 (Non-E/Q Inaccessible Cables)

### A. Statement of Contentions NYS-6 and NYS-7

NYS-6 and NYS-7, safety contentions challenging the aging management of certain electric cables were consolidated for hearing by the Board and, as litigated at the evidentiary hearing on December 12, 2012, read as follows:

> NYS-6: The license renewal application for IP2 and IP3 fails to comply with the requirements of 10 C.F.R. §§ 54.21(a) and 54.29 because Applicant has not proposed a specific plan for aging management of non-environmentally qualified inaccessible medium-voltage cables and wiring for which such aging management is required.
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> NYS-7: The license renewal application for IP2 and IP3 fails to comply with the requirements of 10 C.F.R. §§ 54.21(a) and 54.29 because Applicant has not proposed a specific plan for aging management of non-environmentally qualified inaccessible low-voltage cables and wiring for which such aging management is required.

For ease of discussion, these two contentions are referred to below collectively as NYS-6/7.

### B. NYS-6/7 Background

#### 1. NYS-6/7 Procedural History

NYS-6 and NYS-7 were filed as part of New York's petition to intervene on November 30, 2007.[846] NYS-6 alleged that Entergy failed to comply with 10 C.F.R. §§ 54.21(a) and 54.29 because its LRA lacked a specific program that could adequately manage aging effects on non-environmentally-qualified (non-EQ) inaccessible medium-voltage cables and wiring.[847] New York asserted that the failure to properly manage aging in this area challenged "the integrity of the reactor coolant pressure boundary;" "the capability to shut down the reactor and maintain it in a safe shutdown condition;" and "the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures."[848] In addition, New York cautioned

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[846] New York Petition at 92–103.

[847] Id. at 92.

[848] Id. at 92–93.

that "failure to properly manage aging of the Non-EQ Inaccessible Medium-Voltage Cables could result in the loss of the 6.9kV and 13.8kV safety related buses that supply emergency power to the 480-volt safety equipment including Station Blackout (SBO) loads, service water motors/pumps, safety injection pumps, and other electrical loads" and that the consequence of such failures "may result in accidents beyond the Design Basis Accidents resulting in exposures to the public."[849]

NYS-7 alleged that Entergy failed to comply with 10 C.F.R. §§ 54.21(a) and 54.29 because its LRA lacked a specific aging management program for non-EQ inaccessible low-voltage cables and wiring.[850] New York asserted that Entergy's LRA ignored aging management for low-voltage cables in its entirety, despite the fact that the failure to properly manage aging of non-EQ inaccessible low-voltage cables may adversely impact "[t]he integrity of the reactor coolant pressure boundary;" "[t]he capability to shut down the reactor and maintain it in a safe shutdown condition;" and "[t]he capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures."[851]

On July 31, 2008, we admitted both contentions.[852] In so doing, we stated that 10 C.F.R. § 54.21(a)(3) requires the Integrated Plant Assessment demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.[853] We emphasized that a commitment to develop a program in the future does not demonstrate that the effects of aging will be adequately managed and that the purpose of the hearing process is to provide

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[849] Id. at 93.

[850] Id. at 100; see LBP-08-13, 68 NRC at 84.

[851] New York Petition at 101–02.

[852] LBP-08-13, 68 NRC at 86.

[853] Id.; see also 10 C.F.R. § 54.21.

intervenors with "the opportunity to challenge the adequacy of the AMP before the license is issued."[854]

### 2. Legal Standards and Issues Related to NYS-6/7

NYS-6/7 concerns the adequacy of Entergy's AMP for inaccessible, non-EQ medium- and low-voltage cables.[855] The standards for evaluating the adequacy of an AMP are detailed in Section II(B) above. Briefly, 10 C.F.R. Sections 54.21(a)(3) and 54.29(a) require us to determine whether Entergy has demonstrated that the effects of aging on low-voltage and medium-voltage cables and wiring will be adequately managed, such that there exists reasonable assurance that low-voltage and medium-voltage cables and wiring will continue to perform their intended functions during the period of extended operation.

The specific issues in controversy before the Board are two-fold:[856] (1) whether Entergy's AMP for inaccessible non-EQ cables exposed to significant moisture lacks critical information for testing to be conducted before and during the PEO, including testing methods, assessment criteria, and corrective actions;[857] and (2) whether Entergy must include an AMP focused on exposure of the non-EQ inaccessible low- and medium-voltage power cables to excessive heating.[858]

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[854] LBP-08-13, 68 NRC at 86.

[855] NYS-6 and NYS-7 were consolidated by the Board in LBP-08-13. See LBP-08-13, 68 NRC at 40–41.

[856] See State of New York's Revised Statement of Position Regarding Contentions NYS-6 and NYS-7 (June 29, 2012) at 1–2 (Ex. NYS000410).

[857] See id. at 1.

[858] Id.

### 3. Evidentiary Record Related to NYS-6/7

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-6/7

Entergy presented four witnesses on NYS-6/7 – Alan Cox,[859] Thomas S. McCaffrey,[860] Robert B. Rucker,[861] and Howard G. Sedding.[862] On March 29, 2012, Entergy filed the written direct testimony of its four witnesses,[863] which was admitted into evidence on October 15, 2012.[864]

The NRC Staff presented two witnesses on NYS-6/7 – Cliff K. Doutt[865] and Duc Nguyen.[866] On March 30, 2012, the NRC Staff filed the written testimony of these witnesses,[867] which was admitted into evidence on October 15, 2012.[868]

New York presented a single witness on NYS-6/7 – Earle C. Bascom.[869] On December 15, 2011, New York filed Mr. Bascom's written direct testimony.[870] On June 29, 2012, New York

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[859] Curriculum Vitae of Alan B. Cox (Ex. ENT000031).

[860] Curriculum Vitae of Thomas S. McCaffrey (Ex. ENT000095).

[861] Curriculum Vitae of Roger B. Rucker (Ex. ENT000092).

[862] Curriculum Vitae of Dr. Howard G. Sedding at 1 (Ex. ENT000235).

[863] Testimony of Entergy Witnesses Alan B. Cox, Roger B. Rucker, Thomas S. McCaffrey, and Howard G. Sedding Concerning Contentions NYS-6/NYS-7 (Non-EQ Inaccessible Medium- and Low-Voltage Cables) (Sept. 21, 2012) (Ex. ENTR00233) [hereinafter Entergy NYS-6/7 Testimony].

[864] Tr. at 1269 (Judge McDade).

[865] Statement of Professional Qualifications of Clifford K. Doutt (Ex. NRC000078).

[866] Statement of Professional Qualifications of Duc T. Nguyen (Ex. NRC000079).

[867] NRC Staff Testimony of Cliff Doutt and Duc Nguyen Concerning NYS Contention 6 and 7 (Lack of a Specific Plan for the Aging Management of Non-Environmentally-Qualified Inaccessible Medium and Low-Voltage Cables and Wiring (Mar. 30, 2012) (Ex. NRC000077) [hereinafter NRC Staff NYS-6/7 Testimony].

[868] Tr. at 1269 (Judge McDade).

[869] Biography of Earle C. (Rusty) Bascom, III—Principal Engineer (Ex. NYS000137).

submitted the rebuttal testimony of Mr. Bascom.[871] Both submissions were admitted into evidence on October 15, 2012.[872]

**b. Identification of Admitted Exhibits Relevant to NYS-6/7**

Relevant to NYS-6/7, Entergy submitted 35 exhibits, the NRC Staff submitted four exhibits, and New York submitted 31 exhibits.[873] The exhibits were admitted into the record on October 15, 2012.[874]

**c. Relevant NRC Staff Guidance Documents and Corporate Procedures**

1. NUREG-1800, Rev. 1, "Standard Review Plan for Review of License Renewal Application for Nuclear Power Plants" (Sept. 2005) (SRP-LR) (Ex. NYS00161). A description of this document was provided at page 41 above as it also pertains to RK-TC-2.

2. NUREG-1801, Rev. 1, "Generic Aging Lessons Learned (GALL) Report" (Sept. 2005) (GALL-1) (Exs. NYS00146A–C). A description of this document was provided at page 41 above as it also pertains to RK-TC-2.

3. NUREG-1801, Rev. 2, "Generic Aging Lessons Learned (GALL) Report" (Dec. 2010) (GALL-2) (Exs. NYS00147A–D). A description of this document was provided at page 42 above as it also pertains to RK-TC-2.

4. NUREG/CR-7000, BNL-NUREG-90318-2009, "Essential Elements of an Electric Cable Condition Monitoring Program" (Ex. NYS000148). NUREG/CR-7000 presents the results of research into various aging mechanisms and condition monitoring techniques in order to

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[870] Prefiled Written Testimony of Earle C. Bascom III Regarding Contentions NYS-6 and 7 (Dec. 14, 2011) (Ex. NYS000136) [hereinafter New York NYS-6/7 Testimony].

[871] Pre-Filed Written Rebuttal Testimony of Earle C. Bascom III Regarding Contentions NYS-6 and NYS-7 (June 27, 2012) (Ex. NYS000411) [hereinafter New York NYS-6/7 Rebuttal Testimony].

[872] Tr. at 1269 (Judge McDade).

[873] See Appendix B - Partial Initial Decision.

[874] Tr. at 1269 (Judge McDade).

define the elements of an effective monitoring program for electric cables.[875] The report provides the technical basis for the Staff to use in developing regulatory guidance.[876]

5. EN-DC-346, Cable Reliability Program, Rev. 3 (Apr. 30, 2012) (Ex. ENT000583). EN-DC-346 is a corporate fleet-wide procedure related to Entergy's non-EQ inaccessible cable program.[877] Entergy procedure EN-DC-346 provides guidance for monitoring the insulation condition of underground power cables, as well as for inspection and dewatering of manholes.[878] EN-DC-346 provides testing and inspection methodology for implementing Entergy's cable monitoring program.[879]

## C. Factual Information Related to NYS-6/7

### 1. Non-Environmentally Qualified Cables

The AMP at issue in this contention concerns inaccessible power cables that are not required to meet the environmental qualification standards of 10 C.F.R. § 50.49 (*i.e.*, non-EQ cables).[880] Cables subject to the environmental qualification standards of 10 C.F.R. § 50.49 are cables that are important to the safety of a nuclear power plant and are required to function during an accident when exposed to harsh environmental conditions.[881] Non-EQ cables, by contrast, are either "not needed to mitigate the consequences of the accident or they're not

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[875] RES, NRC, Essential Elements of an Electric Cable Condition Monitoring Program, NUREG/CR-7000, BNL-NUREG-90318-2009 (Jan. 2010) at v (Ex. NYS000148) [hereinafter NUREG/CR-7000].

[876] Id.

[877] See EN-DC-346, Rev. 3, Cable Reliability Program (Apr. 30, 2012) (Ex. ENT000583) [hereinafter EN-DC-346].

[878] Id. at 4.

[879] See id. at 18–23.

[880] Tr. at 3992 (Mr. Rucker for Entergy). EQ-cable is defined at 10 C.F.R. § 50.49. Cable that does not meet the definition of EQ-cable is, by default, non-EQ cable.

[881] See generally 10 C.F.R. § 50.49.

going to be exposed to the environment of an accident."[882] The principal aging mechanism for a non-EQ cable is degradation of the cable insulation due to exposure to moisture.[883]

This contention concerns only inaccessible cables, *i.e.*, those that are buried underground or encased in cable conduits.[884] Because of their location, these cables cannot be visually inspected for aging-related degradation.[885] The terminals, or end points of the cables are, however, accessible and the testing procedures described below are performed on the cable terminals.

### 2. Entergy's Aging Management Program for Non-Environmentally Qualified Inaccessible Power Cables

In this section, we describe Entergy's AMP and the Staff's review process.

#### a. License Renewal Application

As submitted on April 23, 2007, Entergy's LRA contains an AMP for non-EQ inaccessible medium-voltage cables.[886] In Appendix A, which provides a supplement to the UFSAR, Entergy includes a cursory description of the IP2 and IP3 AMPs for non-EQ inaccessible medium-voltage cables:

> The Non-EQ Inaccessible Medium-Voltage Cable Program is a new program that entails periodic inspections for water collection in cable manholes and periodic testing of cables. In scope medium-voltage cables (cables with operating voltage from 2kV to 35kV) exposed to significant moisture and voltage will be tested at least once every ten years to provide an indication of the condition of the conductor insulation. The program includes inspections for water accumulation in manholes at least once every two years.

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[882] Tr. at 3993 (Mr. Rucker for Entergy).

[883] See Entergy NYS-6/7 Testimony at 25–26 (Ex. ENTR00233). See also NRC Generic Letter 2007-01: Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients (Feb. 2007) at 1–2 (Ex. NYS000149).

[884] Entergy NYS-6/7 Testimony at 19 (Ex. ENTR00233).

[885] Id. at 30.

[886] License Renewal Application at B-81 to -82 (Ex. ENT00015B). Although, as described below, Entergy has since modified the program to include low-voltage cables, the name of the program has remained unchanged.

> The Non-EQ Inaccessible Medium-Voltage Cable Program will be implemented prior to the period of extended operation.[887]

Appendix B of the LRA describes the program in slightly more detail. Section B.1.23 repeats the program description and also states that "[i]ndustry and plant-specific operating experience will be considered when implementing this program."[888] Lacking other significant detail, the program simply states that it "will be consistent with the program attributes described in NUREG-1801, Section XI.E3, Inaccessible Medium-Voltage Cables Not Subject to 10 C.F.R. § 50.49 Environmental Qualification Requirements."[889] The program takes no exception from any of the attributes outlined in GALL.[890]

**b. Subsequent Amendments and Submittals**

In February 2011, following the release of GALL-2 (Dec. 2010), the NRC Staff submitted several RAIs to Entergy concerning the Non-EQ Inaccessible Medium-Voltage Cable Program.[891] The NRC Staff alerted Entergy to recent industry developments that in the presence of significant moisture, inaccessible low-voltage power cables (480 V to 2 kV) had experienced age-related degradation. The Staff also recommended that cable test frequencies be increased to every six years (rather than 10 years) and cable manholes should be subject to an annual water accumulation inspection.[892]

In March 2011, Entergy responded to these RAIs by providing substantial additional detail about its non-EQ inaccessible cable program, and agreeing to certain enhancements to

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[887] Id. at A-28, A-55.

[888] Id. at B-83.

[889] Id.

[890] Id. The NRC Staff reviewed Entergy's LRA for consistency with GALL-1. NRC Staff NYS-6/7 Testimony at 5–6 (Ex. NRC000077).

[891] See Letter from Kimberly J. Green, Safety Project Manager, NRC, to Vice President, Operations, Entergy (Feb. 10, 2011) (Ex. NYS000150).

[892] Id. Encl. at 5.

the program as described in the original LRA.[893] In its response, Entergy specifically stated that "Indian Point will include low-voltage power cables in the non-EQ inaccessible medium-voltage cable program, will increase cable testing and manhole inspection frequency, and will provide for manhole inspections after events that could cause flooding of inaccessible cable raceways."[894] Entergy incorporated these changes in its revised Sections A.2.1.22 and B.1.23 of its LRA.[895] In addition, Entergy included "Commitment 15," which expanded its previous medium-voltage cable program to include IP2 and IP3 low-voltage cables.[896] On July 14, 2011, Entergy applied the same change to LRA Section A.3.1.22, increasing inspection frequencies and adding low-voltage cables to the IP3 program.[897]

On July 27, 2011, Entergy again revised LRA Sections A.2.1.22 and A.3.1.22, adding provisions specifying manhole inspections at least annually, and indicating that a more frequent inspection schedule might be established based on plant-specific operating experience with cable wetting or submergence in manholes.[898] On August 9, 2011, Entergy revised those sections once more to specify that, in addition to the annual inspections, "manhole inspection for water after events, such as heavy rain or flooding will be performed."[899] In addition, Entergy

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[893] NL-11-032, Letter from Fred Dacimo, Entergy, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 10 (Mar. 28, 2011) (Ex. NYS000151).

[894] Id. at 11.

[895] Id. at 12–13.

[896] Id. at 13. Commitment 15 states that Entergy will "Implement the Non-EQ Inaccessible Medium-Voltage Cable Program for IP2 and IP3 as described in LRA Section B.1.23." Id.

[897] NL-11-074, Letter from Fred Dacimo, Entergy, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 15 (July. 14. 2011) (Ex. NYS000152).

[898] NL-11-090, Letter from Fred Dacimo, Entergy, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 1–2 (July 27, 2011) (Ex. NYS000153).

[899] NL-11-096, Letter from Fred Dacimo, Entergy, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 2–3 (July 27, 2011) (Ex. NYS000154) [hereinafter NL-11-096].

revised LRA Section B.1.23 to incorporate event-driven manhole inspections.[900] Mr. Cox testified for Entergy that these RAI response letters listing modifications to its AMP are incorporated into the LRA's program descriptions.[901]

In sum, Entergy's current Non-EQ Inaccessible Medium-Voltage Cable Program is contained in its LRA in Appendix A, Sections A.2.1.22 and A.3.1.22, and Appendix B, Section B.1.23, as modified by its RAI responses in letters NL-11-032, NL-11-074, NL-11-090, and NL-11-096. While Entergy's program references GALL-1, according to the testimony of Mr. Doutt of the NRC Staff, the Applicant had addressed the attributes of GALL-2, Section XI.E3, through its RAI responses.[902] Entergy witness Mr. Rucker also testified that the AMP will be implemented via the fleet-wide procedure EN-DC-346.[903]

**3. Required scope of an AMP**

As discussed above, the Commission has stated that a commitment by a license renewal applicant to implement one of the AMPs detailed in GALL is sufficient to provide "reasonable assurance" that the effects of aging will be adequately managed so that intended functions will be maintained consistent with the CLB for the period of extended operations as required by 10 C.F.R. § 54.21(a)(3).[904] Entergy must, however, demonstrate that its program is consistent with GALL.[905]

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[900] Id. These changes also mirror the requirements of GALL-2, which issued in December 2010. See GALL-2 (Ex. NYS00147D).

[901] Tr. at 4070–71 (Mr. Cox for Entergy); see also Tr. at 3997 (Mr. Rucker for Entergy) (stating that "the AMP is described in Appendix B.1.23 [of the LRA] and then as amended by the RAI letters that are cited there.").

[902] Tr. at 4185–86 (Mr. Doutt for the NRC Staff).

[903] Tr. at 4029–30 (Mr. Rucker for Entergy).

[904] Entergy Nuclear Vt. Yankee, L.L.C. & Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station), CLI-10-17, 72 NRC 1, 37 (2010) (citing Oyster Creek, CLI-08-23, 68 NRC at 468).

[905] Id.

The original Indian Point LRA was written using the guidance provided by GALL-1.[906] Section XI.E3 of GALL-1 addressed non-EQ inaccessible medium-voltage cables, defining which cables are included in the program,[907] the acceptable tests,[908] and the testing intervals.[909] In 2010, during the pendency of this proceeding, the NRC Staff issued GALL-2,[910] which made various changes to GALL-1, including (in the case of the AMP at issue in this contention) increasing the frequency of manhole inspections and expanding the scope of covered SSCs.[911] Specifically, the revised Section XI.E3 expanded the AMP for non-EQ inaccessible power cables to include low-voltage cables; increased the frequency of inspection from every ten years to every six years; and increased the frequency of inspection of manholes for water collection from every two years to "at least annually."[912]

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[906] License Renewal Application at B-81 to -82 (Ex. ENT00015B).

[907] GALL-1 at XI.E-8 (Ex. NYS00146C) (stating "[t]his program applies to inaccessible (*e.g.*, in conduit or direct buried) medium-voltage cables within the scope of license renewal that are exposed to significant moisture simultaneously with significant voltage. Significant moisture is defined as periodic exposures to moisture that last more than a few days. . . . Periodic exposures to moisture that last less than a few days (*i.e.*, normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than twenty-five percent of the time."). Medium-voltage cables are those with voltages between 2 kV and 35 kV. Id. at XI.E.7.

[908] Id. (stating the applicant must conduct "a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed.").

[909] Id. (stating that cables "that are within the scope of the program are tested at least once every 10 years. This is an adequate period to preclude failures of the conductor insulation since experience has shown that aging degradation is a slow process. A 10 year testing interval will provide two data points during a 20-year period, which can be used to characterize the degradation rate.").

[910] See GALL-2 (Exs. NYS00147A–D).

[911] Compare AMP XI.E3 in GALL- 1 (Ex. NYS00146C) with AMP XI.E3 in GALL-2 (Ex. NYS00147D).

[912] GALL-2 at XI.E3-2 (Ex. NYS00147D).

Entergy's AMP for inaccessible, non-EQ low- and medium-voltage power cables relies heavily on incorporation by reference of the applicable section of GALL. While such incorporation by reference is permissible, an applicant must also provide sufficient plant-specific information to demonstrate that the AMP will be designed and implemented consistent with GALL.[913] The Staff initially evaluated Entergy's LRA against GALL-1, but subsequently submitted RAIs that led Entergy to adopt the broader attributes of GALL-2.[914] Thus, in response letter NL-11-096, Entergy provided revised LRA sections A.2.1.22 and A.3.1.22, which state that "[t]his new program will be implemented consistent with the corresponding program described in NUREG-1801, Section XI.E3, in GALL-1[915] and include the revised "Commitment 15," which states that "[t]his new program will be implemented consistent with the corresponding program described" in GALL-2.[916]

**4. Staff's Methodology for Determining Consistency with GALL**

In Section II(B) above, we outlined the general approach taken in evaluating a license renewal applicant's AMP for consistency with GALL. Here, we discuss the application of that process relative to Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program.

The NRC Staff approved Entergy's AMP, as modified by Entergy's RAI responses, in the Staff's Supplemental Safety Evaluation Report (SSER), dated August 2011,[917] noting that:

> (a) the applicant's program is based on and consistent with GALL AMP XI.E3, (b) the program enhancements, including the incorporation of [low voltage] power cables, are consistent with industry operating experience and current staff

[913] Vt. Yankee, CLI-10-17, 72 NRC at 37.

[914] See Tr. at 4024 (Mr. Doutt for the NRC Staff).

[915] NL-11-096, Attach. 1 at 1 (Ex. NYS000154)

[916] Id., Attach. 2 at 8.

[917] SSER at 3-5 to -9 (Ex. NYS000160).

> recommendations . . . [and (c)] the applicant has demonstrated that the effects of aging will be adequately managed . . . for the period of extended operation.[918]

In their testimony, Staff witnesses described the process they used for evaluating Entergy's AMPs for consistency with GALL, which can be summarized as consisting of three components: (1) reviewing the LRA document; (2) conducting an audit of the AMPs onsite; and (3) posing RAIs.[919]

Mr. Nguyen testified that the NRC Staff's aging management review began with the LRA itself.[920] He explained that the NRC Staff first reviewed the Applicant's FSAR to understand the electrical power system at the site and to identify cables that require aging management review.[921] The NRC Staff then compared the program description found in Section B.1.23 of the LRA to the program described in GALL.[922]

In that regard, Mr. Nguyen indicated that he looked to see if the ten elements of the GALL AMP are represented in Entergy's program. He concluded that they were included, noting that the details of the Entergy AMP and GALL details are "exactly the same."[923] He also declared that the NRC Staff took into account "any operating experience the Applicant may have" to inform its judgment of the adequacy of the AMP.[924]

According to the testimony of the NRC Staff witnesses Mr. Doutt and Mr. Nguyen, their review was supported by multiple on-site audits. One such audit, as described by these Staff's

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[918] Id. at 3-9.

[919] NRC Staff NY 6/7 Testimony at 13–15 (Ex. NRC000077).

[920] Tr. at 3999–4001 (Mr. Nguyen for the NRC Staff).

[921] Tr. at 4001 (Mr. Nguyen for the NRC Staff).

[922] Tr. at 4002 (Mr. Nguyen for the NRC Staff). At that time, GALL-1, Section XI.E3 only covered medium-voltage cables. Id.

[923] Tr. at 4007 (Mr. Nguyen for the NRC Staff).

[924] Tr. at 4002 (Mr. Nguyen for the NRC Staff).

witnesses, was a review of Entergy's "scoping and screening" process to verify that Entergy had appropriately identified the SSCs within the scope of license renewal.[925] The scoping and screening audit was based on GALL-1, which applied only to medium-voltage cables.[926] According to Mr. Nguyen, "at that time, we did not have any reason to require them to include the low voltage cable in the scope [along with] the medium voltage."[927]

NRC Staff witnesses further testified that other "AMP audits," occurred over multiple visits to the Indian Point plant site between August 2007 and February 2008.[928] During these visits, the Staff reviewed "applicant records supporting the applicant's conclusion that the program elements . . . are consistent with the corresponding elements in the GALL Report AMP."[929] The purpose of the site audit, in Mr. Nguyen's words, was not to gather new information,[930] but "[t]o confirm that what the applicant claims in the application is actually true."[931] At the AMP audits, the audit team reviewed Entergy's internal documents relevant to its AMPs and met with Entergy representatives to review each element of the programs.[932]

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[925] NRC Staff NYS-6/7 Testimony at 13 (Ex. NRC000077). Entergy has documented the low- and medium-voltage cables that are within the scope of its AMP. See IPEC Low-Voltage In-Scope Cable List (Ex. ENT000242); IPEC Medium-Voltage In-Scope Cable List (Ex. ENT000243). At the oral hearing, Mr. Bascom was asked whether he had any concerns with the lists of cables that Entergy had designated as within the scope of the AMP. He replied that he did not. Tr. at 4055–56 (Mr. Bascom for New York).

[926] Audit Report for Plant Aging Management Programs and Reviews: Indian Point Nuclear Generating Unit Nos. 2 and 3 at 1 (Ex. ENT000041) [hereinafter Audit Report].

[927] Tr. at 4048 (Mr. Nguyen for the NRC Staff).

[928] See NRC Staff NYS-6/7 Testimony at 14 (Ex. NRC000077).

[929] Id.

[930] Tr. at 4059–60 (Mr. Nguyen for the NRC Staff).

[931] Tr. at 4059 (Mr. Nguyen for the NRC Staff).

[932] Tr. at 4049–50 (Mr. Nguyen for the NRC Staff).

The Staff's findings from the on-site AMP audit are documented in its audit report,[933] which concluded that "the applicant's AMP elements [for Non-EQ Inaccessible Medium-Voltage Cable] are consistent with the GALL Report AMP elements" (1) through (6).[934] Mr. Nguyen testified that the expansion of the program to include low voltage cables was addressed through the RAI's mentioned above, and that "Entergy's subsequent decision to expand the non-EQ inaccessible medium voltage cable program to include low voltage cables did not prompt the Staff to re-audit" because the Staff was satisfied with its review of Entergy's original AMP.[935]

The Staff separately determined in its review of Entergy's quality assurance (QA) program that all of Entergy's AMPs were consistent with elements 7 through 9 of GALL AMPs.[936] This review was documented as part of the QA review in the SER.[937] The Staff also included in the SER its determination that Energy's AMP for non-EQ inaccessible cables is consistent with element 10, the operating experience element.[938]

Finally, the Staff documented its evaluation in the 2011 SSER,[939] which describes the modifications and expansions of the program made in response to the Staff's RAIs as acceptable "enhancements" that are "consistent with industry operating experience and current staff recommendations."[940] The SSER states the Staff's conclusion that "the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation," and

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[933] See Audit Report (Ex. ENT000041).

[934] Id. at 26.

[935] NRC Staff NYS-6/7 Testimony at 15 (Ex. NRC000077).

[936] See id.

[937] See SER at 3-220 to -22 (Ex. NYS00326C).

[938] See id. at 3-31 to -32; see also SSER at 3-8, 3-15 to -17 (Ex. NYS000160).

[939] See SSER at 3-5 to -9 (Ex. NYS000160).

[940] Id. at 3-7, 3-9.

that the UFSAR Supplement "provides an adequate summary description of the program, as required by 10 C.F.R. 54.21(d)."[941]

**5. Enforcement of License Commitments and Corrective Actions**

The SSER[942] also contains a list of Entergy commitments that will be imposed as conditions of the renewed license.[943] Commitment 15 states that Entergy will "implement the Non-EQ Inaccessible Medium Voltage Cable Program for IP2 and IP3 as described in LRA Section B.1.23."[944] This commitment further specifies that Entergy will implement the program consistent with Section XI.E3 of GALL.[945]

Element 7 of GALL AMP XI.E3 for non-EQ inaccessible cables concerns corrective actions to be performed when the acceptance criteria for cable testing are not met. Staff witnesses Mr. Nguyen and Mr. Doutt testified that, in approving Entergy's AMP, the lack of specificity in the LRA about which tests will be performed, the acceptance criteria for those tests, and the precise corrective actions to be performed were not a matter of concern to the Staff, because the test methods to be applied do not need to be selected yet, and because Entergy has in place what it considers to be an adequate corrective action program.[946] These NRC Staff witnesses testified that "corrective actions are fact-dependent and not one-size-fits-all," and "no purpose would be served with requiring the LRA to include a table or list specifying all corrective actions for all conditions adverse to quality."[947]

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[941] Id. at 3-9.

[942] See id. at A-11.

[943] See Tr. at 4067–68 (Mr. Doutt for the NRC Staff).

[944] SSER at A-11 (Ex. NYS000160).

[945] Id.

[946] NRC Staff NYS-6/7 Testimony at 23–25 (Ex. NRC000077).

[947] Id. at 24.

These witnesses also emphasized the role of inspections and audits, both prior to and during the PEO. Prior to the PEO, the NRC Staff must conduct a 71003 audit[948] to verify that the applicant's procedures are sufficient to meet the commitments of the renewed license.[949] Thereafter, during the renewal period, the regulations of 10 C.F.R. Part 50, Appendix B concerning ongoing inspections and audits would apply.[950]

**D. Findings Relative to Non-EQ Inaccessible Power Cables**

As noted above, the Commission has stated that while an applicant may reference GALL to provide reasonable assurance the aging will be managed, the applicant must demonstrate that its AMP is consistent with GALL to support such a reference. In this section, we discuss Entergy's reference to GALL and its attempt to demonstrate GALL consistency by focusing on the three major issues raised by New York in these contentions *i.e.*, (1) that Entergy's AMP for non-EQ inaccessible medium- and low-voltage power cables exposed to significant moisture lacks the specificity necessary to demonstrate the effects of aging will be adequately managed for the PEO;[951] (2) that the AMP lacks critical information relating to corrective actions, cable testing methods and acceptance criteria, and Entergy's ability to complete cable testing before entering the PEO;[952] and (3) that Entergy has failed to provide an AMP for non-EQ inaccessible low- and medium-voltage power cables exposed to excessive heat.[953] In New York's view, without such details, Entergy's AMP is unable to provide reasonable assurance that the non-

[948] As noted at page 84 above, the 71003 audit involves programmatic inspections performed by the NRC Staff. See NRC Inspection Manual, Inspection Procedure 71003 Post-Approval Site Inspection for License Renewal (ADAMS Accession No. ML073530536).

[949] Tr. at 4079 (Mr. Doutt for the NRC Staff); see also NRC Inspection Manual: Inspection Procedure 71003 (Feb. 2008) (ADAMS Accession No. ML073530536).

[950] See generally 10 C.F.R. pt. 50, app. B.

[951] State of New York's Initial Statement of Position (Dec. 15, 2011) at 15 (Ex. NYS000135).

[952] Id. at 17–25.

[953] Id. at 25–28.

EQ, inaccessible medium- and low-voltage cables will maintain their intended functions during PEO. In addition, New York maintains that, by failing to address impacts from excessive heat on the degradation of cables, Entergy's LRA is deficient.[954]

### 1. Applicant's Declaration that Its Inaccessible Non-EQ Low-and Medium-Voltage Cables and Wiring AMP is Consistent with GALL

Entergy states in its LRA that the Non-EQ Inaccessible Medium-Voltage Cable Program "will be consistent with the program attributes described in" Section XI.E3 of GALL-1.[955] Entergy included similar language as Commitment 15 in the UFSAR supplement as a binding condition of its prospective license, *i.e.*, stating the program "will be implemented consistent with the corresponding program described in NUREG-1801, Section XI.E3."[956] Entergy further declared that the Non-EQ Inaccessible Medium-Voltage Cable Program satisfies all the elements of GALL and seeks no exceptions.[957] Moreover, the NRC Staff subsequently issued RAIs that led Entergy to adopt the broader attributes of GALL-2, which included expanding its AMP to include non-EQ inaccessible low-voltage cables.[958]

As we have discussed above, the Commission has stated that an applicant's "'use of an aging management program identified in the GALL Report constitutes reasonable assurance that it will manage the targeted aging effect during the renewal period.'"[959] We find that Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program incorporates the related AMP

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[954] Id. at 28.

[955] License Renewal Application at B-81 (Ex. ENT00015B).

[956] SSER at A-12 (Ex. NYS000160).

[957] License Renewal Application at B-81 (Ex. ENT00015B).

[958] NL-11-032, Letter from Fred Dacimo, Entergy, to NRC Document Control Desk, Response to Request for Additional Information (RAI), Attach. 1 at 11 (Mar. 28, 2011) (Ex. NYS000151).

[959] Vt. Yankee, CLI-10-17, 72 NRC at 36 (quoting Oyster Creek, CLI-08-23, 68 NRC at 468).

in Section XI.E3 of GALL, and that the LRA includes a binding commitment to implement this program consistent with GALL.

**2. Entergy's Demonstration of Consistency with GALL**

We do not, however, end our inquiry based on Entergy's statement that its AMP is consistent with GALL. Rather, as the Commission has held, "referencing an AMP in the GALL Report does not insulate that program from challenge in litigation,"[960] in that an applicant must demonstrate, not merely claim, that its AMP will be consistent will GALL.[961] We thus turn to Entergy's AMP to assess whether, as New York alleged, that plan lacks sufficient detail to demonstrate consistency with GALL.

**a. Entergy's Implementing Procedures as the Basis for a Reasonable Assurance Finding**

New York argued that Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program, as expressed in its LRA, lacks details as to (1) the cables to be included within the scope of the program; (2) the number, location, and physical characteristics of those cables; (3) the monitoring tests that will be used; (4) the acceptance criteria for the selected monitoring tests; and (5) the corrective actions that will be taken if testing reveals degraded insulation.[962] New York notes that even though "all the essential details that are missing from the AMP with respect to the effects of aging caused by exposure of the cables to significant moisture" are included in the implementing procedure, Entergy's fleet-wide Cable Reliability Program (EN-DC-346),[963] New York nonetheless maintains that EN-DC-346 is not part of the LRA, is not enforceable by

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[960] Id.

[961] Id. (emphasis added).

[962] State of New York's Initial Statement of Position: Contentions NYS-6 and 7 (Dec. 15, 2011) at 1 (Ex. NYS000135) [hereinafter NYS-6/7 SOP].

[963] State of New York's Revised Statement of Position Regarding Contentions NYS-6 and NYS-7 (June 29, 2012) at 3 (Ex. NYS000410) (citing EN-DC-346 (Ex. ENT000583)).

the NRC, and therefore cannot provide the basis for a finding of reasonable assurance.[964] Mr. Bascom on behalf of New York expressed his concerns regarding "the link to where [EN-DC-346 is] regulated or required by the staff's review."[965]

Entergy witness Mr. Cox conceded that EN-DC-346 is an implementing procedure for its AMP, and not part of the AMP itself.[966] He insisted, however, that EN-DC-346 exists to effectuate the commitment made in Appendix B of the LRA.[967] Mr. Rucker, also testifying for Entergy, explained that EN-DC-346 is designed to be an executing or implementing procedure, and Mr. Cox and Mr. McCaffrey testified that Entergy would be required to evaluate any alterations to EN-DC-346 using its internal pre-screening process to determine whether such alteration required NRC approval under 10 C.F.R. § 50.59.[968]

In our discussion of NYS-5 we explained that, although commitments that are not incorporated into the UFSAR Supplement are not legally binding, proposed changes to procedures that are relied upon to fulfill a binding commitment are subject to pre-screening to determine whether they fall within the 10 C.F.R. § 50.59 process.[969] Additionally, the procedures are subject to audit by the Staff, both before and during the PEO.[970] Consequently, we find that a license renewal applicant may rely on such internal procedures to demonstrate that its AMPs will be implemented consistent with GALL.

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[964] Id. at 2.

[965] Tr. at 4081 (Mr. Bascom for New York).

[966] Tr. at 4077 (Mr. Cox for Entergy).

[967] Id.

[968] Tr. at 4075 (Mr. Cox for Entergy) (stating that "[t]he procedure change process requires us to do the screening to determine if it involves an activity described in the FSAR."); Tr. at 4082–86 (Mr. McCaffrey for Entergy).

[969] See supra page 145.

[970] Tr. at 4079 (Mr. Doutt for the NRC Staff).

As the NRC Staff witnesses testified, implementing procedures, where available, are examined as part of the AMP audit by the NRC Staff to determine whether the applicant's AMP fulfills the ten elements of GALL.[971] In this case, Entergy had not finalized its procedures at the time of the audit and, therefore, the Staff did not rely on them in approving the Non-EQ Inaccessible Medium-Voltage Cable Program.[972] We, however, have the advantage of being able to evaluate the AMP along with the details of how it will be implemented. And, as explained below, we find they provide reasonable assurance that the effects of aging on inaccessible non-EQ medium- and low-voltage cables will be adequately managed during the PEO.

**b. Identification of In-scope Cables**

New York argued that Entergy's LRA lacks adequate information about the cables within the scope of the AMP, including their number, location, and physical characteristics.[973] In his written testimony for New York, Mr. Bascom stated that, without this information, he was unable to evaluate whether Entergy can complete testing before the PEO and whether the chosen tests are suited to the types of cables.[974] At the hearing, however, after reviewing the lists of cables at IP2 and IP3 provided by Entergy, Mr. Bascom was unwilling to say that the lists are inadequate or, to his knowledge, that they inaccurately represent the cables at the plant.[975]

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[971] See NRC Staff NYS-6/7 Testimony at 13 (Ex. NRC000077); Tr. at 4049–50 (Mr. Nguyen for the NRC Staff).

[972] NRC Staff NYS-6/7 Testimony at 14–15 (Ex. NRC000077). The NRC Staff witnesses testified that "the Staff does not find it necessary for LRAs to include current finalized detailed procedures for the Staff to review and approve in light of the latitude provided for using 'state of the art' tests in the future." Id. at 16.

[973] See State of New York's Initial Statement of Position Contentions NYS-6 and 7 (Dec. 15, 2011) at 1, 19 (Ex. NYS000135).

[974] See New York NYS-6/7 Testimony at 25–28 (Ex. NYS000136).

[975] See Tr. at 4055–56 (Mr. Bascom for New York).

Accordingly, based on the factors outlined below, we find that the number, location, and physical characteristics of non-EQ inaccessible cables are adequately identified.

Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program identifies those cables that are covered by the program. Specifically, the program applies to "[i]n scope medium-voltage cables (cables with operating voltage from 2kV to 35kV) and low-voltage power cables (400 V to 2 kV) exposed to significant moisture."[976] In accordance with Procedure EN-DC-346 that calls for lists of the in-scope cables,[977] Entergy has prepared lists that include characteristics such as the length, type of insulation, rated voltage, and whether the cables are shielded.[978]

Further, Entergy has committed to implement the program using proven, state-of-the-art test methods in order to assure that the method used will be appropriate to the cable tested.[979] Entergy's LRA also adopts a "commodity" approach, whereby the LRA does not list individual cables, but treats groups of cables with common characteristics as a single commodity, which ensures that individual cables will not be missed for testing purposes.[980] GALL and the SRP-LR both endorse the commodity grouping approach.[981]

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[976] NL-11-096, Attach. 1 at 2 (Ex. NYS000154).

[977] EN-DC-346 at 18 (Ex. ENT000583).

[978] See IPEC Low-Voltage In-Scope Cable List (Ex. ENT000242); IPEC Medium-Voltage In-Scope Cable List (Ex. ENT000243).

[979] See Entergy NYS-6/7 Testimony at 17–23 (Ex. ENTR00233).

[980] Id. at 20. Specifically, the LRA treats "inaccessible medium-voltage (2 kV to 35 kV) cables (*e.g.*, installed underground in conduit or direct buried) not subject to 10 C.F.R. § 50.49 EQ requirements" as a single commodity group. License Renewal Application at 2.5-2 (Ex. ENT00015A).

[981] See id. at 21 (citing GALL-2 at VI.A-1 (Ex. NYS00147D)); SRP-LR at 2.1-14 (Ex. NYS000161)).

Based on the foregoing, we find that Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program, as supported by the EN-DC-346 procedure and the lists of in-scope cables, sufficiently details the cables that are subject to the program.

**c. Testing Methodology, Acceptance Criteria, and Corrective Actions**

New York argues that Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program is inadequate because it "does not identify the cable condition monitoring tests that will be used, does not explain the criteria for determining whether the test results are acceptable, and does not identify what corrective actions, if any, Entergy will take if a defective cable is found."[982] New York witness Mr. Bascom expressed the opinion that, although EN-DC-346 contains specific testing procedures, there is no link between the program as described in the LRA and the testing procedures so as to make the procedures enforceable.[983] We disagree.

GALL-1, Section XI.E3, incorporated into Entergy's LRA, defines the test to be performed to detect the condition of cable conductor insulation as follows:

> The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2 or other testing that is state-of-the-art at the time the test is performed.[984]

Thus, if testing indicates a cable is operating below the acceptance criteria, Entergy must take corrective actions and determine the cause of the degraded condition.[985] And in this regard, Entergy witness Mr. McCaffrey testified that "with the acceptance criteria we have spelled out

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[982] State of New York's Initial Statement of Position Contentions NYS-6 and 7 (Dec. 15, 2011) at 1 (Ex. NYS000135).

[983] Tr. at 4072–73 (Mr. Bascom for New York).

[984] GALL-1 at XI.E-7 (Ex. NYS00146C). The referenced EPRI document provides technical descriptions of several test methods for evaluating the condition of insulation for medium- and low-voltage cables. See EPRI, Effects of Moisture on the Life of Power Plant Cables, EPRI TR-103834-P1-2 (Aug. 1994). Although the document was discussed at the hearing, no party submitted it as an exhibit. We take official notice of its contents. See 10 C.F.R. § 2.337(f).

[985] Tr. at 4136–37 (Mr. McCaffrey for Entergy).

and the trending we will do, we [Entergy] will be able to detect and determine when those cables would fail prior to their failure, based upon our test data."[986]

Mr. Cox acknowledged that Entergy has not indicated in its LRA the specific tests that it will perform in the PEO.[987] Asked whether there was any technical reason why Entergy could not have stated in its LRA which test method it plans to use, Mr. Cox answered that "the technical reason is that the GALL Report says we'll select a test method at the time of the first test that's the state-of-the-art."[988] He further explained that Entergy does not know now what the state of-the-art will be five or ten years from now when the test will be performed.[989]

Staff witness Mr. Nguyen testified that the reason for not requiring an applicant to state a specific test in the LRA is that "we don't want to tie down [the Applicant to] a particular test. We just give the example of '[t]his is one of the acceptable tests.' But in the future if something is coming up the Applicant could have options to adapt."[990]

Mr. Cox also testified that the Non-EQ Inaccessible Medium-Voltage Cable Program is "not as specific" as other programs with respect to testing procedures because the issue of how best to test cable insulation for aging effects such as water treeing [991] is an evolving one, and

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[986] Tr. at 4138 (Mr. McCaffrey for Entergy).

[987] Tr. at 4018–19 (Mr. Cox for Entergy).

[988] Tr. at 4009 (Mr. Cox for Entergy).

[989] Tr. at 4010 (Mr. Cox for Entergy).

[990] Tr. at 4014 (Mr. Nguyen for the NRC Staff).

[991] Water trees are formed in the presence of voltage and water. Under these conditions, the cables can develop channels through the insulation. Then, an event called partial discharge can develop, in which there are localized electrical discharges in the insulation that over time carbonize the water channels and form water trees. They are called water trees because they look somewhat like the trees you would see in the environment. When the water trees form, the dielectric strength of the insulation is more significantly compromised, and to an extent, the water tree can bridge the gap between the conductor and the surrounding shield or sheath, and eventually lead to a breakdown of the insulation which is a failure. Tr. at 4171–72 (Mr. Bascom for New York).

"there's a lot of research being done on what is the best method."[992] In Mr. Cox's view, because the menu of test options described by GALL AMP are all acceptable methods, specifying which tests will be used would not provide additional assurance.[993] Based on the foregoing, we agree, and find Entergy's explanation to be reasonable and consistent with GALL.

The witnesses for Entergy and the NRC Staff further testified that, in their judgment, sufficient oversight will exist to ensure that Entergy uses a test that meets the criteria of the GALL AMP. Entergy witness Mr. Cox stated that "[i]f we're not using a proven test, that's going to be apparent and [the NRC Staff is] going to be able to enforce this as a violation on us for not meeting this commitment."[994] According to Mr. Cox, "[w]e would do the testing and the NRC would be in a position to review that after the fact."[995] He also declared that, although Entergy can change from one "proven test" to another without prior NRC approval, Entergy would need to follow its 10 C.F.R. § 50.59 process "to ensure it doesn't affect the safety of the plant."[996]

The NRC Staff also will have oversight of Entergy's test selection. Staff witness Mr. Nguyen testified that the NRC Staff will "do the 71003 inspection for license renewal before the PEO . . . [and] if the test is not appropriate, then we will resolve [it] at that time."[997] Similarly, NRC Staff witness Mr. Doutt stated that the "inspection would look to see if the commitments,

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[992] Tr. at 4034 (Mr. Cox for Entergy).

[993] Tr. at 4035 (Mr. Cox for Entergy).

[994] Tr. at 4028 (Mr. Cox for Entergy).

[995] Tr. at 4020 (Mr. Cox for Entergy).

[996] Tr. at 4076 (Mr. Cox for Entergy).

[997] Tr. at 4014–15 (Mr. Nguyen for the NRC Staff).

whatever they are, have been implemented correctly."[998] We find this approach to be reasonable and appropriate.

Although the witnesses for Entergy and the NRC Staff testified that the Applicant need not select test methods at the application stage, EN-DC-346 does indicate the specific methods to be used. For condition monitoring of medium voltage cables, the procedures specify Tan Delta, Very Low Frequency (VLF) AC High Potential (Hi-Pot/Withstand), or Partial Discharge testing.[999] New York witness Mr. Bascom stated that the EPRI document referenced in GALL "did have a comprehensive description of the [test] methods that would be applied."[1000] Although Mr. Bascom's initial review of the LRA did not include the EN-DC-346,[1001] he testified at the hearing that "the Cable Reliability Program [EN-DC-346] that's been referenced does designate tests that [Entergy] would [conduct] on the two types of cables that are the subject of

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[998] Tr. at 4023 (Mr. Doutt for the NRC Staff); see also Audit Report at 23 (Ex. ENT000041) ("In accordance with IP 71003, the staff will verify that the license renewal commitments are implemented in accordance with 10 C.F.R. Part 54.").

[999] EN-DC-436 at 16–17 (Ex. ENT000583). According to Entergy witnesses, the Tan Delta Test, also called Power Factor, Dissipation Factor, or Loss Angle, determines the ratio by which leaking current through the cable's insulation diverges from what would be expected of a perfectly insulated cable (an ideal capacitor). Entergy NYS-6/7 Testimony at 67 (Ex. ENTR00233). They testified that for the VLF AC Hi-Pot Test, the cable is taken offline to determine whether it can withstand an excessive voltage ("high potential" or "hi-pot") that might occur during plant operation. Id. at 65, 67. Entergy witnesses testified that "[p]assing a withstand test after a successful tan delta test indicates that there is no significant distributed or local degradation in the insulation system." Id. at 66. Entergy's witnesses also testified that the Partial Discharge Test is used to detect the size and location of discharges through the insulation by measuring the time lapse between frequency disturbances or pulses that move along the length of the cable. Id. at 67. In addition, they explained that the Insulation Resistance Test is performed to evaluate the condition of the load connected to the cable. According to Entergy's witnesses, the test identifies reasonably gross damage, contamination, or deterioration. Id. at 70–71; EN-DC-436 at 17 (Ex. ENT000583). Procedure EN-DC-346 also includes acceptance criteria for the tan delta and insulation resistance tests. EN-DC-346 at 25–27 (Ex. ENT000583). Mr. Rucker also indicated that, while EN-DC-346 does not bind Entergy to using a particular test, it states the preferred testing procedure. Tr. at 4037 (Mr. Rucker for Entergy).

[1000] Tr. at 4013 (Mr. Bascom for New York).

[1001] Tr. at 4039 (Mr. Bascom for New York).

this discussion."[1002] In short, EN-DC-346 contains the specific details that Mr. Bascom testified that he was looking for in the LRA.[1003]

We find that Entergy's testing methods and procedures provide sufficient detail to demonstrate that it will conduct its cable testing consistent with GALL. Procedure EN-DC-346 clearly identifies the tests that will be used and their acceptance criteria. Moreover, if a different state-of-the-art test is developed prior to the time of the actual testing, the program allows Entergy the flexibility to use the state-of-the-art test, subject to a pre-screening for whether NRC approval is required pursuant to 10 C.F.R. § 50.59.

New York's argument that Entergy's testing procedures should essentially be set in stone in the LRA and only modifiable though the license amendment process is directly at odds with the flexibility GALL envisions. In the context of this contention, in which New York has challenged Entergy LRA's implementation of GALL (rather than the GALL itself) and because Entergy's AMP is within the letter and the spirit of GALL (which the Commission has indicated is the guidepost against which we should measure "reasonable assurance") we find that New York's arguments must fail.

We emphasize, however, that if Entergy diverges from or alters EN-DC-346, and elects a test other than one of those listed in GALL or EPRI TR-103834-P1-2, two criteria must be met: (1) the test must be "proven," and (2) it must be "state-of-the-art." As explained above, we cannot rule in 2013 what will be the state-of-the-art throughout the PEO. As part of its ongoing oversight of IPEC operations, the NRC Staff must make that determination at the appropriate time.

**d. Program Enhancements**

Beginning at page 161 above, we described the modifications to the Non-EQ Inaccessible Medium-Voltage Cable Program that Entergy made in response to the Staff's RAIs.

[1002] Tr. at 4038 (Mr. Bascom for New York).

Staff witness Mr. Doutt testified that the RAIs were driven by new operating experience and GALL-2.[1004] The relevant AMP in GALL-2 was, in turn, informed by industry responses to Generic Letter 2007-01,[1005] which had sought information from reactor licensees regarding their monitoring of inaccessible cables in light of reported cable failures.[1006]

Staff witness Mr. Nguyen likewise testified that the request for Entergy to expand the program to include low-voltage cables was a direct result of the issuance of GALL-2.[1007] Mr. Doutt for the Staff added that the increased cable testing frequency in GALL-2 was designed in part to increase the number of tests that occur in the renewal period so that the results could be trended.[1008] With respect to manholes, Entergy witnesses Mr. Rucker and Mr. McCaffrey testified that the current inspection frequency at Indian Point is greater than the annual inspections called for by GALL-2.[1009]

We find that Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program, as enhanced in response to the Staff's RAIs, goes beyond the attributes of GALL-1 to incorporate the key changes reflected in GALL-2, including expansion of the program to include non-EQ inaccessible low-voltage cables. We also find that the modification to IPEC's AMP for inaccessible non-EQ low and medium-voltage cables provides reasonable assurance that the effects of aging on these components will be adequately managed during a PEO.

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[1004] Tr. at 4185–86 (Mr. Doutt for the NRC Staff).

[1005] NRC Generic Letter 2007-01, Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients (Feb. 7, 2007) (Ex. NYS000149).

[1006] See Tr. at 4088 (Mr. Doutt for the NRC Staff).

[1007] Tr. at 4048 (Mr. Nguyen for the NRC Staff).

[1008] Tr. at 4088 (Mr. Doutt for the NRC Staff).

[1009] Tr. at 4092 (Mr. McCaffrey for Entergy); Tr. at 4093 (Mr. Rucker for Entergy) (referencing Manhole Preventive Maintenance Frequencies (Ex. ENT000248)).

#### e. Conclusions Relating to Entergy's Demonstration of Consistency with GALL

As described above, Entergy has committed to implementing its Non-EQ Inaccessible Medium-Voltage Cable Program in accordance with GALL-1. It has also extended the original AMP to low-voltage cables and increased the testing frequency in accordance with the stricter attributes of GALL-2. The AMP is also supported by a fleet-wide procedure that specifies which tests will be applied to which cables, and the criteria for evaluating the results of the testing. Further, changes to Entergy's testing program will be subject to ongoing oversight by the NRC Staff. Accordingly, as based on a preponderance of the evidence before us, we find that Entergy has demonstrated that its program is consistent with the elements of GALL, and thus provides reasonable assurance that the effects of aging of inaccessible non-EQ cables that maybe exposed to moisture will be effectively managed during the PEO.

### 3. The Need for an AMP for Non-EQ Inaccessible Low- and Medium-Voltage Power Cables Exposed to Excessive Heat

In addition to the foregoing, NYS-6/7 also alleges that Entergy's LRA does not contain an AMP for non-EQ inaccessible low- and medium-voltage power cables exposed to excessive heat.[1010] As explained below, based on the evidentiary record before us, we find that the testing to be conducted pursuant to Entergy's Non-EQ Inaccessible Medium-Voltage Cable Program is adequate to detect degradation due to excessive heating in advance of cable failure.

#### a. Thermal Degradation of Power Cables

New York witness Mr. Bascom testified that many cable failures occur "from the slow degradation of the cable insulation due to . . . exposure to excessive heat."[1011] According to Mr.

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[1010] See State of New York's Initial Statement of Position Contentions NYS-6 and 7 (Dec. 15, 2011) at 25–28 (Ex. NYS000135). Because NYS-6/7 as admitted challenged the adequacy of Entergy's AMP for non-EQ low- and medium-voltage cables, we interpret New York's argument on this issue as a challenge to the adequacy of Entergy's Non-EQ Inaccessible Medium Voltage Cable Program, rather than a demand for a new, separate AMP.

[1011] New York NYS-6/7 Testimony at 13 (Ex. NYS000136).

Bascom, "thermally induced cable degradation occurs when a power cable is operated above its rated temperature and the insulation melts or burns causing the insulation's dielectric strength, that is, its voltage insulating properties, to degrade to the point of an electrical breakdown."[1012]

Mr. Bascom identified three mechanisms that could cause excessive heating of the cable insulation: (1) failure of the surrounding environment to dissipate the heat generated by current passing through the cable; (2) an external heat source near the cable, such as a steam line or hot water pipe; and (3) heat from other cables in close proximity, particularly in underground conduits, causing a mutual heating effect.[1013] NRC Staff witnesses testified that NRC's research "has not shown the three issues discussed by Mr. Bascom to be a concern at operating plants."[1014] The NRC Staff witnesses opined that previous cable failures at Indian Point were not caused by excessive heat.[1015]

The first mechanism described by Mr. Bascom is also referred to as "ohmic heating."[1016] He testified that losses of heat (ohmic losses) from the cables themselves can generate elevated temperatures when the heat leaving the cables passes through a surrounding environment with high thermal resistance.[1017] Mr. Bascom explained that ohmic losses occur in any power cable carrying electrical current, "whether it's operating above or below its temperature limits."[1018]

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[1012] Id. at 29.

[1013] Id. at 30.

[1014] NRC Staff NYS-6/7 Testimony at 26 (Ex. NRC000077).

[1015] Id.

[1016] Tr. at 4106 (Mr. Bascom for New York).

[1017] Id.

[1018] Tr. at 4183 (Mr. Bascom for New York).

Mr. Bascom asserted that Entergy failed to demonstrate that none of its inaccessible cables is ever operated above their rated temperatures.[1019] He then went on to say that he found nothing in the LRA to indicate that thermal degradation would not be an issue at Indian Point.[1020] In his opinion, "[b]ecause all the safety-related power cables at IP 2 and 3 are low-voltage," the lack of an AMP calls into question how these "safety-related low-voltage power cables will continue to perform their critical function" during the PEO.[1021] Consequently, Mr. Bascom testified that it would be "worthwhile" for Entergy to "evaluate that there are no hot spots or at least review loading that may have changed over the life of the system that might increase ohmic losses or additional cables being installed in parallel that provide mutual heating that could contribute to elevated temperature."[1022]

On behalf of New York, Mr. Bascom also testified that "the likelihood of excessive ohmic heating from a single cable can be minimized if the cable is properly designed and properly installed."[1023] In his opinion, insulation degradation may occur "if a cable experiences excessive temperatures due to ohmic heating because it has not been properly designed or installed."[1024]

Mr. Bascom conceded, however, that temperatures far above the rated limit for cables are unlikely to be a problem at Indian Point: "[s]ince these cables have been in service for some time, that type of [high temperature] condition probably would have identified itself already by

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[1019] New York NYS-6/7 Testimony at 32 (Ex. NYS000136).

[1020] Tr. at 4097, 4099 (Mr. Bascom for New York).

[1021] New York NYS-6/7 Testimony at 32 (Ex. NYS000136).

[1022] Tr. at 4140–41 (Mr. Bascom for New York).

[1023] New York NYS-6/7 Rebuttal Testimony at 5 (Ex. NYS000411).

[1024] Id.

the presence of cable failures."[1025] He testified that his concern, instead, is with accelerated aging brought on by long-term exposure to small increases in temperature.[1026]

**b. Ohmic Heating As Addressed Through Proper Design**

Entergy witnesses testified that ohmic heating is not an aging management issue, but instead an issue considered during facility design.[1027] Under this view, aging management is not necessary because, in a properly designed plant, cable failures due to thermal stress and decay would not occur, regardless of the age of the cables. Entergy witness Mr. McCaffrey testified that "the plant was designed to take these design thermal issues into account" with respect to potential heating of the cables.[1028] He further stated that he has reviewed calculations prepared for the design of the plant that accounted for soil temperatures and ampacity[1029] and that such calculations were performed in accordance with an engineering standard for insulated cables.[1030] According to another Entergy witness, Dr. Sedding, "the design assumptions in . . . nuclear utilities are very conservative. So therefore, the probability of any cable system . . . being at or close to the maximum operating temperatures . . . is extremely small."[1031] Dr. Sedding stated that the design criteria for nuclear plants seek to ensure that cables will operate well below their maximum operating temperature during normal

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[1025] Tr. at 4111 (Mr. Bascom for New York).

[1026] Id.

[1027] Tr. at 4119 (Mr. McCaffrey and Dr. Sedding for Entergy).

[1028] Tr. at 4104 (Mr. McCaffrey for Entergy).

[1029] As explained by Staff witness Mr. Nguyen, "ampacity is the capacity of the cable to carry the current" while remaining within its rated temperature. Tr. at 4147 (Mr. Nguyen for the NRC Staff).

[1030] Tr. at 4108 (Mr. McCaffrey for Entergy).

[1031] Tr. at 4131–32 (Dr. Sedding for Entergy).

operation.[1032] Further, Dr. Sedding and Mr. Rucker testified that the cables at Indian Point "have extruded polymer insulation that cannot lose their insulating or cooling values due to failure of an active system."[1033]

Staff witness Mr. Nguyen also testified that the cable system at Indian Point, if designed correctly, would preclude thermal degradation, because "the ampacity of the cables will be calculated such that the cable will never exceed the rated temperature."[1034] He further testified that the design applies an "ampacity corrective factor" to take into account for such elements as the number of cables inside a conduit and the ambient temperature.[1035] He stated that during regular operations, the cable will not operate at the full current for much of the time, reflecting the conservative nature of the design.[1036] Furthermore, according to Mr. Nguyen, were Entergy to change the loading, it would need to determine whether the cable could handle the ampacity based on the design calculations.[1037] In short, it is Mr. Nguyen's opinion that Indian Point is designed such that the current carried through non-EQ power cables during normal operations will not cause them to exceed their rated temperature, whether the cables are isolated or bundled together. He further testified that the only aging effect identified for underground cables is "water tree submersion," and that thermal impacts from localized heat sources only occur in above-ground cables, which are managed by Entergy's separate AMP for non-EQ cables

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[1032] Id.

[1033] Entergy NYS-6/7 Testimony at 77 (Ex. ENTR00233).

[1034] Tr. at 4148 (Mr. Nguyen for the NRC Staff).

[1035] Id.

[1036] Tr. at 4150 (Mr. Nguyen for the NRC Staff).

[1037] Id.

exposed to adverse localized environments.[1038] This testimony was not contradicted by Mr. Bascom, New York's witness for NYS-6/7.

Entergy witness Mr. McCaffrey also expressed confidence that "if we did our initial design correctly . . . there are no ohmic heating issues that are going to drive aging of our cables" over the life of the plant.[1039] Further, he testified that, the site drawings indicate that there are no external sources of heat at Indian Point effecting the underground cables; "[s]o the only potential source of heat would be [the] cables themselves."[1040] Mr. McCaffrey also testified that he is unable to foresee a situation in which a cable that had performed properly in the initial license term would fail during the PEO due to ohmic heating.[1041]

Nonetheless, in an apparent attempt to demonstrate that plant design would not address this issue, New York witness Mr. Bascom pointed to a single example of a cable failure due to thermal degradation from ohmic heating.[1042] But that incident did not occur in a nuclear power plant and involved higher voltage cables.[1043] Mr. Bascom, while conceding that this single example "is not representative of the cables that are in Indian Point 2 and 3,"[1044] nonetheless asserted that it serves as an example of where, "after the initial design conditions were

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[1038] Tr. at 4151–52 (Mr. Nguyen for the NRC Staff); see also License Renewal Application at B-85 to -86 (Ex. ENT00015B).

[1039] Tr. at 4126 (Mr. McCaffrey for Entergy).

[1040] Tr. at 4105 (Mr. McCaffrey for Entergy).

[1041] Tr. at 4136 (Mr. McCaffrey for Entergy).

[1042] Report of Earle C. Bascom III, P.E. in Support of Contentions NYS-6 and 7 (Dec. 15, 2011) at 27 (Ex. NYS000138); Tr. at 4159–60 (Mr. Bascom for New York).

[1043] Report of Earle C. Bascom III, P.E. in Support of Contentions NYS-6 and 7 (Dec. 15, 2011) at 27 (Ex. NYS000138); see also Tr. at 4159–60 (Mr. Bascom for New York).

[1044] Tr. at 4160 (Mr. Bascom for New York).

configured, there was a period where [the cable system] operated successfully and then it did fail" due to ohmic heating from prolonged exposure to excessive loads.[1045]

Entergy witness Dr. Sedding testified that, in his experience in the nuclear industry, "we are not aware at present date of any failures that we have observed due to excessive ohmic heating."[1046] He added that, in instances in which cables have failed, forensic analysis of such failures did not reveal evidence of overheating due to ohmic heating.[1047] Dr. Sedding further opined that, in his experience, cable failures that result from incorrectly designed cable ampacity tend to be fairly rapid, in some cases within months of commencing operation.[1048] He went on to say that he has not encountered a situation where a cable degraded over a long period of time as a result of being operated at a temperature slightly above its rated operating temperature.[1049]

Speaking to the specific case of Indian Point, another Entergy witness, Mr. McCaffrey observed that, "we have seen no degradation or failures on our medium voltage cables or our underground cables due to aging,"[1050] and "I know of no history of ohmic heating that has caused degradation of the cables."[1051]

Based on the evidence presented, we find that the operating experience at nuclear power plants has not shown excessive heating of non-EQ cables to be an issue. Instead, based on the record before us, we find that the design of the cable system at Indian Point is sufficient

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[1045] Id.

[1046] Tr. at 4116 (Dr. Sedding for Entergy).

[1047] Id.

[1048] Tr. at 4118 (Dr. Sedding for Entergy).

[1049] Tr. at 4120–21 (Dr. Sedding for Entergy).

[1050] Tr. at 4104 (Mr. McCaffrey for Entergy).

[1051] Tr. at 4115–16 (Mr. McCaffrey for Entergy).

to prevent excessive heating in underground cables. Given that New York failed to put forward any evidence suggesting that the design of the cable system at Indian Point is flawed, or provided any reason to suspect there were errors in cable installation, we find that Entergy's and the NRC Staff's witnesses credibly established that underground cables are not impacted by external heat sources, and that the cables and conduits are designed such that heat from the cables themselves is not an issue.

In effect, New York's challenge is not with Entergy's AMP but instead an attempt to contest Indian Point facility design as reflected in the current licensing basis for the plant. But such a challenge is clearly outside the scope of license renewal, and so must be rejected.[1052]

**c. Inaccessible Above-Ground Cables Included In Another AMP**

As originally proffered by New York, NYS-6/7 did not distinguish between above-ground and underground inaccessible cables, although it subsequently did make such a distinction.[1053] As discussed above beginning at page 180, the exposure of underground inaccessible, non-EQ low- and medium-voltage cables to excessive heating from external sources is not an effect that requires aging management. With regard to above-ground inaccessible non-EQ low-and medium-voltage cables, Entergy witness, Mr. Rucker testified that concerns about excessive heating are dealt with by a separate AMP, which Entergy refers to as its "Non-EQ Insulated Cables and Connections Program."[1054] That AMP calls for inspection of a representative

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[1052] See Amergen Energy Co., L.L.C. (Oyster Creek Nuclear Generating Station), CLI-06-24, 64 NRC 111, 117–18 (2006) ("review of a license renewal application does not reopen issues relating to a plant's current licensing basis").

[1053] In its rebuttal statement of position, New York refocused its argument on underground cables. See State of New York's Revised Statement of Position Regarding Contentions NYS-6 and NYS-7 (June 29, 2012) at 7–9 (Ex. NYS000398).

[1054] Tr. at 4100–01 (Mr. Rucker for Entergy); see License Renewal Application at B-85 (Ex. ENT00015B).

sample of accessible cables in adverse localized environments. Entergy witnesses testified that the program is consistent with the corresponding AMP in Section XI.E1 of GALL-1.[1055]

Significantly, New York did not challenge the adequacy of the Non-EQ Insulated Cables and Connections Program to manage thermal aging effects on above-ground cables.[1056] Accordingly, the issue presented by NYS-6/7 is confined to whether Entergy's Non-EQ Inaccessible Medium and Low Voltage Cable Program is sufficient to address the effects of thermally-induced aging on inaccessible, underground cables.

#### d. Use of Testing Results to Detect Impending Failure Due to Excessive Heating

Finally, New York witness Mr. Bascom testified that, in his opinion, the testing program for inaccessible cables described in Entergy's LRA is insufficient to detect impending excessive heating-related failures because it focuses strictly on moisture as a cause of aging effects.[1057] He declared that the testing methods in Entergy's AMP for inaccessible cables are insufficient to prevent cable failures due to elevated temperatures, because those methods "would likely detect a degradation of the insulation after it has happened."[1058] He further asserted that thermal stress "generally has to progress for an extended period of time before the insulation would degrade to the point that you detect it [with] one of these tests."[1059]

Mr. Bascom then offered two methods by which inaccessible cables could be monitored for excessive heating. He stated that the first method, Distributed Temperature Sensing, involves retrofitting the cables with "a fiber optic sensor that provides temperature readings

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[1055] See Entergy NYS-6/7 Testimony at 46 (Ex. ENTR00233).

[1056] We make no finding as to the adequacy of the Non-EQ Insulated Cables and Connections Program because it is beyond the scope of NYS-6/7 and no party has raised a separate challenge to that program.

[1057] Tr. at 4106 (Mr. Bascom for New York).

[1058] Tr. at 4112 (Mr. Bascom for New York).

[1059] Tr. at 4113 (Mr. Bascom for New York).

along the length of the cable every meter,"[1060] followed by trending the data over time.[1061] Mr. Bascom conceded, however, that while such systems have been used in electricity-generating utilities, they have not been used in the nuclear industry.[1062] As for the second method, Mr. Bascom testified that Entergy should identify potential "hot spots" and insert discrete thermocouples to monitor their temperature.[1063]

As was the case with our previous findings regarding the impact of ohmic heating on underground cables and the adequacy of an existing AMP to address above-ground cable heating, we do not believe that the testing actions proposed by the State are necessary to provide reasonable assurance that these cables will continue to perform their intended functions during the PEO.

The underground cables at Indian Point pose difficulties for monitoring their condition. Mr. McCaffrey testified that Indian Point's current configuration of cables do not offer a way for the direct measurement of temperature in the conduits or duct bank systems of the inaccessible cables.[1064] Still, it was Mr. McCaffrey's expressed opinion that even without direct temperature measurements, the testing procedures in its AMP for inaccessible non-EQ cables are sufficient to guard against cable failures due to degradation from excessive heat. Mr. Rucker explained that, for underground cables, "[y]ou cannot access the external environment . . . [t]hat is why we

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[1060] New York NYS-6/7 Testimony at 32 (Ex. NYS000136).

[1061] Id.

[1062] Tr. at 4107 (Mr. Bascom for New York).

[1063] New York NYS-6/7 Testimony at 32–33 (Ex. NYS000136).

[1064] Tr. at 4136 (Mr. McCaffrey for Entergy).

test those cables."[1065] Mr. McCaffrey asserted that "[t]he testing we do is able to detect degradation of cable before it fails."[1066]

Staff witness Mr. Doutt provided insight into how Entergy's testing would detect thermal degradation and guard against failure. He pointed to NUREG/CR-7000, a Staff technical document entitled "Essential Elements of an Electric Cable Condition Monitoring Program," which provides details of various testing procedures.[1067] Table 3.1 of that document lists the condition monitoring techniques and the corresponding stressors and aging mechanisms that each can detect.[1068] For the Tan-Delta test (*i.e.*, the "Dielectric Loss – Dissipation Factor/Power Factor" test) that Entergy's witnesses testified they intend to use for testing medium voltage cables,[1069] the stressors likewise include elevated temperature to detect aging mechanisms including thermally induced cracking.[1070] For the "Insulation Resistance" test that Entergy's witnesses stated they intend to use for testing low-voltage cables,[1071] the stressors include elevated temperature to detect aging mechanisms including thermally induced cracking in the presence of moisture.[1072]

Mr. Doutt further testified that "the test that they are proposing, thermal [degradation] would be one of the stressors that could be detected by that test."[1073] Although the aging

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[1065] Tr. at 4102 (Mr. McCaffrey for Entergy).

[1066] Tr. at 41254104–05 (Mr. McCaffrey for Entergy).

[1067] Tr. at 4154 (Mr. Doutt for the NRC Staff).

[1068] NUREG/CR-7000 at 3-15 to -19 (Ex. NYS000148).

[1069] Tr. at 4029 (Mr. Rucker for Entergy).

[1070] NUREG/CR-7000, at 3-15 (Ex. NYS000148).

[1071] Tr. at 4029 (Mr. Rucker for Entergy).

[1072] NUREG/CR-7000, at 3-15 (Ex. NYS000148).

[1073] Tr. at 4154 (Mr. Doutt for the NRC Staff).

mechanisms may be different for thermal stress than for moisture stress, "the aging effect would be the same. You are looking at how did it degrade[s] the insulation. And that degradation . . . is what [the tests] are designed to look for."[1074] Another NRC Staff witness Mr. Nguyen likewise opined that the "testing methods that they propose will detect the aging effect due to heating because [the] reduced insulation resistance will be picked up by the testing procedure."[1075] New York witness Mr. Bascom, conceded that insulation resistance testing may pick up degradation in advance of failure.[1076]

Entergy witness Dr. Sedding testified that while he was not willing to guarantee that incremental degradation of cable insulation would be detectable from the testing measurements,[1077] it was his opinion that measurements such as VLF/Tan Delta would have a probability of indicating that there was a deterioration mechanism in process.[1078] As mentioned above, we find that, with the acceptance criteria Entergy has defined, the Applicant will be able to detect and determine potential cable failure,[1079] and if testing indicates a cable is operating below the acceptance criteria, Entergy will be able to take corrective actions and, inter alia, determine the cause of the degraded condition.[1080] Also we find that the testing proposed by Entergy is sufficient to provide reasonable assurance that cable failures from thermally-induced insulation degradation will not occur.

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[1074] Id.

[1075] Tr. at 4151 (Mr. Nguyen for the NRC Staff).

[1076] Tr. at 4140 (Mr. Bascom for New York).

[1077] Tr. at 4134 (Dr. Sedding for Entergy).

[1078] Tr. at 4144–45 (Dr. Sedding for Entergy).

[1079] Tr. at 4138 (Mr. McCaffrey for Entergy).

[1080] Tr. at 4136–37 (Mr. McCaffrey for Entergy).

## E. Summary of Findings Relative to NYS-6/7

Because the Commission has established that an AMP consistent with GALL provides reasonable assurance, our task is to determine whether Entergy has provided sufficient information to demonstrate that the AMP for non-EQ inaccessible medium- and low-voltage cables is consistent with GALL. In this regard, we find that Entergy's AMP, as described in LRA Sections A.2.1.22 and A.3.1.22 (UFSAR Supplements), Section B.1.23, and in the Entergy responses to the Staff's RAIs, incorporate the ten elements of the GALL-1 AMP for non-EQ medium-voltage inaccessible cables. In addition to the statement in the revised LRA that the program will be implemented consistent with the corresponding GALL-1 AMP,[1081] the updated program description incorporates non-EQ low-voltage inaccessible cables into the program, and specific testing procedures that incorporate the attributes of GALL-2.[1082] Further, we find that Entergy will be required by binding license conditions to implement the program in a manner consistent with GALL.[1083] New York's concerns about excessive heating as a source of cable degradation fails to establish that any aspect of the AMP for non-EQ inaccessible medium- and low-voltage cables is inconsistent with the GALL or otherwise deficient.

## F. Conclusions of Law

We find that the preponderance of the evidence demonstrates that the elements of Entergy's AMP for non-EQ inaccessible medium- and low-voltage cables are consistent with the corresponding elements of GALL and, as such, that program provides the requisite "reasonable assurance" under 10 C.F.R. §§ 54.21(a)(3) and 54.29(a).[1084] Accordingly, the issues raised by New York regarding the adequacy of Entergy's AMP for the aging management of these cables

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[1081] See NL-11-096, Attach. 1 at 1–2 (Ex. NYS000154).

[1082] Id.

[1083] Id.

[1084] See Audit Report at 23 (Ex. ENT000041).

have been resolved in favor of the Applicant and do not prevent the NRC from issuing the requested license renewal.

# VI. SAFETY CONTENTION NYS-8 (Transformers)

## A. Statement of Contention NYS-8

NYS-8, a safety contention which challenges the aging management of electrical transformers, as litigated on December 13, 2012, reads as follows:

> The LRA for IP2 and IP3 violates 10 C.F.R. §§ 54.21(a) and 54.29 because it fails to include an aging management plan for each electrical transformer whose proper function is important for plant safety.[1085]

## B. NYS-8 Background

### 1. NYS-8 Procedural History

NYS-8 was filed as part of New York's petition to intervene and has not been amended. This contention asserts that, because transformers perform their function without moving parts or a change in configuration or properties, they are subject to aging management review (AMR) under 10 C.F.R. § 54.21. According to New York, the failure to properly manage aging of transformers might compromise "the integrity of the reactor coolant pressure boundary"; "the capability to shut down the reactor and maintain it in a safe shutdown condition"; or "the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures."[1086] In addition, New York cautioned that failure to properly manage the effects of aging on electrical transformers "could result in loss of emergency power to the 480 volt safety equipment and 6.9kV busses, including all station blackout loads," and that the consequence of failures "may result in accidents beyond the Design Basis Accidents resulting in exposures to the public."[1087]

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[1085] New York Petition at 103; LBP-08-13, 68 NRC 43, 89 (2008). The Board clarified that although the scope of this contention includes the allegation that Entergy has not proposed an AMP for each electrical transformer in IP2 and IP3 required for compliance with 10 C.F.R. §§ 50.48 and 50.63, this contention does not include transformer support structures.

[1086] New York Petition at 104.

[1087] Id.

On July 31, 2008, the Board admitted NYS-8, concluding that a genuine dispute existed as to whether 10 C.F.R. § 54.21 requires Entergy's LRA to contain an AMP for transformers.[1088] Noting that transformers are not included in the lists in 10 C.F.R. § 54.21(a)(1)(i) of components that are expressly included or excluded from AMR, the Board stated that it would require, inter alia, representations from the parties "whether transformers are more similar to the included, or to the excluded, component examples."[1089]

**2. Legal Standards and Issues Related to NYS-8**

As discussed above in more detail with respect to RK-TC-2, NYS-5, and NYS-6/7, NRC regulations require each reactor LRA to contain a list of structures and components subject to AMR,[1090] and the Commission may only issue a renewed license upon a finding that reasonable assurance exists that the effects of aging during the PEO on such structures and components will be adequately managed.[1091] The structures and components subject to AMR include those "[t]hat perform an intended function, as described in § 54.4, without moving parts or without a change in configuration or properties."[1092] The regulation further provides a list of structures and components that are expressly subject to AMR, as well as those that expressly are not.[1093]

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[1088] LBP-08-13, 68 NRC at 88–89.

[1089] Id. at 89.

[1090] 10 C.F.R. § 54.21(a)(1) (2012).

[1091] Id. § 54.29(a)(1).

[1092] Id. § 54.21(a)(1)(i) (emphasis added).

[1093] Id.

### 3. Evidentiary Record Related to NYS-8

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-8

Entergy presented four witnesses on NYS-8 – John W. Craig,[1094] Dr. Steven E. Dobbs,[1095] Thomas S. McCaffrey,[1096] and Robert B. Rucker.[1097] On March 28, 2012, Entergy submitted the testimony of these four witnesses (and a revised version on March 30, 2012),[1098] which was admitted into evidence on October 15, 2012.[1099]

The NRC Staff presented two witnesses on NYS-8 – Roy Mathew[1100] and Sheila Ray.[1101] On March 29, 2012, the NRC Staff submitted the testimony of these two witnesses,[1102] which was admitted into evidence on October 15, 2012.[1103]

New York presented a single witness on NYS-8 – Dr. Robert C. Degeneff.[1104] On December 12, 2011, New York submitted Dr. Degeneff's written direct testimony (a revised

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[1094] Curriculum Vitae of John W. Craig (Ex. ENT000094).

[1095] Curriculum Vitae of Steven E. Dobbs (Ex. ENT000093).

[1096] Curriculum Vitae of Thomas S. McCaffrey (Ex. ENT000095).

[1097] Curriculum Vitae of Roger B. Rucker (Ex. ENT000092).

[1098] See Testimony of Applicant Witnesses Roger Rucker, Steven Dobbs, John Craig, and Thomas McCaffrey Regarding Contention NYS-8 (Electrical Transformers) (Mar. 30, 2012) (Ex. ENTR00091) [hereinafter Entergy NYS-8 Testimony].

[1099] Tr. at 1269 (Judge McDade).

[1100] Roy K. Mathew, Statement of Professional Qualifications (Ex. NRC000032).

[1101] Sheila Ray, Statement of Professional Qualifications (Ex. NRC000033).

[1102] NRC Staff's Testimony of Roy K. Mathew and Sheila Ray Concerning Contention NYS-8 (Transformers) (March 29, 2012) (Ex. NRC000031) [hereinafter NRC Staff NYS-8 Testimony].

[1103] Tr. at 1269 (Judge McDade).

[1104] Curriculum Vitae of Robert C. Degeneff (Ex. NYS000004).

version was filed on December 14, 2011).[1105] On June 29, 2012, New York submitted the rebuttal testimony of Dr. Degeneff (a revised version was submitted on August 6, 2012).[1106] The revised versions of these exhibits were admitted into evidence on October 15, 2012.[1107]

**b. Identification of Admitted Exhibits Relevant to NYS-8**

Relative to NYS-8, Entergy submitted 42 exhibits, the NRC Staff submitted nine exhibits, and New York submitted 51 exhibits.[1108] These exhibits were admitted into the record on October 15, 2012.[1109]

**c. Relevant NRC Staff and Industry Guidance Documents**

1. Nuclear Power Plant License Renewal; Revisions; Final Rule. 60 Fed. Reg. 22,461. The Statement of Considerations (SOC) to the license renewal rule discusses the characteristics of components that do or do not require aging management review, categorizing SSCs as passive if "they perform their intended function without moving parts or without a change in configuration or properties and the effects of aging degradation for these components are not readily monitorable."[1110]

2. NEI 95-10, Industry Guideline for Implementing the Requirements of 10 C.F.R. Part 54 – The License Renewal Rule. This document states that transformers do not require AMR,

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[1105] See Pre-Filed Written Testimony of Dr. Robert C. Degeneff Regarding Contention NYS-8 (Dec. 14, 2011) (Ex. NYSR00003) [hereinafter New York NYS-8 Testimony].

[1106] See Rebuttal Testimony of Dr. Robert C. Degeneff, D. Eng. Regarding Contention NYS-8 (Aug. 6, 2012) (Ex. NYSR00414) [hereinafter New York NYS-8 Rebuttal Testimony].

[1107] Tr. at 1269 (Judge McDade).

[1108] See Appendix B - Partial Initial Decision.

[1109] Tr. at 1269 (Judge McDade); see Licensing Board Order (Scheduling Post-Hearing Matters and Ruling on Motions to File Additional Exhibits) (Jan. 15, 2013) (unpublished); see Licensing Board Order (Admitting Entergy's Exhibits) (Aug. 20, 2013) (unpublished).

[1110] Nuclear Power Plant License Renewal; Revisions, 60 Fed. Reg. 22,461, 22,477 (May 8, 1995) (Ex. NYS000016) [hereinafter Statement of Considerations]. See also 10 C.F.R. § 54.21(a).

based on a determination that "[t]ransformers perform their intended function through a change in state" and "degradation of the transformer's ability to perform its intended function is readily monitorable."[1111]

#### 4. Contention Issues

In the context of NYS-8, New York addresses several issues integral to a determination of whether AMR is required for in-scope transformers at IPEC. These include: a discussion of transformer operation that assesses whether transformers perform their function in an active or passive manner;[1112] a review of transformers' aging management regulatory history; a summary of the legal foundation for assessing transformers' AMR; an analysis of the difference between monitoring transformers for gross or impending failure; information as to whether transformers change their configuration, properties, or state during operations; an assessment of the ability to monitor age-related transformer degradation; and a comparison of transformer operations with the operation of SSCs included in or excluded from AMR by the regulations in 10 C. F. R. § 54.21(a)(1)(i). The evidence for each of these issues and the Board's findings are discussed in the subsequent sections of this opinion followed by a summary of these findings.

### C. Transformer Operation

As accurately summarized by Entergy's witnesses without objection or contradiction from any other party:

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[1111] Nuclear Energy Institute, Industry Guideline for Implementing the Requirements of 10 C.F.R. Part 54 – The License Renewal Rule (NEI 95-10 Rev. 6) (June 2005) at B-14, C-12 (Ex. ENT000098) [hereinafter NEI 95-10].

[1112] For convenience, in its SOC for the 1995 update of Part 54 rules, the Commission has used the term "passive" to describe SSCs for which "aging degradation is not readily monitored," and has indicated that those SSCs "perform an intended function without moving parts or without a change in configuration or properties" and "that 'a change in configuration or properties' should be interpreted to include 'a change in state.'" Statement of Consideration at 22,477 (Ex. NYS000016). Conversely, the term "active" is used for SSCs with moving parts or a change in configuration, properties, or state that can be used to readily monitor their functional degradation. See id.

> a transformer is an electrical device that converts alternating current ("AC") power at a certain voltage level to AC power at a different voltage level . . . or which provides isolation to electrical circuits. Current refers to the passage of electrons through a conductor (*i.e.*, a material that easily permits electric current to flow) . . . . Voltage is a force that causes current to flow through an electrical conductor.[1113]

Entergy's witnesses went on to state that "a transformer is formed by winding two coils of wire around the same iron form or core. The coil or winding used to input power to the transformer is called the primary winding. The coil or winding used to output power from the transformer is called the secondary winding."[1114] The alternating current in the primary coil produces a magnetic field in the iron core that constantly varies in magnitude over time and induces a voltage in the secondary winding.[1115] Although there is a slight loss of power, the magnetic field is contained in the iron core and impacts the secondary coil.[1116] The voltages and currents at output terminals of the transformer are in close relationship to the ratio of the turns of wire that exist in the primary and secondary transformer windings.[1117] The ratio of the primary and secondary windings thus is referred to as the "turns ratio" of the transformer.[1118]

As described by Entergy, and not challenged by any of the parties, the intended function of a transformer is to increase the voltage (*i.e.*, a step-up transformer in which there are more turns in the secondary coil than in the primary coil), to decrease the voltage (*i.e.*, a step-down transformer in which there are fewer turns in the secondary coil than in the primary coil), or to provide isolation between the input and output circuits (*i.e.*, an isolation transformer where the

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[1113] Entergy NYS-8 Testimony at 26–27 (Ex. ENTR00091).

[1114] Id. at 27.

[1115] Id. at 28.

[1116] Id.

[1117] Id.; Tr. at 4398–402 (Dr. Dobbs for Entergy).

[1118] Entergy NYS-8 Testimony at 28 (Ex. ENTR00091).

number of turns are the same in the primary and secondary coils).[1119] Further, the corresponding change in the current is the inverse of the change in voltage.[1120]

Dr. Degeneff for New York stated that the insulation structure within the windings may be deformed or damaged by any short circuit induced movement within the coils, possibly leading to a sudden failure of the transformer.[1121] Dr. Degeneff further testified that if the movements and damage are less severe, any shorting of current may break down the insulating oil in the transformer, leading to the formation of combustible gases in the oil with the presence of acetylene indicating some sort of arcing within the transformer.[1122] Mr. McCaffrey testified for the Applicant that Entergy has installed online gas monitors for its main generation transformers,[1123] but that the transformers involved with returning power online after a station blackout do not have continuous online gas monitoring.[1124]

As noted above, there was no dispute among the parties regarding description of transformer workings expressed above. We find that the summary presented above is a reasonable description of the basic operation of a transformer.

**D. Regulatory History of Aging Management for Transformers**

During the 1995 revisions to 10 C.F.R. Part 54, the Commission stated that "structures and components that perform active functions can be generically excluded from an aging management review on the basis of performance or condition-monitoring programs."[1125]

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[1119] Id. at 29.

[1120] Id. at 29–30.

[1121] Tr. at 4278–79 (Dr. Degeneff for New York).

[1122] Id.

[1123] Tr. at 4269 (Mr. McCaffrey for Entergy).

[1124] Tr. at 4444 (Mr. McCaffrey for Entergy).

[1125] Statement of Considerations at 22,477 (Ex. NYS000016).

Examples of structures and components requiring AMR (*i.e.*, passive) and those excluded from AMR (*i.e.*, active) are provided in the regulations.[1126] Transformers were not included as an example on either list.

Entergy, the NRC Staff, and New York witnesses agree that station auxiliary transformers and the IP3 GT (gas turbine) auto-start transformer (1) perform license renewal intended functions that fall within the scope of 10 C.F.R. § 54.4;[1127] (2) perform that intended function without moving parts;[1128] and (3) are not subject to replacement based on qualified life or specified time period.[1129] Therefore, the controversy framed by this contention involves only whether transformers serve "active" functions based on a change in properties or state that can be readily monitored.

While not legally binding, the NRC Staff issued a position paper in 1997 (*i.e.*, Grimes Letter or Position Paper) that expressed the Staff's opinion that transformers should be excluded from AMR because they perform "active" functions by "stepping down voltage from a higher to a lower value, stepping up voltage to a higher value, or providing isolation to a load."[1130] This position paper compared transformers to examples of components explicitly excluded by 10 C.F.R. § 54.21(a)(1)(i) from AMR in terms of how the performance of their

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[1126] 10 C.F.R. § 54.21(a)(1)(i).

[1127] Entergy NYS-8 Testimony at 98 (Ex. ENTR00091); NRC Staff NYS-8 Testimony at 11, 17 (Ex. NRC000031); New York NYS-8 Testimony at 4 (Ex. NYSR00003). Although Entergy included all electrical components as within the scope of license renewal, the main transformers and the unit auxiliary transformers do not perform a license renewal intended function as defined in 10 C.F.R. § 54.4.

[1128] Entergy NYS-8 Testimony at 40–41 (Ex. ENTR00091); NRC Staff NYS-8 Testimony at 12 (Ex. NRC000031): New York NYS-8 Testimony at 6 (Ex. NYSR00003).

[1129] Entergy NYS-8 Testimony at 14 (Ex. ENTR00091); NRC Staff NYS-8 Testimony at 11, 8 (Ex. NRC000031); New York NYS-8 Testimony at 8 (Ex. NYSR00003). See also Tr. at 4434 (Mr. Rucker for Entergy).

[1130] Letter from Christopher Grimes, NRC, to Douglas J. Walters, NEI, "Determination of Aging Management Review for Electrical Components," (Sept. 19, 1997) at 2 (Ex. ENT000097) [hereinafter Grimes Letter].

intended functions would be achieved and whether aging degradation of these components would be readily monitored. This position paper went on to describe several monitoring tests for transformers and claimed that these tests "provide a direct indication of the performance of the transformer."[1131] As confirmed by NRC Staff witness Ms. Ray, Revision 1 and Revision 2 of the NRC Staff's *Standard Review Plan for Review of License Renewal Applications For Nuclear Power Plants* (SRP-LR),[1132] which both reference the Grimes Letter, simply state that transformers are not subject to AMR (*i.e.*, they are considered "active" components) with no further elaboration.[1133]

In its statement of position, Entergy references the Commission's decision in the Seabrook license renewal case,[1134] and alleges that the decision "implicitly endorsed the Staff's 1997 guidance concerning transformers."[1135] Likewise, the NRC Staff represented that "[i]n the recent Seabrook decision, the Commission rejected a contention virtually identical to . . . NYS-8,"[1136] and suggested that Seabrook supports the position that transformers are "active" components.

Regarding the historical handling of transformers for other LRAs, the precedent of the Staff's SRP-LR and the Grimes Letter as determinative of whether transformers change configuration, properties, or state is discussed further in Section VI(F) of this initial decision beginning at page 208. And with regard to the Commission's decision in Seabrook, that ruling

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[1131] Id. at 2.

[1132] SRP-LR Rev. 1 at 2.1-23 (Ex. NYS000195); SRP-LR at 2.1-26 (Ex. NYS000161).

[1133] See Tr. at 4462–64 (Ms. Ray for the NRC Staff).

[1134] See NextEra Energy Seabrook, L.L.C. (Seabrook, Unit 1), CLI-12-05, 75 NRC 301 (2012).

[1135] Applicant's Statement of Position Regarding Contention NYS-8 (Electrical Transformers) (Mar. 28, 2012) at 18 (Ex. ENT000090).

[1136] NRC Staff's Initial Statement of Position on Contention NYS-8 (Transformers) (Mar. 29, 2012) at 12 (Ex. NRC000030).

was not a merits determination regarding the aging management requirements for transformers. Instead, it dealt with the admissibility of a contention challenging the applicant's lack of AMR for transformers.

Entergy and the NRC Staff argue that Seabrook endorses the Grimes Letter, which concludes that transformers serve "active" functions and should be excluded from AMR. We find no such endorsement in the Commission's ruling. In Seabrook, the Commission clearly and repeatedly stated that, in their opinion, the intervenors did not provide sufficient support for an admissible contention.[1137] The Commission mentioned the Grimes Letter, but stated that the intervenors were derelict in not addressing the technical position outlined by the Staff.[1138] The Commission took no position on the merits of the contention and neither supported nor refuted the Staff's opinion that transformers serve "active" functions. Lacking a definitive decision by the Commission that transformers are active, we find that the Seabrook decision does not control our determination in this proceeding.

In contrast, on the full evidentiary record in this proceeding, New York persuasively established that the nonbinding Staff guidance expressed in the Grimes Letter is incorrect in that electrical transformers are "passive" components that must be covered by an AMP because:

1. Transformers perform their function without moving parts or a change in configuration or properties.

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[1137] See Seabrook, CLI-12-05, 75 NRC at 319 (stating that the Commission agrees with NextEra that "Friends/NEC's contention is too thinly supported to merit admission."); id. at 320 (stating that the Commission "decline[s] here to find Friends/NEC's conclusory statements sufficient to support an admissible contention."); id. at 322 ("In sum, the Board erred in admitting Contention 2, as it lacks the support required by 10 C.F.R. § 2.309(f)(1)(v)").

[1138] Seabrook, CLI-12-05, 75 NRC at 320 (stating that "Friends/NEC and Mr. Blanch disregard the Staff guidance. As a result, Mr. Blanch's conclusory statement that transformers are "passive" components is not adequate as a basis for the contention."); id. (stating that "in the absence of a supported challenge to the guidance, we do not find a genuine dispute with the applicant meriting litigation in this proceeding.").

2. Changes that take place during transformer operations do not involve a change in properties or state of the transformer itself, but rather occur in the electrical energy passing through the transformer.

3. Transformers are more similar to the regulatory examples of "passive" components than to the regulatory examples of "active" components.

4. The normal monitoring of transformers cannot detect incremental functional degradation, and therefore is not very useful in aging management.

5. At least 18 documented transformer failures at various power reactors may have been avoided if they had been subjected to an AMP.

6. The effects of a transformer failure at a nuclear power reactor are potentially catastrophic.

These topics and other issues raised in this contention by the parties are addressed further in the subsequent sections of this decision.

## E. Legal Foundation for Assessing the Need for AMR of Transformers

### 1. Need for AMR

The aging management review requirements and process will not be repeated here as those matters were discussed in Section II(B).

### 2. Aging Management: Part 54 License Renewal and Part 50 Maintenance Rule

NRC Staff witnesses conceded that transformers are within the scope of license renewal.[1139] However, while transformers are in-scope, according to Ms. Ray for the Staff, they do not require AMPs because, "they are active components."[1140] Entergy's witnesses agreed, adding, "[a]s with other active components, Entergy has implemented at IPEC performance monitoring and preventive maintenance programs designed to monitor and assess the functionality of transformers" in accordance with 10 C.F.R. § 50.65, *i.e.*, the maintenance rule, and industry guidance.[1141]

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[1139] NRC Staff NYS-8 Testimony at 11 (Ex. NRC000031).

[1140] Tr. at 4292–93 (Ms. Ray for the Staff).

[1141] Entergy NYS-8 Testimony at 11 (Ex. ENTR00091).

The Commission stated in its SOC that "the license renewal rule should credit existing maintenance activities and maintenance rule requirements for most structures and components."[1142] But this statement does not exclude all current 10 C.F.R. Part 50 or CLB issues from the scope of license renewal, only SSCs with "active" functions are explicitly exempt from AMR.[1143] SSCs with "passive" functions present limitations that must be considered in determining whether an SSC can be excluded from AMR for license renewal.[1144] This position is reflected in the Staff's approach in license renewal proceedings, which is to require AMR be performed for numerous "passive" SSCs that fall within the CLB and maintenance rule to assure that the program is adequate to manage aging affects during the PEO.[1145]

And with regard to SSCs that have a "passive" function, the Commission has stated:

> Although the requirements of the maintenance rule apply to systems, structures, and components that perform both active and passive functions, the Commission has determined that performance and condition-monitoring programs for structures and components that perform passive functions present limitations that should be considered in determining that structures and components can be generically excluded from an aging management review for license renewal.
>
> On the basis of consideration of the effectiveness of existing programs which monitor the performance and condition of systems, structures, and components that perform active functions, the Commission concludes that structures and components associated only with active functions can be generically excluded from a license renewal aging management review.[1146]

In summary, 10 C.F.R. § 54.30, does not per se exclude SSCs that currently fall under the maintenance rule from 10 C.F.R. Part 54 requirements. The only structures and components excluded from AMR are those with "active" functions that are readily monitorable.

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[1142] Id. at 22,471.

[1143] 10 C.F.R. § 54.21; Statement of Consideration at 22,472 (Ex. NYS000016).

[1144] Statement of Consideration at 22,472 (Ex. NYS000016).

[1145] NRC Staff NYS-8 Testimony at 10 (Ex. NRC000031).

[1146] Statement of Consideration at 22,471–72 (Ex. NYS000016) (emphasis added).

## F. Change in Configuration, Properties, or State in a Transformer

This section focuses on whether transformers should be considered "passive" because there is not a change in property or state during operations. In later sections, we discuss the ability to "readily monitor" transformer degradation, and we review whether transformers are "subject to replacement based on a qualified life or specified time period"[1147] and we compare transformers to components listed in the regulations to help ascertain to which of the components in the two groups[1148] that transformers are most similar.

### 1. Evidence Related to the Change in Configuration, Properties, or State in a Transformer

Essential to our resolution of this contention is whether alleged changes that take place during transformer operations (*e.g.*, changes in voltage, current, and magnetism)[1149] occur due to a change in the properties or state of the transformer itself, or of the electrical energy passing through the transformer.

In its 1997 position paper, the NRC Staff stated that "[t]ransformers perform their intended function through a change in state by stepping down voltage from a higher to a lower value, stepping up voltage to a higher value, or providing isolation to a load."[1150] The Staff's witnesses, Mr. Mathew and Ms. Ray, opined that "[t]ransformers perform their intended functions through a change in state (*i.e.*, a change in voltage, current, and magnetic flux). In other words, a transformer changes its state by transforming electrical energy into magnetic

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[1147] 10 C.F.R. § 54.21(a)(1)(ii).

[1148] The two groups are SSCs expressly excluded from AMR by regulation and those SSCs that specifically require AMR. See 10 C.F.R. § 54.21(a)(1)(i).

[1149] We note that if a transformer is not 100 percent efficient, its internal temperature can increase as electrical energy passes through it. Nevertheless, as neither Entergy nor the NRC Staff presented evidence of this potential or even suggested that this phenomenon constitutes a change in the properties or state of a transformer, the Board does not address this issue.

[1150] Grimes Letter at 2 (Ex. ENT000097).

energy, then back into electrical energy again."[1151] Ms. Ray added that "[i]n order for the transformer to operate, there has to be a change in flux, and that changing magnetic flux is the change in state."[1152]

Entergy's position mirrors the NRC Staff's views. Entergy's witnesses testified that "transformers perform their intended functions with a readily monitorable change in configuration or properties and therefore do *not* meet the Section 54.21(a)(1)(i) AMR criterion and are properly *excluded* from AMR under Part 54."[1153] Their position is that:

> [w]hen a transformer is energized from an electrical source, it changes from an idle state to an active state, and the electrical and magnetic properties of the transformer change. These changes in electric and magnetic properties are integral to transformer operation, necessary for performance of the transformer's intended function, and can be directly measured or observed.[1154]

Dr. Dobbs also testified that he believes all electrical devices have a change in state when they are turned on.[1155]

Key to Entergy's position is Dr. Dobbs' expressed opinion that the voltage and current are not properties of the electricity (because electricity is merely a charge),[1156] but are properties inherent in the transformer based on its turns ratio.[1157] He went on to add that the magnetic field generated within a transformer is also a property of the transformer.[1158] This position

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[1151] NRC Staff NYS-8 Testimony at 11 (Ex. NRC000031).

[1152] Tr. at 4376–77 (Ms. Ray for the NRC Staff).

[1153] Entergy NYS-8 Testimony at 10 (Ex. ENTR00091) (emphasis in original).

[1154] Id. at 11.

[1155] Tr. at 4316 (Dr. Dobbs for Entergy).

[1156] While Entergy's witness seemed to take umbrage at any suggestion that voltage and current are properties of electricity (see Tr. at 4344–45 (Dr. Dobbs for Entergy)), this somewhat academic point has little bearing on our decision. The term electricity is often used interchangeably with electrical energy or power.

[1157] Entergy NYS-8 Testimony at 32–34 (Ex. ENTR00091).

[1158] Id. at 33–34.

matched the NRC Staff opinion mentioned above that the changing magnetic flux is the change in state of a transformer and that this change in flux is how a transformer operates.

Staff witnesses Ms. Ray and Mr. Mathew emphasized that their position, (*i.e.*, that transformers are "active" devices), is reflected in the guidance presented in the Staff's *Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses* (Reg. Guide 1.1888) and the Staff's SRP-LR, as well as in NEI's *Industry Guidelines for Implementing the Requirements of 10 C.F.R. Part 54 - the License Renewal Rule* (NEI 95-10).[1159] Entergy witnesses Mr. Rucker and Mr. Craig augmented these references to include EPRI's *License Renewal Electrical Handbook* (EPRI 1013475),[1160] and noted that both Table 2.1-5 of the SRP-LR and Appendix B to NEI 95-10 state that transformers do not meet the 10 C.F.R. § 54.21(a)(1)(i) criterion for "AMR-included" components (*i.e.*, items that perform an intended function without moving parts or a change in configuration or properties).[1161] Entergy's witnesses referenced the EPRI 1013475 statement that the current passing through the primary winding of a transformer "'changes the physical properties of the transformer in a way that causes a voltage to be induced in the terminals of the secondary winding,'" and that "'[t]his property change of the transformer terminals is integral to the function of the transformer; *i.e.*, a transformer performs its function by changing its physical properties.'"[1162] While Entergy does not cite the physical properties EPRI claims are changing so as to cause this induction of voltage into the secondary winding, Entergy witnesses Mr. Rucker and Mr. Craig concluded that

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[1159] Tr. at 4362, 4364–65 (Ms. Ray and Mr. Mathew for the NRC Staff) (referring to RES, Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses (Regulatory Guide 1.1888) (Sept. 2005) (Ex. ENT000099); SRP-LR Rev. 1 (Ex. NYS000195); NEI 95-10 (Ex. ENT000098)).

[1160] EPRI, Plant Support Engineering: License Renewal Electrical Handbook, Rev. 1 to EPRI-1003057 (Feb. 2007) (Ex. ENT000100).

[1161] Entergy NYS-8 Testimony at 19 (Ex. ENTR00091).

[1162] Id. at 21.

NEI 95-10 and EPRI 1013475 reflect the industry view that transformers are "active" components that do not require AMR under 10 C.F.R. Part 54.[1163]

In contrast, New York witness Dr. Degeneff testified that "[t]ransformers do not contain any moving parts, and during their operation, transformers experience no change in properties, no change in configuration, or any other sort of change."[1164] Dr. Degeneff disagreed with Entergy, stating that changes in voltage and current are changes in characteristics of the electrical power, not the transformer. He testified that:

> Dr. Dobbs [a witness for Entergy] argues that voltage and current cannot be properties of electricity because they are created by an external force. However, this is fundamentally incorrect. The laws of physics dictate that voltage and current are properties of the electrical power flowing through the transformer, not properties of the transformer itself. Current is the flow rate of electric charge. Voltage is the electromagnetic force that causes charge to flow through a conductor.[1165]

Dr. Degeneff stated that "[i]t is commonly accepted that voltage and current are properties of electricity," and that, in his opinion, Dr. Dobbs recognizes this fact by defining electrical power as the voltage times the current.[1166] According to Dr. Degeneff, this demonstrates that "[e]lectricity cannot exist without voltage and current— [*i.e.*,] these are its properties."[1167] He maintained that, in contrast transformers are effective conduits with constant characteristics (*i.e.*, unchanging core size, turns ratio, and insulation thickness) making them "passive" devices that are merely a channel for the flow of electricity.[1168]

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[1163] Id. at 19.

[1164] New York NYS-8 Testimony at 6 (Ex. NYSR00003).

[1165] New York NYS-8 Rebuttal Testimony at 11–12 (Ex. NYSR00414).

[1166] Id. at 12 (citing Entergy NYS-8 Testimony at 62 (Ex. ENTR00091)).

[1167] Id.

[1168] Tr. at 4343 (Dr. Degeneff for New York).

Dr. Degeneff also testified that he does not believe magnetism is a property of a transformer, as alleged by Entergy, and he further testified that the magnetic field is a property of electricity caused by the movement of electric current.[1169] He then went on to claim that Dr. Dobbs essentially acknowledged this in his explanation of transformer operation when he stated that "both positive and negative electric charges are surrounded by an electric field, and movement of those charges produces a magnetic field."[1170] Dr. Degeneff also stated that, "[w]hen there is no electric current flowing into the transformer, there is no magnetic field [in a transformer] because the transformer's coils and core are incapable of producing one."[1171] To him, this illustrates that the magnetic field is only produced when electric current passes through the transformer in the same manner that a magnetic field is produced as electrical current passes through a cable – a component considered to be "passive" under 10 C.F.R. § 54.21.[1172] Furthermore, Dr. Degeneff testified that the magnetic field created by the electric current does not change the properties of the component whether it is a transformer or a cable.[1173]

Dr. Degeneff acknowledged that "Entergy and NRC Staff argue that as long as electricity is flowing correctly through the transformer, its performance is not degraded, and when the transformer fails it is obvious."[1174] He countered this argument by stating that because of "the transformer's passive nature, electricity can continue to pass through a degraded transformer up until the moment of transformer failure. For example, degradation to a transformer's

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[1169] New York NYS-8 Rebuttal Testimony at 28–29 (Ex. NYSR00414).

[1170] Id. at 13 (citing Entergy NYS-8 Testimony at 33 (Ex. ENTR00091)).

[1171] Id.

[1172] Id.

[1173] Id.

[1174] Id. at 38–39.

insulation will not result in any noticeable change to the current and voltage, but over time this could lead to transformer failure."[1175] According to Dr. Degeneff:

> it is the failure that is readily apparent, not the degradation. Transformer failure is the effect of unnoticed degradation, which is what an AMP is meant to prevent . . . . A transformer that appears to be functioning properly can nonetheless be in a degraded condition that will lead to failure.[1176]

Finally, Dr. Degeneff testified that, based on his 40 years of experience with transformers, it was his opinion that Entergy's position that transformers are "active" components is contrary to the overwhelming position of the engineering community, and Dr. Dobbs' opinion is "over the top and . . . is not a reasonable position to take."[1177] Dr. Dobbs, however, responded that Dr. Degeneff relied on the "academic community for support, and the academic community's opinions do not apply in the case of nuclear power."[1178]

**2. Findings Related to the Change in Configuration, Properties, or State in a Transformer**

While the NRC has concluded that the meaning of the term "property" should include "state" to avoid confusion with references that use the latter term,[1179] neither 10 C.F.R. Part 54 nor the SOC defines the term "property" as used in Section 54.21(a)(1)(i). Nevertheless, we conclude that delineating the difference between property and state is of little importance to the resolution of this contention, and there is little reason not to consider these two terms as essentially synonymous.

We agree with the description in the Grimes Letter that a transformer operates by "stepping down voltage from a higher to a lower value, stepping up voltage to a higher value, or

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[1175] Id. at 38.

[1176] Id. at 39.

[1177] Tr. at 4442 (Dr. Degeneff for New York).

[1178] Tr. at 4450–51 (Dr. Dobbs for Entergy).

[1179] Statement of Consideration at 22,477 (Ex. NYS000016).

providing isolation to a load."[1180] But, the Grimes Letter provided no technical justification to support the conclusion that this transformation of electrical power characteristics is a change in property or state of the transformer. Even more mysterious to us is how the NRC Staff could reach the conclusion that there is a change in transformer state with an isolation transformer, *i.e.*, a transformer with a one-to-one ratio between the coils that does not alter the voltage and current of the passing electrical energy.

The guidance provided by the Grimes Letter has likely contributed to subsequent guidance documents (*i.e.*, Regulatory Guide 1.188 and the SRP-LR)[1181] and industry guidelines (*i.e.*, NEI 95-10 and EPRI 1013475)[1182] that exclude transformers from AMR as "active" components. We find that these subsequent documents are not independent assessments of a transformer's activity, but merely a repetition of the previous position expressed in the 1997 Grimes Letter – an opinion that, at best, has scant documentation justifying its technical conclusions. As a consequence, we conclude that the NRC Staff's incorporation of its own guidance in addressing the need for aging management of transformers in its review of LRA's, including this one, rests upon the Grimes Letter.

Entergy's position is consistent with the NRC Staff's as originally documented in the Grimes Letter, *i.e.*, that transformers perform their intended function through a change in state by modifying voltage or providing isolation to a load.[1183] It is Entergy's position that the transformation of electrical energy into magnetic energy at the primary coil and then back into

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[1180] Grimes Letter at 2 (Ex. ENT000097).

[1181] See RES, Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses (Regulatory Guide 1.1888) (Sept. 2005) (Ex. ENT000099); see also SRP-LR Rev. 1 (Ex. NYS000195).

[1182] See NEI 95-10 (Ex. ENT000098); EPRI, Plant Support Engineering: License Renewal Electrical Handbook, Rev. 1 to EPRI-1003057 (Feb. 2007) (Ex. ENT000100).

[1183] See Grimes Letter at 2 (Ex. ENT000097).

electrical energy at the secondary coil are properties of the transformer itself, rather than properties of the energy passing through the transformer.[1184] According to the Applicant's witnesses, during this alleged change in state, "the electrical and magnetic properties of the transformer change. These changes in electric and magnetic properties are integral to transformer operation, [and] necessary for performance of the transformer's intended function . . . ."[1185] Specifically, Dr. Dobbs testified that he believes that the change in voltage, current, and the development of magnetism within a transformer are properties of the transformer itself and not properties of the electrical energy passing through the transformer.[1186] We do not agree.

We find Entergy's and the Staff's position, while not beyond the bounds of reason, nonetheless is a stretch and, if one believes New York witness Dr. Degeneff, as we do, their position that transformers are "active" devices due to their change in state during operations runs counter to the prevailing view of the electrical engineering community.[1187] While Dr. Dobbs argued that Dr. Degeneff's statement addresses only the position of the academic community and so has no relevance to this license renewal proceeding,[1188] we find nothing academic in Dr. Degeneff's 16 years of post-doctoral practical experience prior to his 17 years in academia followed by his 6 years of additional practical experience since leaving his University position.[1189] We conclude that there is no indication that his representation of the electrical engineering community's position on transformers is inaccurate and that his assessment is

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[1184] Entergy NYS-8 Testimony at 11 (Ex. ENTR00091).

[1185] Id.

[1186] Id. at 32–34.

[1187] Tr. at 4442 (Dr. Degeneff for New York).

[1188] Tr. at 4450–51 (Dr. Dobbs for Entergy).

[1189] See Curriculum Vitae of Robert C. Degeneff (Ex. NYS000004).

relevant to determining whether these devices are “active” or “passive” as used in the context of this 10 C.F.R. Part 54 proceeding.

We further find that the description of transformer operations demonstrates that the physical properties of transformer parts do not change during operations, and, therefore, that the properties or state of the transformer do not change as electrical energy passes through it. We believe that this description is more reasonable than Entergy’s position that voltage, current, and magnetism are not properties of the electrical energy but of the transformer itself. We find that transformer parts are the same prior to, during, and after being energized, similar to electrical cables that are designated “passive” components that do not change with the flow of electricity.

Consistent with this position, we also find that a change in voltage and current occurs not in the transformer parts, but in the characteristics of the energy passing through these components. Specifically, we find that a transformer does not generate the magnetism, but, instead, the magnetism is generated by the flow of electricity passing through the input electrical cable. The varying magnetism as it is passed into the primary winding is passively captured by the core of a transformer, which efficiently transfers the varying magnetism to the secondary side where it passively induces electrical current in the secondary coil that is connected to the output electrical cable.

Dr. Dobbs for Entergy also stated that transformers are “active” because of the change in state from idle to “active” when they are energized from an electrical source.[1190] We reject this position because to accept it would mean that all electrical devices be considered “active” because they change state when they are turned on. As will be discussed further in this decision, Dr. Dobbs’ position is at odds with the list of passive components requiring AMR listed in 10 C.F.R. § 54.21(a)(1)(i).

[1190] Entergy NYS-8 Testimony at 11 (Ex. ENTR00091).

In support of their position that a transformer acts in an "active" manner, the Applicant and the NRC Staff argue that electrons entering the transformer on the primary side are not the same electrons exiting the transformer on the secondary side.[1191] We are not convinced of the relevance of the gap in electron flow to the demonstration that transformers perform "active" functions. Clearly, the fact that the exact same electrons would not appear in the output power from a transformer, as they would with the flow of electrons through an electrical cable, illustrates a difference between these two electrical components. But having said this, we find that there is no evidence supporting a causal relationship between the difference in electron output in cables and transformers and the relative activity associated with how these two components perform their intended function. Nor do we see how this fact is of any use in assessing the functional performance of a transformer – the topic that is covered in Section VI(H).

Summarizing, we find that the change in voltage, current, and magnetism within a transformer are properties of the electrical power flowing through a transformer, not the transformer itself. With no moving parts and no change in configuration, properties, or state, transformers should not be excluded from AMR by regulatory definition.[1192] But whether the performance and condition of transformers are readily monitorable relative to this change in electrical energy characteristics is discussed further in the Section VI(H).

## G. Monitoring for Gross Failure or Impending Failure

### 1. Evidence Related to the Monitoring for Gross Failure or Impending Failure

The Commission has determined that it is possible to generically exclude "active" components from AMR, because, in part, these components have performance and condition

[1191] Tr. at 4351, 4356 (Ms. Ray for the NRC Staff); Tr. at 4457–58 (Mr. Craig for Entergy).

[1192] See 10 C.F.R. § 54.21(a)(1)(i).

characteristics that are readily monitorable.[1193] As accurately defined by New York witness Dr. Degeneff, performance monitoring tracks whether an SSC is performing its intended function (*i.e.*, assuring gross failure has not occurred), while condition monitoring is concerned with changes in performance with time (*i.e.*, trends) in order to predict failure.[1194] The Commission discusses this concept in its SOC:

> The Commission believes that regardless of the specific aging mechanism, only aging degradation that leads to degraded performance or condition (*i.e.*, detrimental effects) during the period of extended operation is of principal concern for license renewal. Because the detrimental effects of aging are manifested in degraded performance or condition, an appropriate license renewal review would ensure that licensee programs adequately monitor performance or condition in a manner that allows for the timely identification and correction of degraded conditions. . . .
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> When the Commission concluded that the proper approach for a license renewal review was one that focused on mitigating the detrimental effects of aging regardless of the mechanisms causing the effects, the intent was to concentrate efforts on identification of functional degradation . . . . Once functional degradation is identified through performance or condition monitoring, corrective actions can be applied.[1195]

In the context of addressing aging management of electrical cables, the SOC goes on to state that the Commission considered the need for monitoring functional degradation, expressing concern about the lack of methods that can provide the necessary information about the condition of a component as reflective of the extent of aging degradation on the component's remaining qualified life, stating the desire for continuous monitoring, and expressing concern about system failures that might be induced during accident conditions.[1196] Entergy witness Mr. Craig, stated that while the Commission raised these issues in the context

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[1193] Statement of Consideration at 22,476 (Ex. NYS000016).

[1194] Tr. at 4248 (Dr. Degeneff for New York).

[1195] Statement of Consideration at 22,469 (Ex. NYS000016).

[1196] Id. at 22,477–78.

of electrical cables, he believes that this is "an example that was intended to provide guidance to show the need to have a performance or condition monitoring . . . ."[1197]

There was no disagreement on this point between the parties. Dr. Degeneff stated that monitoring for impending failure is the required trait of an SSC to qualify as an "active" component excluded from AMR.[1198] He concluded that "the purpose of the license renewal rule is to prevent gross failure, not to detect it."[1199]

A witness for Entergy, Mr. Craig, agreed and testified that it is important to monitor the performance and condition of an SSC,[1200] with the caveat that the monitoring goal is to identify transformer degradation before failure rather than simply noting the ultimate failure of an SSC.[1201]

When questioned about whether the ability to detect gross failure is sufficient to exempt an SSC from AMR, Staff witness Ms. Ray testified that "the point is to track aging, not to necessarily detect the gross failure, but to detect continual aging of the component."[1202] She agreed that the "express concerns of the Commission all point to the need to monitor for degradation rather than just be cognizant of the complete failure when it occurred."[1203]

**2. Findings Related to the Monitoring for Gross Failure or Impending Failure**

Consistent with the parties' position, we find that the ability to detect incremental functional degradation (as opposed to gross failure) is the important criteria for an SSC to be

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[1197] Tr. at 4239 (Mr. Craig for Entergy).

[1198] Id.

[1199] New York NYS-8 Rebuttal Testimony at 38 (Ex. NYSR00414).

[1200] Tr. at 4223 (Mr. Craig for Entergy).

[1201] Tr. at 4231, 4232, 4234, 4245 (Mr. Craig for Entergy).

[1202] Tr. at 4243 (Ms. Ray for the NRC Staff).

[1203] Id.

considered "readily" monitorable. We find monitoring that only focuses on the present condition, without providing sufficient information to realistically interpret what will happen in the future is of limited use in managing aging. As a consequence, we also find that those SSCs within the scope of 10 C.F.R. Part 54 that cannot be measured for trending data to predict impending failure could not realistically be considered to be "readily" monitorable.

## H. Ability to Monitor Age-related Functional Degradation of Transformers

### 1. Evidence Related to the Ability to Monitor Age-related Functional Degradation of Transformers

The Commission has determined that it is possible to generically exclude "active" components from AMR, because, in part, these components have performance and condition characteristics that are readily monitorable.[1204] Conversely, as the SOC states, "[t]he Commission has determined that passive structures and components for which aging degradation is not readily monitored are those that perform an intended function without moving parts or without a change in configuration or properties."[1205] All parties agree that the fundamental reason that a device is considered "active" is that it is "readily monitorable" as a result of having moving parts or a change in configuration, properties, or states.[1206]

New York witness Dr. Degeneff testified that:

> [a]ge related degradation in transformers will not be observable through changes in the operating characteristics of a transformer during its normal operation. Many kinds of age related degradation are undetectable without complex testing. If one were able to detect that a transformer were failing through monitorable changes in its performance, transformers would not fail because any prudent operator would replace them before they did. Instead, in many instances transformers operate within normal parameters until catastrophic failure occurs.[1207]

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[1204] Statement of Consideration at 22,476 (Ex. NYS000016).

[1205] Id. at 22,477.

[1206] Tr. at 4225–27 (Mr. Craig for Entergy); Tr. at 4227–28 (Mr. Matthew for the NRC Staff); Tr. at 4229 (Dr. Degeneff for New York).

[1207] New York NYS-8 Testimony at 29 (Ex. NYSR00003).

NRC Staff witness Ms. Ray disagreed. She testified that "with a transformer, there is a battery of tests that you can perform, to track the aging degradation,"[1208] and then specifically referenced the continuous monitoring of the output voltage and current.[1209] In response to the Board questions, Ms. Ray stated that monitoring voltage and current can give some indication of a problem, but other tests would be required to assess the condition of a transformer's internal components.[1210] Mr. Mathew, witness for the NRC Staff, discussed alarms and devices that provide a warning if a transformer fails to function, but he could not identify any monitoring technique that could reliably indicate the condition of a transformer prior to failure.[1211]

Entergy's witnesses stated that "the electrical and magnetic properties of a transformer change. These changes in electric and magnetic properties are integral to transformer operation, necessary for performance of the transformer's intended function, and can be directly measured or observed."[1212] Consistent with the NRC Staff's position that aging degradation can be monitored by measuring the output condition, Entergy witnesses stated that "[a] change in transformer properties can be observed via directly measurable changes in the transformer terminal voltages and currents."[1213]

New York witness Dr. Degeneff, while not disagreeing that the output voltage and current can be continuously monitored, testified that he believes tracking these parameters at the output terminals only indicates the transformer's performance (*i.e.*, whether it is working), without providing any information on a transformer's condition (*i.e.*, incremental or functional

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[1208] Tr. at 4377–78 (Ms. Ray for the NRC Staff).

[1209] Tr. at 4378–79 (Ms. Ray for the NRC Staff).

[1210] Tr. at 4448 (Ms. Ray for the NRC Staff).

[1211] Tr. at 4409–11 (Mr. Mathew for the NRC Staff).

[1212] Entergy NYS-8 Testimony at 11 (Ex. ENTR00091).

[1213] Id. at 36.

degradation).[1214] As noted in the previous section, in Dr. Degeneff's opinion, "it is the failure that is readily apparent, not the degradation."[1215] Dr. Degeneff further stated that:

> [t]he vast majority of age related degradation in a transformer cannot be observed based on changes in electrical performance. For example, the insulation integrity of a transformer's winding structure cannot be determined by monitoring a change in the electrical performance, because the dielectric strength of the insulation may not be affected until the transformer fails.[1216]

Dr. Degeneff went on to state that several other transformer failure modes cannot readily be detected during operation, including short circuiting, polymerization, diminished mechanical and structural integrity of the core and coil assembly, and deformation of the coil windings.[1217]

Entergy and the NRC Staff provided testimony on numerous monitoring techniques that can be used, and are being used, as part of Entergy's CLB to monitor the performance and condition of its transformers. In addition to monitoring the input and output electrical characteristics (*i.e.*, voltage and current), according to the Staff's 1997 Grimes Letter:

> [a]ny degradation of the transformer's ability to perform its intended function is readily monitorable by a change in the electrical performance of the transformer and the associated circuits. Trending electrical parameters measured during transformer surveillance and maintenance such as Doble test results, and advanced monitoring methods such as infrared thermography, and electrical circuit characterization and diagnosis provide a direct indication of the performance of the transformer. Therefore, transformers are not subject to an aging management review.[1218]

Entergy's witnesses testified that the Applicant uses industry standard preventive and predictive maintenance techniques on its large oil-filled transformers for both offline and online monitoring for assessment of transformer performance and condition.[1219] Specifically, Entergy

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[1214] New York NYS-8 Rebuttal Testimony at 36–39 (Ex. NYSR00414).

[1215] Id. at 39.

[1216] New York NYS-8 Testimony at 29–30 (Ex. NYSR00003).

[1217] Id. at 29–33.

[1218] Grimes Letter at 2 (Ex. ENT000097).

[1219] Entergy NYS-8 Testimony at 97 (Ex. ENTR00091).

witnesses Mr. Rucker and Mr. McCaffrey stated that the "[s]pecific details of IPEC large power transformer inspection and maintenance practices are contained in [*Large Power Transformer Inspection Guidelines*, an Entergy Fleet Engineering Guide]."[1220] The Applicant's witnesses further stated that an IPEC maintenance document entitled *Station or Unit Auxiliary Transformer Annual In-Service Inspection* is an "example of an IPEC-specific procedure detailing in-service inspection activities for certain large oil-filled transformers."[1221]

Entergy witness Mr. McCaffrey testified that the electronic tests performed during a refueling outage (generally a two-year cycle)[1222] or when a transformer is out of service include power factor, capacitance, hot collar, excitation current, leakage current, transformer turns ratio, and winding resistance, and that these tests give some indication about the health of the major subcomponents inside a transformer.[1223] According to Mr. McCaffrey, other tests performed offline include sweep frequency response analysis, insulation resistance, visual inspections, and cleaning.[1224] Mr. McCaffrey also stated that dissolved gas analysis (DGA), oil quality, furanic oil compound analysis, and thermography testing are done while the transformer is in service, while a corona scan is done while the transformer is energized.[1225] Of these tests, NRC Staff witness Mr. Mathew noted that oil analysis, the Doble test, and the power factor test are used for condition monitoring.[1226]

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[1220] Id. (citing Entergy Fleet Engineering Guide EN-EG-G-001, Large Power Transformer Inspection Guidelines, Rev. 2 (Mar. 2011) (Ex. ENT000121)).

[1221] Id. (citing IPEC Maintenance Procedure 0-XFR-407-ELC, Rev. 0, Station or Unit Auxiliary Transformer Annual In-Service Inspection (May 18, 2007) (Ex. ENT000124)).

[1222] Tr. at 4264 (Mr. McCaffrey for Entergy).

[1223] Tr. at 4253 (Mr. McCaffrey for Entergy).

[1224] Tr. at 4254 (Mr. McCaffrey for Entergy).

[1225] Id.

[1226] Tr. at 4249 (Mr. Mathew for the NRC Staff).

According to Mr. McCaffrey and Mr. Rucker for Entergy, "[p]redictive maintenance results are monitored and trended to identify degrading conditions within transformers."[1227] They went on to state that Entergy has used these results to develop the *Indian Point Energy Center Large Power Transformer Life Cycle Management Plan*.[1228] These witnesses testified that the plan, which is updated as necessary (based on operating experience and changing plant conditions) to ensure that the transformer monitoring strategies at IPEC remain valid, "provides reasonable assurance that the transformers operate satisfactorily" without in-service failure until their estimated replacement date.[1229]

The Applicant's witnesses also testified that Entergy "performs predictive and preventive maintenance on dry type transformers, including visual inspections/cleaning, insulation resistance measurement, and winding resistance measurement."[1230] For example, *Station Service and Load Center Transformers Outage Inspection* is "a plant procedure governing outage-related inspection and maintenance activities for dry type transformers."[1231] Mr. McCaffrey testified that some of the tests have been performed on transformers at Indian Point under the maintenance plan for many years and new tests "have been coming on as the technology has evolved and the industry has accepted these practices."[1232]

In Dr. Degeneff's opinion, however, many of the tests identified as being used to determine transformer degradation are limited because they must be conducted while the

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[1227] Entergy NYS-8 Testimony at 97 (Ex. ENTR00091).

[1228] Id. at 97–98 (citing Indian Point Energy Center Large Power Transformer Life Cycle Management Plan (2011) (Ex. ENT000125)).

[1229] Id. at 98.

[1230] Id.

[1231] Id. (citing IPEC Maintenance Procedure 0-XFR-401-ELC, Station Service and Load Center Transformers Outage Inspection (Apr. 5, 2007) (Ex. ENT000126)).

[1232] Tr. at 4256 (Mr. McCaffrey for Entergy).

transformer is offline, including the test for aging effects of cellulose insulation, some of the dissolved gas analyses in the transformer's oil, and the test for mechanical integrity of the core and coils (which requires physical inspection of the transformer).[1233] He expressed his opinion that "[i]t is unrealistic to represent that the aging condition of a transformer can be ascertained while the transformer is in operation."[1234] According to Dr. Degeneff, his major issues with Entergy's current program are the frequency of the monitoring and evaluation, and the lack of commitment to update the program as better mechanisms and methods for measuring the health of transformers are developed.[1235]

While the goals of Entergy's existing monitoring program are to track the health of the transformers, Entergy witnesses recognized that the industry cannot identify all the failure mechanisms for transformers and prevent them from happening. But Entergy witness Mr. McCaffrey testified that the Applicant has incorporated the current industry practices to monitor transformer health into its preventive maintenance programs and is using that information to identify degrading trends.[1236]

Additionally, as part of Entergy's effort to establish that transformers are not AMR-appropriate components, its witnesses discussed known transformer failures as an indication of the effectiveness of readily monitoring transformers. Entergy witness Mr. McCaffrey testified that transformers generally have a long service life, in the range of decades, but "the failure profile generally is a bathtub curve . . . [with] much higher failure rates in the first few years, and then "once it's functioning, then it may function without incident for 20 years" followed by a

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[1233] New York NYS-8 Rebuttal Testimony at 39–40 (Ex. NYSR00414).

[1234] Id. at 40.

[1235] Tr. at 4297 (Dr. Degeneff for New York).

[1236] Tr. at 4255 (Mr. McCaffrey for Entergy).

period of increased failure rates with age.[1237] He further testified that most transformers fail because of the deterioration of the insulation surrounding the electrical wires in the winding coils,[1238] but could only recall three failures in the history of the plant.[1239] According to Mr. McCaffrey, the failures to date do not suggest such transformers should be managed under 10 C.F.R. Part 54.[1240]

In contrast, Dr. Degeneff stated that there have been a number of transformer failures at various power reactors, and listed 18 instances in his report.[1241] Furthermore, he testified that, "[i]n the last five years, Entergy has experienced three major transformer failures," and, according to EPRI's calculations, the rate of failures in the nuclear industry increased from four percent in 1991 to about 16 percent in 2001.[1242] Dr. Degeneff pointed to an NRC 2009–2010 Information Notice that reads "[a] relatively high incidence of transformer failures has occurred in the last few years, the majority of which could have been avoided had the licensee fully evaluated and effectively implemented corrective actions and recommendations identified in industry operating experience."[1243] He further stated that the "problem is not that failures aren't preventable, but that such preventative measures are not requirements under the Part 50 regulations. Mandating an AMP for transformers would force licensees to take such additional

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[1237] Tr. at 4261 (Mr. McCaffrey for Entergy).

[1238] Tr. at 4275 (Mr. McCaffrey for Entergy).

[1239] Tr. at 4256 (Mr. McCaffrey for Entergy).

[1240] Entergy NYS-8 Testimony at 105 (Ex. ENTR00091).

[1241] Report of Dr. Robert C. Degeneff in Support of Contention NYS-8 (Dec. 12, 2011) at 18–22 (Ex. NYS000005).

[1242] Tr. at 4299 (Dr. Degeneff for New York) (referring to EPRI, Life Cycle Management Planning Sourcebooks, Vol. 4: Large Power Transformers (Ex. NYS000034)).

[1243] NRC Information Notice 2009-10, Transformer Failures-Recent Operating Experience (Jul. 7, 2009) at 2 (Ex. NYS000019); see also New York NYS-8 Rebuttal Testimony at 34 (Ex. NYSR00414).

steps."[1244] He posited that "[a]lthough NRC staff generally believes that transformers do not need to be subject to aging management programs, these transformer failures underscore the need for the proper maintenance and aging management of transformers."[1245]

For their part, NRC Staff witnesses noted that these failures were readily apparent, commenting that sometimes the failure was accompanied by an explosion and/or fire, both of which were obvious signs of distress.[1246] In other cited examples, they testified that the failure resulted in activation of alarms or reactor or turbine trips or reactor scrams. These NRC Staff witnesses concluded that "[t]he fact that these failures were readily apparent shows that transformers are active components, *i.e.*, components whose performance or functionality is readily apparent, readily observable, readily monitored and directly verified."[1247]

As previously mentioned, Entergy witness Mr. McCaffrey testified that only a few transformers have failed at Indian Point.[1248] Two IP3 transformers failed – one shortly after plant startup and another in 2007.[1249] Mr. McCaffrey stated that the 2007 event (identified in NRC Information Notice 2009-10) was related to a fault that occurred in the IP3 No. 31 main step-up transformer – a large oil-filled transformer that is within the scope of the maintenance rule.[1250] In accord with the maintenance rule, Entergy conducted a root cause analysis and instituted significant corrective actions in response to the event, which Entergy's witnesses

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[1244] New York NYS-8 Rebuttal Testimony at 34–35 (Ex. NYSR00414).

[1245] Report of Dr. Robert C. Degeneff in Support of Contention NYS-8 (Dec. 12, 2011) at 17 (Ex. NYSR00005).

[1246] NRC Staff NYS-8 Testimony at 24 (Ex. NRC000031).

[1247] Id.

[1248] Tr. at 4256 (Mr. McCaffrey for Entergy).

[1249] Tr. at 4259 (Mr. McCaffrey for Entergy).

[1250] Tr. at 4449 (Mr. McCaffrey for Entergy).

attributed to a design flaw in the transformer Phase B bushing, and not the effects of aging on the transformer.[1251] Mr. McCaffrey went on to state that there is no online testing that can be done to determine the health of a bushing.[1252]

New York witness Dr. Degeneff disagreed with this assessment. He testified that the bushing was about 31 years old when it failed and when it was last inspected six years before failure, the wear was deemed to be high but acceptable.[1253] Dr. Degeneff stated that Entergy was well aware of the historical performance of this bushing because the Applicant's report on aging noted that this type of bushing exhibits slow degradation that leads to an eventual failure.[1254] Furthermore, Dr. Degeneff noted that, in a Staff document, the Staff criticized Entergy for not addressing the condition of this bushing.[1255]

Entergy's witnesses also acknowledged that another transformer-related event occurred in November 2010 with a main transformer at IP2 (another large oil-filled transformer that is within scope of the maintenance rule) as a result of the failure of main transformer Phase B bushing.[1256] As with the 2007 failure, Entergy performed a root cause evaluation, which determined that this transformer failed even though (1) appropriate maintenance testing and analyses (*e.g.*, Doble testing and physical inspections) had been performed on the transformer prior to the event with no adverse trends or abnormalities; (2) the bushing had a good operating history and had no indications of degradation during predictive monitoring; and (3) there were

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[1251] Entergy NYS-8 Testimony at 105 (Ex. ENTR00091).

[1252] Tr. at 4283 (Mr. McCaffrey for Entergy).

[1253] Tr. at 4437 (Dr. Degeneff for New York).

[1254] Tr. at 4437–38 (Dr. Degeneff for New York) (referencing EN Large Power Transformer Status at 1 (Ex. NYS000040)).

[1255] Tr. at 4438 (Dr. Degeneff for New York) (noting Indian Point Nuclear Generating Unit 3 – NRC Integrated Inspection Report 05000286/2007003 (Aug. 8, 2007) at iii (Ex. ENTR00347)).

[1256] Entergy NYS-8 Testimony at 106 (Ex. ENTR00091).

no known operating deficiencies associated with these bushings supplied by the transformer vendor when the main transformer was installed in 2006.[1257] An independent failure analysis of the bushing concluded that the bushing failure was due to a design/manufacturing weakness.[1258] Related corrective actions at IPEC included replacing the affected main transformer bushings and increasing the frequency of electrical testing of the main transformers from every four years to every two years.[1259]

Additionally, in Table 4 attached to Entergy's written testimony, Entergy's witnesses responded to Dr. Degeneff's concerns regarding the monitoring of age-related degradation in transformers by listing the "means by which Entergy addressed alleged concerns at IPEC" for each of the "aging mechanisms or other concerns identified by Dr. Degeneff."[1260]

Dr. Degeneff responded that this Entergy information does not address the potential that age-related degradation will go unnoticed in transformers at Indian Point.[1261] He opined that the transformer failure rate across the country shows performance monitoring is not adequate to maintain transformer functionality, because most of the transformer failure modes do not affect transformer operating performance until the transformer actually fails.[1262] Therefore, according to Dr. Degeneff, "the performance monitoring outlined in Table 4 . . . is insufficient to maintain the functionality of aging transformers."[1263] He also testified that Table 4 refutes Entergy's and the Staff's claim that age-related degradation in transformers is readily monitored, because

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[1257] Id.

[1258] Id.

[1259] Id.

[1260] Id. at 102–04.

[1261] New York NYS-8 Rebuttal Testimony at 41–43 (Ex. NYSR00414).

[1262] Id.

[1263] Id. at 42.

Entergy's experts admit that there are "conditions that may require the transformer oil to be drained so that a physical inspection of the transformer's internal structure can be conducted."[1264] In Dr. Degeneff's opinion, "[t]his shows that the transformer's ability to perform its intended function is not monitored solely by a change in the electrical performance of the transformer."[1265]

### 2. Findings Related to the Ability to Monitor Age-related Functional Degradation of Transformers

By regulation an SSC is excluded from AMR by either (1) containing moving parts or having a change in configuration or properties as defined by 10 C.F.R. § 54.21(a)(1)(i); or (2) by having a change of state and being readily monitorable as stated in the SOC for the 1995 revisions to the 10 C.F.R. Part 54 rules. In Section VI(F), we addressed the first of these two exclusion criteria and found that the changes in voltage, current, and magnetism are not associated with changes in the properties or state of a transformer as claimed by Entergy and the NRC Staff, but instead are changes in the characteristics of the electrical energy passing through this device. We now address whether a transformer's traits are "readily monitorable."

As described above, both Entergy and the NRC Staff assert that the change in transformer properties can be easily and continuously monitored directly by measuring the terminal voltages and currents.[1266] We agree that output voltage and current can be continuously monitored and would indicate gross failure of the transformer, as would waiting for

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[1264] Id. at 43.

[1265] Id.

[1266] While the energy through a transformer is converted from electrical to magnetic and back to electrical, there was no evidence presented to suggest that the changes in the magnetism could be measured to readily monitor the condition of this device to predict the timing of component failure. Nor did the parties provide any indication that measuring the difference in electrons between the primary and secondary coils was feasible or, in the unlikely event it was, that the resulting information would provide any meaningful monitoring data.

alarms, explosions, or fires as suggested by the Staff.[1267] But, in order for a transformer to be considered "readily monitorable," consistent with the direction provided by the Commission in its SOC,[1268] a transformer would have to be susceptible to monitoring for incremental (*i.e.*, functional) degradation.[1269] We find that neither Entergy nor the Staff was able to refute New York's position that age-related degradation of a transformer is not "monitorable" in that it will not be reflected in any noticeable change to the electrical characteristics of transformer operations and that, over time, this lack of trending data can lead to an unforeseen transformer failure.

We thus agree with Dr. Degeneff that "[t]he presence of certain age-related degradation that can cause failure and is undetectable by performance monitoring is the very reason why an AMP is necessary for transformers."[1270] We further find that monitoring voltage, current, and magnetism within a transformer is not effective in monitoring the functional degradation of this component as it ages during the PEO.

Beyond measuring voltage and current at the output terminals, numerous other tests and assessments are available to monitor the performance and condition of a transformer, and have been incorporated into the current preventive maintenance programs developed by Entergy. In its 1997 position paper, the Staff discusses the trending of "electrical parameters measured . . . [from] Doble test results, and advanced monitoring methods such as infrared thermography, and electrical circuit characterization and diagnosis."[1271] But the Grimes Letter does not provide any technical quantification or justification regarding the actual success of these trending analyses in

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[1267] NRC Staff NYS-8 Testimony at 24 (Ex. NRC000031).

[1268] Statement of Consideration at 22,476, 22,477–78 (Ex. NYS000016).

[1269] Tr. at 4223, 4231, 4232, 4234, 4245 (Mr. Craig for Entergy); Tr. at 4243 (Ms. Ray for the NRC Staff).

[1270] New York NYS-8 Rebuttal Testimony at 39 (Ex. NYSR00414).

[1271] Grimes Letter at 2 (Ex. ENT000097).

providing any indicators that might be useful in predicting the impending failure of a transformer. Further, we find that Entergy and the NRC Staff did not provide evidence sufficient to establish that these alternative tests would be successful in consistently tracking the progressive degradation of transformers so as to make these components "monitorable."

Nor has Entergy established that its use of other monitoring techniques could track the allegedly "active" functions of its transformers. For instance, Entergy witness Mr. McCaffrey admitted that the majority of transformer failures are related to the degradation of the insulation surrounding the electrical wires of the winding coils.[1272] Consistent with the thorough discussion in the SOC regarding the challenges in monitoring electrical cables, we find that there has been no persuasive evidence proffered in this proceeding that any of these other tests will effectively monitor for impending failure of a transformer. The lack of proven techniques for measuring the trend in functional degradation further reinforces our conclusion that transformers are "passive" devices.

To be sure, detailed corporate programs and plant-specific procedures have been developed for IPEC by Entergy and incorporated into its CLB to track transformer performance.[1273] And while these programs are based on the current knowledge of industry practice, we find that Entergy's and the NRC Staff's testimony does not demonstrate the effectiveness of these tests and assessments in detecting impending transformer failures. As such, these unproven techniques fall short of establishing that transformers can be "readily monitored."[1274]

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[1272] Tr. at 4275 (Mr. McCaffrey for Entergy).

[1273] These procedures include: Large Power Transformer Inspection Guidelines, Entergy's Fleet Engineering Guide EN-EG-G-001, Rev. 2 (Mar. 2011) (Ex. ENT000121); Station or Unit Auxiliary Transformer Annual In-service Inspection, IPEC Maintenance Procedure 0-XFR-407-ELC, Rev. 0 (May 2007) (Ex. ENT000124); Indian Point Energy Center Large Power Transformer Life Cycle Management Plan, 2011 (Ex. ENT000125).

[1274] While transformer failures at IPEC have been infrequent, the NRC Staff was concerned enough about the industry wide failure rates of transformers to issue an Information Notice in

We also find that the service life of transformers provides further support for making these SSCs subject to AMR. Regardless of the failure rate to date, according to Entergy's witness Mr. McCaffrey, the service life of transformers is in the range of decades, not years.[1275] Therefore, it seems reasonable to us that the likely time for accelerated transformer failures may well occur during the PEO, enhancing the need for adequate aging management during the license renewal period.

At the same time, we recognized, as mentioned above, that Entergy has developed and implemented detailed programs and procedures as part of its CLB to track the operational performance of transformers using the current state of practice in the industry. Based on the testimony of Mr. McCaffrey, we find that some of the tests have been performed on transformers at Indian Point under the maintenance plan for many years and new ones have been added to reflect current technology and industry acceptance.[1276] Entergy's predictive maintenance results (monitored and trended to identify degrading conditions within transformers) are summarized in *Indian Point Energy Center Large Power Transformer Life Cycle Management Plan*.[1277] Although the Applicant has conceded that the industry cannot identify all the failure mechanisms for transformers and prevent them from happening, we find

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2009 to alert the industry about the relatively high incidence of failures that, in their opinion, could have been avoided for the most part had the operator fully evaluated and effectively implemented corrective actions and recommendations identified in industry operating experience. NRC Information Notice 2009–10, Transformer Failures-Recent Operating Experience (July 7, 2009) at 2 (Ex. NYS000019). We note that review of industry "Operating Experience" and "Corrective Actions" are two of the required ten elements of an effective aging management program.

[1275] Tr. at 4261 (Mr. McCaffrey for Entergy).

[1276] Tr. at 4256 (Mr. McCaffrey for Entergy).

[1277] Entergy NYS-8 Testimony at 97–98 (Ex. ENTR00091) (citing Indian Point Energy Center Large Power Transformer Life Cycle Management Plan (2011) (Ex. ENT000125)).

that Entergy has incorporated the current industry practices to monitor transformer health into its preventive maintenance programs and is using that information to identify degrading trends.[1278]

We thus concur with Entergy's witnesses who believe that their plan, combined with the corporate fleet-wide programs and plant specific procedures, provides some degree of assurance that the transformers will operate satisfactorily until the planned replacement date of the transformers, and that these programs and plans are updated as necessary. For example, as New York witness Dr. Degeneff testified, the IP2 main transformers were replaced in 2006 based on the results of the life cycle management program.[1279] While these particular transformers are not within the scope of license renewal, nonetheless deployment of this same corrective measure could take place with the station auxiliary transformers that are within scope of license renewal, and also fall under the maintenance rule of the CLB. Based on this, we believe that these same programs and procedures would, if adopted into an AMP, go a long way toward demonstrating that the effects of transformer aging would be adequately managed for the PEO. But no AMP currently exists to be modified and implemented to track aging degradation of transformers.

In summary, while transformer operation can readily be monitored for gross failure by measuring the output voltage and current, there is no evidence that these values are useful in effectively tracking the incremental degradation of a transformer and providing trending data needed to predict its future life – actions that are required in aging management to implement corrective actions before there is a complete loss of the intended function of this component. We find therefore that monitoring for only gross failure does not adequately manage the effects of aging through the PEO. The lack of ability to readily monitor transformers for impending failure requires additional review at time of license renewal. While the existing procedures and

[1278] Tr. at 4255 (Mr. McCaffrey for Entergy).

[1279] Tr. at 4276 (Dr. Degeneff for New York).

plans that are already in place for meeting the maintenance rule during operations are unproven to date, they would likely provide considerable assistance in tracking aging management of IPEC's transformers through the PEO if incorporated into an AMP.

## I. Similarities with SSCs Included in or Excluded from AMR by Regulation

As we noted previously, the regulations provide non-exclusive examples of those structures and components that are subject to AMR[1280] and those that are excluded from this review.[1281] Because transformers are not listed in either group, we asked the parties to compare transformers to selected components from each group to support their arguments for designating the correct classification for transformers. The evidence submitted for these comparisons and our findings are summarized as follows.

### 1. Evidence Related to the Similarities with SSCs Included in or Excluded from AMR by Regulation

#### a. General Statements

In the Grimes Letter, the NRC Staff compared the similarity of transformers to the examples of components explicitly excluded from AMR in 10 C.F.R. Part 54 relative to how the performance of their intended functions would be achieved and whether aging degradation of these components could be readily monitored.[1282] Therein, the NRC Staff concluded that

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[1280] Structures and components considered "passive" and designated as subject to AMR include reactor vessel, the reactor coolant system pressure boundary, steam generators, the pressurizer, piping, pump casings, valve bodies, the core shroud, component supports, pressure retaining boundaries, heat exchangers, ventilation ducts, the containment, the containment liner, electrical and mechanical penetrations, equipment hatches, seismic Category I structures, electrical cables and connections, cable trays, and electrical cabinets. See 10 C.F.R. § 54.21(a)(1)(i).

[1281] Structures and components considered "active" and designated as excluded from AMR include "pumps (except casing), valves (except body), motors, diesel generators, air compressors, snubbers, the control rod drive, ventilation dampers, pressure transmitters, pressure indicators, water level indicators, switchgears, cooling fans, transistors, batteries, breakers, relays, switches, power inverters, circuit boards, battery chargers, and power supplies." 10 C.F.R. § 54.21(a)(1)(i).

[1282] See Grimes Letter at 1–4 (Ex. ENT000097).

"[t]ransformers perform their intended function through a change in state similar to switchgear, power supplies, battery chargers, and power inverters, which have been excluded [by 10 C.F.R.] § 54.21(a)(1)(i) from an aging management review."[1283] As we noted previously, no technical justification was provided in the Grimes Letter explaining how the NRC Staff arrived at this conclusion, nor did the NRC Staff point out any dissimilarities between transformers and the other components listed in the regulations that do not have a change in state and require AMR as passive components.

In support of this contention, however, New York witness Dr. Degeneff stated that, because of their allegedly "passive" "characteristics, transformers are more similar to pipes, electrical cables and other components for which an AMP is required than they are to components like transistors and batteries for which an AMP is not required."[1284] According to Dr. Degeneff, this is because a transformer changes the electrical energy passing through it just as many of the "included components change the 'properties' of the fluids, electric power, or fuel that travel through or are contained within those structures and components."[1285] He testified that the "'properties' of the included structures and components, themselves, do not [change] during their intended use" and that "transformers may have service lives exceeding 60 years, like many of the 'included' components."[1286] As discussed in the previous section, Dr. Degeneff concluded that the intended functions of transformers cannot be monitored online, which places them in the list of structures requiring AMR.[1287]

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[1283] Grimes Letter at 2 (Ex. ENT000097).

[1284] New York NYS-8 Testimony at 6–7 (Ex. NYSR00003).

[1285] Id. at 17.

[1286] Id.

[1287] New York NYS-8 Rebuttal Testimony at 40 (Ex. NYSR00414).

Entergy's and the NRC Staff's witnesses disagreed with New York's position and discussed the differences and similarities between transformers and the components listed in 10 C.F.R. § 54.21(a)(1)(i) that, in their opinion, demonstrate that transformers align more closely with those components that are excluded from AMR (*i.e.*, "active" components). The witnesses supported their position with a discussion comparing transformers with electrical cables (requiring AMR), piping (requiring AMR), and transistors (excluded from AMR). They also compared transformers to steam generators, reactor pressure vessels, heat exchangers, batteries, power invertors, power supply, circuit breakers, and battery chargers, as summarized below.

**b. Comparison with Electrical Cables**

Dr. Degeneff testified that the flow of power through a transformer is similar to the flow of power through an electrical cable and, consistent with an electrical cable, a transformer should be considered a "passive" component requiring AMR.[1288] He stated that "electrical cables and transformers can be represented by exactly the same system of equations, and they perform essentially the same way."[1289] He further opined that transformers are simply two current-carrying cables adjacent to each other.[1290] He also stated that "[t]he physical laws that describe how the magnetic field is developed around a cable are exactly the same physical laws that describe how a magnetic field is developed in a transformer."[1291] Moreover, according to Dr. Degeneff, "NRC Staff's experts agreed that two cables can function as a simple transformer."[1292]

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[1288] New York NYS-8 Testimony at 6–7 (Ex. NYSR00003).

[1289] Tr. at 4379–80 (Dr. Degeneff for New York).

[1290] New York NYS-8 Testimony at 18–19 (Ex. NYSR00003).

[1291] Id. at 18.

[1292] New York NYS-8 Rebuttal Testimony at 21–22 (Ex. NYSR00414) (citing NRC Staff NYS-8 Testimony at 23 (Ex. NRC000031)).

While magnetic fields generated around the cable vary and the magnitude and phase of the currents through the cable and voltages across it may change, Dr. Degeneff indicated that "the physical properties of the cable (*e.g.*, conductor shape, material composition of the cable, cable insulation, and the resultant resistance capacitance per unit length) are not designed to change."[1293] He stated that transformers and cables are similar in that "both conduct power from one place to another . . . [b]ut neither the cable nor the transformer changes its state or changes its configuration."[1294] And he further testified that the same tests that Entergy and the NRC Staff declared can be used to actively monitor transformers, could also be used on cables if desired, but cables nonetheless are still classified as "passive" devices.[1295]

Entergy witness Dr. Dobbs testified that he agreed with Dr. Degeneff's statement to the extent that the same laws apply to both cables and transformers, but that he disagreed with Dr. Degeneff's broad-brush analogy between electrical cables and transformers, and the implication that both should be classified as "passive" components under 10 C.F.R. Part 54.[1296] According to Dr. Dobbs, "[t]wo wires or cables in proximity to one another do *not* constitute a transformer in form or operation."[1297] More specifically, Dr. Dobbs declared that

> [p]ower plant cables are routed in a way that minimizes such magnetic coupling. Any electromagnetic coupling between power cables is referred to as 'crosstalk' or 'noise' and is undesirable.
>
> In contrast, the magnetic coupling in a transformer is maximized by design and transfers considerable power from the primary winding to the secondary winding.[1298]

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[1293] New York NYS-8 Testimony at 18 (Ex. NYSR00003).

[1294] Tr. at 4380 (Dr. Degeneff for New York).

[1295] Tr. at 4381 (Dr. Degeneff for New York).

[1296] Entergy NYS-8 Testimony at 65–66 (Ex. ENTR00091).

[1297] Id. at 67 (emphasis in original).

[1298] Id.

Regarding the comparison between transformers and cables, NRC Staff witnesses testified that transformers are "different than passive components like electrical cables because cables perform their intended function (transmit power or signals) without a change in state, configuration, or properties and the effects of aging degradation for cables are not readily monitorable. In contrast, the effects of aging degradation on transformers are readily monitorable."[1299] And while the Staff witnesses agreed with Dr. Degeneff that two cables in close proximity to each other can function as a simple transformer, they went on to declare that:

> [such an] observation is not relevant to the question whether a transformer is an active or a passive component. Transformers perform their intended function through a change in state similar to batteries, transistors, battery chargers, switchgear, power supplies, and power inverters, which have been excluded in 10 C.F.R. § 54.21(a)(1)(i) from an aging management review.[1300]

And in support of the Staff's view of the difference between transformers and cables, Ms. Ray testified further that "the purpose [of an electrical cable] is to transmit power, essentially voltage and current. But a transformer provides isolation, in addition to supplying voltage and current to a load . . . the voltage and current coming in is not the same as the voltage and current coming out."[1301]

In response to the NRC Staff witnesses' assertion that the similarities between cables and transformers are not relevant to the question whether a transformer is an "active" or "passive" component, Dr. Degeneff maintained that the similarities are very relevant for this inquiry, because "the same elements that make it difficult to detect functional degradation in cables also make it difficult to detect functional degradation in transformers."[1302] Dr. Degeneff also declared that the aging effects for both cables and transformers are difficult to detect

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[1299] NRC Staff NYS-8 Testimony at 21 (Ex. NRC000031).

[1300] Id. at 23.

[1301] Tr. at 4377 (Ms. Ray for the NRC Staff).

[1302] Id. at 22–23.

because of embrittlement of the insulation, but noted that "[t]he concern with both is exactly the same—as the insulation embrittles and degrades, the component's ability to withstand electrical stress decreases."[1303] According to Dr. Degeneff, "[t]his decrease cannot be observed in the electrical performance of the transformer or the cable, and left undetected will lead to catastrophic insulation failures."[1304]

**c. Comparison with Piping**

Dr. Degeneff also testified that he believes the flow of power through a transformer is similar to the flow of water in a pipe and, consistent with piping, should be considered a "passive" component requiring AMR.[1305] He stressed that, like the voltage of the power flowing through a transformer, the properties of fluids in a pipe (including temperature, pressure, velocity, viscosity, and density, among others) do change.[1306] He stated that "[t]he phase of the fluid in a pipe may even change. Yet, a pipe itself is a component which is included within the scope of § 54.21(a)(1)."[1307]

According to Dr. Degeneff, "[t]he pipe itself is not designed to change its own properties. In fact, if the pipe's properties changed it would present significant engineering and design problems."[1308] He testified that this is the same situation with transformers in that:

> power merely passes through a transformer. It is the unchanging physical properties of the transformer that cause that power to change voltage at a ratio determined by the transformer's unchanging design properties. Different amounts of power may be applied to a transformer, but the voltage will always

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[1303] Id. at 24.

[1304] Id.

[1305] New York NYS-8 Testimony at 18 (Ex. NYS000003).

[1306] Id.

[1307] Id. at 18–19.

[1308] Id. at 19.

> change at the same ratio, because the unchanging properties of the transformer dictate only one turns ratio.[1309]

In response, Entergy witness Dr. Dobbs testified that the change in voltage, current, and the development of magnetism within a transformer are properties of the transformer, a corollary that does not pertain to pressure and flow in relation to water.[1310] According to Dr. Dobbs:

> [p]ressure and flow are attributes associated with, but not properties of, water. . . . [A] property is something that is inherent in the object. Neither pressure nor flow is inherent to water. If water is not acted upon by some external force, then it has neither pressure nor flow.[1311]

He concluded that "pressure and flow are *not* properties of water; they result from outside forces acting on the water. Similarly, electricity is charge. It has no voltage or current unless it is acted on by some outside force."[1312]

Dr. Dobbs also testified that the SOC specifically stated that a pressure-retaining boundary is a "passive" function.[1313] As a result, he declared the characteristics of all fluid-type components such as piping cannot be considered in this argument because these components are already excluded from AMR by their pressure-retaining characteristic.[1314]

In rebuttal, Dr. Degeneff suggested that Dr. Dobbs presented an inconsistent argument on what constitutes a property of an object.[1315] Noting that Dr. Dobbs asserted that pressure and flow are not properties of fluid because they result from outside forces acting on the

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[1309] Id.

[1310] Entergy NYS-8 Testimony at 32, 71 (Ex. ENTR00091).

[1311] Id. at 32.

[1312] Id. at 69 (emphasis in orginal).

[1313] Tr. at 4405 (Dr. Dobbs for Entergy).

[1314] Tr. at 4405–06 (Dr. Dobbs for Entergy).

[1315] New York NYS-8 Rebuttal Testimony at 24 (Ex. NYSR00414).

fluid,[1316] and that a magnetic field is a property of the transformer, despite Dr. Dobbs admission that the magnetic field is caused by an external force acting on the transformer,[1317] Dr. Degeneff declared this characterization of property is incorrect. According to him, "[p]ressure and flow are properties of fluid, not properties of a pipe. Furthermore, if these were properties of the pipe, the pipe would be considered an active component, which it is not."[1318] He went on to testify that the flow of power through a transformer is directly analogous to the flow of water through a pipe,[1319] stating that they are modeled by similar equations.[1320] This, he declared, supports his conclusions that the current flowing through a transformer is analogous to the velocity of flow through a pipe and that the turns ratio in a transformer is analogous to the relationship between the area of a pipe's at intake and the area of a pipe's exit point.[1321]

In an effort to further support his opinion that the flow of electrical energy through transformers performs differently than the flow of water through piping, Dr. Dobbs for Entergy stated that "[t]he fields of fluid dynamics and electromagnetism . . . are governed by different physical laws and described by different mathematical equations."[1322] He repeated this position in response to the Board's questions at the evidentiary hearing.[1323] However, when queried about specific modeling equations that might overlap between the fields of fluid dynamics and

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[1316] Entergy NYS-8 Testimony at 69 (Ex. ENTR00091).

[1317] Id. at 35.

[1318] New York NYS-8 Rebuttal Testimony at 24 (Ex. NYSR00414).

[1319] Id. at 24–26.

[1320] Tr. at 4406–07 (Dr. Degeneff for New York).

[1321] New York NYS-8 Rebuttal Testimony at 24–26 (Ex. NYSR00414).

[1322] Entergy NYS-8 Testimony at 72 (Ex. ENTR00091).

[1323] Tr. at 4402–03 (Dr. Dobbs for Entergy).

electromagnetism, Dr. Dobbs admitted that he was not well versed in the field of fluid dynamics.[1324]

The NRC Staff's witnesses testified that transformers are different than piping because piping performs its intended function without a change in state, configuration or property while a transformer perform its intended function through a change in state.[1325] In addition, the Staff's witnesses testified that "age-related degradation in the reactor vessel, containment, and piping is not readily monitorable and failure to perform their intended functions may not be readily monitorable, while failure of a transformer to perform its intended function and degradation are both readily monitorable."[1326] The NRC Staff's witnesses also declared that transformers are not like pipes because, while pipes may change the property of the fluid that travels through them, that is not a pipe's primary function.[1327] This can be contrasted, according to the Staff's witnesses, with the fact that "transformers cannot transport power . . . without changing the power, either changing current or voltage or both."[1328]

In response to this argument, Dr. Degeneff stated that "electricity flowing through the transformer need not undergo a change during transformer operation", and, in fact, would not do so if the turns ratio is 1 to1 as is the case with transformers used in power quality applications to reduce electrical noise.[1329]

NRC Staff witnesses also testified that "[b]ecause its operation depends on electromagnetic induction between two stationary coils and a magnetic flux of changing

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[1324] Tr. at 4403–05 (Dr. Dobbs for Entergy).

[1325] NRC Staff NYS-8 Testimony at 22 (Ex. NRC000031).

[1326] Id.

[1327] Id.

[1328] Id.

[1329] New York NYS-8 Rebuttal Testimony at 27 (Ex. NYSR00414).

magnitude and 'polarity,' transformers are necessarily active AC devices."[1330] Therefore, the Staff's witnesses concluded, "power transformers are active devices which do not require aging management review or an aging management program in accordance with 10 C.F.R. § 54.21(a)(1)(i)."[1331] The Staff's witnesses did not, however, explain why and how the "activity" associated with an AC device, such as a transformer, could be used to monitor the aging effects of a transformer, nor did the Staff's witnesses clarify why this argument would not exclude all AC devices from AMR.

When discussing the difference between an allegedly "active" transformer and a designated "passive" piping, Staff witness Ms. Ray stated that, with piping, the fluid coming in is the same as the fluid coming out while the same is not so with the power flowing through a transformer.[1332] She also stated that, while the wall thickness of a pipe can be measured, a test is required while a transformer is continuously monitored for voltage and current.[1333]

**d. Comparison with Transistors**

Entergy's witnesses testified that a transistor is a three-terminal semiconductor device usually made of a single piece of silicon.[1334] They stated that a small external voltage is applied to one of the terminals to change the state of the silicon from one of resistance to one of conductivity.[1335] The SOC stated that a transistor can "change its state" and therefore should be considered as an "active" SSC.[1336] Entergy's witnesses stated that the operation of a

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[1330] NRC Staff NYS-8 Testimony at 23 (Ex. NRC000031).

[1331] Id.

[1332] Tr. at 4378–79 (Ms. Ray for the NRC Staff).

[1333] Id.

[1334] Entergy NYS-8 Testimony at 73–74 (Ex. ENTR00091).

[1335] Id.

[1336] Statement of Consideration at 22,477 (Ex. NYS000016).

transformer is similar to a transistor and that "the changing magnetism in the core of a transformer is analogous to the changing resistivity in a transistor."[1337]

The NRC Staff's witnesses testified that transistors can be easily monitored for performance.[1338] According to the Staff's witnesses, like transformers, gross failure of transistors is readily detectable during plant operation and both transformers and transistors are covered by existing monitoring and maintenance procedures. Accordingly, it is the Staff's view that transformers, like transistors, do not require an AMP to manage age-related degradation.[1339]

On behalf of New York, Dr. Degeneff agreed that a transistor functions by altering its state to be either a conductor (*i.e.*, when it is on) or a resistor with high impendence (*i.e.*, when it is off), depending upon a triggering electrical current.[1340] But he disagreed with the Entergy witnesses concerning the change in state, testifying that "the characteristics and properties of the transformer do not change during its operation, *e.g.*, the size, weight, turns ratio, etc. do not change if it is operated within its design limits; they are invariant. In contrast, the properties of a transistor, itself, do change during its normal intended use."[1341] In this regard, Dr. Degeneff explained that:

> Resistance is a property of a transistor. During operation, a transistor's resistance is changed, causing a change in the transistor's properties. Furthermore, the change in resistance can cause a change in the transistor's state from a conductor to an insulator. The Statement of Consideration

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[1337] Entergy NYS-8 Testimony at 75 (Ex. ENTR00091).

[1338] NRC Staff NYS-8 Testimony at 23 (Ex. NRC000031).

[1339] Id.

[1340] New York NYS-8 Testimony at 21 (Ex. NYSR00003); see also Tr. at 4388 (Dr. Degeneff for New York).

[1341] New York NYS-8 Testimony at 21 (Ex. NYSR00003); see also Tr. at 4388 (Dr. Degeneff for New York).

> specifically cites this change in state as the reason for excluding transistors from AMR.[1342]

Dr. Degeneff also testified that the changing magnetic field is not a property of the transformer itself but is created by the energy flowing through the transformer and does not cause a change in the transformer's properties or state.[1343] He stated that "[u]nlike the transistor, the transformer always remains a conductor. In comparison, a magnetic field is also created by the electric current traveling through a cable, but this does not make a cable an active component . . . ."[1344]

**e. Comparisons with Batteries**

New York witness Dr. Degeneff stated that for a battery, unlike a transformer, the characteristics of the battery fluid changes resulting in a definitive change in state.[1345] He testified that the chemicals used in producing energy are part of the composition of the battery and that the electrolytic properties of these chemicals change as the battery discharges.[1346] Dr. Degeneff further declared that:

> [i]n contrast, only the properties of the power flowing through a transformer change. The key properties of a battery that has been discharged will be different from a full battery, but the key properties of a transformer that has had power flow through it will not be different from the properties of a transformer which has not been used.[1347]

Entergy witness Dr. Dobbs testified that these differences are irrelevant because "both transformers and batteries experience a change in their configuration or properties in performing their intended functions, and that proper operation of either device can be readily monitored at

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[1342] New York NYS-8 Rebuttal Testimony at 28–29 (Ex. NYSR00414).

[1343] Id. at 29.

[1344] Id.

[1345] Tr. at 4385 (Dr. Degeneff for New York).

[1346] New York NYS-8 Testimony at 26 (Ex. NYSR00003).

[1347] Id.

its external terminals as it operates."[1348] NRC Staff witnesses used a similar argument in stating that transformers are similar to batteries because, like batteries, they operate without moving parts and change their state during operations.[1349] Dr. Degeneff responded that, like a transistor, a battery changes state while the transformer itself does not experience either a change in properties or a change in state.[1350]

#### f. Comparison with other Fluid-Containing Structures and Components

Entergy witness Dr. Dobbs testified that in classifying a pipe, a heat exchanger, a steam generator, and a reactor vessel as "passive," the relevant commonality is that they all serve as pressure retaining boundaries.[1351] New York witness Dr. Degeneff disagreed, claiming that, "the relevant inquiry is whether a component undergoes changes in configuration, properties, or state during operation,"[1352] and while "all of these components contain external materials (fluid or nuclear fuel) that undergo a change in properties or state; however, the components themselves does not change properties, configuration or state."[1353]

As a reason for the Staff's classification of a heat exchanger as a "passive" component, Staff witness Ms. Ray claimed that a heat exchanger is hard to monitor.[1354] Moreover, according to Staff's witnesses, transformers are different than the reactor pressure vessel, piping, containment, and steam generator that "perform their intended function without a change in state, configuration or property" in that "[t]ransformers, in contrast, perform their intended

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[1348] Entergy NYS-8 Testimony at 81 (Ex. ENTR00091).

[1349] NRC Staff NYS-8 Testimony at 20 (Ex. NRC000031).

[1350] New York NYS-8 Rebuttal Testimony at 30 (Ex. NYSR00414).

[1351] Entergy NYS-8 Testimony at 73 (Ex. ENTR00091).

[1352] New York NYS-8 Rebuttal Testimony at 27 (Ex. NYSR00414).

[1353] Id. at 28.

[1354] Tr. at 4382 (Ms. Ray for the NRC Staff).

function through a change in state."[1355] The Staff's witnesses also testified that these SSCs "require an aging management review because functionality is measured indirectly and age-related degradation in them cannot be easily monitored."[1356]

In response, while agreeing that transformers may be "more easily" monitored than heat exchangers, Dr. Degeneff declared that neither would rise to the level of being classified as "readily monitorable."[1357]

**g. Comparisons with other Electrical Devices**

Regarding other electrical devices such as a power supply, inverter, circuit board, battery charger or circuit breaker, New York witness Dr. Degeneff stated that the operation of a transformer is not similar to these "excluded" components because these devices have "a mechanism to dynamically control the relationship between the input and output and, as such, each is a truly active device."[1358]

As an example, Dr. Degeneff stated that for a power supply (which takes AC power and converts it into DC power) to perform its intended function (*i.e.*, adjusting the load's power properties to deliver the desired voltage and current) requires regulation that is controlled by an electric control circuit apart from the main circuit.[1359] He testified that "[t]he power supply, decides, so to speak, what kind of power to supply to the load, whereas the transformer can only supply the power that the load requires."[1360]

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[1355] NRC Staff NYS-8 Testimony at 22 (Ex. NRC000031).

[1356] Id. at 23.

[1357] Tr. at 4382 (Dr. Degeneff for New York).

[1358] New York NYS-8 Testimony at 28 (Ex. NYSR00003).

[1359] Id. at 27–28.

[1360] Id.

Dr. Degeneff also explained that an inverter takes DC power and converts it into AC power by controlling the magnitude, frequency, and wave shape of the output power through the use of an external control that allows the power inverter to vary the relationship between the input and output power.[1361] This is dissimilar, he declared, to the operation of a transformer where the relationship between the input and output power is fixed and determined by the characteristics of the power fed into it and the load supplied by it.[1362]

According to New York's witness, while the performance of a circuit board depends on what a circuit board is designed to do, a circuit board exists for the purpose of performing some "active" function.[1363] Dr. Degeneff testified further that the circuit board is actively adjusting the output on a continuous basis as the input is adjusted.[1364] He also declared that a similar situation exists with a power supply that changes its internal configuration to change a varying AC input voltage into a constant DC voltage.[1365] Dr. Degeneff testified that this contrasts with the operation of a transformer where, if the input voltage changes, so does the output voltage at a ratio determined by its fixed turns ratio.[1366] With a battery charger, Dr. Degeneff noted, it "will have some component, some active component in it to limit the amount of charging."[1367]

Entergy witness Dr. Dobbs criticized the approach Dr. Degeneff used to segregate transformers from these other AMR-excluded electrical devices, asserting that Dr. Degeneff applied a "theory of inherited exclusion" when classifying power inverters, circuit boards, battery

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[1361] Id. at 26–27.

[1362] Id.

[1363] Tr. at 4387–88 (Dr. Degeneff for New York).

[1364] Id.

[1365] Tr. at 4386 (Dr. Degeneff for New York).

[1366] Id.

[1367] Tr. at 4408 (Dr. Degeneff for New York).

chargers, and power supplies as "active" components because, in part, they have solid state devices.[1368] Dr. Degeneff responded that Entergy was mischaracterizing his argument when claiming that power inverters, power supplies, and circuit boards are all excluded from AMR merely because they have solid state devices.[1369] Dr. Degeneff stated that his actual statement was that "since these components have solid state devices they can change state from a conductor to an insulator (or vice versa), and as such would be considered active devices."[1370] Dr. Degeneff then declared that, "[c]ontrary to Dr. Dobbs' statement, this is not true for transformers, which cannot change state."[1371]

Regarding power supplies, Dr. Dobbs repeated his argument that "how much control is or is not present is irrelevant to its classification as 'active' or excluded in context of the Part 54."[1372] He went on to state that "[n]o power supply details are given in 10 C.F.R. § 54.21(a)(1)(i) or in the 1995 License Renewal SOC, so the fact that power supplies are on the AMR-excluded list has nothing to do with voltage regulation."[1373]

The NRC Staff witnesses agreed with Entergy that whether a component has an external control does not determine whether it is a long-lived "passive" component that requires aging management.[1374] The Staff's witnesses went on to say that, like transformers, these other electrical devices "can be easily monitored for performance. Gross failure of these components

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[1368] Entergy NYS-8 Testimony at 83–86 (Ex. ENTR00091).

[1369] New York NYS-8 Rebuttal Testimony at 31–32 (Ex. NYSR00414).

[1370] Id. at 32.

[1371] Id.

[1372] Entergy NYS-8 Testimony at 82 (Ex. ENTR00091).

[1373] Id.

[1374] NRC Staff NYS-8 Testimony at 23, 24 (Ex. NRC000031).

is readily detectable during plant operation."[1375] The Staff's witnesses stated further that transformers can have external control mechanisms that dynamically control the relationship between input and output voltages.[1376] But Dr. Degeneff answered that the transformers to which the Staff's witnesses were referring contain no-load tap changers (devices which have the ability to change the turns ratio).[1377] According to Dr. Degeneff, these tap changers are not necessary for a transformer to function and do not change the basic operation of a transformer.[1378] Dr. Degeneff also stated that the external controls on power inverters and power supplies, like a transistor, are necessary to cause those devices to "perform some activity and change state or configuration, making it an active device."[1379] According to Dr. Degeneff, "[a] transformer never changes state, even if it has a tap changer."[1380]

### 2. Findings Related to the Similarities with SSCs Included in or Excluded from AMR by Regulation

Because it is not evident why certain components are classified as AMR included or excluded, we find that comparing transformers (or any other component for that matter) to the regulatory cited components is not conclusive in determining a perfect fit with one group or denoting universal differences with the other group.

Entergy witness Dr. Dobbs concluded that because New York's reasons for considering transformers as passive devices and adding them to the exclusion list were not mentioned in the regulations or SOC, "they cannot be a reason for classification."[1381] Dr. Dobbs is correct that

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[1375] Id.

[1376] Id.

[1377] New York NYS-8 Rebuttal Testimony at 31 (Ex. NYSR00414).

[1378] Id.

[1379] Id.

[1380] Id.

[1381] Tr. at 4390 (Dr. Dobbs for Entergy).

the regulations and SOC are essentially silent on the specific reasons why a component is placed in its respective AMR group. But Dr. Dobbs' argument can be turned against Entergy to the degree that this lack of an explanation appears to rob many of his comparisons with regulatory cited components as a "reason for classification," rendering this exercise nearly meaningless.

Ultimately, the best we can hope for is to weigh the arguments provided by the parties and determine to what group of components, generally, a transformer is most similar and to what group a transformer is most dissimilar. So, with Dr. Dobbs point in mind, we move forward with our comparison of transformers to the 10 C.F.R. § 54.21(a)(1)(i) listed components to glean whatever useful information may be derived from this consideration.

And, in doing so, we find that Dr. Degeneff's testimony, summarized above, provides sufficient evidence that transformers are more similar to the "passive" components that require AMR than to the "active" components that are excluded from AMR. Specifically, we find that transformers are more closely aligned with electrical cables, piping, steam generators, pump casings, valve bodies, and heat exchanges (*i.e.*, "passive" components that require AMR) than they are with transistors, batteries, pumps, and valves (*i.e.*, "active" components that don't require AMR). Furthermore, while the difference between transformers and other "active" components like power supplies, inverters, battery chargers, and circuit boards is debatable, there are plausible differences between the performance of transformers and many of the "active" components excluded from AMR, including the aforementioned transistors, batteries, pumps, and valves.

In their comparisons, both Dr. Dobbs for Entergy and Ms. Ray and Mr. Matthew for the NRC Staff rely on the premise that changes in the voltage, current, and magnetic flux in a transformer is a change in state of the device and not a change in characteristics of the power flowing through the device and that transformers are readily monitorable by measuring the output electrical parameters (*i.e.*, terminal voltage and current). According to these witnesses

for Entergy and the NRC Staff, it is the measurement of this change in state that makes transformers similar to devices that are excluded by regulation from AMR (*i.e.*, power inverters, battery chargers, power supplies, and circuit boards) and dissimilar to devices that are required to undergo AMR (*i.e.*, pump casings, valve bodies, and ventilation ducts).[1382] The NRC Staff's witnesses also relied on the premise that transformers can be easily monitored for performance in that gross failure is readily detectable during plant operation.[1383] We do not agree with any of these points.

Entergy's and the Staff's arguments ultimately collapse under our finding that transformers do not change properties or state during operation. In the Grimes Letter, the NRC Staff attempted to justify its position that transformers are excluded from AMR by stating that a transformer's alleged change in state is similar to other components excluded in the regulations (*i.e.*, 10 C.F.R. § 54.21(a)(1)(i)). But the Staff failed to convincingly explain why transformers are dissimilar to components which require AMR, including electrical cables, piping, reactor pressure vessels, steam generators, pump casings, valve bodies, heat exchangers, and ventilation ducts. Furthermore, the NRC Staff did not provide sufficient technical justification in the Grimes Letter regarding monitorability, *i.e.*, the actual success of assessing current trending to identify potential future failure. While the Staff is correct that gross transformer failure can be detected by monitoring output, as discussed in Section VI(H)(2) beginning at page 230 above, currently the available measurements and tests do not have a clear success rate in tracking the progressive degradation of transformers despite the decade-plus period since the Staff's initial position paper was issued.

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[1382] Tr. at 4384 (Ms. Ray for the NRC Staff); Tr. at 4389, 4394–97 (Dr. Dobbs for Entergy).

[1383] NRC Staff NYS-8 Testimony at 23 (Ex. NRC000031).

In regards to piping and other pressure boundary components, Entergy witness Dr. Dobbs stated that pressure and flow are not properties of water,[1384] concluding that "they result from outside forces acting on the water. Similarly, electricity is charge. It has no voltage or current unless it is acted on by some outside force."[1385] While this is true, we find that the outside force does not come from piping in the case of water, or from the transformer in the case of electricity. A transformer does not change its properties or state as electricity is passed through it any more than piping changes its state with the flow of water. The Board finds that the change in the electrical characteristics through a transformer is analogous to the change in the characteristics of water flowing through a pipe (a component that does require AMR).

At the hearing, Dr. Dobbs raised a new argument against comparing the change in flow of water through a pipe to the change in electrical current in a transformer. He stated that piping, which has a pressure-retaining boundary, is automatically exempted from AMR as explained in the 1995 SOC,[1386] and concluded that any similarities between the internal flow of water in piping and electron flow in a transformer is trumped by the AMR exemption of a pipe as a pressure-retaining boundary.[1387] We find this argument faulty because the regulations and the SOC list piping separately from components containing a pressure-retaining boundary. If anything, this implies that piping must have some other characteristic that allows it to be excluded from AMR beside the fact that it has a pressure-retaining function.

The NRC Staff's witnesses also claimed that power transformers are "active" AC devices,[1388] but do not explain why a transformer would be classified as "active" just because it

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[1384] Entergy NYS-8 Testimony at 32, 71 (Ex. ENTR00091).

[1385] Id. at 69.

[1386] Tr. at 4405 (Dr. Dobbs for Entergy).

[1387] Id.

[1388] NRC Staff NYS-8 Testimony at 23 (Ex. NRC000031).

is an AC device. These Staff witnesses also noted that with an "active" pipe, the fluid coming in is the same as the fluid going out, which is not the case with the power in a transformer. While this is true, the Staff did not convincingly explain how this trait has any bearing on whether a device does or does not require AMR. Specifically, there is nothing in the record stating how this trait would be useful in monitoring for age-related degradation, or that it is even feasible to utilize this performance characteristic. Staff witness Ms. Ray also stated that the wall thickness of a pipe can be measured (*i.e.*, a discrete test is required) while a transformer is continuously monitored for voltage and current.[1389] This argument also is not persuasive because the pressure and flow from a pipe could also be measured to monitor for pipe failure. Furthermore, while monitoring a transformer or a pipe for outflow characteristics would help indicate gross failure, it would do little to help track incremental degradation necessary to predict impending failure.

We find that a transformer differs from a transistor (an "active" component that is exempt from AMR) due to the uncontested fact that a transistor changes state from one of resistance to one of conductivity by the use of a triggering current. Entergy claimed these components are similar because the changing magnetism in the core of a transformer is analogous to the changing resistivity in a transistor.[1390] We find, however, that the change in magnetism does not occur in the transformer itself (as the change in state does with transistor operation), but, rather, is caused by the changes in the alternating current flowing through the transformer. To accept Entergy's argument, one also would have to consider cables to be "active" devices because of this change in magnetism. The Applicant relies upon this change in magnetism to group transformers with "active" components through its similarities with the change in state of a transistor. But we decline to follow suit, given the changing magnetism in both transformers and

[1389] Tr. at 4378–79 (Ms. Ray for the NRC Staff).

[1390] Entergy NYS-8 Testimony at 75 (Ex. ENTR00091).

electrical cables is caused by the power flowing through these components, as opposed to changes in their state.

Regarding a battery, we find that the change in state or property of the battery fluid and the gradual decline in its output voltage can be monitored to track the incremental degradation of its condition. The record does not contain any support for the proposition that a similar incremental change consistently occurs in the output voltage from a transformer as it degrades. On the contrary, the evidence points to the fact that in most circumstances, transformers tend to work with no change in output voltage until, at some point, output voltage is quickly terminated during unanticipated catastrophic failure.

**J. Summary of Factual Findings Relating to the Need for AMR of a Transformer**

Our decision on this contention focuses on two issues: (1) whether a transformer changes properties/state during operations, and (2) whether a change in performance is readily monitorable to provide adequate aging management for this component. Relative to the first issue, both Entergy witnesses and NRC Staff witnesses maintained that transformers perform their intended functions through a change in state due to the variations in voltage, current, and magnetic flux as electricity passes through the component. They also asserted that a transformer changes its state by transforming electrical energy into magnetic energy, then back into electrical energy.[1391] But New York witness Dr. Degeneff convincingly explained that "during its operation, a transformer does not experience a change in state—its constituent parts are exactly the same before the transformer is placed in service and during the period it is in service."[1392]

We agree with New York that the change in state described by witnesses for Entergy and the NRC Staff does not occur in the transformer, but, rather this change is caused by the

[1391] NRC Staff NYS-8 Testimony at 11 (Ex. NRC000031); Entergy NYS-8 Testimony at 10–11 (Ex. ENTR00091).

[1392] New York NYS-8 Rebuttal Testimony at 20 (Ex. NYSR00414).

alterations in the electrical energy passing through the transformer. The varying magnetic field within the transformer and the change in voltage from the input terminals to the output terminals occurs due to the alternating current of electricity and are not directly a modification of the configuration, properties, or state of the transformer hardware itself.

With regard to the second issue, Entergy and the NRC Staff both submit that the operation of a transformer is readily monitored by tracking its output voltage or current.[1393] New York does not disagree that the output voltage and current can be continuously monitored, but argues that this only tracks whether a transformer has failed or not, and does not provide any advanced indication of impending failure. Monitoring a transformer's output parameters tracks its function (*i.e.*, whether it is working), but does not provide any information on a transformer's condition (*i.e.*, whether it has suffered any incremental degradation).[1394]

We find that New York is correct. While transformer operation can be readily monitored for gross failure by measuring the output voltage and current, there is no evidence that monitoring these variables is useful in tracking the service life of a transformer and predicting its future failure – actions that are required in managing aging to implement corrective actions before there is a complete loss of its intended function. Entergy is using a variety of tests to monitor transformers under its CLB, but no evidence has been provided by any of the parties indicating that the incremental degradation of transformers can be successfully monitored to predict impending failure on a consistent basis. By a preponderance of the evidence presented to the Board, we find that a transformer can only be monitored for gross failure and not for temporal degradation, as would be needed to "readily" monitor the device through the PEO to meet the requirements of issue two above. And this inability to readily monitor a device is a

[1393] Tr. at 4377–79 (Ms. Ray for the NRC Staff); Entergy NYS-8 Testimony at 37 (Ex. ENTR00091).

[1394] New York NYS-8 Rebuttal Testimony at 36–39 (Ex. NYSR00414).

characteristic associated with a "passive" SSC that indicates the component must be included under AMR for license renewal.

The Applicant and the Staff would prevail regarding this contention if simply monitoring for complete failure is sufficient for aging management. But we find that the heart of the 10 C.F.R. Part 54, as expressed in the 1995 SOC, required being able to track structures and components for impending failure so that corrective actions can be identified and implemented prior to a failure.

Further, when comparing transformer operations to the SSCs specifically listed in 10 C.F.R. § 54.21(a)(1) as either included in or excluded from AMR, we conclude that transformers are more closely aligned with those components that require AMR (*e.g.*, electrical cables, piping, reactor vessel, reactor coolant system pressure boundary, steam generators pump casings, valve bodies, heat exchangers).[1395] Furthermore, there are plausible differences between the performance of transformers and the many of the SSCs excluded from AMR (*e.g.*, transistors, batteries, pumps, and valves).[1396]

To be sure, Entergy is currently monitoring its transformers under its CLB using detailed, corporate-wide and plant-specific procedures.[1397] While the Commission has stated that monitoring/inspections performed during current operations under 10 C.F.R. Part 50 and the CLB are excluded from review during license renewal as defined in 10 C.F.R. § 54.30, the mere fact that the intended function of transformers is being monitored in accordance with the CLB does not exempt them from needing to be included in an AMR program for license renewal.

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[1395] 10 C.F.R. § 54.21(a)(1)(i).

[1396] Id.

[1397] These corporate-wide and plant-specific procedures include: Large Power Transformer Inspection Guidelines, Entergy's Fleet Engineering Guide EN-EG-G-001, Rev. 2 (Mar. 2011) (Ex. ENT000121); Station or Unit Auxiliary Transformer Annual In-service Inspection, IPEC Maintenance Procedure 0-XFR-407-ELC, Rev. 0 (May 2007) (Ex. ENT000124); Indian Point Energy Center Large Power Transformer Life Cycle Management Plan (2011) (Ex. ENT000125).

Indeed, by using the existing procedures the Applicant now employs as part of its CLB, it is plausible that the Applicant can, as part of its AMR, adequately manage the effects of aging so that transformer intended functions will be maintained during the PEO.

**K. Conclusions of Law**

As a “passive” component with no moving parts, and no change in configuration, properties or state, transformers fall with the scope of 10 C.F.R. Part 54 (as defined by 10 C.F.R. § 54.4) and must undergo AMR pursuant to 10 C.F.R. § 54.21(a)(1). Lacking an AMP for transformers, Entergy has not demonstrated that it will adequately manage the effects of aging on these components as required by 10 C.F.R. §§ 54.21(a)(3) to assure that the intended functions of these devices are maintained consistent with the CLB through the PEO. Accordingly, the need for AMR of transformers raised by NYS-8 is resolved in favor of New York and license renewal for IP2 and IP2 cannot be authorized or issued until Entergy has performed the required AMR on transformers that are within the scope of 10 C.F.R. Part 54.

## VII. NEPA CONTENTION NYS-12C (SAMA – Decontamination and Clean-Up Costs)

### A. Statement of Contention NYS-12C

NYS-12C, a SAMA contention that challenges the accuracy severe accident cost estimates, as litigated on October 17 and 18, 2012, reads as follows:

> Entergy's severe accident mitigation alternatives (SAMA) for Indian Point 2 and Indian Point 3 does not accurately reflect decontamination and clean up costs associated with a severe accident in the New York Metropolitan Area and, therefore, Entergy's SAMA Analysis underestimates the cost of a severe accident in violation of 10 C.F.R. § 51.53(c)(3)(ii)(L).[1398]

### B. NYS-12C Background

#### 1. NYS-12C Procedural History

As filed by New York on November 30, 2007, NYS-12 contended that Entergy's SAMA analysis did "not accurately reflect decontamination and clean up costs associated with a severe accident in the New York City metropolitan area, and therefore, [that] Entergy's SAMA analysis underestimates the cost of a severe accident."[1399] Accordingly, New York alleged that the SAMA analysis failed to satisfy the requirements of 10 C.F.R. § 51.53(c)(3)(ii)(L).

New York claimed that the cost formula contained in the MACCS2 computer program used by Entergy underestimates the cost associated with a severe accident due to its use of unrealistic decontamination costs.[1400] According to New York, a "severe accident resulting in the dispersion of radionuclides from a nuclear power plant likely will result in the dispersion of small sized radionuclides" that are more expensive to remove and clean up than large-sized radionuclide particles.[1401] Accordingly, New York argued that this error compromised the values for CDNFRM and TIMDEC used as inputs to MACCS2 – the Applicant's analytical model used

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[1398] New York Petition at 140.

[1399] Id.

[1400] Id.

[1401] Id. at 141.

to perform its SAMA analysis,"[1402] and, as a result the SAMA analysis in the LRA did not accurately determine which mitigation measures are cost effective.[1403]

NYS-12 was admitted by the Board on July 31, 2008, to the extent that it challenged the reasonableness of "the cost data for decontamination and clean up used in MACCS2."[1404] Thereafter, New York amended NYS-12 three times. In the first two amendments, NYS-12A and NYS-12B, New York sought to apply NYS-12 to the NRC Staff's DSEIS[1405] and Entergy's revised SAMA analysis,[1406] respectively. Both revised contentions were admitted.[1407] New York then submitted NYS-12C in February 2011 to update NYS-12B based on the NRC Staff's issuance of the FSEIS.[1408] In each submission, New York continued to maintain that the SAMA analysis substantially underestimated the cost of a severe accident by substantially underestimating the costs of decontamination measures.[1409] We admitted NYS-12C replacing NYS-12/12A/12B.[1410]

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[1402] Id.

[1403] Id. at 141–42.

[1404] LBP-08-13, 68 NRC 43, 102.

[1405] See State of New York Contentions Concerning NRC Staff's Draft Supplemental Environmental Impact Statement (Feb. 27, 2008). Note that New York's filing was submitted in 2009, not 2008 as indicated in the original filing.

[1406] See State of New York's Motion for Leave to File New and Amended Contentions Concerning the December 2009 Reanalysis of Severe Accident Mitigation Alternatives (Mar. 11, 2010).

[1407] See Licensing Board Order (Ruling on New York State's New and Amended Contentions) at 3–4 (June 16, 2009) (unpublished); see also LBP-10-13, 71 NRC 673, 683–84 (June 30, 2010).

[1408] See State of New York Contention 12-C Concerning NRC Staff's December 2010 Final Environmental Impact Statement and the Underestimation of Decontamination and Clean Up Costs Associated With a Severe Reactor Accident in the New York Metropolitan Area (Feb. 3, 2011).

[1409] Id. at 1.

[1410] Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 9 (unpublished).

### 2. Legal Standards and Issues Related to NYS-12C

NYS-12C arises under NEPA and the NRC's implementing Part 51 regulations,[1411] and, as noted above, challenges the SAMA analysis required by 10 C.F.R. § 51.53(c)(3)(ii)(L). As discussed in the introductory section of this decision, the goal of NEPA is two-fold: (1) to ensure that agency decisionmakers will have detailed information concerning significant environmental impacts of proposed projects when they make their decisions; and (2) to guarantee that such information will be available to the larger audience that may also play a role in the decision-making process.[1412]

As previously noted, NEPA does not mandate substantive results; rather, NEPA imposes procedural obligations on Federal agencies, requiring them to take a "hard look" at the environmental impacts of a proposed action and reasonable alternatives to that action.[1413] This standard requires the agency to undertake a rigorous exploration and an objective analysis of environmental impacts. Merely offering "general statements about 'possible' effects and 'some risk' do[es] not constitute a 'hard look' absent a justification regarding why more definitive information could not be provided."[1414] Taking a hard look "'foster[s] both informed decision-making and informed public participation,'"[1415] and thus ensures that the agency does not act upon "'incomplete information, only to regret its decision after it is too late to correct.'"[1416]

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[1411] 42 U.S.C. §§ 4321–70; 10 C.F.R. pt. 51.

[1412] Robertson, 490 U.S. at 349.

[1413] La. Energy Servs., L.P. (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87–88 (1998); see also Balt. Gas & Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87, 97 (1983) (holding that NEPA requires agencies to take a "hard look" at environmental consequences prior to taking major actions).

[1414] Pa'ina Haw., L.L.C., CLI-10-18, 72 NRC at 74 (quoting Blue Mountains Biodiversity Project, 161 F.3d at 1213).

[1415] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 88 (quoting Carmel-by-the-Sea v. Dep't of Transp., 123 F.3d 1142, 1150–51 (9th Cir. 1997)).

[1416] Id. (quoting Marsh v. Or. Natural Res. Council, 490 U.S. 360, 371 (1989)).

NEPA's "hard look," however, is tempered by a "rule of reason."[1417] An agency need only address reasonably foreseeable impacts, not those that are "remote and speculative" or "inconsequentially small."[1418] NEPA requires only "[r]easonable forecasting."[1419] As the Commission stated in its Pilgrim decision:

> NEPA "should be construed in the light of reason if it is not to demand" virtually infinite study and resources. Nor is an environmental impact statement intended to be a "research document," reflecting the frontiers of scientific methodology, studies and data. . . . And while there "will always be more data that could be gathered," agencies "must have some discretion to draw the line and move forward with decisionmaking." In short, NEPA allows agencies "to select their own methodology as long as that methodology is reasonable."[1420]

Performed under NEPA, a SAMA analysis evaluates the degree to which specific additional mitigation measures may reduce the probability or consequences of various accident scenarios on a site-specific basis.[1421] It is a quantitative cost-benefit analysis, comparing the costs of implementing a mitigation measure against the value of its benefit.[1422] The analysis also takes into account the probabilities of accident scenarios, so that the analysis ultimately

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[1417] La. Energy Servs., L.P. (National Enrichment Facility), LBP-06-8, 63 NRC 241, 258–59 (2006) (citing Long Island Lighting Co. (Shoreham Nuclear Power Station), ALAB-156, 6 AEC 831, 836 (1973)); see also Dep't of Transp. v. Pub. Citizen, 541 U.S. 752, 767 (2004) (stating that the rule of reason is inherent in NEPA and its implementing regulations).

[1418] See, e.g., Shoreham, ALAB-156, 6 AEC at 836. According to the Council on Environmental Quality (CEQ), the "rule of reason" is "a judicial device to ensure that common sense and reason are not lost in the rubric of regulation." Final Rule: National Environmental Policy Act Regulations; Incomplete or Unavailable Information, 51 Fed. Reg. 15,618, 15,621 (Apr. 25, 1986).

[1419] Scientists' Inst. for Pub. Info., Inc. v. AEC, 481 F.2d 1079, 1092 (D.C. Cir. 1973); see also Robertson, 490 U.S. at 354–55, 359 (rejecting the notion that NEPA requires a "worst case analysis").

[1420] Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 315–16 (2010) (internal citations omitted).

[1421] Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), CLI-12-15, 75 NRC 704, 706 (2012); Duke Energy Corp. (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-02-17, 56 NRC 1, 5 (2002).

[1422] Pilgrim, CLI-12-15, 75 NRC at 706–07.

"assesses whether and to what extent the probability-weighted consequences of the analyzed severe accident sequences would decrease if a specific mitigation alternative were implemented."[1423] A SAMA analysis must necessarily be site specific "[b]ecause the potential consequences [of a severe accident] will largely be the product of the location of the plant . . . ."[1424]

SAMA analyses, as issues of mitigation, "need only be discussed in 'sufficient detail to ensure that environmental consequences [of the proposed project] have been fairly evaluated.'"[1425] According to the Commission, in the SAMA context NEPA requires the FSEIS to include an analysis containing reasonable estimates. More specifically, the Commission stated that in order to satisfy its obligations under NEPA the FSEIS need only explain any

> known shortcomings in available methodology, disclosure of incomplete or unavailable information and significant uncertainties, and a reasoned evaluation of whether and to what extent these or other considerations credibly could . . . alter the . . . SAMA analysis conclusions . . . .[1426]

As a NEPA analysis, "the SAMA analysis is not based on either the best-case or the worst-case accident scenarios, but on mean accident consequence values, averaged over the many hypothetical severe accident scenarios . . . ."[1427] When assessing a SAMA analysis, "the question is not whether more or different analysis can be done."[1428] It is clear that "because the SAMA analysis is largely quantitative, resting on inputs used in computer modeling, it will

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[1423] Id. at 707 (internal quotation marks omitted).

[1424] Limerick Ecology Action, Inc. v. NRC, 869 F.2d 719, 739 (3d Cir. 1989)

[1425] McGuire & Catawba, CLI-03-17, 58 NRC at 431 (alteration in original) (quoting Robertson, 490 U.S. at 353).

[1426] Pilgrim, CLI-10-22, 72 NRC at 208–09.

[1427] Pilgrim, CLI-12-15, 75 NRC at 708.

[1428] Id. at 714.

always be possible to propose that the analysis use one or more other inputs."[1429] Put another way, "[g]iven the quantitative nature of the SAMA analysis, where the analysis rests largely on selected inputs, it may always be possible to conceive of alternative and more conservative inputs, whose use in the analysis could result in greater estimated accident consequences."[1430] Simply because alternate inputs could be used, does not demonstrate that the original inputs used were unreasonable.[1431] Like other NEPA evaluations, the SAMA analysis evaluation is governed by the rule of reason and "alternatives must be bounded by some notion of feasibility."[1432] The Commission has therefore stressed that the "proper question is not whether there are plausible alternative choices for use in the analysis, but whether the analysis that was done is reasonable under NEPA."[1433] To be successful, New York thus must point to a deficiency that renders the SAMA analysis unreasonable under NEPA.

### 3. Evidentiary Record Related to NYS-12C

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-12C

Entergy presented three witnesses to provide testimony on NYS-12C – Lori A. Potts,[1434] Dr. Kevin R. O'Kula,[1435] and Grant A. Teagarden.[1436] On March 30, 2012, Entergy filed the

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[1429] FirstEnergy Nuclear Operating Co. (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-08, 75 NRC 393, 406 (emphasis in original).

[1430] NextEra Energy Seabrook, L.L.C. (Seabrook Station, Unit 1), CLI-12-05, 75 NRC 301, 323 (Mar. 8, 2012).

[1431] Id.

[1432] Pilgrim, CLI-12-15, 75 NRC at 724 (citations omitted).

[1433] Seabrook, CLI-12-05, 75 NRC at 323.

[1434] Curriculum Vitae of Lori A. Potts (Ex. ENT000004).

[1435] Curriculum Vitae of Kevin R. O'Kula (Ex. ENT000005).

[1436] Curriculum Vitae of Grant A. Teagarden (Ex. ENT000007).

written testimony of these three witnesses,[1437] which was admitted into evidence on October 15, 2012.[1438]

The NRC Staff presented four witnesses to provide testimony on NYS-12C – Dr. Nathan E. Bixler,[1439] Dr. S. Tina Ghosh,[1440] Joseph A. Jones,[1441] and Donald G. Harrison.[1442] On March 30, 2012, the NRC Staff filed the written testimony of these four witnesses,[1443] which was admitted into evidence on October 15, 2012.[1444]

New York presented one witness to provide testimony on NYS-12C – Dr. François J. Lemay.[1445] On December 21, 2011, New York filed the written testimony of Dr. Lemay.[1446] On

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[1437] See Testimony of Entergy Witnesses Lori Potts, Kevin O'Kula, and Grant Teagarden on Consolidated Contention NYS-12C (Severe Accident Mitigation Alternatives Analysis) (Mar. 30, 2012) (Ex. ENT000450) [hereinafter Entergy NYS-12C Testimony].

[1438] Tr. at 1269 (Judge McDade).

[1439] Nathan Bixler Statement of Professional Qualifications (Ex. NRC000042).

[1440] Tina Ghosh Statement of Professional Qualifications (Ex. NRC000043).

[1441] Joseph Jones Statement of Professional Qualifications (Ex. NRC000044).

[1442] Donald Harrison Statement of Professional Qualifications (Ex. NRC000045).

[1443] See NRC Staff Testimony of Nathan E. Bixler, S. Tina Ghosh, Joseph A. Jones, and Donald G. Harrison Concerning NYS' Contentions NYS 12/16 (Mar. 30, 2012) (Ex. NRC000041) [hereinafter NRC Staff NYS-12C/16B Testimony].

[1444] Tr. at 1269 (Judge McDade).

[1445] Curriculum Vitae of Dr. François J. LeMay (Ex. NYS000291).

[1446] See Pre-Filed Written Testimony of Dr. François J. Lemay Regarding Consolidated NYS-12-C (NYS-12/12-A/12-B/12-C) (Dec. 21, 2011) (Ex. NYS000241) [hereinafter New York NYS-12C Testimony].

June 29, 2012, New York submitted written rebuttal testimony by Dr. Lemay.[1447] Both of these submissions were admitted into evidence on October 15, 2012.[1448]

**b. Identification of Admitted Exhibits Relevant to NYS-12C**

Relevant to NYS-12C, Entergy submitted 41 exhibits, the Staff submitted 23 exhibits, and New York submitted 110 exhibits.[1449] These exhibits were admitted into the record on October 15, 2012.[1450]

**c. Significant NRC Staff Guidance Documents, Industry Guidance Documents, and Corporate Procedures Relevant to NYS-12C**

1. NUREG-1150, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (Dec. 1990) (Exs. NYS00252A–C). NUREG-1150 is a guidance document published by the NRC that presents an assessment of the risks from severe accidents based on studies representing five commercial nuclear power plants in the US.[1451] It summarizes the results of those studies and provides perspectives on how the results may be used by the NRC in carrying out its safety and regulatory responsibilities.[1452] NUREG-1150 states that its objective is to provide a current assessment of the severe accident risks of nuclear power plants of different designs, to summarize the perspectives gained in performing these risk analyses, and to

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[1447] See Pre-Filed Written Rebuttal Testimony of Dr. François J. Lemay Regarding Consolidated Contention NYS-12C (NYS-12/12-A/12-B/12-C) (June 29, 2012) (Ex. NYS000420) [hereinafter New York NYS-12C Rebuttal Testimony].

[1448] Tr. at 1269 (Judge McDade).

[1449] See Appendix B - Partial Initial Decision.

[1450] Tr. at 1269 (Judge McDade).

[1451] RES, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (NUREG-1150) at iii (Dec. 1990) (Exs. NYS00252A–D) [hereinafter NUREG-1150].

[1452] Id. at 1-2.

provide a set of probabilistic risk assessment (PRA) models and results that can support the ongoing prioritization of potential safety issues and related research.[1453]

2. NEI 05-01, Rev. A, Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document (Nov. 2005) (Ex. NYS000287). NEI 05-01 was published by the Nuclear Energy Institute, a trade association that represents the nuclear industry. NEI 05-01 states that it provides a template for completing a SAMA analysis to support license renewal,[1454] and that it was developed to provide guidance to reactor license renewal applicants for completing the SAMA analysis required by NRC's regulations.[1455] The stated purpose of this document is to identify information that should be included in the SAMA portion of an LRA ER to reduce the need for NRC requests for additional information.[1456]

3. NUREG/CR-6613,[1457] Code Manual for MACCS2, Vol. 1, User's Guide (May 1998) (Ex. NYS000243). This report describes the MACCS2 code. It states that it is intended to allow experienced users of the MACCS2 code or other consequence codes to prepare input files and interpret code results.[1458]

4. NUREG/CR-4551, SAND86-1309, Vol. 2, Rev. 1, Part 7, Evaluation of Severe Accident Risks: Quantification of Major Input Parameters (Dec. 1990) (Ex. NYS000248). This

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[1453] Id.

[1454] Nuclear Energy Institute, Severe Accident Mitigation Alternatives (SAMA Analysis) Guidance Document (NEI 05-01) at 1 (Nov. 2005) (Ex. NYS000287) [hereinafter NEI 05-01].

[1455] Id.

[1456] Id.

[1457] The NUREG/CR designation indicates that this is a Contractor Report.

[1458] NUREG/CR-6613, Code Manual for MACCS2, Vol. 1, User's Guide at xi (May 1998) (Ex. NYS000243) [hereinafter MACCS2 User's Guide].

report presents the results of the reviews of MACCS[1459] input parameters.[1460] Specifically, this report provides recommended MACCS values for, among others, economic input parameters and the basis for their selection.[1461]

5. NUREG/CR-3673, Sandia National Labs, Economic Risks of Nuclear Power Reactors Accidents (May 1984) (Ex. NRC000058). At the time of its publication, NUREG/CR-3673 developed and employed improved models to estimate the economic risks from unanticipated events which possibly occur during nuclear reactor operation.[1462] This report developed offsite consequences that result from a severe accident.[1463]

**C. Evidence Related to SAMA – Decontamination and Clean-up Costs**

Entergy's witnesses testified that their SAMA analysis evaluates "potential long-term severe accident consequence scenarios for the purpose of making reasonable cost-benefit evaluations under NEPA."[1464] According to these witnesses, the SAMA analysis was not designed to model a single radiological release event under specific conditions at a single moment in time because it is concerned with mean annual consequences.[1465] Instead, as Entergy's witnesses testified, "it models numerous accident release conditions that could, based on probabilistic analysis, occur at any time under varying weather conditions during a one-year

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[1459] The MACCS code is the earlier version of the MACCS2 code. Id. at 1-3 to -4. The first version of MACCS released to the public was distributed by Sandia in 1987. Id. at 1-2. MACCS2 was developed and first released to the public in 1998. Id. at 1-4.

[1460] NUREG/CR-4551, SAND86-1309, Vol. 2, Rev. 1, Part 7, Evaluation of Severe Accident Risks: Quantification of Major Input Parameters at iii (Dec. 1990) (Ex. NYS000248).

[1461] Id.

[1462] Sandia National Labs, Economic Risks of Nuclear Power Reactors Accidents (NUREG/CR-3673) at EX-1 (May 1984) (Ex. NRC000058) [hereinafter NUREG/CR-3673].

[1463] Id.

[1464] Entergy NYS-12C Testimony at 18 (Ex. ENT000450).

[1465] Id.

period. The goal was to estimate annual average impacts for the entire 50-mile radius study area."[1466]

Entergy's witnesses further testified that their SAMA analysis was intended to "identify potential changes to a nuclear power plant, or its operations, that could reduce the already-low risk (the likelihood and/or the impact) of a severe accident for which the benefit of implementing the change may outweigh the cost of implementation."[1467] They stated that potential changes that could reduce the risk of a severe accident (called SAMAs or SAMA candidates) include hardware modifications or operational changes.[1468]

Entergy's witnesses stated that, in order to identify SAMAs or SAMA candidates, a four-step SAMA analysis was completed,[1469] including:

> (1) characterizing the overall plant severe accident risk and the leading contributors to the risk; (2) identifying potential plant improvements (*i.e.*, SAMA candidates) that could reduce the risk of a severe accident; (3) quantifying the risk-reduction potential and the implementation cost for each SAMA candidate; and (4) determining whether implementation of the SAMA candidates may be cost-effective.[1470]

Documentation submitted by the Applicant to the NRC Staff reflects that Entergy followed this four-step approach in performing its SAMA analysis for IPEC.[1471] According to Dr. O'Kula and Mr. Teagarden for Entergy, in order to identify cost-beneficial (*i.e.*, cost-effective) SAMAs, an implementation cost assessment is performed for each SAMA, the estimated benefit of each

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[1466] Id. (emphasis omitted).

[1467] Id. at 17.

[1468] Id.

[1469] Id. at 18.

[1470] Id.

[1471] See License Renewal Application at 4-48 to -50 (Ex. ENT00015B). Entergy also followed this approach in performing its December 2009 revised SAMA; see also NL-09-165, Attach. 1 at 3–9 (Ex. ENT000009).

SAMA is compared to its estimated implementation cost,[1472] and if the benefit of the SAMA is greater than its cost, the SAMA is considered cost beneficial.[1473] The Staff's review of Entergy's SAMA analysis is summarized in Section 5.2 of the FSEIS and documented in full in Appendix G of the FSEIS.[1474]

Entergy used the MACCS2 computer code to perform the IPEC SAMA analysis in order to estimate plant-specific offsite population doses and economic consequences that could result from the postulated accidental release of radioactive materials to the atmosphere during a severe accident at IPEC.[1475] The MACCS2 code purports to offer users flexibility by facilitating the performance of site-specific calculations and evaluations of sensitivities and uncertainties.[1476]

According to various witnesses for Entergy, Entergy used certain inputs to its MACCS2 modeling to provide offsite consequence information, including meteorological data, population distribution within the 50-mile SAMA analysis region for the projected year 2035, reactor core radionuclide inventories, source term and release characteristics, and region-specific economic data that are considered site specific, and that Entergy used values that appear in NUREG-1150 as inputs to the MACCS2 code.[1477] These NUREG-1150 values are the focus of NYS-12C.

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[1472] Entergy NYS-12C Testimony at 22–23 (Ex. ENT000450).

[1473] Id. at 23.

[1474] See FSEIS at 5-4 to -13 (Dec. 2010) (Exs. NYS00133B–C); see also id. at G-1 to -51 (Ex. NYS00133I).

[1475] Entergy NYS-12C Testimony at 23–24 (Ex. ENT000450).

[1476] MACCS2 User's Guide at 1-2 (Ex. NYS000243). MACCS2 was developed because of the inability of its predecessor code, CRAC2, to offer sufficient flexibility for the performance of sensitivity studies and the evaluation of alternative parameter values for its models. Id.

[1477] Entergy NYS-12C Testimony at 62 (Ex. ENT000450); Tr. at 1947–50, 2064–66 (Mr. Teagarden for Entergy). Site-specific inputs refer to parameters such as metrological data, population distributions, land value, etc.

As discussed below, New York took issue with the use of the NUREG-1150 values, and proposed alternative values for the following MACCS2 inputs:

> CDNFRM, which defines the nonfarmland decontamination cost per individual for each level of decontamination.
>
> TIMDEC, which defines the time required for completion of each of the decontamination levels.
>
> VALWNF, which defines the value of the per capita nonfarm wealth in the region.
>
> POPCST, which defines the per capita removal cost for temporary or permanent relocation of population and businesses in a region rendered uninhabitable during the long-term phase time period.
>
> DPRATE, which defines the depreciation rate applied to property improvements during the period of interdiction.
>
> DSRATE, which defines the expected rate of return from land, buildings, equipment, etc. (*e.g.*, the inflation-adjusted real mortgage rate for land and buildings could be used).
>
> FRNFIM, which defines the nonfarm wealth improvements fraction.[1478]

Except for VALWNF, which was developed using economic data specific to the IPEC region, all other parameters used by Entergy in the IP2 and IP3 SAMA analyses were selected from the Sample Problem A values presented in NUREG-1150.[1479] It was uncontested that the TIMDEC and CDNFRM input values have the most significant impact among the MACCS2 parameters at

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[1478] See Entergy NYS-12C Testimony at 65–67 (Ex. ENT000450) (identifying values that New York's expert witness, Dr. Lemay, proposes different values); see also MACCS2 User's Guide at 7-13 to -14, 7-18, 7-10 to -11 (Ex. NYS000243).

[1479] New York NYS-12C Testimony at 9, 21 (Ex. NYS000241). MACCS2 User's Guide contains fourteen sample problems. MACCS2 User's Guide at 4-1 to -9 (Ex. NYS000243). The MACCS2 User's Guide uses these sample problems to compare the MACCS and MACCS2 codes and to illustrate different aspects of code functionality. See id. at 4-3. Sample Problem A is based on input data used for the NUREG-1150 assessment of Surry Unit 1. Id. "Sample Problem A input values" is synonymous with "NUREG-1150 values".

issue here, with the others being essentially irrelevant to the MACCS2 model's economic cost results.[1480] Therefore, the Board limits its consideration to these two values.

The TIMDEC parameter defines the time required for completion of each of the user-selected decontamination levels.[1481] The MACCS2 code requires users to input this decontamination time for each level of decontamination effectiveness being assessed (*i.e.*, dose reduction factor or DRF).[1482] Entergy used an input of 60 days for a DRF of 3 and 120 days for DRF of 15.[1483] Entergy witnesses accurately testified that the two DRFs and the associated decontamination times (60 and 120 days) used by the Applicant in its SAMA analyses "are fully consistent with the NUREG-1150 values for those MACCS2 parameters."[1484]

The CDNFRM input to MACCS2 defines the nonfarmland decontamination cost per individual for each level of decontamination considered.[1485] Similar to TIMDEC, the MACCS2 code requires users to input CDNFRM values for each DRF.[1486] Entergy witnesses testified that Entergy selected values of $5,184/person and $13,824/person for DRFs of 3 and 15, respectively,[1487] which were based on the Sample Problem A inputs (*i.e.*, $3,000/person and

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[1480] Tr. at 2054 (Dr. Lemay for New York). During the hearing, New York's expert, Dr. Lemay, stated that "[i]t was our assessment that CDNFRM and TIMDEC were the most important ones, and the rest had minimal impact on the calculation of the offsite economic cost." Id. at 2054–55.

[1481] MACCS2 User's Guide at 7-10 (Ex. NYS000243).

[1482] Entergy NYS-12C Testimony at 89 (Ex. ENT000450). The DRF is the ratio of the radiological dose (typically 1 meter above the surface) before the remediation activity to the dose after the remediation activity. Id. at 67. A DRF of 3 means that the resulting population dose at that location will be reduced to one-third of what it would be without decontamination activity. Id. A DRF of 15 means that the resulting population dose at the location would be reduced to 1/15 of what it would have been without decontamination. Id.

[1483] Id. at 72.

[1484] Id.

[1485] MACCS2 User's Guide at 7-11 (Ex. NYS000243).

[1486] Id.

[1487] Entergy NYS-12C Testimony at 89 (Ex. ENT000450).

$8,000/person, respectively), and adjusting these values using the ratio of current to past consumer price indices (CPIs).[1488]

According to the testimony of its witnesses, in preparing its SAMA analysis, Entergy used these input values in the CHRONC module of the MACCS2 code.[1489] This module of the MACCS2 code calculates, among other things, the economic costs associated with both an emergency phase and a long-term phase following a severe accident.[1490] The CHRONC module calculates the offsite population dose incurred during the long-term phase and the economic costs of both phases for one weather sequence.[1491] The MACCS2 code output, which is the offsite economic cost consequence and offsite population dose values, was multiplied by the calculated severe accident frequency.[1492] This calculation resulted in the key risk values of interest for determining potentially cost-beneficial SAMAs: population dose risk (PDR); and offsite economic cost risk (OECR).[1493] The individual PDRs and OECRs from the spectrum of different accident release categories were then summed to determine the overall PDR and overall OECR for the SAMA analysis.[1494]

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[1488] Id.; Tr. at 1951 (Mr. Teagarden for Entergy). NEI 05-01 states that economic data should be expressed in today's dollars by being converted to today's dollars using the ratio of current to past consumer price indices. NEI 05-01 at 13 (Ex. NYS000287).

[1489] The CHRONC module is one of three modules in the MACCS2 code (along with ATMOS and EARLY) that executes in sequence to calculate consequence values necessary for a SAMA analysis. See MACCS2 User's Guide at 2-1 (Ex. NYS000243).

[1490] Id. at 7-1. The CHRONC module of MACCS2 also calculates the long-term offsite population dose (following the emergency-phase time period) due to direct exposure from contaminated ground and inhalation of suspended material, and indirect exposure due to ingestion of contaminated foods and water. Id.

[1491] Entergy NYS-12C Testimony at 41 (Ex. ENT000450).

[1492] Id. at 45. As explained above, the first step of the SAMA analysis is to characterize the overall plant severe accident risk by developing a plant specific PRA. Id. at 18–19.

[1493] Id. at 45.

[1494] Id.

To identify SAMAs that may be cost beneficial, the benefit in terms of mitigated consequences of each mitigation alternative, or SAMA, was estimated in accordance with NRC guidance documents and compared with the estimated cost of implementing the proposed SAMA.[1495] The results of the cost-benefit analysis of IPEC's SAMA candidates are documented in NL-09-165 and in Appendix G of the FSEIS.[1496]

The Staff reviewed the CDNFRM and TIMDEC inputs selected by Entergy and found them reasonable based on the available information and appropriate for a NEPA analysis at IP2 and IP3.[1497] Section 5.2 and Appendix G of the FSEIS contain a discussion and evaluation of the IP2 and IP3 SAMA analyses, including the methods used in those analyses and results.[1498] Additionally, the NRC Staff's review of Entergy's SAMA analysis is summarized in Section 5.2 of the FSEIS and documented in Appendix G of the FSEIS.[1499] The details of the Staff's position will not be discussed here as it is not materially different from the Entergy's position outlined above.[1500]

New York's witness, Dr. Lemay, asserted that Entergy, in its SAMA analysis, failed to adequately address site-specific assumptions and inputs related to clean-up and decontamination costs in the New York City metropolitan region in the event of a severe accident at IPEC.[1501] Dr. Lemay, testified that developing site-specific MACCS2 Code inputs is important because

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[1495] Id. at 46.

[1496] See NL-09-165 at 5–9 (Ex. ENT000009).

[1497] NRC Staff NYS-12C/16B Testimony at 12–16 (Ex. NRC000041).

[1498] See FSEIS at 5-1 to -13, G-1 to -51 (Ex. NYS00133B–C, I).

[1499] See id. at 5-4 to -12 (Exs. NYS00133B–C); see also id. at G-1 to -51 (Ex. NYS00133I).

[1500] See, e.g., NRC Staff's Initial Statement of Position on Consolidated Contention NYS-12C (Mar. 30, 2012).

[1501] New York NYS-12C Testimony at 7 (Ex. NYS000241).

> [i]nputs to the MACCS2 code are dependent on the locations of the nuclear reactor. The costs and methods of cleaning up after a severe accident will be very different depending on whether a reactor is surrounded by farmland, forests, suburban areas, urban areas, or hyper-urban areas. Thus, to determine reasonable input values, one must look at site-specific data or, where site-specific data is not available, modify available data to reflect site-specific conditions.[1502]

Dr. Lemay further asserted that Entergy's decision to use Sample Problem A values in NUREG-1150, rather than developing site-specific MACCS2 input parameters, led to a substantial underestimation of the costs of decontamination measures which must be considered in Entergy's LRA.[1503]

Dr. Lemay focused on two MACCS2 code input parameters: TIMDEC and CDNFRM.[1504] He testified that Entergy's underestimation of decontamination costs is primarily a result of Entergy's use of MACCS2 Sample Problem A input values for the CHRONC module. This underestimation, according to Dr. Lemay, "was mostly due to costs and times for decontamination that were unrealistic given current known decontamination data and the complexities of an urban to hyper-urban area such as that surrounding IP."[1505]

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[1502] Id. at 19–20.

[1503] Id. at 7–8.

[1504] See ISR Report at iii-iv (Ex. NYS000242). As indicated above, New York challenges additional input parameters. However, as Dr. Lemay stated and as discussed above, the TIMDEC and CDNFRM parameters are the most important. Tr. at 2054 (Dr. Lemay for New York). Dr. Lemay's focus on TIMDEC and CDNFRM is largely the result of performing a sensitivity analysis on MACCS2 input parameters. New York NYS-12C Testimony at 23 (Ex. NYS000241). He stated that a sensitivity analysis was performed "to determine which input parameters directly and most significantly affect the costs of mitigative actions following a severe accident." Id. at 23–24. Based on this sensitivity analysis, New York's witness testified that he determined decontamination costs are the dominant factor in the evaluation of remediation costs following a severe accident. Id. at 27; Tr. at 2054–55 (Dr. Lemay for New York). Dr. Lemay also testified that the decontamination factor was also determined to be one of the most sensitive parameters related to decontamination costs. New York NYS-12C Testimony at 27 (Ex. NYS000241). However, he did not challenge the decontamination factors chosen by Entergy. Id.

[1505] Id. at 70.

Dr. Lemay further testified that Entergy's TIMDEC values have not been justified,[1506] and by comparing the time utilized by Entergy to decontaminate the impacts of a severe accident to the decontamination time associated with two actual severe accidents – Chernobyl and Fukushima – it was evident to him that Entergy's TIMDEC values are unreasonable input values.[1507] Based on the time required to decontaminate the areas surrounding those two accidents, Dr. Lemay stated that decontamination times between 2 to 15 years (versus 60 days for a DRF of 3) and between 4 and 30 years (versus 120 days for a DRF of 15) are more reasonable.[1508] He testified that, if all other parameters used by Entergy remain unchanged, the resulting OECR, based on changing decontamination time, is 3 to 5.7 times higher than the OECR calculated by Entergy.[1509] Dr. Lemay stated that "the only real support NRC Staff or Entergy's testimony provides for the . . . TIMDEC values is NUREG-1150 and NUREG/CR-3673 . . . "[1510] which rely on values that are not reasonable.

Regarding the CDNFRM parameter, Dr. Lemay took issue with Entergy's use of $5,184/person and $13,824/person for decontamination cost values.[1511] As stated above, Entergy obtained these values by adjusting values from NUREG-1150 of $3,000/person and

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[1506] Id. at 54.

[1507] Id. at 51–55.

[1508] ISR Report at 24–25 (Ex. NYS000242); New York NYS-12C Testimony at 51–55 (Ex. NYS000241). It is noted, as Dr. Lemay testified, that the MACCS2 code limits decontamination times to a maximum of one year. ISR Report at 24 (Ex. NYS000242); Tr. at 2200–04 (Dr. Lemay for New York). Therefore, New York's witness had to modify the source code to allow for the possibility that decontamination would take longer than the values used by Entergy (*i.e.*, values greater than one year). ISR Report at 24 (Ex. NYS000242).

[1509] Id. at 24–25; New York NYS-12C Testimony at 51–55 (Ex. NYS000241).

[1510] New York NYS-12C Rebuttal Testimony at 48 (Ex. NYS000420).

[1511] ISR Report at 11 (Ex. NYS000242); New York NYS-12C Testimony at 30 (Ex. NYS000241). As stated above, the difference in these values is attributed to the use of a dose reduction factor of 3 and a dose reduction factor of 15.

$8,000/person by the CPI change from 1986 to 2005.[1512] Dr. Lemay testified that the source of the decontamination cost parameters in NUREG-1150 is unknown, and thus a factual basis for the decontamination cost parameters used by Entergy, simply does not exist.[1513] He added that Entergy's reliance on these NUREG-1150 numbers leads to an underestimation of the decontamination costs.[1514]

In support of his testimony, Dr. Lemay developed a methodology to calculate site-specific CDNFRM values for the IPEC region,[1515] which resulted in CDNFRM values much higher than the values calculated by Entergy using NUREG-1150 values.[1516] Given this discrepancy, Dr. Lemay asserted that Entergy's use of NUREG-1150 input values is not reasonable for the IPEC region.[1517]

It should be noted that Dr. Lemay made clear that his approach to calculate site-specific CDNFRM values was not an independent SAMA analysis and was not intended to be used as a substitute analysis to satisfy NEPA.[1518] Instead, he only suggested that his report shows that Entergy's and the NRC Staff's SAMA analysis underestimated the economic costs of a severe

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[1512] Entergy NYS-12C Testimony at 53 (Ex. ENT000450).

[1513] New York NYS-12C Rebuttal Testimony at 16–25 (Ex. NYS000420).

[1514] New York NYS-12C Testimony at 7 (Ex. NYS000241).

[1515] ISR Report at 13–14 (Ex. NYS000242). First, ISR divided the spatial grid within the 50-mile radius of the IPEC region defined in the Entergy MACCS2 site input file into two discrete areas for the purpose of evaluation: (a) the "NYC metropolitan area," and (b) "the areas outside of the NYC metropolitan area." Id. at 13. Second, for each of these areas, ISR calculated the costs of light and/or heavy decontamination using decontamination costs obtained from four sources. Id. Third, for each approach, ISR calculated a single total cost for the IPEC region. Id. at 14. Fourth, ISR divided the total cost by the total population. Id. Lastly, ISR updated the per capita costs to 2005 dollars using the CPI. Id.

[1516] See id. at 24–25. The range of CDNFRM values developed by New York's expert range from $19,000/person to approximately $900,000/person, depending on the level of decontamination modeled. Id. at 23.

[1517] New York NYS-12C Testimony at 30 (Ex. NYS000241).

[1518] New York NYS-12C Rebuttal Testimony at 5 (Ex. NYS000420).

accident at IPEC through the use of non-site specific generic assumptions that make their SAMA analysis unreasonable.[1519]

Dr. Lemay also took issue with Entergy's claim that the NUREG-1150 CDNFRM values used "have a long-established and appropriate technical basis."[1520] He stated that Entergy's and the NRC Staff's reliance upon undocumented and unsupported CDNFRM values is unreasonable,[1521] and that neither Entergy nor the NRC Staff has provided a documented basis for the CDNFRM value used in the calculation of economic costs associated with a severe accident at IPEC.[1522] Dr. Lemay also stated that NUREG-1150 does not contain the source of the CDNFRM value used by Entergy.[1523] According to him, instead of providing an extensive discussion of the methods used in developing decontamination cost values, NUREG-1150 directs the reader to NUREG/CR-4551 (*i.e.*, a companion study published in December 1990) and NUREG/CR-4691 (*i.e.*, the MACCS manual).[1524] These documents, in his opinion, do not provide a discussion of how the CDNFRM values in Sample Problem A were obtained.[1525]

Although recognizing that Entergy and the NRC Staff cite NUREG/CR-3673 in an attempt to justify the CDNFRM values used by the Applicant,[1526] Dr. Lemay opined that this

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[1519] Tr. at 2149–51 (Dr. Lemay for New York).

[1520] Entergy NYS-12C Testimony at 129 (Ex. ENT000450). The NRC witnesses make similar claims. NRC Staff NYS-12C/16B Testimony at 44–45 (Ex. NRC000041).

[1521] New York NYS-12C Rebuttal Testimony at 16–25 (Ex. NYS000420).

[1522] Id. at 3.

[1523] Tr. at 2149–51 (Dr. Lemay for New York).

[1524] New York NYS-12C Rebuttal Testimony at 20 (Ex. NYS000420) (citing NUREG-1150 at 2-20 (Ex. NYS00252A)) ("The reader seeking extensive discussion of the methods used is directed to Reference 2.8 and to Reference 2.36, which discusses the computer code used to perform the offsite consequence analysis (*i.e.*, the MELCOR Accident Consequence Code System (MACCS), Version 1.5).").

[1525] Id. at 21.

[1526] Id. (citing NRC Staff NYS-12C/16B Testimony at 97–98 (Ex. NRC000041)).

document provides inadequate support for the values selected by Entergy.[1527] Dr. Lemay noted that NUREG/CR-3673 gives approximate costs of decontamination that, once adjusted for the consumer price index, match the values used by Entergy and the NRC Staff,[1528] and it appears that the CDNFRM values used by Entergy and the NRC Staff were based on NUREG/CR-3673 that in turn references an unpublished, currently missing document referred to as "Os84".[1529] Dr. Lemay argues that "[t]he document [Os84] upon which [Entergy's] . . . costs estimates are based, as stated in NUREG/CR-3673, does not appear to exist in a published form and therefore was not likely to have been subject to peer review or public comment."[1530] Therefore, according to New York's witness, "it is not a reliable source upon which experts in this field would base any findings."[1531]

In sum, based on this testimony, New York claims that Entergy and the Staff failed to address site-specific assumptions related to values for decontamination cost and therefore has failed to meet its burden under NEPA. Additionally, New York asserts that Entergy's values for TIMDEC are unreasonable in light of two actual severe accidents and that Entergy's values for CDNFRM are unreasonable because they lack acceptable documentation.

**D. NYS-12C Findings**

Initially, we find that Entergy's SAMA analysis is sufficiently site specific. Second, we find that Entergy's use and the NRC Staff's approval of the NUREG-1150 TIMDEC and

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[1527] Id. at 23–24.

[1528] Id. at 23.

[1529] Id.; Tr. at 2005, 2009 (Dr. Lemay for New York). The references section of NUREG/CR-3673 lists [Os84] as "Ostmeyer, R.M., and G.E. Runkle, An Assessment of Decontamination Costs and Effectiveness for Accident Radiological Releases. Albuquerque, N.M. Sandia National Laboratories, to be published." See Sandia National Labs, Economic Risks of Nuclear Power Reactors Accidents (NUREG/CR-3673) 8-8 (May 1984) [hereinafter NUREG/CR-3673] (Ex. NRC000058).

[1530] New York NYS-12C Rebuttal Testimony at 24 (Ex. NYS000420).

[1531] Id.

CDNFRM input values was reasonable and appropriate for Indian Point and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L).

**1. Site Specificity of Entergy's SAMA Analysis**

It bears repeating that NEPA requires that a SAMA analysis must be site specific "[b]ecause the potential consequences [of a severe accident] will largely be the product of the location of the plant . . . ."[1532] That said, for the following reasons, we find that Entergy's SAMA analysis is sufficiently site specific.

As Dr. Lemay conceded, one of the key advantages of the MACCS2 code over previous codes is that it allows the user to specify inputs, but he asserted that failing to develop site-specific input parameters leads to an underestimation of the costs associated with a severe accident at IPEC.[1533]

The Board finds merit in New York's position that the *input values* utilized by Entergy and approved by the NRC Staff are not site specific, and notes that the foundational support for the derivation of these values is a missing, unpublished document. Without the basis for the input values to scrutinize, the Board finds it difficult to determine whether there is any indication that these input values are sufficiently site specific to the IPEC region. Further, the Board agrees that that the "costs and methods of cleaning up after a severe accident will be very different depending on whether a reactor is surrounded by farmland, forests, suburban areas, urban areas, or hyper-urban areas."[1534]

Regardless, given the fact that "MACCS2 applies the CDNFRM values on a per person basis"[1535] we conclude that costs in Entergy's SAMA analysis are sufficiently site specific for the

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[1532] Limerick Ecology Action, 869 F.2d at 739.

[1533] New York NYS-12C Testimony at 19 (Ex. NYS000241).

[1534] Id.

[1535] NRC Staff NYS-12C/16B Testimony at 69 (Ex. NRC000041).

following reasons. As an NRC Staff witness, Mr. Jones, testified, "Entergy's SAMA analysis accounted for the unique characteristics of New York City through the application of population-based cost parameters which allows full consideration of the population density and corresponding building density unique to New York City."[1536] According to the NRC Staff's witnesses, "the high-population within the SAMA area is multiplied by the CDNFRM values, when appropriate, making the cost site-specific to the New York metropolitan area."[1537]

Further, Entergy's witness, Mr. Teagarden, echoed Staff's position, testifying that "the cost for non-farm decontamination [CDNFRM] is site-specific as we apply the population density."[1538] Mr. Teagarden stated that "it's important to note the decontamination costs are developed on a per capita basis. It's a per person basis. So that when they're applied within the MACCS code like some other values that are applied on a per capita basis they become site-specific."[1539] We agree.

For the IPEC SAMA analysis, Entergy developed a year 2035 population estimate based on census data and population projections that are specific to the IPEC SAMA analysis region.[1540] Therefore, the large population centers (including the New York City metropolitan area) within the IPEC SAMA analysis region were multiplied by the decontamination cost values.[1541] As Mr. Jones and Dr. Bixler testified for the NRC Staff, "[b]y using a per-person basis, this approach takes into account the site-specific high population density of New York

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[1536] Id. at 15.

[1537] Id. at 69.

[1538] Tr. at 2166 (Mr. Teagarden for Entergy).

[1539] Tr. at 1949–50 (Mr. Teagarden for Entergy).

[1540] Entergy NYS-12C Testimony at 48 (Ex. ENT000450); Tr. at 2139–40 (Mr. Teagarden for Entergy). New York also challenged Entergy's population projection, which is discussed in Section VIII beginning at page 294.

[1541] NRC Staff NYS-12C/16B Testimony at 69 (Ex. NRC000041); Tr. at 1950 (Mr. Teagarden for Entergy).

City and the correspondingly high density of buildings."[1542] Dr. Lemay for NYS agreed that the application of decontamination costs on a per person basis, as is done in MACCS2, is a valid approach.[1543]

Based on this testimony, we find that these input values are per capita based and were multiplied by the IPEC region population distribution, so as to result in a site-specific SAMA analysis. The Board notes the important distinction between our conclusion that the ultimate decontamination cost estimate (or the SAMA analysis) is site specific and New York's argument that the decontamination cost input parameters are not site specific. While the Board finds that there is no evidence that the challenged NUREG-1150 values are site specific, the Board concludes that, given that the decontamination cost input parameter is a per capita number, the ultimate decontamination cost estimate (that results from multiplying the per capita input values by the site-specific IPEC region population) results in a site-specific decontamination cost estimate.

**2. Reasonableness of MACCS2 Input Parameters**

In addition to concluding that Entergy's SAMA analysis is site specific, we find that the NRC Staff's acceptance of the input parameters in Entergy's SAMA analysis, *i.e.*, TIMDEC and CDNFRM, was reasonable.

**a. TIMDEC**

It bears emphasis that a SAMA analysis examines the mean annual consequences of numerous postulated accident scenarios, spanning a spectrum of potential initiating events, accident sequences, and severity of consequences.[1544] This is done for the entire 50-mile

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[1542] NRC Staff NYS-12C/16B Testimony at 41 (Ex. NRC000041); see also id. at 69 ("The detailed methodology described in NUREG/CR-4551 and applied at the per-person level provides a reasonable and tested approach for use in the SAMA analysis.").

[1543] Tr. at 2136 (Dr. Lemay for New York) ("I think that whoever came up with the decontamination cost per person it's a brilliant insight . . . .").

[1544] Entergy NYS-12C Testimony at 18 (Ex. ENT000450).

radius region surrounding a plant.[1545] As Entergy's and the NRC Staff's witnesses testified, a SAMA analysis does not seek to "exactly mimic a real-life scenario"[1546] in modeling highly localized and variable decontamination activities, or to provide detailed clean-up costs associated with a single, specific accident scenario.[1547] Against this backdrop, the Board must determine if the NRC Staff was reasonable in approving Entergy's use of the TIMDEC parameters from NUREG-1150 for the IPEC SAMA analysis. For the following reasons, we find that the approval of the NUREG-1150 TIMDEC parameters was reasonable.

As noted above, TIMDEC is a MACCS2 input parameter that accounts for the time it would take to decontaminate following a severe accident.[1548] In MACCS2, TIMDEC represents an average time period during which people are temporarily interdicted while decontamination activities are completed to reduce the dose by the specified dose reduction factor.[1549] This same average was used for each and every scenario, from the most minimally contaminating event sequence to the worst. It is not intended to be representative of any specific scenario. Following the expiration of the TIMDEC period, and upon satisfaction of the specified habitability criteria, MACCS2 assumes the relocation of people back to their residences.[1550] Thus, TIMDEC is only an average of the time that an individual is relocated due to dose constraints.[1551]

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[1545] Id.

[1546] Tr. at 2189 (Mr. Teagarden for Entergy).

[1547] NRC Staff NYS-12C/16B Testimony at 90 (Ex. NRC000041) ("As with any modeling effort, it is likely that an actual decontamination effort would depart from the modeled inputs based on the extent of the accident, environmental conditions during the clean-up, and actual resources expended during the clean-up.").

[1548] MACCS2 User's Guide at 7-10 (Ex. NYS000243).

[1549] Entergy NYS-12C Testimony at 77 (Ex. ENT000450).

[1550] Id.

[1551] Id.

Relying on the testimony and reports of Dr. Lemay, New York argues that the TIMDEC parameters used by Entergy and accepted by the NRC Staff are not rationally related to the IPEC region.[1552] Dr. Lemay suggested that characteristics such as building and population density influence the time it takes to decontaminate and, thus, influence TIMDEC.[1553] His position is based on an observation of the time required to decontaminate the areas surrounding Chernobyl and Fukushima.[1554]

Despite New York's argument that the TIMDEC input values are not realistic, the record shows that Entergy's use of these TIMDEC values is reasonable for three reasons. First, the analysis of Chernobyl relied on by New York, even if it were fully presented, is for a single scenario of an extreme case. If it were possible to use it along with case/scenario specific TIMDECs, its inclusion in the SAMA analysis would require weighting it by its low probability of occurrence. Second, we note that the NRC Staff's witnesses Mr. Harrison and Dr. Ghosh testified that the NRC has examined decontamination times for more than 37 years, beginning in 1975 with the Reactor Safety Study, which discussed decontamination activities that are capable of restoring areas to habitability quickly given sufficient resources.[1555] These witnesses further testified that the genesis of the values used by Entergy can be traced back to NUREG/CR-3673.[1556] This document identified an average effort required to restore habitability to an area after the most severe type of reactor accident.[1557] It states an average clean up is

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[1552] New York NYS-12C Testimony at 51–55 (Ex. NYS000241).

[1553] ISR Report at 24–25 (Ex. NYS000242). Dr. Lemay also suggested that the type of radionuclides released during a severe reactor accident influence decontamination times. New York NYS-12C Testimony at 36 (Ex. NYS000241).

[1554] New York NYS-12C Testimony at 52–55 (Ex. NYS000241).

[1555] NRC Staff NYS-12C/16B Testimony at 89 (Ex. NRC000041).

[1556] Id. at 90.

[1557] Id.

expected to take 90 days with approximately 46,000 workers for this most severe type of reactor accident.[1558] Thus, 90 days is viewed as an average time to complete decontamination efforts following the most severe reactor accident.[1559] As the NRC Staff witnesses testified, some severe accidents that result in little clean up being required, may take less time or involve fewer resources, and more severe accidents would take longer.[1560] In either situation, NUREG/CR-3673 identified the time to complete decontamination efforts to be about 90 days or less when averaged over all scenarios of severe reactor accidents.[1561] NUREG-1150 adopted 60 days and 120 days as the values to be used as the average times to be expected to achieve dose reduction factors of 3 and 15, respectively, when examining a wide spectrum of severe accident scenarios.[1562] Given that the NRC has examined decontamination times for more than 37 years and that the origin of the 90-day decontamination time (and the related 60-day and 120-day values) is known and reviewable and based upon an average over a wide spectrum of severe accident scenarios, the Board considers it reasonable for Entergy to have adopted 60-day and 120-day average decontamination time values from NUREG-1150 for dose reduction factors of 3 and 15, respectively.

Third, we find that Entergy's selected TIMDEC values are reasonable given that the decontamination times represent the average over all the modeled severe accidents, not solely worst case scenarios. As mentioned, a SAMA analysis "is not based on either the best-case or the worst-case accident scenario, but on mean accident consequence values, averaged over

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[1558] Id.

[1559] Id. Dr. Lemay agreed that the TIMDEC value is intended to be average value. See Tr. at 2181 (Dr. Lemay for New York) ("At the end of this average decontamination period, people are allowed back to their homes.").

[1560] NRC Staff NYS-12C/16B Testimony at 90 (Ex. NRC000041).

[1561] Id.

[1562] Entergy NYS-12C Testimony at 86 (Ex. ENT000450).

the many hypothetical severe accident scenarios."[1563] According to the NRC Staff's witnesses Mr. Harrison and Dr. Ghosh, the decontamination times selected by Entergy are appropriate given the need to develop a decontamination time representative of all possible severe accident scenarios.[1564] According to the NRC Staff, a 1990 report (*i.e.*, NUREG/CR-4551) reviewed the MACCS2 input parameters used in NUREG-1150, including TIMDEC, and again concluded that an "average clean-up was expected to take 90 days . . . for this most severe type of reactor accident."[1565] Given the evidence before us, we find that their conclusion was not unreasonable.

According to the NRC Staff's witnesses, "to be able to provide a reliable and reasonable analysis, the decontamination times must represent all the modeled severe accidents including ones that require little decontamination."[1566] We agree. As noted by the NRC Staff's experts, "[a]s with any modeling effort, it is likely that an actual decontamination effort would depart from the modeled inputs based on the extent of the accident, environmental conditions during the clean-up, and actual resources expended during the clean-up."[1567]

Given the purpose of a SAMA analysis, we find that Entergy's use of these average numbers as the input value for TIMDEC is reasonable. As we have emphasized, a SAMA analysis is not designed to model a single radiological release event at a single moment in time. Rather, a SAMA analysis "models numerous accident release conditions that could, based on probabilistic analysis, occur at any time under varying weather conditions during a one-year

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[1563] Pilgrim, CLI-12-15, 75 NRC at 708.

[1564] NRC Staff NYS-12C/16B Testimony at 89 (Ex. NRC000041). The NRC Staff argued that New York's alternative times are based on worst case scenarios.

[1565] Id. at 90 (citing NUREG/CR-4551, vol. 2, pt. 7, "Evaluation of Severe Accident Risks: Quantification of Major Input Parameters – MACCS Input" (Ex. ENT000059)).

[1566] Id.

[1567] Id.

period. The goal is to estimate annual average impacts for the entire 50-mile radius study area."[1568] Accordingly, given the legitimate goal of a SAMA analysis and the input requirement of the MACCS2 code for a single average decontamination time as an input value which is representative of all possible severe accident scenarios, we find that Entergy's use and the NRC's approval of these TIMDEC values is reasonable and conclude that the NRC Staff's approval of the TIMDEC input values satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L).

**b. CDNFRM**

New York's primary argument concerning the CDNFRM values used by Entergy, and accepted by the NRC Staff, is that NUREG-1150's pedigree does not justify the use of its numbers. Accordingly, the last issue to be resolved for this contention presents a unique question: can a license renewal applicant, when performing a SAMA analysis, reasonably rely on input values whose basis cannot be directly reviewed? Despite not being able to review the source of the input values for CDNFRM, for the reasons set forth below, the Board answers this question in the affirmative and finds that the NRC Staff's approval of the NUREG-1150 CDNFRM values was reasonable. Given the sensitivity of the MACCS2 model to the CDNFRM parameter, Dr. Lemay testified for New York that it is unreasonable to rely on a value whose source is not accessible, because neither NUREG-1150 nor NUREG/CR-4551 explains how the CDNFRM values were developed.[1569]

We agree with New York with regard to the absence of source documentation of the NUREG-1150 values. And we agree with New York that sound science demands that if analysis results are determined to be sensitive to a particular input parameter, then that parameter should be closely scrutinized. Further, the Board agrees with New York that it is

[1568] Entergy NYS-12C Testimony at 18 (Ex. ENT000450) (emphasis omitted).

[1569] Tr. at 2004–05 (Dr. Lemay for New York).

difficult to scrutinize a value whose source does not exist. Despite being in agreement with New York on these points, we conclude that Entergy's reliance on the input values obtained from NUREG-1150 is justified by the peer reviews conducted on documents using the same CDNFRM value, and that the Applicant's use of this value was reasonable.

Entergy's witnesses stated that the use of the challenged NUREG-1150 values is standard for SAMA analyses.[1570] They noted that, to their knowledge, all prior NRC license renewal applicants have used these same values (as appropriately escalated) in their SAMA analyses,[1571] and that the key economic inputs were vetted before their inclusion in NUREG-1150. We find that Entergy and the NRC Staff were justified in relying on the secondary peer reviews of the economic cost variables. As reflected in NUREG/CR-4551,

> [o]ffsite accident consequences for NUREG-1150 source terms were estimated using the MELCOR Accident Consequence Code System (MACCS). Before these calculations were performed, most MACCS input parameters were reviewed, and for each parameter reviewed, a best-estimate value was recommended. This report presents the results of these reviews. Specifically, recommended values and the basis for their selection are presented for MACCS . . . economic input parameters.[1572]

Thus, the Board finds that the economic input parameters, including CDNFRM, were reviewed and a best-estimate was recommended during the NUREG-1150 peer review process.

The NUREG-1150 CDNFRM values can be traced to NUREG/CR-3673.[1573] NUREG/CR-3673 states that it developed and employed "improved models to estimate the economic risks from unanticipated events which occur during U.S. [light water reactor] LWR

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[1570] Entergy NYS-12C Testimony at 61 (Ex. ENT000450). NRC guidance states that "[s]tandard MACCS2 modeling for NRC assessments uses the parameters in Sample Problem A." NUREG/CR-6953, Vol. 1, "Review of NUREG-0654, Supp. 3, Criteria for Protective Action Recommendations for Severe Accidents" at 32 (Dec. 2007) (Ex. ENT000291).

[1571] Tr. at 1951 (Mr. Teagarden for Entergy) ("And those values to our knowledge have been used in every SAMA analysis of the Entergy panel's knowledge being based in NUREG-1150 and then escalated for time.").

[1572] NUREG/CR-4551, Vol. 2, Rev. 1, Pt. 7 at iii/iv (Ex. NYS000248).

[1573] Entergy NYS-12C Testimony at 57 (Ex. ENT000450).

operation."[1574] As part of this effort, the study estimated the offsite costs of post-accident population protective measures and public health impacts for severe LWR accidents,[1575] including non-farm area decontamination costs (*i.e.*, CDNFRM). NUREG/CR-3673 states that "[t]he cost estimates used in this study for various levels of decontamination effort in an area are taken from a detailed review of decontamination effectiveness and costs performed at Sandia National Laboratories (SNL)."[1576] The "detailed review" apparently was documented in the unpublished report by Robert Ostmeyer and Gene Runkle (*i.e.*, Os84 or the Ostmeyer report). None of the parties or their witnesses could locate a copy of the report.[1577] Herein lies the problem – the source of the MACCS2 CDNFRM input values cannot be reviewed.

Nevertheless, the Board does not find that the document's unavailability renders the NRC Staff's or Entergy's reliance on the NUREG-1150 decontamination cost values "altogether unreasonable" under NEPA.[1578] The NUREG/CR-3673 authors had access to the Ostmeyer report when they prepared NUREG/CR-3673.[1579] Moreover, NUREG/CR-3673 expressly states that Dr. Ostmeyer provided technical assistance and advice during the preparation of NUREG/CR-3673.[1580] Thus, we do not agree with New York that NUREG/CR-3673 is necessarily an unreliable source.[1581]

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[1574] NUREG/CR-3673 at EX-1 (Ex. ENT000466).

[1575] Id. NUREG/CR-3673 states that offsite costs associated with population evacuation and temporary relocation, agricultural product disposal, land and property decontamination, land interdiction, and public health impacts and medical care costs are included in the new economic consequence models. Id. at EX-1.

[1576] New York NYS-12C Rebuttal Testimony at 23 (Ex. NYS000420).

[1577] Tr. at 2005 (Dr. Lemay for New York), 2009 (Mr. Jones for the NRC Staff).

[1578] Pilgrim, CLI-12-01, 75 NRC 39, 57 (2012).

[1579] Tr. at 2010 (Dr. Ghosh for the NRC Staff).

[1580] NUREG/CR-3673 at xix (Ex. ENT000466).

[1581] New York NYS-12C Rebuttal Testimony at 24 (Ex. NYS000420).

Consistent with NEPA's rule of reason, the Applicant and the NRC Staff acted "based on the best available information and analysis" in completing the SAMA evaluation.[1582] NEPA does not require agencies to resolve all uncertainties, including, in this case, uncertainties associated with the NUREG-1150 values used in the IPEC SAMA analysis.[1583]

As mentioned above, Entergy and the NRC Staff witnesses testified that they considered the appropriateness of the NUREG-1150 numbers to the IPEC SAMA analysis. Ms. Potts for Entergy, who helped prepare the IPEC SAMA analysis, testified that she and other Entergy technical reviewers considered the applicability of the NUREG-1150 values and concluded that they are reasonable values for IPEC.[1584] New York, thru Dr. Lemay, made clear, and the Board is sympathetic to its position, that it would be difficult to determine the appropriateness of a number when the basis of that number is not known. But, given that NUREG-1150 was made available for public comment and was subjected to peer review, and based upon the foregoing discussion of the situation and the witnesses' testimony, we find that the use of the NUREG-1150 CDNFRM values was not unreasonable.

Lastly, the Board notes Entergy's and the NRC Staff's argument that the alternative CDNFRM values proposed by New York are not reasonable. But conversely, at least in this instance, New York was not required to develop reasonable alternative CDNFRM values.[1585]

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[1582] Balt. Gas & Elec. Co., 462 U.S. at 102.

[1583] Izaak Walton League of Am. v. Marsh, 655 F.2d 346, 377 (D.C. Cir. 1981)

[1584] Tr. at 2067–69, 2080 (Ms. Potts for Entergy). Ms. Potts noted that Entergy described the bases for this conclusion in its February 2008 RAI Response. Tr. at 2080–81 (Ms. Potts for Entergy).

[1585] As we noted previously, the Commission has made it clear that a Board's consideration of a NEPA contention is to be more than an EIS fine-tuning session, suggesting that, at least in instances when a challenge is made to the validity of the publicly-available analysis upon which a Staff modeling input finding is made, there must be some suggestion that there is a reason to believe that using the Staff-endorsed value will provide a result that significantly skews the impact being assessed. In this instance, New York's attempted showing that there is no valid support for this significant input parameter, if successfully established, would provide that

Instead, it is ultimately the NRC Staff's burden to demonstrate the reasonableness of the SAMA analysis. Moreover, New York does not appear to be proposing the alternate CDNFRM values as replacement values. Instead, New York's witness, Dr. Lemay, only suggests that his proposed CDNFRM values call into question the reasonableness of Entergy's values. Dr. Lemay merely offered an alternative approach to developing an appropriate CDNFRM value – a value that has a documented source history whose basis can be explored. Dr. Lemay stated:

> for better or worse, you can criticize my values. You can examine them. You can pull them apart. You can discuss the number of floors I've used, the number of surfaces I've used and it's understandable and it's something that you can examine. We can't do that with the other numbers.[1586]

The Board agrees with Dr. Lemay – having a documented source to be scrutinized and reviewed would have been useful in reviewing Entergy's reliance on the contested CDNFRM values. But we are mindful that this is a NEPA-based contention, and that all NEPA requirements are governed by a rule of reason. We are further guided by the Commission's holdings that "the proper question is not whether there are plausible alternative choices for use in the analysis, but whether the analysis that was done is reasonable under NEPA";[1587] and therefore, "the question is not whether more or different analysis can be done" since "it may always be possible to conceive of alternative and more conservative inputs, whose use in the analysis could result in greater estimated accident consequences."[1588] Thus, for the reasons stated above, we find that the lack of source documentation for the CDNFRM parameter does not, under NEPA, prove fatal to Entergy's SAMA analysis.

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support to the degree that it essentially would provide a "null" value for this significant factor as an input to the MACCS2 model.

[1586] Tr. at 2138 (Dr. Lemay for New York).

[1587] Seabrook, CLI-12-05, 75 NRC at 323.

[1588] Pilgrim, CLI-12-15, 75 NRC at 714.

## E. Conclusions of Law

We find that a preponderance of the evidence submitted regarding this contention supports the conclusion that Entergy's SAMA analysis is sufficiently site specific and a reasonable method under NEPA standards given that key input parameters are per capita based and multiplied by a site-specific population distribution. Furthermore, Entergy's use of and the NRC's approval of the TIMDEC and CDNFRM values was reasonable and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L). It was reasonable for Entergy to use the selected TIMDEC values given its technical basis and what the values represent. Additionally, it was not unreasonable for Entergy to rely on the CDNFRM value given the level of review of NUREG-1150 and its predecessor documents. Accordingly, NYS-12C is resolved in favor of the NRC Staff and the issues raised by this contention do not prevent the Commission from issuing the requested renewal licenses.

## VIII. NEPA CONTENTION NYS-16B (SAMA – Population Estimates)

### A. Statement of Contention NYS-16B

NYS-16B, a SAMA contention that challenges population estimates, as litigated on October 22, 2012, reads as follows:

> [New York] asserts two significant errors in the population estimate [used in Entergy's SAMA analysis for Indian Point]: (1) failure to account for census undercount; and (2) failure to account for the commuter population present within the 50 mile zone of Indian Point.[1589]

### B. NYS-16B Background

#### 1. NYS-16B Procedural History

As filed by New York on November 30, 2007, NYS-16 challenged Entergy's assertion, in its SAMA analysis, that it conservatively estimated the population radiation dose resulting from a severe accident.[1590] New York questioned Entergy's population projection for 2035, pointing out that the U.S. Census estimate of the population of Manhattan in 2006 is larger than Entergy's 2035 projection.[1591]

NYS-16 was admitted on July 31, 2008 "to the extent it challenge[d] whether the population projections used by Entergy are underestimated."[1592] We stated that this is a "question of model input data material to the making of accurate SAMA analyses."[1593]

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[1589] State of New York, Entergy Nuclear Operations, Inc., and NRC Staff Joint Stipulation (Jan. 23, 2012) at 2.

[1590] New York Petition at 163–64. New York's original contention also alleged that Entergy's air dispersion model would not accurately predict the geographic dispersion of radionuclides released in a severe accident. New York later decided "not to pursue the part of Contention NYS-16 challenging Entergy's air dispersion model . . . ." State of New York Initial Statement of Position Contention NYS-16/16A/16B ("NYS-16B") (Dec. 16, 2011) at 1 n.1 (Ex. NYS000206). See also State of New York, Entergy Nuclear Operations, Inc., and NRC Staff Joint Stipulation (Jan. 23, 2012) at 2.

[1591] New York Petition at 164 n.37.

[1592] LBP-08-13, 68 NRC at 112.

[1593] Id.

On February 27, 2009, New York submitted NYS-16A in response to the NRC Staff's December 2008 draft supplemental environmental impact statement (SEIS).[1594] NYS-16A largely repeated the arguments discussed in New York's original petition but focused on the SEIS rather than Entergy's ER.[1595] We admitted NYS-16A on June 16, 2009, "to the degree that the Draft SEIS fails to address the issues raised by New York in NYS-16 . . . "[1596] and noted that New York would not be allowed to address arguments that were beyond the limiting language of the admitted contention.[1597]

On March 11, 2010, New York filed NYS-16B in response to Entergy's December 2009 SAMA reanalysis.[1598] Again, NYS-16B largely repeated the arguments discussed in New York's original petition and its February 27, 2009, filing.[1599] In a footnote, New York asserted that Entergy's calculations also underestimate the population dose for failing to count tourists and commuters.[1600] We admitted NYS-16B on June 30, 2010.[1601]

On January 30, 2012, Entergy filed a motion in limine seeking to exclude portions of New York's expert report and three exhibits on the grounds that New York has raised a new issue in its pre-filed testimony and corresponding evidentiary submission – Entergy's alleged

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[1594] See State of New York Contentions Concerning NRC Staff's Draft Supplemental Environmental Impact Statement (Feb. 27, 2009) at 9.

[1595] See id. at 9–14.

[1596] See Order (Ruling of New York's New and Amended Contentions) (June 16, 2009) at 6 (unpublished).

[1597] See id.

[1598] See State of New York's Motion for Leave to File New and Amended Contentions Concerning the December 2009 Reanalysis of Severe Accident Mitigation Alternatives (Mar. 11, 2010).

[1599] See id. at 7–12.

[1600] See id. at 8 n.3.

[1601] See LBP-10-13, 71 NRC 673, 686.

failure to account for "census undercount."[1602] The NRC Staff supported Entergy's motion in limine[1603] and New York opposed it.[1604] We denied Entergy's motion on March 6, 2012.[1605] In our order denying Entergy's motion, we stated that the issue of census undercount is not a new issue noting that we admitted NYS-16 to the extent that it challenges whether the population projections used by Entergy are underestimated.[1606] We further noted that any claim by Entergy or the NRC Staff that census undercount is not within the scope of the contention was undercut by the parties joint stipulation.[1607]

**2. Legal Standards and Issues Related to NYS-16B**

NYS-16B challenges the acceptance of Entergy's SAMA analysis in the FSEIS. The legal standards and issues associated with SAMAs were discussed in detail in Section VII(B)(2) beginning at page 262, and will not be repeated here.[1608]

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[1602] See Applicant's Motion in Limine to Exclude Portions of the Prefiled Testimony, Report, and Exhibits Filed by New York State and Dr. Stephen Sheppard in Support of Consolidated Contention NYS-16B (Jan. 30, 2012) at 2.

[1603] See NRC Staff's Answer to Applicant's Motion in Limine to Exclude Portions of the Prefiled Testimony, Report, and Exhibits Filed By New York State and Dr. Stephen Sheppard in Support of Consolidated Contention NYS-16B (Feb. 9, 2012).

[1604] See State of New York's Answer to Entergy's Motion in Limine to Exclude Portions of Pre-Filed Testimony and Exhibits for Consolidated Contention NYS-16B (Feb. 17, 2012).

[1605] Order (Granting in Part and Denying in Part Applicant's Motions in Limine) (Mar. 6, 2012) at 11 (unpublished)

[1606] Id. at 10.

[1607] Id. at 11. See also State of New York, Entergy Nuclear Operations, Inc., and NRC Staff Joint Stipulation (Jan. 23, 2012) at 2.

[1608] See supra Section VII(B)(2).

### 3. Evidentiary Record Related to NYS-16B

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-16B

Entergy presented four witnesses to provide testimony on NYS-16B – Lori A. Potts,[1609] Dr. Kevin R. O'Kula,[1610] Grant A. Teagarden,[1611] and Jerry L. Riggs.[1612] On March 28, 2012, Entergy filed the written testimony of these witnesses listed above,[1613] which was admitted into evidence on October 15, 2012.[1614]

The NRC Staff presented four witnesses to provide testimony on NYS-16B – Dr. Nathan E. Bixler,[1615] Dr. S. Tina Ghosh,[1616] Joseph A. Jones,[1617] and Donald G. Harrison.[1618] On March 30, 2012, the NRC Staff filed the written testimony of these four witnesses,[1619] which was admitted into evidence on October 15, 2012.[1620]

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[1609] Curriculum Vitae of Lori A. Potts (Ex. ENT000004).

[1610] Curriculum Vitae of Kevin R. O'Kula (Ex. ENT000005).

[1611] Curriculum Vitae of Grant A. Teagarden (Ex. ENT000007).

[1612] Curriculum Vitae of Jerry L. Riggs (Ex. ENT000008).

[1613] See Testimony of Entergy Witnesses Lori Potts, Kevin O'Kula, Grant Teagarden, and Jerry Riggs on Consolidated Contention NYS-16B (Severe Accident Mitigation Alternatives Analysis) (Mar. 28, 2012) (Ex. ENT000003) [hereinafter Entergy NYS-16B Testimony].

[1614] Tr. at 1269 (Judge McDade).

[1615] Nathan Bixler Statement of Professional Qualifications (Ex. NRC000042).

[1616] Tina Ghosh Statement of Professional Qualifications (Ex. NRC000043).

[1617] Joseph Jones Statement of Professional Qualifications (Ex. NRC000044).

[1618] Donald Harrison Statement of Professional Qualifications (Ex. NRC000045).

[1619] See NRC Staff Testimony of Nathan E. Bixler, S. Tina Ghosh, Joseph A. Jones, and Donald G. Harrison Concerning NYS' Contentions NYS 12/16 (Mar. 30, 2012) (Ex. NRC000041) [hereinafter NRC Staff NYS-12C/16B Testimony].

[1620] Tr. at 1269 (Judge McDade).

New York presented the testimony of one witness on NYS-16B – Dr. Stephen C. Sheppard.[1621] On December 16, 2011, New York filed the written testimony of Dr. Sheppard.[1622] On June 29, 2012, New York submitted written rebuttal testimony by Dr. Sheppard.[1623] Both of these submissions were admitted into evidence on October 15, 2012.[1624]

**b. Identification of Admitted Exhibits Relevant to NYS-16B**

Relevant to NYS-16B, Entergy submitted 31 exhibits, the NRC Staff submitted 22 exhibits, and New York submitted 38 exhibits. These exhibits were admitted into the record on October 15 and 22, 2012, and February 19, 2013.[1625]

**c. Relevant Guidance Documents, and Reports**

1. Nuclear Energy Institute, Rev. A, Severe Accident Mitigation Alternatives (SAMA Analysis) Guidance Document (NEI 05-01) (Nov. 2005) (Ex. NYS000287). A description of the document was provided at page 268 above as it also pertains to NYS-12C.

2. Enercon Services, Inc., Site Specific MACCS2 Input Data for Indian Point Energy Center, Rev. 1 (Dec. 1, 2009) (Ex. NYSR00211). This report reflects the work performed by Enercon Services, Inc. (*i.e.*, Entergy's consultant) in developing the projected year 2035

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[1621] Curriculum Vitae of Stephen C. Sheppard (Ex. NYS000208).

[1622] See Pre-Filed Written Testimony of Dr. Stephen Sheppard, Ph.D. Regarding Contention NYS-16/16A/16B ("NYS-16B") (Dec. 16, 2011) (Ex. NYS000207) [hereinafter New York NYS-16B Testimony].

[1623] See Rebuttal Testimony of Dr. Stephen C. Sheppard, Ph.D. Regarding Contention NYS-16/16A/16B ("NYS-16B") (June 29, 2012) (Ex. NYS000404) [hereinafter New York NYS-16B Rebuttal Testimony].

[1624] Tr. at 1269 (Judge McDade).

[1625] Id.; id. at 2519 (admitting Ex. ENT000589); see also Order (Granting New York's Motion for Leave to Submit Revised Exhibits) (Feb. 19, 2013) (unpublished) (admitting Ex. NYSR00211).

population estimate.[1626] This report provides the details of Entergy's 2035 population projection used in performing its SAMA analysis.[1627]

3. Report of Stephen C. Sheppard, Ph.D. in Support of Contention NYS-16/16A/16B ("NYS-16B") (Dec. 16, 2011) (Ex. NYS000209). This document is Dr. Sheppard's expert report that was submitted in conjunction with his pre-filed testimony. Dr. Sheppard's report discusses the methodology used by Entergy to develop the estimated 2035 population, explains the alleged inadequacies in Entergy's methods, and provides what he believes to be a more appropriate estimate of the 2035 population.[1628]

## C. Evidence Related to SAMA – Population Estimates

### 1. Entergy's SAMA Analysis Methodology

Entergy's witnesses, Dr. O'Kula and Mr. Teagarden, testified that they used the MACCS2 computer code to perform the IPEC SAMA analysis.[1629] They explained that MACCS2 was used to estimate plant-specific offsite population doses and economic consequences that could result from the postulated accidental release of radioactive materials to the atmosphere during a severe accident at a nuclear power plant.[1630]

This contention challenges Entergy's population estimates that are used in the MACCS2 code to estimate offsite consequences. Dr. O'Kula and Mr. Teagarden testified for Entergy that MACCS2 executes three modules in sequence to calculate SAMA values: ATMOS, EARLY, and

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[1626] See Enercon Services, Inc., Site Specific MACCS2 Input Data for Indian Point Energy Center, Rev. 1 (Dec. 1, 2009) (Ex. NYSR00211) [hereinafter Enercon Report]).

[1627] Id. at 1-1 to 2-7.

[1628] Report of Dr. Stephen C. Sheppard, Ph.D. in Support of Contention NYS-16/16A/16B ("NYS-16B") (Dec. 16, 2011) (Ex. NYS000209) [hereinafter Sheppard Report].

[1629] Entergy NYS-16B Testimony at 24 (Ex. ENT000003).

[1630] Id. at 23.

CHRONC.[1631] They stated that population data are used as inputs to the EARLY and CHRONC modules.[1632] More specifically, they testified that the EARLY module uses population data to calculate radiation dose consequences due to exposure during the first seven days from the time of the release (*i.e.*, the emergency phase), and the CHRONC module uses population data to calculate (1) the long-term radiation doses due to exposure after the emergency phase; and (2) the economic impacts from each accident sequence including the economic cost of short-term and long-term protective actions.[1633]

Entergy's witnesses then explained how, in calculating severe accident consequences, MACCS2 takes into account variations in population density.[1634] Using the estimated population and other site-specific and region-specific inputs, MACCS2 calculates the population dose and economic cost based on the simulated radiological release and then sums the results.[1635] Next, according to Entergy's witnesses, the offsite population dose and offsite economic cost consequence values are multiplied by the calculated severe accident frequency results obtained from the PRA models.[1636] This calculation results in the key risk values for determining potentially cost beneficial SAMAs: (1) population dose risk (PDR); and (2) the offsite economic

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[1631] Id. at 24 (citing MACCS2 User's Guide at 2-1 (Ex. NYS000243)).

[1632] Id. (citing MACCS2 User's Guide at 2-2 (Ex. NYS000243)).

[1633] Id. (citing MACCS2 User's Guide at 2-2 (Ex. NYS000243)).

[1634] Id. at 24–25.

[1635] Id. at 25–26; Tr. at 1928 (Mr. Teagarden for Entergy). MACCS2 uses a polar-coordinate spatial grid to structure the transport downwind of a plume under various meteorological conditions. MACCS2 User's Guide at 2-4 to -5 (Ex. NYS000243). The spatial grid is the 50-mile region divided into a polar coordinate grid with IPEC in the center. Id. The polar grid is comprised of radial rings centered on the site with boundaries at various radii. Id.

[1636] Entergy NYS-16B Testimony at 27 (Ex. ENT000003).

cost risk (OECR).[1637] The individual PDRs and OECRs for the different accident scenarios are summed to determine the overall PDR and overall OECR for the SAMA analysis.[1638]

**2. The Calculation of Entergy's 2035 Population Estimate**

Entergy's witnesses testified that Entergy developed the 2035 population estimate used in the IPEC SAMA analysis in accordance with the guidance of NEI 05-01.[1639] NEI 05-01 states, "[t]ypically, with increasing population, the predicted population is estimated for a year within the second half of the period of extended operation. Extrapolation to a later date, and therefore a larger population, adds conservatism to the analysis."[1640] Entergy's LRA states that the year 2035 was chosen because it is the last year of the IP3 extended operating period and two years after the end of IP2 extended operating period.[1641]

Ms. Potts and Mr. Riggs testified that in order to estimate the 2035 population, Entergy first determined the year 2000 permanent population within a 50-mile radius of IPEC, and then projected those populations out to the year 2035.[1642] To determine the year 2000 permanent population for each of the counties represented within the 50-mile radius of IPEC, Entergy used areal weighting, which assumes a constant population distribution over the area assessed, to account for those counties that were not completely within the region of interest.[1643] Entergy

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[1637] Id.

[1638] Id.

[1639] Id. at 31–32.

[1640] Nuclear Energy Institute, Severe Accident Mitigation Alternatives (SAMA Analysis) Guidance Document (NEI 05-01) at 13 (Nov. 2005) (Ex. NYS000287) [hereinafter NEI 05-01].

[1641] License Renewal Application at 2-36 (Ex. ENT00015B).

[1642] Entergy NYS-16B Testimony at 32 (Ex. ENT000003) (citing Enercon Report at 1-1 to -3 (Ex. NYSR00211).

[1643] Id. at 35.

then used population estimates from state and local governments, based on published 2000 U.S. Census data, to determine the population for each county.[1644]

The testimony reflected that to project the 2000 population estimate to year 2035, Entergy first obtained available county-level population projection estimates from New York and the surrounding states.[1645] For each county, Entergy used these state population projections consistent with the methodology described in the Enercon Report to extrapolate the 2000 permanent population census data to 2035 permanent population values.[1646]

According to its witnesses, Entergy then adjusted the county-level population projections upward to account for the likely presence of a transient population.[1647] To obtain the transient population estimates for each county, Entergy used state and local estimates of the transient population to estimate the ratio of the permanent-to-transient population in 2004.[1648] The year 2035 transient population was assumed to be the 2004 transient-to-permanent population ratio multiplied by the extrapolated 2035 permanent population.[1649] The projected total population within the 50-mile radius thus was estimated for the year 2035, the end of the proposed license renewal period, by combining the 2035 extrapolated permanent population with the 2035 extrapolated transient population.[1650]

Through this procedure, Entergy estimated a 2035 permanent population of approximately 18.9 million persons residing within 50 miles of IPEC, with a positive adjustment

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[1644] Id. at 32.

[1645] Id. at 33.

[1646] Id. (citing Enercon Report at 2-1 (Ex. NYSR00211)).

[1647] Id. The transient population includes business travelers and tourists. Id.

[1648] Id. at 32.

[1649] Id. at 33.

[1650] Enercon Report at 2-5 (Ex. NYSR00211).

for the transient tourist and business traveler population of approximately 349,000 bringing the total population to approximately 19.2 million.[1651] According to its witnesses, Entergy then used this total population in the MACCS2 code to complete its SAMA analysis.[1652]

The FSEIS indicates that the NRC Staff reviewed the methodologies and assumptions Entergy used in projecting the 2035 permanent and transient population[1653] and concluded that Entergy's "methods and assumptions for estimating population [were] reasonable and acceptable for the purpose of the SAMA evaluation."[1654] Additionally, Sandia[1655] determined that Entergy's projected population growth was reasonable.[1656] Accordingly, the NRC and Sandia stated that "Entergy's population data and projected population growth analysis provide reasonable (and slightly conservative) population values for its SAMA analysis."[1657]

**3. Alleged Deficiencies in Entergy's Population Estimate**

Dr. Sheppard, New York's witness, testified that Entergy's population estimates are deficient in two respects.[1658] First, Dr. Sheppard asserted that by working from base census

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[1651] Id.; FSEIS at G-25 (Ex. NYS00133I).

[1652] Entergy NYS-16B Testimony at 35 (Ex. ENT000003).

[1653] See, e.g., FSEIS at G-24 to -25 (Ex. NYS00133I).

[1654] Id. at G-20.

[1655] Sandia was a technical assistance contractor to the NRC and assisted in responding to NYS-16B. Id. at G-22.

[1656] Id. at G-25. Sandia performed its own estimate of the population surrounding IPEC during the license renewal period. To perform its estimate, Sandia utilized two different approaches to estimate the population. After comparing its own independent analyses of population, Sandia concluded that Entergy's projection was reasonable. NRC Staff NYS-12C/16B Testimony at 94–97 (Ex. NRC000041).

[1657] FSEIS at G-25 (Ex. NYS00133I); see also NRC Staff NYS-12C/16B Testimony at 94–97 (Ex. NRC000041).

[1658] Entergy relied on Census 2000 data as the foundation or "starting point" for its 2035 population estimate. Tr. at 2408 (Mr. Teagarden for Entergy). Dr. Sheppard does not challenge the use of this data as the appropriate starting point. New York NYS-16B Rebuttal Testimony at 17 (Ex. NYS000404); Tr. at 2407 (Dr. Sheppard for New York). Dr. Sheppard instead argued

data Entergy's SAMA analysis fails to take into consideration the undercount of minority populations that has been well-documented and accepted by the Census Bureau.[1659] Second, Dr. Sheppard asserted that by focusing only on the resident and transient populations, the report is neglecting the substantial number of workers who commute into the region from areas farther than 50 miles from IPEC.[1660] Dr. Sheppard stated that if the appropriate adjustments are made for these factors, the estimated year 2035 population in the region increases by approximately 1.2 million people.[1661] He testified that these two deficiencies render Entergy's 2007 SAMA analysis and its 2009 SAMA reanalysis defective.[1662]

Regarding the alleged undercount, Dr. Sheppard asserted that since the 1990s, "there has been a clear understanding that the census of population conducted by the U.S. Census Bureau is subject to systematic undercount."[1663] According to Dr. Sheppard, census undercount is "generally accepted by demographers and by economists and other social scientists . . . ."[1664] He stated that census undercount mostly applies to minority populations and that making adjustments for the undercounted population is important to ensure the most accurate possible measure of the population that could be at risk in the event of a severe accident at IPEC.[1665]

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that the Census 2000 data gives an artificially low count of the population within the 50-mile region surrounding IPEC. New York NYS-16B Testimony at 11–12 (Ex. NYS000207).

[1659] Sheppard Report at 1 (Ex. NYS000209).

[1660] Id.

[1661] Id. This alleged 1.2 million person increase places the projected 2035 population at 20,456,285 people, which is a 6.38 percent increase relative to the Entergy estimate. Id.

[1662] Id.

[1663] Id. at 4.

[1664] Tr. at 2407 (Dr. Sheppard for New York).

[1665] Id.

Much of Dr. Sheppard's position is based on data from the Census Bureau's March 2001 Accuracy and Coverage Evaluation (A.C.E.) report and a subsequent U.S. Census Board Report that analyzed the A.C.E report.[1666] According to Dr. Sheppard, the U.S. Census Board Report provided estimated undercount rates for minority populations in the states surrounding IPEC that range from 0.52 percent to 4.49 percent.[1667] Based on these figures, and assuming no undercount of the white population around IPEC, Dr. Sheppard suggested applying a 1.11 percent undercount rate to the 2000 census figures for non-white population.[1668] This approach would add 231,632 people to the relevant population projection.[1669]

Regarding the alleged failure to account for commuters, Dr. Sheppard testified that Entergy's SAMA analysis fails to account for the number of people that would be present within 50 miles of IPEC during a substantial part of the day because they commute from areas outside the 50-mile region to workplaces that are within the 50-mile region.[1670] Dr. Sheppard asserted that because such workers are part of the population potentially at risk from a severe accident, it is important to include them in the estimate of population in the area.[1671]

To estimate the number of commuters, Dr. Sheppard used data on county-to-county commuter flows from the year 2000.[1672] He testified that these data provide the estimated

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[1666] See Sheppard Report (Ex. NYS000209). Dr. Sheppard relied on U.S. Census Monitoring Board Presidential Members, "Final Report to Congress" (Sept. 1, 2001) (Ex. NYS000213). This report, in turn, relies in part on data from the Census Bureau's March 2001 A.C.E. report, which discusses the results of the 2000 census.

[1667] Sheppard Report at 5 (Ex. NYS000209).

[1668] Id. According to Dr. Sheppard, the 1.11 percent undercount used by him is slightly less than the 1.18 percent undercount estimated by the U.S. Census Monitoring Board Report for the entire U.S. Id.

[1669] Id. at 8.

[1670] Id. at 5.

[1671] Id.

[1672] Id. at 6.

number of commuters coming into a county each day from any other individual county in the United States.[1673] According to Dr. Sheppard, this procedure estimates the 2000 commuter populations into that portion of each county that is within 50 miles of IPEC.[1674] To determine 2035 commuter population, Dr. Sheppard took the county population growth rates from 2000 to 2035 and applied those growth rates to total commuter population for each county.[1675] Dr. Sheppard stated that this approach would lead to an estimated 995,778 commuters entering the 50-mile area surrounding IPEC on an average day in 2035.[1676]

In sum, Dr. Sheppard, on behalf of New York, maintained that by accounting for census undercount and commuters, it has provided an improved estimate of the total population of 20,456,285 people in the 50-mile area surrounding IPEC, which is 6.38 percent higher than the total population figure used by Entergy. According to Dr. Sheppard, Entergy underestimated the costs of a severe accident at IPEC because it did not account for census undercount and commuters.

**D. NYS-16B Findings**

For the reasons set forth below, we find that Entergy's estimate and the NRC's approval of the projected population estimate are reasonable and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L). First, Entergy reasonably relied on unadjusted Census 2000 data for the basis of its projected population. Second, Entergy's exclusion of commuters from the projected population was reasonable.

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[1673] Id.

[1674] New York NYS-16B Testimony at 15 (Ex. NYS000207).

[1675] Id.

[1676] Id. at 16.

### 1. Census Undercount

In regards to the alleged undercount of the minority population within the 50-mile region of IPEC, even if true the level of the undercount is difficult to estimate, especially given the evidence supporting a potential overcount in the data used by Entergy. As stated above, Entergy relied on Census 2000 data as the foundation or "starting point" for its 2035 population estimate.[1677] Dr. Sheppard did not challenge the use of this data as the appropriate starting point.[1678] Instead, he argued that the Census 2000 data gives an artificially low count of the population within the 50-mile region surrounding IPEC,[1679] based on data from the March 2001 A.C.E.[1680] We do not agree.

The record shows that there was some potential overcounting of the population within the 50-mile region surrounding IPEC. The March 2001 A.C.E. report, which was relied upon by Dr. Sheppard, indicates that there was a net undercount of approximately 1.18 percent for Census 2000.[1681] Entergy, however, provided evidence indicating that the U.S. Census Bureau conducted further research to produce a more complete revision of the estimates that might be used to adjust the census base used in the intercensal estimates.[1682] This work, A.C.E. Rev. II, identifies errors in the March 2001 A.C.E. report, concluding that "[t]he March 2001 A.C.E. estimates of Census 2000 coverage were determined to be unacceptable because A.C.E. failed

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[1677] Tr. at 2408 (Mr. Teagarden for Entergy).

[1678] New York NYS-16B Rebuttal Testimony at 17 (Ex. NYS000404); Tr. at 2407 (Dr. Sheppard for New York).

[1679] New York NYS-16B Testimony at 11–12 (Ex. NYS000207).

[1680] Id. at 10–11.

[1681] U.S. Census Bureau, Technical Assessment of A.C.E. Rev. II at iii (Mar. 12, 2003) (Ex. ENT000016).

[1682] Entergy NYS-16B Testimony at 41 (Ex. ENT000003).

to measure a significant number of erroneous census enumerations."[1683] As reported by the Census Bureau, the results of the more recent Census Bureau publication "are substantially different from those of March 2001, changing the estimated net coverage of the total household population from a net undercount of 1.18% to a net overcount of 0.49%."[1684] Despite its more recent publication, the Census Bureau nonetheless did not change the base for its intercensal population estimates due to certain limitations in the March 2001 A.C.E. methodology.[1685]

While Dr. Sheppard did not dispute the A.C.E. Rev. II findings that the undercount was overstated, he continued to maintain that the non-white population within the 50-mile region still was undercounted by 3 percent.[1686] It was his opinion that, although the A.C.E. Revision II's post enumeration sampling indicated a slight overcount of the white population, the demographic analysis showed a net undercount nationwide.[1687] He also testified that approximately 40 percent of the population surrounding IPEC is black or Hispanic, which is nearly double the national average.[1688] Asserting that large minority and urban populations are disproportionately affected by census undercount, Dr. Sheppard concluded that the 50-mile radius surrounding IPEC is particularly prone to census undercount.[1689] Therefore, Dr.

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[1683] Id. (quoting U.S. Census Bureau, Technical Assessment of A.C.E. Rev. II at 1 (Mar. 12, 2003) (Ex. ENT000016)).

[1684] U.S. Census Bureau, Decision on Intercensal Census 2000 Estimates at 2 (Mar. 12, 2003) (Ex. ENT000018) (emphasis in original).

[1685] U.S. Census Bureau, Technical Assessment of A.C.E. Rev. II at 1 (Mar. 12, 2003) (Ex. ENT000016). It should be noted that despite recommending not changing the base for its intercensal population estimates, this report states that these estimates are "dramatically superior to the March 2001 A.C.E. estimates . . . ." Id.

[1686] New York NYS-16B Testimony at 23 (Ex. NYS000207).

[1687] Id. at 25–26.

[1688] Id. at 26.

[1689] Id.

Sheppard asserted that Entergy should have adjusted its population estimate to account for the census undercount of minorities living within 50 miles of IPEC.[1690]

In contrast, Entergy's witness, Mr. Riggs, testified that he performed his own calculation to determine the projected 2035 population using the numbers cited by Dr. Sheppard.[1691] Mr. Riggs testified that using the values cited in the A.C.E. Rev. II study, he also calculated a net overcount of minorities within the IPEC SAMA analysis region.[1692]

Nevertheless, we need not determine with certainty whether there was a slight population undercount or overcount because, based on our review of the record, the Board finds that it was reasonable for Entergy to rely on the unadjusted Census 2000 data. As stated above, Entergy used, as a starting point, the Census 2000 data.[1693] And New York agreed that this was appropriate.[1694] Since the publication of the Census 2000 data, the Census Bureau has developed several intercensal population estimates for the area under consideration, first indicating that there was a net undercount of approximately 1.18% for Census 2000,[1695] but then identifying errors in the March 2001 A.C.E. Report,[1696] and indicating that the estimated population actually could be changed from a net undercount to a net overcount.[1697]

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[1690] Id. at 13.

[1691] Tr. at 2420 (Mr. Riggs for Entergy).

[1692] Id.

[1693] Tr. at 2408 (Mr. Teagarden for Entergy).

[1694] New York NYS-16B Rebuttal Testimony at 17 (Ex. NYS000404); Tr. at 2407 (Dr. Sheppard for New York).

[1695] U.S. Census Bureau, Technical Assessment of A.C.E. Rev. II at iii (Mar. 12, 2003) (Ex. ENT000016).

[1696] U.S. Census Bureau, Decision of Intercensal Census 2000 Estimates at 2 (Mar. 12, 2003) (Ex. ENT000018).

[1697] Id.

In light of this evidence, the Board finds that even if there was an undercount of minorities in the 50-mile region surrounding IPEC, it was not unreasonable for Entergy to use, and the NRC Staff to approve, the unaltered use of Census 2000 data for a SAMA analysis performed under NEPA as a basis for the estimation of the 2035 population in the 50-mile region surrounding the IPEC region. The "proper question is not whether there are plausible alternative choices for use in the analysis, but whether the analysis that was done is reasonable under NEPA,"[1698] and we find that it was.

Lastly, it is worth noting that there appears to be no regulatory requirement or precedent suggesting the need to adjust officially reported U.S. Census data for known or possible undercounts for use in a NEPA analysis. As Entergy's witnesses noted, NRC and EPA guidance documents recommend the use of officially reported census data without specifying the need to adjust the data for undercount or, for that matter, overcount.[1699] With this in mind, and for the reasons set forth above, the Board finds that Entergy and the NRC Staff were not required to adjust the 2035 population estimate to reflect any minor census undercount that may or may not exist.

**2. Commuters**

New York argues that Entergy's 2035 population estimate is also flawed for not including in the transient population those commuters who enter and remain in the SAMA analysis region on a daily basis, and are "just as at risk" because they "enter and remain within the 50 mile radius of IPEC on a daily basis . . . ."[1700] New York offered no additional explanation as to why commuters are "just as at risk" as permanent residents, and we are left with only conclusory statements proffered by New York's witness in support of this proposition. In response to New

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[1698] Seabrook, CLI-12-05, 75 NRC at 323.

[1699] Entergy NYS-16B Testimony at 42–43 (Ex. ENT000003).

[1700] New York NYS-16B Testimony at 14 (Ex. NYS000207).

York's statements of position and the testimony of Dr. Sheppard, Entergy's witnesses testified that:

> [u]nlike permanent residents, commuters are not always within the 50-mile region and thus may not be within the region at the time of a severe accident.
>
> Commuters evacuated or relocated from within the 50-mile region would be able to return to their home immediately and thus would not incur temporary housing, food or moving costs.
>
> Commuters do not have personal property within the 50-mile region that would be subject to decontamination or interdiction.[1701]

The Board finds the testimony of Entergy's witnesses persuasive. Commuters may not be within the region during a severe accident, if they are within the region during a severe accident they would be able to return to their homes outside the region subject to decontamination or interdiction, and they do not have personal property within this region. Therefore, the Board finds that commuters, as compared to residents, are not at risk in a way that must be accounted for in a SAMA analysis.

Additionally, the Board concludes that the acceptance in the FSEIS of Entergy's decision not to include commuters was reasonable based on the level of conservatism underlying the MACCS2 code's treatment of transients. MACCS2 equates transients to permanent residents.[1702] For example, with respect to the population dose risk, the MACCS2 code assumes that each person included in the population data (including transients) resides in the 50-mile region 100 percent of the time.[1703] This is a conservative assumption for transients because "shoppers and recreational visitors may be in the 50-mile region for only a few hours, or a few days each year."[1704] Therefore, as Entergy's witnesses testified, the population dose

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[1701] Entergy NYS-16B Testimony at 44 (Ex. ENT000003).

[1702] Id. at 29.

[1703] Id.

[1704] Entergy NYS-16B Testimony at 29–30 (Ex. ENT000003); Tr. at 2508 (Mr. Jones for the NRC Staff).

calculated by MACCS2 overestimates the dose for this component of the population as a result of the extended exposure period conservatively assumed for transients.[1705]

The same appears true with respect to offsite economic cost estimates, considering all persons in the 50-mile region as permanent residents leads to conservative estimates since the MACCS2 calculation is determined through a set of per capita input parameters that would typically not be incurred by transients.[1706] As examples of these conservative estimates, Entergy's witnesses discussed six specific per capita inputs including daily costs for an evacuated person (EVACST, RELCST), one-time relocation cost due to exceeding dose criteria (POPCST), decontamination costs for non-farm property (CDNFRM), and loss of non-farm wealth (VALWNF and VNFRM).[1707]

The Board agrees that applying these offsite economic cost estimates to transients is unrealistic. Transients would not incur costs related to short-term or long-term housing, relocation, decontaminating non-farm property, or value lost due to condemned land. As a result, the MACCS2 code overestimates the offsite economic cost estimates for transients, which adds a level of conservatism. Therefore, the Board finds that including transients in the population data results in a higher, more conservative estimate of population dose and offsite economic cost estimates into the IPEC SAMA analysis.

Based on the testimony presented by the parties, the Board finds that Entergy appropriately accounted for transient populations for the 50-mile region within the SAMA analysis. Commuters originating from outside the 50-mile region are not "just as at risk" as permanent residents so as to require that they be accounted for under the MACCS2 model. Additionally, we find that the level of conservatism afforded by treating transients as permanent

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[1705] Entergy NYS-16B Testimony at 29–30 (Ex. ENT000003).

[1706] Id. at 30–31.

[1707] Id.

residents supports Entergy's and the NRC Staff's decision not to include commuters when accounting for transient populations. Therefore, the Board finds that Entergy's decision to exclude commuters from its transient population estimate was reasonable.

**E. Conclusions of Law**

In summary, a preponderance of the evidence presented by the parties shows that Entergy's estimate and the NRC's approval of the projected population is reasonable and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L). It was reasonable for Entergy to rely on unadjusted Census 2000 data and to exclude commuters from the projected population. Accordingly, NYS-16B is resolved in favor of the NRC Staff and the issues raised by this contention do not prevent the Commission from issuing the requested renewal licenses.

## IX. NEPA CONTENTION NYS-17B (Real Estate Values)

### A. Statement of Contention NYS-17B

NYS-17B, a NEPA contention that challenges the failure to consider the impact of license renewal on real estate values, as litigated on October 22, 2012, reads as follows:

> The FSEIS fails to address the impact of the continued operation of IP2 and IP3 for another 20 years on off-site land use, including real estate values in the surrounding area in violation of 10 C.F.R. §§ 51.71(a), 51.71(d), 51.95(c)(1), and 51.95(c)(4).[1708]

### B. NYS-17B Background

#### 1. NYS-17B Procedural History

New York filed NYS-17 with its initial petition to intervene, and we admitted NYS-17 as a contention of omission.[1709] In so doing we stated that "[i]n conducting its analysis of the impact of the license renewal on land use, Entergy should have considered the impact on real estate values that would be caused by license renewal or non-renewal."[1710]

On February 27, 2009, New York submitted an amended version of the contention, NYS-17A, based on the NRC Staff's DSEIS. We admitted NYS-17A and consolidated it with NYS-17, ruling that "this amended contention updates the original to reflect that New York contends that the NRC Staff erred in a similar manner to Entergy and that the original contention was now relevant to the Draft SEIS, as well as to the ER."[1711] Subsequently, on January 24, 2011, New York submitted a second amended version of the contention, NYS-17B, that directed its

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[1708] State of New York Contention 17B (Jan. 24, 2011) at 2.

[1709] LBP-08-13, 68 NRC at 116.

[1710] Id.

[1711] Licensing Board Order (Ruling on New York State's New and Amended Contentions) (June 16, 2009) at 7–8 (unpublished).

argument to the FSEIS.[1712] We admitted the contention and consolidated it with its earlier versions.[1713]

**2. Legal Standards and Issues Related to NYS-17B**

As noted above at page 24, the NRC has the burden to defend its authorship of the EIS, and, by regulation, divided the environmental impacts of license renewal of nuclear power plants into two categories. Category 1 impacts are those that the Commission has determined are common across plants—they have been evaluated generically in the GEIS for license renewal. These impacts are outside the scope of individual license renewal proceedings.[1714] Category 2 impacts are those that require plant-specific analysis in a supplemental EIS. Table B-1 of 10 C.F.R. Part 51, Appendix B defines whether a given impact category falls under Category 1 or Category 2.

Offsite land use is a Category 2 impact.[1715] The GEIS explains that "[b]ecause land use changes may be perceived by some community members as adverse and by others as beneficial, the staff is unable to assess generically the potential significance of site-specific off-site land use impacts."[1716] At a minimum, two examples of offsite land-use impacts from license renewal were presented in the GEIS: "During the renewal term, new land-use impacts could result from plant-related population growth or from the use by local governments of the plants' tax payments to provide public services that encourage development."[1717] In admitting NYS-17,

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[1712] State of New York Motion for Leave to File Timely Amended Bases to Contention 17A (Now to Be Designated Contention 17B) (Jan. 24, 2011).

[1713] See Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (Jul. 6, 2011) at 16 (unpublished). We also explained that the scope of the contention does not include impacts of long-term storage of nuclear fuel.

[1714] See 10 C.F.R. § 51.53(c)(3)(i).

[1715] Id. at pt. 51, app. B, tbl. B-1.

[1716] GEIS at 4-109 (Ex. NYS00131B).

[1717] Id. at 4-108.

we held that offsite land-use impacts are not limited to the examples of population or tax changes, but encompass all impacts resulting from changes in property values.[1718]

### 3. Evidentiary Record Related to NYS-17B

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-17B

Entergy presented three witnesses in support of its position on NYS-17B – Donald P. Cleary,[1719] C. William Reamer,[1720] and Dr. George S. Tolley.[1721] On March 28, 2012, Entergy submitted the written testimony of these witnesses,[1722] which was admitted into evidence on October 15, 2012.[1723]

The NRC presented three witnesses in support of its NEPA review – Jeffrey J. Rikhoff,[1724] Andrew L. Stuyvenberg,[1725] and John P. Boska.[1726] On October 9, 2012, the NRC Staff submitted the joint testimony of these witnesses,[1727] which was admitted into evidence on October 15, 2012.[1728]

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[1718] LBP-08-13, 68 NRC at 116.

[1719] Curriculum Vitae of Donald P. Cleary (Ex. ENT000133).

[1720] Curriculum Vitae of C. William Reamer (Ex. ENT000140).

[1721] Curriculum Vitae of George S. Tolley, Ph.D. (Ex. ENT000143).

[1722] Testimony of Entergy Witnesses Donald P. Cleary, C. William Reamer, and George S. Tolley Regarding Contention NYS-17B (Property Values) (Mar. 28, 2012) (Ex. ENTR00132) [hereinafter Entergy NYS-17B Testimony].

[1723] Tr. at 1269 (Judge McDade).

[1724] Statement of Qualifications of Jeffrey J. Rikhoff (Ex. NRC000082).

[1725] Statement of Qualifications of Andrew L. Stuyvenberg (Ex. NRC000083).

[1726] Statement of Qualifications of John P. Boska (Ex. NRC000084).

[1727] NRC Staff's Testimony of Jeffrey J. Rikhoff, Andrew L. Stuyvenberg, and John P. Boska Concerning Contentions NYS-17, 17A and 17B (Land Use) (Ex. NRCR00081) [hereinafter NRC Staff NYS-17B Testimony].

[1728] Tr. at 1269 (Judge McDade).

New York presented a single witness in support of NYS-17B – Dr. Stephen C. Sheppard.[1729] On January 30, 2012, New York submitted Dr. Sheppard's written direct testimony.[1730] On June 29, 2012, New York submitted the rebuttal testimony of Dr. Sheppard.[1731] Both of these submissions were admitted into evidence at the hearing.[1732]

**b. Identification of Admitted Exhibits Relevant to NYS-17B**

Relevant to NYS-17B, Entergy submitted 59 exhibits, the NRC Staff submitted nine exhibits, and New York submitted 29 exhibits.[1733] The exhibits were admitted into the record.[1734]

**c. Relevant Guidance Document**

1. NUREG-1555, Supplement 1, Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan for Operating License Renewal, Section 4.4.3 (Ex. ENT00019B). This guidance document "directs the staff's analysis and assessment of potential impacts on offsite land use during the renewal term."[1735]

## C. Evidence Related to Real Estate Values

The NRC Staff witnesses testified that their drafting of the relevant portions of the FSEIS addressing the effects of license renewal on land use was consistent with the agency's

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[1729] Curriculum Vitae of Stephen C. Sheppard (Ex. NYS000208).

[1730] Pre-Filed Direct Testimony of Stephen C. Sheppard, Ph.D. Regarding Contention NYS 17B (Jan. 30, 2012) (Ex. NYSR00224) [hereinafter New York NYS-17B Testimony].

[1731] Pre-Filed Written Rebuttal Testimony of Stephen C. Sheppard Regarding Contention NYS-17B (June 28, 2012) (Ex. NYS000434) [hereinafter New York NYS-17B Rebuttal Testimony].

[1732] Tr. at 1269 (Judge McDade).

[1733] See Appendix B - Partial Initial Decision.

[1734] Tr. at 1269 (Judge McDade).

[1735] RES, Standard Review Plans for Environmental Reviews for Nuclear Power Plants, NUREG-1555, Supp. 1: Operating License Renewal, Section 4.4.3. (Oct. 1999) (Ex. ENT00019B) [hereinafter NUREG-1555].

Standard Review Plan, NUREG-1555, Supplement 1,[1736] which specifies procedures for the Staff to follow in conducting its review of the impacts of license renewal on offsite land use.[1737] In identifying and evaluating impacts, the SRP's procedures state that the Staff should begin with the potential impacts discussed in the GEIS, and should then use site-specific information provided in the applicant's ER and in the records of public meetings and correspondence related to the application.[1738] More specifically, the SRP states that the Staff should:

> Analyze the offsite land-use impacts associated with operations during the renewal term, as follows:
>
> - Determine the new land-use impacts that could result from plant-related population growth or from the use by local governments of the plants' tax payments to provide public services that encourage development.
> - Predict the geographic distribution of new development, if any.
> - Estimate the effects of in-migrants and induced economic activity on offsite land use.[1739]

The FSEIS for IP2 and IP3 addresses the impacts of relicensing IP2 and IP3 on offsite land use under the rubric of socioeconomic impacts in Sections 4.4.3 and 8.2. In Section 4.4.3 of the FSEIS, the Staff concluded that "the socioeconomic impacts of continued plant operation [including impacts on offsite land use] would be SMALL."[1740] The bases for this conclusion were that (1) the number of permanent employees at Indian Point during the renewal term will not change and therefore no population-related impacts will occur, and (2) the payments and taxes paid by Entergy will remain relatively unchanged, and therefore no taxation-related impacts will

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[1736] See NRC Staff NYS-17B Testimony at 9–10 (Ex. NRCR00081).

[1737] See NUREG-1555 § 4.4.3 (Ex. ENT00019B).

[1738] Id. at 4.4.3-4.

[1739] Id.

[1740] See FSEIS at 8-24 (Ex. NYS00133C).

occur.[1741] The Staff's discussion of the offsite land-use impacts of continued operation did not address impacts on property values.[1742]

Mr. Rikhoff of the NRC Staff testified that in drafting the FSEIS the Staff operated on the belief that it was not required by NEPA, NRC regulations, or Staff guidance to address impacts on land values, only on land use.[1743] Nevertheless, he pointed to the GEIS,[1744] which addresses "housing marketability" with the observation that, in general, the license renewal term of a plant should have similar impacts on housing marketability and values as the original license term.[1745]

The GEIS includes a 1996 case study forecasting the specific impacts of license renewal at Indian Point. With respect to impacts on property values, the GEIS concludes that "[h]ousing impacts related to housing value and marketability that occur during the license renewal term are the same as those currently being experienced."[1746] Mr. Rikhoff testified for the Staff that it was his view that "[b]ecause any impact to property values would have occurred prior to or during plant construction, that impact is already reflected in existing property values."[1747]

The Staff's analysis of the impacts of the "no-action alternative" of denying license renewal and the subsequent decommissioning of Indian Point was published in Section 8.2 of the FSEIS. With regard to impacts from physical changes in offsite land use, the FSEIS

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[1741] See id. at 4-45 to -47 (Ex. NYS00133B). See also NRC Staff NYS-17B Testimony at 12 (Ex. NRCR00081) ("Since there would be no increase in employment or new construction or other improvements during the license renewal term, there would be no population or tax revenue-related impacts on offsite land use as a result of license renewal.").

[1742] See NRC Staff NYS-17B Testimony at 14 (Ex. NRCR00081).

[1743] See id. at 7–8. In response to a comment on the DSEIS, the Staff wrote in the FSEIS that "[t]he impact of nuclear plant operations on real estate values was not identified [in the GEIS] as an issue to be addressed by license renewal." FSEIS at A-122 (Ex. NYS00133D).

[1744] Id.

[1745] GEIS at 4-103 (Ex. NYS00131B).

[1746] Id. at C-85 (Ex. NYS00131G).

[1747] NRC Staff NYS-17B Testimony at 15 (Ex. NRCR00081).

identified the possible removal of transmission lines and "conclude[d] that the impacts on land use from plant shutdown would be SMALL."[1748]

The FSEIS analysis further notes that should Indian Point cease operations, payments-in-lieu-of-taxes (PILOT), property taxes, and other tax payments by Entergy would diminish.[1749] According to the FSEIS, "Entergy paid a combined $21.2 million in PILOT payments, property taxes, and other taxes to Westchester County, the Town of Cortlandt, the Village of Buchanan, the Verplanck Fire District, and the Hendrick Hudson Central School District in 2005 . . . ."[1750] In particular, payments to the Village of Buchanan "contributed about 39 percent of the Village of Buchanan's total revenue of $5.08 million . . . ."[1751]

The FSEIS addressed the effect of shutting down Indian Point on local property values and property taxes:

> The shutdown of IP2 and IP3 may result in increased property values of the homes in the communities surrounding the site (Levitan and Associates, Inc. 2005). This would result in some increases in tax revenues. However, to fully offset the revenues lost from the shutdown of IP2 and IP3, taxing jurisdictions most likely would have to compensate with higher property taxes (Levitan and Associates, Inc. 2005). The combined increase in property values and increased taxes could have a noticeable effect on some area homeowners and business, though Levitan and Associates did not indicate the magnitude of this effect and whether the net effect would be positive or negative.[1752]

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[1748] FSEIS at 8-22 (Ex. NYS00133C).

[1749] Id. at 8-24.

[1750] Id.

[1751] Id.

[1752] Id. at 8-25. The Levitan and Associates, Inc. study to which the FSEIS refers was prepared by a consultant on behalf of Westchester County for the purpose of evaluating impacts and options concerning the retirement of Indian Point. See Levitan & Associates, Inc., Indian Point Retirement Options, Replacement Generation, Decommissioning / Spent Fuel Issues, and Local Economic / Rate Impacts (June 9, 2005) (Ex. NYS000056). It was not commissioned by the NRC Staff.

The FSEIS concluded that the cost in revenue losses to local communities from the cessation of Entergy's tax and PILOT payments would outweigh any benefits due to increased property values and property tax revenues:

> Revenue losses from Indian Point operation would affect the communities closest to and most reliant on the plant's tax revenue and PILOT. If property values and property tax revenues increase, some of these effects would be smaller. The NRC staff concludes that the socioeconomic impacts of plant shutdown would likely be SMALL to MODERATE (MODERATE effects for the Hendrick Hudson Central School District, Village of Buchanan, Town of Cortlandt, and the Verplanck Fire District). See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential impacts of plant shutdown.[1753]

Entergy argued that the FSEIS appropriately concludes that the offsite land-use impacts under the no-action alternative are SMALL and the overall socioeconomic impacts under the no-action alternative are SMALL to MODERATE. The details of Entergy's position will not be discussed here as it is not materially different from the NRC Staff's position outlined above.[1754]

### D. Alleged Deficiencies Relating to Real Estate Values in the FSEIS

Dr. Sheppard for New York testified that the value of property affects how the land will be utilized. He explained that "increased values of residential property will cause owners to make more careful use of land and allocate the land to different types of uses."[1755] Accordingly, he argued that Indian Point's impacts on property values are directly tied to its impacts on land use, and therefore consideration of the latter must include the former.[1756] New York noted that the Staff did not conduct any independent analysis on the effect of license renewal or non-renewal on property values.[1757] New York further argued that the Staff mischaracterized the

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[1753] FSEIS at 8-25 (Ex. NYS00133C).

[1754] See, e.g., Entergy's Statement of Position on Contention NYS-17B (Property Values) (Mar. 28, 2012).

[1755] New York NYS-17B Testimony at 40 (Ex. NYSR00224).

[1756] See id. at 8, 11.

[1757] State of New York Initial Statement of Position Contention NYS-17B (Dec. 17, 2011) at 27–28 (Ex. NYS000223).

Levitan report's conclusion that property values would "likely" rise if Indian Point is retired.[1758] Although the Staff acknowledged that the Levitan report did not indicate whether the overall effect on tax revenues of increased property tax collection and reduced payments from Entergy would be positive or negative, New York argued that the Staff instead assumed without analysis that revenues would decrease.[1759]

Through the course of this proceeding, New York submitted five reports that had been prepared by Dr. Stephen Sheppard.[1760] At the hearing, Dr. Sheppard stated that his position was best articulated in his final, December 2011 report, which unlike his previous reports was based on a statistical analysis of housing data in the vicinity of Indian Point.[1761] In his last report and testimony, Dr. Sheppard attempted to show through statistical analysis that the start of operations of IP2 and IP3 between 1974 and 1976 had the effect of reducing property values within 5 kilometers of the facility by over $1 billion, but that the retirement of IPEC would have the opposite impact.[1762]

He hypothesized those property owners who held property over the period between 1974 and 1976 (the period when IP2 and IP3 commenced commercial operations) experienced

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[1758] Id. at 15–16.

[1759] Id. at 17.

[1760] See Report of Stephen C. Sheppard, Potential Impacts of Indian Point Relicensing on Property Values (Nov. 29, 2007) (Ex. NYS000226) [hereinafter 2007 Sheppard Report]; Report of Stephen C. Sheppard, Potential Impacts of Indian Point Relicensing with Delayed Site Remediation (Feb. 26, 2009) (Ex. NYS000227); Report of Stephen C. Sheppard, Determinants of Property Values (Mar. 15, 2010) (Ex. NYS000228); Report of Stephen C. Sheppard, Potential Economic Impacts Related to Property Value Diminution in Communities Surrounding the IPEC, (Jan. 24, 2011) (Ex. NYS000230); Report of Stephen C. Sheppard, Impacts of the Indian Point Energy Center on Property Values (Revised Jan. 30, 2012) (Ex. NYSR00231) [hereinafter December 2011 Sheppard Report].

[1761] See Tr. at 2571–72 (Dr. Sheppard for New York) ("The December 2011 report is the only report that I have filed that actually presents analysis of data collected from [the] area around Indian Point.").

[1762] See generally December 2011 Sheppard Report (Ex. NYSR00231).

a lower rate of return on their property than property owners who held their property entirely over a period prior to 1974 or after 1976.[1763] In other words, in his opinion, those who bought property before 1974 and sold it after 1976 would have experienced the "shock" associated with the activation of IP2 and IP3, reducing the rate of return on their property. By contrast, for property both purchased and sold after 1976, Dr. Sheppard supposed that the effect of IP2 and IP3 would be reflected in both the purchase price and the sale price, and for property purchased and sold before 1974, IP2 and IP3 would have no effect.[1764]

In his testimony, Dr. Sheppard and Entergy's expert Dr. Tolley referred to Dr. Sheppard's approach as "repeat sales" analysis.[1765] Although Dr. Sheppard's report does not cite to other studies that have used this analytical method, he testified that "[t]his approach is similar to so-called 'event studies' that are widely used to determine the impact of events that affect the value of stocks and other financial instruments."[1766]

To test his hypothesis, Dr. Sheppard stated that he obtained housing sales data for approximately 1,500 properties within five kilometers of Indian Point.[1767] He then performed a regression analysis to compare the rate of return for properties in his "treatment group" (those purchased before 1974 and sold after 1976) with those in the "control group" (those both purchased and sold before 1974 or after 1976). He concluded that the results supported his hypothesis and that the commencement of operations of IP2 and IP3 created a "disamenity" that lowered the rate of return on property by approximately 3 percent per year.[1768]

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[1763] See id. at 14–32.

[1764] Id. at 30.

[1765] See Tr. at 2578 (Dr. Tolley for Entergy), 2602 (Dr. Sheppard for New York).

[1766] New York NYS-17B Testimony at 14 (Ex. NYSR00224).

[1767] Id. at 31.

[1768] Id. at 32–33. Dr. Sheppard defined a disamenity as "a localized land use[,] . . . structure or activity on the land that generates . . . an adverse impact that reduces the desirability or use of

By aggregating this 3 percent reduction in annual return across all homes within 5 kilometers of Indian Point over a 9-year average ownership period, Dr. Sheppard estimated the total loss to homeowners at approximately $1 billion.[1769] Dr. Sheppard testified that based on the assumptions in his model, this is a "conservative estimate," in part because his treatment group does not include the period of operation of Unit 1 and construction of IP2 and IP3.[1770] He surmised that "there may have been some [additional] adverse property value impacts that took place prior to 1974."[1771]

According to Dr. Sheppard, the $1 billion in decreased property values that he calculated represents the benefit that would accrue to the community surrounding Indian Point upon the cessation of operations of IP2 and IP3. This is based on his assumption "that when [Indian Point] is gone and the site is restored these changes will be undone."[1772]

## E. NYS-17B Findings

We find that Dr. Sheppard's analysis contains numerous flaws that render its conclusions unreliable, and it consequently fails to discredit the NRC Staff's assessment of the impact of Indian Point on local land use and property values.

### 1. Treatment Period

Several of the flaws in Dr. Sheppard's analysis derive from the way he defines the treatment period. Dr. Sheppard identifies the commencement of operations of IP2 and IP3 as the "event" that triggered a decrease in property values, which were reflected in a lower rate of return on property purchased before the Indian Point units became operational and sold after

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the land by other nearby land owners or occupants." Tr. at 2556 (Dr. Sheppard for New York); see also New York NYS-17B Testimony at 13 (Ex. NYSR00224).

[1769] New York NYS-17B Testimony at 33–34 (Ex. NYSR00224).

[1770] Id. at 37–38.

[1771] Id.

[1772] Id. at 39.

facility operations began.[1773] But this assumption fails to account for the fact that before IP2 and IP3 existed, there was already a functioning nuclear reactor at Indian Point, as Unit 1 began commercial operations in 1962.[1774] Although Dr. Sheppard sought to diminish the impact of Unit 1 as "a much smaller unit that was shut down in 1974,"[1775] we find it difficult to credit the notion that the existing Indian Point power plant was not itself a disamenity in 1974, or that the additional units created a significantly larger disamenity than the preexisting plant. When queried on our concern, Dr. Sheppard testified that the effects of Unit 1 "would have been interesting alternative things to investigate," but he did not because "they wouldn't be as directly relevant" to NYS-17B.[1776]

It is also unclear why the commencement of operations of IP2 in 1974 should be the beginning of the "event" that triggered the decrease in property values. One would expect that home purchasers would anticipate the disamenity of additional nuclear reactors well before IP2 and IP3 became operational (due to, for example, the announcement of development plans, the start of construction, etc.), and this would be reflected in sale prices. Along these lines, Dr. Tolley for Entergy testified that "people take account of anticipation effects. If they know that this plant is going to open and they don't like it, they're not going to bid as much for the property."[1777]

Beyond these flaws in the treatment period, Dr. Sheppard also rejects the possibility that other factors exist to explain the discrepancy in the rates of return between his control group and his treatment group. In particular, he fails to control for broad economic trends that affected

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[1773] Id. at 14.

[1774] See U.S. NRC, Indian Point – Unit 1, http://www.nrc.gov/info-finder/decommissioning/power-reactor/indian-point-unit-1.html (last visited October 24, 2013).

[1775] New York NYS-17B Testimony at 29 (Ex. NYSR00224).

[1776] Tr. at 2560 (Dr. Sheppard for New York).

[1777] Tr. at 2588 (Dr. Tolley for Entergy).

housing prices during the period of his study, such as the energy crisis and economic downturn in the late 1970s, and the housing bubble that burst in 2007. Dr. Sheppard replied to these concerns by asserting that his experimental design accounted for such trends:

> concerns about high interest rates or other dislocations in the housing market . . . will affect the control group. They might affect the treatment group, as well, but . . . my estimates are driven by the difference between the experience of those properties . . . that are in the treatment group compared with those in the control group.[1778]

In attempting to disclaim this control problem, however, Dr. Sheppard instead brought it into focus: economic trends unrelated to Indian Point operation affect the control group and the treatment group disproportionately. For example, those in the treatment group, with periods of ownership which started before 1974 and ended after 1976, are more likely to have been impacted by the energy crisis and economic downturn of the late 1970s than those in the control group. Accordingly, it is possible that the lower rate of return experienced by properties in the treatment group was because of this downturn, rather than any effect of IP2 and IP3 specifically.

The error is compounded by the fact that Dr. Sheppard's data are not evenly distributed through time, but are weighted toward more recent home sales. This is readily apparent from the descriptive statistics Dr. Sheppard provides for his data—the minimum, maximum, and mean value for the key variables in his model. For the variable "sale year," which represents the end of a period of ownership of a property, the values range from a minimum of 1959 to a maximum of 2009, with a mean of 1998.[1779] The fact that the mean is closer to the maximum suggests that the dataset is weighted toward more recent sales, which only makes sense, because one of Dr. Sheppard's criteria for selecting properties for inclusion in his study was that the property had been sold between 1999 and 2009.[1780]

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[1778] Tr. at 2563–64 (Dr. Sheppard for New York).

[1779] New York NYS-17B Testimony at 27 (Ex. NYSR00224).

[1780] Id. at 23. A small number of properties were sold outside this time period. Id.

That the weighting is, in fact, pronounced is demonstrated by Entergy's witness, Dr. Tolley, who showed that the more recent observations are not only disproportionately represented in the sample, they make up the bulk of the control group.[1781] Accordingly, it is possible that the higher rates of return experienced by the control group are due to the housing bubble of the late 1990s and early 2000s, and not because they avoided the shock of IP2 and IP3 commencing operations. Because Dr. Sheppard does not control for such trends in the housing market, we find that there is no certainty that the effect he is measuring is due to Indian Point, rather than general economic conditions.

Dr. Sheppard also discounts the possibility that other contemporaneous occurrences during this broad, two-year "event" could have impacted housing values. Dr. Tolley, however, testified that such a long event period imposes "a danger 'that the period under examination is so long that other events might occur which could incorrectly confirm or refute the test hypothesis.'"[1782] Dr. Sheppard did explain that "I'm aware of the fact that there were . . . other industrial land uses, and other changes in land use that happened during that time."[1783] He further claimed that by including the distance from Indian Point as an explanatory variable in his model, he has effectively targeted the analysis to the effects of Indian Point. But, according to Dr. Tolley, because Dr. Sheppard has not identified other sources of disamenity or controlled for the distance to them, the error remains.[1784] Based on the parties' testimony, we must agree that this identified failure to control for such occurrences deprives Dr. Sheppard's analysis of much of its probative value.

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[1781] See Entergy NYS-17B Testimony at 109, 119 (Ex. ENT000132).

[1782] Id. at 128 (citing R. Smith II, "The 1958 Automobile Information Disclosure Act: A Study of the Impact of Regulation," 4 J. of Indus. Econ. 28, 392 (1980) (Ex. ENT000180)).

[1783] Tr. at 2576 (Dr. Sheppard for New York).

[1784] Tr. at 2579 (Dr. Tolley for Entergy).

### 2. Comparing Costs and Benefits

Dr. Sheppard also forecasts that a rebound in property values "can be expected to occur when operations cease."[1785] As to how soon the rebound will occur, or whether it will be sudden or gradual, Dr. Sheppard was not specific:

> [I]f IPEC were to be completely removed, there would be a period of above-normal returns to residential property owners resulting in substantial property value appreciation. This increase in property values would affect all residential property in place at the time that the IPEC "treatment" is removed. *I have not endeavored to predict when that will occur*.[1786]

Whether the licenses are renewed or not, Dr. Sheppard posits that the same benefit would accrue at the end of the period of operations, and so the choice for decisionmakers is between "getting $1 billion in 2015 versus getting $1 billion 20 years later."[1787] What Dr. Sheppard's analysis fails to address, however, is that the end of commercial operations is only the first step in a lengthy process of decommissioning the plant. We find that he has failed to consider that many years may pass between the time the plant ceases operations and when all the spent fuel is removed and the site is fully decommissioned.

Mr. Reamer testified for the Applicant that "Entergy has adopted a decommissioning strategy that involves taking up to 60 years before fully completing decommissioning of the site."[1788] Mr. Boska for the Staff explained that the 60-year decommissioning option allows for radionuclides to decay over time, making it easier to remove waste and easier for technicians to

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[1785] Tr. at 2565 (Dr. Sheppard for New York).

[1786] December 2011 Sheppard Report at 11 (Ex. NYSR00231) (emphasis added).

[1787] Id.

[1788] Entergy NYS-17B Testimony at 95 (Ex. ENT000132); see also NRC Staff NYS-17B Testimony at 20–21 (Ex. NRCR00081).

monitor decommissioning activities.[1789] Under this option, "Entergy expects to begin removal of radioactive material in 2064."[1790]

Mr. Reamer testified for Entergy that during decommissioning, "[t]he plant will remain, the spent fuel will remain, the impacts like view of the plant, noise, traffic remain unchanged . . . ."[1791] Accordingly, we find that during the time between shutdown and decommissioning, the disamenity of the plant would continue to some degree.

Also problematic for Dr. Sheppard's analysis is the question of the impact of closure of IP2 and IP3 on local property tax revenue. At the Board's request, Entergy submitted an accounting of its current tax and PILOT payments.[1792] In 2012, Entergy paid approximately $27 million in PILOT payments to Westchester County, the Town of Cortlandt, Hendrick Hudson School District, and the Village of Buchanan for those parcels of the plant not currently subject to property tax assessment; and approximately $871,000 in property taxes for the remaining parcels not covered by the PILOT agreement.[1793] In 2014 and 2015, Entergy's PILOT agreements will expire if not renewed.[1794] If Indian Point shuts down, a party may terminate the agreement, "in which case the property will immediately become subject to assessment and taxation under New York's normal property tax system."[1795] Because the plant parcels are not currently subject to assessment, it is unclear what Entergy's tax payments would be during

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[1789] See Tr. at 2718 (Mr. Boska for the NRC Staff).

[1790] NRC Staff NYS-17B Testimony at 21 (Ex. NRCR00081).

[1791] Tr. at 2617 (Mr. Reamer for Entergy).

[1792] See Declaration of Cory Gruntz (Nov. 21, 2012) (Ex. ENT000591).

[1793] Id. at 2, 4.

[1794] Id. at 4.

[1795] Id.

decommissioning, but we agree that it is reasonable to assume, as Entergy states, that the value "would be significantly diminished in the context of a permanent shut-down."[1796]

Dr. Sheppard's final report does not assess the reduction in revenues from the PILOT and other taxes that would no longer be paid by Entergy. Because Dr. Sheppard makes no assessment of the costs to the community of the license denial alternative, he makes no comparison of the calculated property value benefits against the costs of reduced revenues from Entergy. He thus does not address the possibility that although the property tax revenue benefits associated with increased home values may be gradual during and after the lengthy decommissioning period, the costs associated with lost property tax revenues will be immediate. Benefits and costs that occur across time should be adjusted via a discount rate to account for the time value of money.

Dr. Tolley testified that the "present value loss of the PILOT payments . . . [is] overwhelming . . . [as compared to] the property value rebound, because the property value rebound isn't felt for so many years in the future."[1797] Based on the experience of other closed plants, Dr. Tolley estimated "that Entergy's PILOT and property tax payments would be approximately 18 percent of what they are now . . . ."[1798] He calculated that the present value of lost PILOT payments over the 20-year renewal period is approximately $180 million, compared to the $18 million present value of the $1 billion in future benefits associated with property values rebounding.[1799] We find Dr. Tolley's estimation reasonable and adopt his conclusion.

Additionally, Dr. Sheppard's hypothesis that shutting down Indian Point will cause property values to rebound on the order of $1 billion depends on the assumption that Indian

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[1796] Id.

[1797] Tr. at 2659–60 (Dr. Tolley for Entergy).

[1798] Entergy NYS-17B Testimony at 102 (Ex. ENTR00132).

[1799] George S. Tolley, Property Value Effects of Indian Point License Renewal (Mar. 2012) at 53 (Ex. ENT000144) [hereinafter Tolley Report].

Point will be promptly replaced with another use that does not present a disamenity. We find that this assumption is unfounded. The land on which Indian Point sits is zoned for heavy industrial use, and there is no compelling reason to believe that this will change, even though Dr. Sheppard speculates that rising property values during and after IPEC's decommissioning phase could lead local land owners to petition for a change in zoning.[1800] On the contrary, the 2005 master plan for the Village of Buchanan suggests that, even in the event of a facility shutdown, the site "is likely to remain industrial for the foreseeable future."[1801]

Dr. Sheppard testified that, in theory, and taking into account regulatory restrictions, land will be "used for those purposes that generate the greatest value . . . ."[1802] He testified that he has not undertaken an examination "of what might constitute the highest and best use" at the Indian Point site post-decommissioning, or "what's likely to happen there."[1803] But his assertion that the community will reap a $1 billion gain in property values presupposes that Indian Point will not be replaced by another industrial usage with its own set of property value impacts, and on this there is simply no evidence to support Dr. Sheppard's suppositions. If the licenses for IP2 and IP3 are not renewed, the industrial disamenities at the site will likely continue. Perhaps if Indian Point had never been built the site would not be industrial now, but that ship sailed many years ago.

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[1800] Tr. at 2612 (Dr. Sheppard for New York).

[1801] Village of Buchanan, Comprehensive Master Plan (Mar. 2005) at IIB-11 (Ex. ENTR00137).

[1802] New York NYS-17B Testimony at 8 (Ex. NYSR00224).

[1803] Tr. at 2611 (Dr. Sheppard for New York). In Dr. Sheppard's 2007 report, he stated that "the highest and best alternative use of the site where the nuclear power plant is located would . . . [be] a combination of attractive riverfront development that would be likely to include employment and other attractive locations." 2007 Sheppard Report at 3 (Ex. NYS000226).

### 3. Entergy's Alternatives Analysis

To rebut Dr. Sheppard's analysis, Entergy put forward a competing study of Indian Point's effect on property values prepared by its expert, Dr. Tolley.[1804] Rather than looking at the change in rates of return over time, Dr. Tolley compared the asking prices for homes listed on the market at a single point in time (July 2011) at varying distances from Indian Point.[1805] By controlling for the characteristics of individual homes, he hoped to find the marginal effect of distance from Indian Point (if any) on the price of a home.[1806] This method of isolating a characteristic of valuation was referred to by Dr. Tolley as hedonic regression.[1807]

Dr. Tolley's model estimated the effect of distance from Indian Point on housing price as a quadratic equation.[1808] He explained that if Indian Point is a disamenity, the expected result would be that prices would rise sharply at short distances from the plant, and then would continue to increase more gradually with increasing distances.[1809] Instead, the outcome of Dr. Tolley's regression was the paradoxical result that prices are higher for homes nearest to the plant as compared to homes a short distance from the plant, and for homes beyond a short distance from the plant prices begin to rise at an increasing rate at farther distances. The results of his analysis imply that nearness to IPEC is actually an amenity up to almost 2 miles from the plant, but then becomes an increasingly larger disamenity as distance from the plant

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[1804] See Tolley Report (Ex. ENT000144).

[1805] Id. at 5.

[1806] Id.

[1807] Id.

[1808] Id. at 20. A quadratic equation describes the relationship between two variables (here, home prices and distance from Indian Point) as a function of the square of one of the variables (here, distance from Indian Point).

[1809] Id.

becomes greater.[1810] Dr. Tolley concludes that "the regression gives no support for the hypothesis that [Indian Point] depresses property values."[1811]

Dr. Sheppard testified that he believes that Dr. Tolley's results corroborate his own study, pointing out that the effect of the linear term of distance is not statistically significant, only the quadratic (squared) term is.[1812] Therefore, according to Dr. Sheppard, one should drop the insignificant linear term, producing the result that prices continuously rise with distance, consistent with his preferred disamenity.[1813] We do not agree, and place more weight on Dr. Tolley's conclusion attributing the statistical significance of the distance-squared term to "unmeasured effects that happen to be correlated with distance."[1814]

Further, Dr. Sheppard criticized Dr. Tolley's analysis for not considering other functional forms, particularly the square root of distance.[1815] Applying the square root of distance estimation to Dr. Tolley's data, Dr. Sheppard obtained a statistically significant result.[1816] In response, however, Dr. Tolley testified that Dr. Sheppard's suggestion of the square root of distance could be seen as an instance of "cherry picking" a model to fit the data.[1817] We agree.

Similar to Dr. Sheppard's analysis, Dr. Tolley's regressions suffer from design flaws that render them of limited value in determining the effect of the plant on local property values. As

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[1810] Id. at 21.

[1811] Id. at 22; see also Tr. at 2594–96 (Dr. Tolley for Entergy).

[1812] Tr. at 2600–01 (Dr. Sheppard for New York).

[1813] Tr. at 2684 (Dr. Sheppard for New York).

[1814] Tolley Report at 22 (Ex. ENT000144); see also Tr. at 2594–96 (Dr. Tolley for Entergy).

[1815] New York NYS-17B Rebuttal Testimony at 24 (Ex. NYS000434).

[1816] Id. at 36.

[1817] Tr. at 2609 (Dr. Tolley for Entergy). Dr. Tolley's report notes that "[s]ensitivity tests were run with alternative functional forms (log-log, semi-log, linear form without distance squared) that did not change the conclusion." Tolley Report at 22 (Ex. ENT000144).

Dr. Tolley conceded, "unobserved or omitted variables have a large potential influence in hedonic pricing analysis."[1818] Chiefly, Dr. Tolley's model does not control for the effect of other disamenities in the vicinity of Indian Point.

Dr. Sheppard additionally criticized Dr. Tolley's study for "the small sample size, the use of asking price instead of sales price, the inconsistencies in distance variables used, the lack of a true control group, and the failure to evaluate alternative functional forms,"[1819] all of which we consider to be compelling criticisms. But we find that the same is true of Dr. Sheppard's analysis, which we find suffer from glaring fatal flaws not readily inherent in Dr. Trolley's conclusions.

**4. Adequacy of the NRC Staff's Analysis**

In the ruins of this statistical labyrinth, we are left to determine whether the Staff's FSEIS complies with NEPA. We conclude that it does. Although the Staff's analysis is minimal, based on the evidentiary record, we cannot say that it is incorrect, or that it fails to take the requisite "hard look."

The Staff's assessment that the effects of relicensing IP2 and IP3 on offsite land use will be "small" reflects the fact that an additional twenty years of operation will retain the status quo. New York has put forward no evidence to indicate that any significant land-use changes will occur during the renewal period, other than the allegation that the continued presence of Indian Point keeps housing values below their potential and prevents an earlier transition of the Indian Point site to other, potentially higher-value uses.

The Staff maintained that it is not required to consider the impacts of relicensing Indian Point and the no-action alternative on property values.[1820] We do not think that such a cramped

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[1818] Entergy NYS-17B Testimony at 63 (Ex. ENTR00132).

[1819] New York NYS-17B Rebuttal Testimony at 38 (Ex. NYS000434).

[1820] NRC Staff NYS-17B Testimony at 7 (Ex. NRCR00081).

interpretation is consistent with NEPA's mandate to consider impacts "affecting the quality of the human environment."[1821]

But the dispute is irrelevant here because, despite its protestations, the Staff has analyzed the impacts on property values. As it turns out, the Staff did undertake a reasonable analysis of the effects on land use of renewing the licenses for IP2 and UP3. Further, the case study of Indian Point in the GEIS provides the basis for the Staff's conclusion that renewal would have no new impacts on housing values. And although the Staff's discussion in the FSEIS was limited to population-based and taxation-based impacts, the GEIS included an analysis of the effect of renewal on property values.[1822]

We likewise find that the Staff undertook sufficient consideration of the license denial and its effects on land use. The Staff noted that shutdown of Indian Point could cause property values in the vicinity to increase, along with property tax revenues, but it reasonably concluded that these effects could (and probably would) be counteracted by the loss in PILOT revenues.[1823]

Although the Staff did not undertake an independent quantitative analysis of the effects of plant shutdown on tax revenues and property values, to do so was not required. NEPA "does not call for certainty or precision, but an *estimate* of anticipated (not unduly speculative) impacts."[1824] Further, "an environmental impact statement [is not] intended to be a 'research document,' reflecting the frontiers of scientific methodology."[1825]

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[1821] See 42 U.S.C. § 4332.

[1822] GEIS at 4-109 (Ex. NYS00131B).

[1823] FSEIS at 8-15 (Ex. NYS00133C).

[1824] La. Energy Servs., L.P. (Nat'l Enrichment Facility), CLI-05-20, 62 NRC 523, 536 (2005) (emphasis in original).

[1825] Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 315 (2011).

## F. Conclusions of Law

We find that a preponderance of the evidence submitted regarding this contention supports the conclusion that, in this case, the Staff's reasoned, qualitative approach to weighing the costs and benefits of plant shutdown on property values and the local community was reasonable and satisfies the requirements of 10 C.F.R. § 51.95 and NEPA. Accordingly, NYS-17B is resolved in favor of the NRC Staff and the issues raised by this contention do not prevent the Commission from issuing the requested renewal license.

# X. NEPA CONTENTION NYS-37 (No-Action Alternative)

## A. Statement of Contention NYS-37

NYS-37, a NEPA contention that challenges the lack of an energy alternatives discussion, as litigated on October 24 and November 28, 2012,[1826] reads as follows:

> The FSEIS discussion of energy alternatives (Chapter 8) fails to provide a meaningful analysis of energy alternatives or responses to criticism of the DSEIS, in violation of the requirements of 42 U.S.C. §§ 4331 and 4332; 10 C.F.R. §§ 51.91(A)(1), and (C), 51.92(2), 51.95(C)(4), and Part 51, Subpart A, Appendix A and Appendix B; 40 C.F.R. §§ 1052.1, 1052.2(G), 1502.9, and 1502.14; and 5 U.S.C. § 551 et seq.[1827]

## B. NYS-37 Background

### 1. NYS-37 Procedural History

NYS-37 updated and superseded NYS-9 and NYS-33. We admitted NYS-9 on the limited ground that it challenged the lack of an energy-alternative discussion in the "no-action" section of the ER.[1828] Subsequently, after publication of the DSEIS, we admitted NYS-33, which alleged that the discussion of energy alternatives in the DSEIS violated NEPA because it failed to provide a rigorous analysis of the costs, benefits, and feasibility of energy conservation and other measures under the "no-action" alternative.[1829] Simultaneously, we consolidated NYS-33 with NYS-9 "based on the similarities of issues . . . ."[1830]

On July 6, 2011, the Board admitted NYS-37 "to the extent that it update[d] and supersede[d] NYS-9/33 and to the extent that it challenge[d] the adequacy of the discussion in

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[1826] Tr. at 2919–3273.

[1827] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 29 (unpublished).

[1828] Licensing Board Memorandum and Order (Ruling on Petitions to Intervene and Requests for Hearing) (July 31, 2008) at 49 (unpublished).

[1829] Licensing Board Order (Ruling on New York State's New and Amended Contentions) (June 16, 2009) at 9, 13 (unpublished).

[1830] Id. at 13.

the FSEIS addressing comments made regarding the environmental impact of the no-action alternative as described in the DSEIS."[1831] When admitting this contention, we reminded the parties that "we [were] not authorizing a broad-ranged inquiry into alternative scenarios and the need for power, which [are] precluded by Commission regulations [in a license renewal proceeding], and which [this Board had] previously excluded."[1832]

### 2. Legal Standards and Issues Related to NYS-37

#### a. No-Action Alternative

When taking the requisite hard look at the environmental consequences of the alternatives to the proposed licensing action, NRC regulations require the EIS to discuss the no-action alternative.[1833] The NRC's GEIS defines and explains the no-action alternative in the arena of license renewal as follows:

> [T]he no-action alternative is denial of a renewed license. Denial of a renewed license as a power generating capability may lead to a variety of potential outcomes. In some cases, denial may lead to the selection of other electric generating sources to meet energy demands as determined by appropriate state and utility officials. In other cases, denial may lead to conservation measures and/or decisions to import power. In addition, denial may result in a combination of these different outcomes. Therefore, the environmental impacts of such resulting alternatives would be included as the environmental impacts of the no-action alternative.[1834]

Thus, the Staff is instructed to analyze the potential environmental impacts associated with not renewing the license within the "no-action alternative" section of the energy-alternatives chapter in the EIS.[1835]

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[1831] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 34 (unpublished).

[1832] Id. at 35.

[1833] 10 C.F.R. pt. 51, app. A § 4.

[1834] GEIS at 8-2 (Ex. NYS00131D).

[1835] RES, NRC, Standard Review Plans for Environmental Reviews for Nuclear Power Plants NUREG-1555, Supp. 1: Operating License Renewal at 8.1-3 (Oct. 1999) (Ex. ENT00019B).

Commission regulations, however, do not require the inclusion of an analysis within the EIS regarding the need for the power generated by an existing plant in license renewal proceedings.[1836] Specifically, 10 C.F.R. § 51.95(c)(2) reads, in pertinent part:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation.

**b. NEPA**

NYS-37 arises under NEPA and the NRC's implementing Part 51 regulations.[1837] As noted above, NEPA requires that an agency must prepare an EIS before approving any major Federal action that may significantly affect the quality of the human environment.[1838] The goal of NEPA is two-fold: (1) to ensure that agency decisionmakers will have detailed information concerning significant environmental impacts of proposed projects when they make their decisions; and (2) to guarantee that such information will be available to the larger audience that may also play a role in the decision-making process.[1839]

Pursuant to 10 C.F.R. § 51.91(a)(1), "[t]he final environmental impact statement will include responses to any comments on the draft environmental impact statement . . . ." These responses may include:

> (i) Modification of alternatives, including the proposed action;
>
> (ii) Development and evaluation of alternatives not previously given serious consideration;
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> (iii) Supplementation or modification of analyses;

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[1836] See 10 C.F.R. § 51.95(c)(2).

[1837] 42 U.S.C. §§ 4321–70; 10 C.F.R. pt. 51.

[1838] 42 U.S.C. § 4332(2)(C).

[1839] Robertson, 490 U.S. at 349.

(iv) Factual corrections;

(v) Explanation of why comments do not warrant further response, citing sources, authorities or reasons which support this conclusion.[1840]

### 3. Evidentiary Record Related to NYS-37

#### a. Identification of Witnesses Who Provided Testimony Relevant to NYS-37

Entergy presented three witnesses to provide testimony on NYS-37 – Donald Cleary,[1841] David Harrison, Jr.,[1842] and Eugene Meehan.[1843] On March 30, 2012, Entergy filed the written testimony of these three witnesses.[1844] On October 15, 2012, this testimony was admitted into evidence.[1845]

The NRC Staff presented one witness to provide testimony on NYS-37 – Andrew Stuyvenberg.[1846] On March 30, 2012, the NRC Staff filed the written testimony of this witness.[1847] On October 15, 2012, this testimony was admitted into evidence.[1848]

New York presented three witnesses to provide testimony on NYS-37 – David Schlissel,[1849] Peter Bradford,[1850] and Peter Lanzalotta.[1851] New York submitted the written

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[1840] 10 C.F.R. § 51.91(a)(1)(i)–(v).

[1841] Curriculum Vitae of Donald P. Cleary (Ex. ENT000133).

[1842] Curriculum Vitae of David Harrison, Jr. (Ex. ENT000480).

[1843] Curriculum Vitae of Eugene T. Meehan (Ex. ENT000482).

[1844] Testimony of Entergy Witnesses Donald P. Cleary, David Harrison Jr., and Eugene T. Meehan Regarding Contention NYS-37 (Energy Alternatives) (Mar. 30, 2012) (Ex. ENT000479) [hereinafter Entergy NYS-37 Testimony].

[1845] Tr. at 1269 (Judge McDade).

[1846] Statement of Qualifications of Andrew L. Stuyvenberg (Ex. NRC000083).

[1847] NRC Staff's Testimony of Andrew L. Stuyvenberg Concerning Contention NYS-9, NYS-33 and NYS-33 (Alternatives, Consolidated) (Mar. 30, 2012) (Ex. NRC000133) [hereinafter Andrew Stuyvenberg Testimony].

[1848] Tr. at 1269 (Judge McDade).

testimony on December 14, 2011.[1852] Subsequently, New York filed rebuttal written testimony.[1853] On October 15, 2012, both of these submissions were admitted into evidence.[1854]

**b. Identification of Admitted Exhibits Relevant to NYS-37**

Relevant to NYS-37, New York submitted 124 exhibits, the NRC Staff submitted 16 exhibits, and Entergy submitted 52 exhibits.[1855] All of these exhibits were admitted into the record on October 15, 2012.[1856]

**C. Discussion of the No-Action Alternative in the FSEIS**

"At the heart of this contention is the claim that the NRC Staff relied on outdated information and ignored well-reasoned and supported comments to the DSEIS in conducting its analysis and in reaching conclusions relating to the no-action alternatives that were articulated in the FSEIS."[1857] According to New York's witness, David Schlissel, the Staff's FSEIS[1858]

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[1849] Curriculum Vitae of David A. Schlissel (Ex. NYS000050).

[1850] Curriculum Vitae of Peter A. Bradford (Ex. NYS000104).

[1851] Curriculum Vitae of Peter J. Lanzalotta (Ex. NYS000097).

[1852] Pre-filed Written Testimony of David A. Schlissel Regarding Contention NYS-37 (Dec. 13, 2011) (Ex. NYS000046) [hereinafter David Schlissel Testimony]; Pre-filed Written Testimony of Peter Bradford Regarding Contention NYS-9-33-37 ("NYS-37") (Dec. 13, 2011) (Ex. NYS000048) [hereinafter Peter Bradford Testimony]; Pre-Filed Written Testimony of Peter J. Lanzalotta Regarding Contention NYS-9-33-37 (Dec. 13, 2011) (Ex. NYS000047) [hereinafter Peter Lanzalotta Testimony] .

[1853] Pre-Filed Written Rebuttal Testimony of David A. Schlissel Regarding Contention NYS-37 (June 29, 2012) (Ex. NYS000437).

[1854] Tr. at 1269 (Judge McDade).

[1855] See Appendix B - Partial Initial Decision.

[1856] Tr. at 1269 (Judge McDade).

[1857] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 34 (unpublished).

[1858] The no-action alternative is discussed primarily in Sections 8.2, 8.3, and 8.4 of the FSEIS. See FSEIS (Ex. NYS00133C).

"ignored significant developments that have occurred in New York State's energy markets since the [ER] was released in 2007 that make it more likely that New York State can replace Indian Point's generation by 2015 when the [Indian Point] units are scheduled to retire . . . ."[1859] Primarily, according to Mr. Schlissel, the 2007 ER "pre-dated the 2007 financial crisis, the subsequent prolonged economic recession, fundamental changes in the natural gas sector, significant decreases in wholesale energy prices, and decreased energy demand and load forecasts."[1860] Thus, according to Mr. Schlissel:

> [t]hese reduced energy sales and peak loads will delay and defer the need for the energy and capacity from Indian Point Units 2 and 3 if their operating licenses were not renewed and will likewise impact the timing and viability of the no-action energy alternative. Cumulatively, these developments create a more favorable environment for retiring Indian Point Units 2 and 3 at the end of their operating licenses . . . and for replacing their generation capacity with energy efficiency, repowered generation, purchased electrical power, renewable energy, or some combination thereof, at less environmental impact and cost than considered by the FSEIS.[1861]

More specifically, Mr. Schlissel testified that the ER and the FSEIS externally relied upon "the National Research Council's 2006 report on the alternatives to Indian Point and Levitan's 2005 report on the retirement of Indian Point and the natural gas sector."[1862] According to Mr. Schlissel, because these studies pre-dated the 2007 financial crisis, they do not accurately reflect the "lower than expected electricity sales and peak loads and reduced projections of future electricity sales and peak loads for an extended period of time and will impact directly the time frame within which the alternatives . . . would need to be implemented under the no-action alternative."[1863] Mr. Schlissel further stated that the Staff's "impact analysis ignores the fact that

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[1859] David Schlissel Testimony at 6 (Ex. NYS000046).

[1860] Id. at 9–10.

[1861] Id. at 7.

[1862] Id. at 10.

[1863] Id. at 11.

New York State experienced a 4.1% drop in power demand due to the recession and weak economic recovery."[1864]

Mr. Schlissel also testified that the collapse of natural gas prices, in conjunction with the recession, has been "game changing" in the energy market since 2007.[1865] He asserted that these combined factors have "complement[ed] each other such that a lot of the base load coal plants . . . are falling victim to the economics of not being used as much as they had been prior" to 2007.[1866] Thus, according to Mr. Schlissel, these recent factors and their environmental impacts need to be considered when analyzing the possibility of removing Indian Point from the New York energy suppliers under the no-action alternative section of the FSEIS.[1867] This, according to Mr. Schlissel, the Staff failed to do.[1868]

Additionally, Mr. Schlissel criticized the Staff for not performing a site-specific analysis of energy efficiency as an alternative to relicensing Indian Point.[1869] He asserts that in lieu of a site-specific analysis, the Staff generically adopted within the Indian Point FSEIS the energy-efficiency findings of its Shearon Harris[1870] and Three Mile Island Unit 1 assessments.[1871]

According to Mr. Schlissel, using the Shearon Harris energy-efficiency findings in the Indian Point FSEIS fails to provide a factual basis for the energy-conservation conclusions

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[1864] Id. at 11–12.

[1865] See Tr. at 2952 (Mr. Schlissel for New York).

[1866] Id.

[1867] See Tr. at 2953 (Mr. Schlissel for New York).

[1868] See id.

[1869] See David Schlissel Testimony at 23 (Ex. NYS000046).

[1870] Id.; see also NRR, GEIS, Supp. 33 Regarding Shearon Harris Nuclear Power Plant, Unit 1 Final Report, NUREG 1437 (Aug. 2008) (Ex. NYS000065).

[1871] David Schlissel Testimony at 23 (Ex. NYS000046); see also NRR, GEIS, Supp. 37 Regarding Three Mile Island Nuclear Station, Unit 1 Final Report, NUREG 1437 (June 2009) (Ex. NYS000066).

within the no-action alternative section because "[t]he Shearon Harris facility shares little, if any, similarity to the substantially larger, deregulated, Indian Point facilities."[1872] In addition, he testified that the energy-efficiency findings in the Three Mile Island Unit 1 assessment are not relevant here because, these findings rely "on a single study, conducted in 2004 of Pennsylvania's energy efficiency potential . . . [that] makes no reference to New York State, Indian Point, or the energy efficiency potential relevant or forecasted to be available in the zones currently receiving power from Indian Point."[1873]

Mr. Schlissel also testified that the "Staff's analysis of New York's renewable sector is neither consistent nor thorough."[1874] He stated, as indicated in his 2009 and 2011 declarations, that New York State can replace a significant amount of the capacity and energy supplied by Indian Point with renewable generation if the units are not relicensed.[1875] According to Mr. Schlissel, New York is well on its way to meeting this goal as illustrated by the fact that the percentage of in-state electricity used between 2001 and 2009 generated by in-state renewable resources increased from 16 percent to 23 percent.[1876] However, according to Mr. Schlissel, these facts, which were provided to the Staff in the contentions and DSEIS comments for this proceeding, were not analyzed in the FSEIS.[1877]

According to Mr. Schlissel, the Staff disregarded the reports and declarations he had provided with contentions and DSEIS comments for this proceeding, and instead relied on the Department of Energy's and the Energy Information Administration's (DOE/EIA) annual energy

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[1872] David Schlissel Testimony at 23 (Ex. NYS000046).

[1873] Id. at 23–24.

[1874] Id. at 29.

[1875] Id. at 26.

[1876] Id. at 27.

[1877] See id. at 28–29.

outlook report for 2010 to 2035 to analyze New York's renewable sector to "'help select reasonable alternatives to license renewal.'"[1878] For instance, in Mr. Schlissel's opinion, the Staff adopted "DOE/EIA's conclusion that coal generation is forecast to decline, but [inexplicably] ignore[d] DOE/EIA's conclusion that renewable generation is forecast to sharply increase over the time period relevant to license renewal."[1879] A further example of how the Staff's analysis was deficient, according to Mr. Schlissel, is that "the FSEIS emphasizes the negative environmental impacts of wind, while discounting its positive environmental benefits."[1880]

In addition, Mr. Schlissel criticized the FSEIS for not analyzing the reduced need for capacity through the improvements that New York has made to the downstate electricity grid since 2007.[1881] He testified that, "developers in New York have been actively licensing and building upgrades and enhancements to the transmission system."[1882] For instance, the "three Linden Variable Frequency Transformers began operating at the Linden New Jersey cogeneration facility on December 8, 2009 and have the capability to feed up to 315 MW of electricity into New York City from the New Jersey power system."[1883] According to Mr. Schlissel, "[t]hese transformers are helping to stabilize NYC's power grid, increase reliability, and reduce the need for new capacity inside the city."[1884] Yet, the FSEIS failed to discuss this

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[1878] Id. at 29 (citing FSEIS at 8-28 (Ex. NYS00133A)).

[1879] Id.

[1880] Id. at 33.

[1881] See id. at 36.

[1882] Id.

[1883] Id.

[1884] Id. at 36–37.

and other operating and proposed upgrades to New York's electricity grid that would "'assist in maintaining system reliability in the event that one or both of the Indian Point plants close."[1885]

For the reasons discussed above, Mr. Schlissel concluded that:

> [b]ecause the NRC Staff did not provide an accurate and meaningful impact analysis for . . . generation alternatives, and did not accurately account for lowered load forecasts and energy prices, and changes in New York's energy markets since the recession, the FSEIS does not give decisionmakers a real sense of the economic and environmental costs and benefits of the no-action alternative.[1886]

New York's witness, Peter Bradford, largely concurred with Mr. Schlissel.[1887] Mr. Bradford emphasized that the "FSEIS does not give decisionmakers a clear and reasonably up-to-date picture of New York's power supply without one or both of the Indian Point units."[1888] Like Mr. Schlissel, Mr. Bradford opined that the no-action alternative section of the FSEIS inaccurately relies on outdated information.

As a result, Mr. Bradford testified that retiring the Indian Point units will result in fewer environmental impacts than the FSEIS suggests, and that "[m]any of these developments were called to the NRC's attention by witnesses for the State of New York well in advance of the publication of the FSEIS" but the Staff ignored much of this information.[1889] Thus, Mr. Bradford concluded that "the FSEIS overstate[d] the need for [relicensing Indian Point] . . . [and is] likely to mislead decisionmakers as to the environmental impact and feasibility of the no-action alternative to relicensing one or both Indian Point units."[1890]

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[1885] Id. at 37.

[1886] Id. at 7–8.

[1887] Compare David Schlissel Testimony at 7–8 (Ex. NYS000046) with Peter Bradford Testimony at 7 (Ex. NYS000048).

[1888] Peter Bradford Testimony at 7 (Ex. NYS000048).

[1889] Id. at 7–8.

[1890] Id. at 34.

New York's third witness, Peter Lanzalotta, by and large concurred with Mr. Schlissel and Mr. Bradford.[1891] Mr. Lanzalotta testified that:

> [t]he FSEIS provides little or no useful information on whether or to what extent the capabilities of New York State's existing electric transmission system and related facilities will support or limit the various alternatives discussed in Section 8 of the FSEIS and thus what will occur if Indian Point is not relicensed.[1892]

With regard to transmission capacity, Mr. Lanzalotta asserted that the "FSEIS appears to ignore the approval of the Hudson Transmission Partner Line. . . . This 345 kV line will connect Pennsylvania, New Jersey, Maryland grid . . . to midtown Manhattan, running between Bergen Substation in Ridgefield, New Jersey and terminating at Consolidated Edison substations."[1893] According to Mr. Lanzalotta, when approving the Hudson Transmission Partner Line, the New York State Public Service Commission found that "the [Hudson Transmission Partner] facility will assist in maintaining system reliability in the event that one or both of the Indian Point plants close."[1894]

Mr. Lanzalotta also testified that "[t]he FSEIS ignores substantial developments in the downstate market that reduce the need to implement corrective measures if the [Indian Point] units are retired. As a result, it substantially overstates the potential constraints on replacement power, and overstates the potential economic costs of a[n Indian Point] retirement scenario."[1895]

In response to New York's testimony, the Staff's witness, Andrew Stuyvenberg, emphasized that "[t]he alternatives analysis in Chapter 8 [of the FSEIS] is an *explicit* indication

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[1891] Compare David Schlissel Testimony at 7–8 (Ex. NYS000046) with Peter Bradford Testimony at 7 (Ex. NYS000048) and Peter Lanzalotta Testimony at 5–6 (Ex. NYS000047).

[1892] Peter Lanzalotta Testimony at 5 (Ex. NYS000047).

[1893] Id. at 7–8.

[1894] Id. at 8.

[1895] Id. at 22.

that IP2 and IP3 can be replaced.[1896] According to Mr. Stuyvenberg, in the DSEIS and the FSEIS, the staff considered a number of alternatives that could reasonably and feasibly replace Indian Point."[1897] Moreover, Mr. Stuyvenberg stressed that the "Staff did not assert that the 'IP2 and IP3 power reactors' could not be replaced, nor did it assert that 'IP2 and IP3 power reactors' are necessary."[1898]

In his testimony, Mr. Stuyvenberg stated that while the Staff is not required to analyze energy conservation as an alternative to license renewal, it did so in light of the no-action alternative because of substantial evidence New York provided in its 2009 comments on the DSEIS. While it is his opinion that conservation is not among the reasonable set of alternatives the Staff is required to analyze in the DSEIS or the FSEIS, Mr. Stuyvenberg testified the GEIS addresses conservation, because it is an option "that states and utilities may use to reduce their need for power generation capability."[1899]

Mr. Stuyvenberg also stated that "[t]he purpose of license renewal is 'to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license in order to meet future system generating needs.'"[1900] Nevertheless, Mr. Stuyvenberg testified that the GEIS acknowledges that "conservation is a possible consequence of the no-action alternative and recognizes that, while conservation is not a discrete power generation source, it is an option that may be used to reduce the need for generation capability."[1901] He indicated that the GEIS specifically states that energy conservation is an

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[1896] Andrew Stuyvenberg Testimony at 54 (Ex. NRC000133).

[1897] Id. at 54–55.

[1898] Id. at 55.

[1899] Id. at 6–7.

[1900] Id.

[1901] Id. at 7.

important tool available to energy planners in managing need for power and generating capacity.[1902] Hence, "[a]s a result, the GEIS thus discusses the environmental impacts of conservation."[1903]

Mr. Stuyvenberg noted that the Indian Point DSEIS "received a lot of comments and input from various parties, but particularly from the State of New York about the value and the extent to which the State viewed [energy conservation and efficiency] to be an important part of its energy policy and its processes."[1904] He emphasized that "the Staff relied on [New York's] DSEIS comments to establish the *state-specific viability* of conservation and energy efficiency [in the FSEIS]."[1905] According to Mr. Stuyvenberg:

> [t]hese New-York-specific assertions [made in response to the DSEIS] all indicate that 1) aggressive programs could replace Indian Point's capacity; 2) the State was actively working to implement programs that were even more aggressive than existing programs and continues to do so; and 3) the State's potential new programs could provide even more energy efficiency and conservation capacity than existing estimates suggested. These indications all support a conclusion by NRC Staff that New York could conceivably harness sufficient energy efficiency and conservation capacity by 2015 to offset the entire capacity of IP2 and IP3.[1906]

Having said this, Mr. Stuyvenberg testified that, "contrary to New York State's assertions, the Staff did not rely on either Shearon Harris or Three Mile Island FSEISs to establish the viability of energy efficiency/conservation as alternative to Indian Point license renewal."[1907] These FSEISs, according to Mr. Stuyvenberg, were only used to determine that "communities immediately surrounding the Indian Point site would suffer prompt and significant

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[1902] Id. (citing GEIS at 8-2 (Ex. NYS00131D)).

[1903] Id.

[1904] Tr. at 2994 (Mr. Stuyvenberg for the NRC Staff).

[1905] Andrew Stuyvenberg Testimony at 10 (Ex. NRC000133) (emphasis in original).

[1906] Id. at 11.

[1907] Id. at 12.

negative [economic] impacts, while any potential offsetting benefits from the implementation of conservation programs would be relatively more diffuse, and would not, in an immediate and targeted way, supply replacement revenue to the communities surrounding Indian Point."[1908] Thus, Mr. Stuyvenberg reiterated that "the Staff relied on New-York-specific estimates of viability submitted by New York State Office of the Attorney General in its DSEIS comments of March 18, 2009" to establish for the FSEIS the viability of energy efficiency and conservation as an alternative to Indian Point license renewal.[1909]

In response to New York's specific criticisms that the FSEIS failed to analyze the recent improvements New York has made to the downstate electricity grid, Mr. Stuyvenberg testified that "transmission [capacity] is not something the Staff has counted against any alternative [presented in the FSEIS]."[1910] He stated that "it [is] assumed [by the Staff] that any of the alternatives considered would not be constrained by transmission."[1911] Similarly, he testified that while the FSEIS discusses the environmental impacts of energy alternatives to relicensing Indian Point, it does not discuss the environmental impact of constructing transmission systems for those alternative energy sources.[1912]

In response to New York's specific criticism that the FSEIS failed to consider the current low price of natural gas in its analysis of natural-gas-fueled facilities as an alternative to relicensing Indian Point, Mr. Stuyvenberg stated that the Staff did not assign any specific environmental impact to the pricing of natural gas as an alternative energy source to the nuclear energy produced at Indian Point because the pricing of natural gas, and the impact of electricity

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[1908] Id.

[1909] Id.

[1910] Tr. at 3213 (Mr. Stuyvenberg for the NRC Staff).

[1911] Tr. at 3213–14 (Mr. Stuyvenberg for the NRC Staff).

[1912] See Tr. at 3215 (Mr. Stuyvenberg for the NRC Staff).

costs in the event that Indian Point is not relicensed, are out of the NRC's control.[1913] According to Mr. Stuyvenberg,

> [i]n responding to comments about the particular issue of electricity costs, the Staff pointed out that any impact on electricity costs and service impacts from the loss of IP-2 and IP-3 electrical generating capacity is speculative. And due to the deregulation of the energy market in the State of New York, competition for the sale of electricity may keep electricity costs and services under control.[1914]

Additionally, in regards to the no-action alternative, Mr. Stuyvenberg testified that:

> [it] does not include a discussion of the likelihood or extent of the specific measures to be taken if license renewal is denied. The NRC Staff defers to state and utility-level decisionmakers with regard to decisions about the type and amount of generation to be relied upon should IP2 and IP3 cease operations. Decisions regarding which alternatives to implement are not the NRC's to make.[1915]

But Mr. Stuyvenberg also noted that the FSEIS section on the no-action alternative states that:

> [p]lant shutdown will result in a net loss of power generating capacity. The power not generated by IP2 and IP3 during the license renewal term would likely be replaced by (1) power supplied by other producers (either existing or new units) . . . (2) demand-side management and energy conservation, or (3) some combination of these options. The environmental impacts of these options are considered in Section 8.3 of the SEIS.[1916]

Finally, in response to the New York's allegation that the FSEIS failed to respond to New York's comments and criticisms to the DSEIS, Mr. Stuyvenberg noted that New York State submitted over 100 pages of comments on the DSEIS, and testified that contrary to New York's assertions, "the Staff addressed [within the FSEIS] all of the comments submitted by . . . New

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[1913] See Tr. at 3222 (Mr. Stuyvenberg for the NRC Staff).

[1914] Id.

[1915] Andrew Stuyvenberg Testimony at 33 (Ex. NRC000133) (quoting FSEIS at 8-22 (Ex. NYS00133C)); see also Tr. at 3158 (Mr. Stuyvenberg for the NRC Staff).

[1916] Andrew Stuyvenberg Testimony at 33 (Ex. NRC000133); see also Tr. at 3158 (Mr. Stuyvenberg for the NRC Staff).

York State . . . ."[1917] In addition to these comments, according to Mr. Stuyvenberg, three New York State executive agencies separately submitted written comments on the DSEIS: the New York State Department of State, the New York State Department of Environmental Conservation, and the New York State Office of the Attorney General.[1918] Mr. Stuyvenberg also noted that "New York State was not the only entity to submit comments on the DSEIS. The Staff responded to approximately 1140 pages of public comments from more than 500 individuals and organizations, many of whom presented views that differed from those presented by New York State."[1919] Mr. Stuyvenberg testified that "[r]egardless of a commenter's identity or view, the Staff evaluated the information presented and, where appropriate, made changes to the text that had appeared in the DSEIS."[1920]

In sum, Mr. Stuyvenberg

> disagrees with [New York's allegations in Contention NYS-37]. It is the Staff's position that the alternatives[, including the no-action alternative,] analyzed are reasonable, the analysis is adequate, and that the analysis meets applicable regulatory requirements and thus constitutes a reasonable consideration of the environmental impacts of alternatives to license renewal.[1921]

Entergy witness Mr. Cleary agreed with the Staff that:

> the FSEIS contains an appropriate evaluation of alternatives and considers, among other things, the environmental impacts of new natural gas-fired generation, energy conservation, and combinations of alternatives, including a combination involving repowering an existing fossil-powered plant, renewable generation, and a considerable amount of conservation. For alternatives found to not be reasonable alternatives to replace approximately 2000 MWe of baseload power, the FSEIS provides the requisite explanation of the reasons for

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[1917] Andrew Stuyvenberg Testimony at 25 (Ex. NRC000133).

[1918] Id.

[1919] Id. at 27; see also FSEIS at App. A (Exs. NYS00133C–D).

[1920] Andrew Stuyvenberg Testimony at 28 (Ex. NRC000133). For instance, Mr. Stuyvenberg testified that "in light of DSEIS comments and the existence of greenhouse-gas policies in New York" the Staff removed coal-fired power as a likely alternative to replace the power generated by Indian Point from the FSEIS. Id.

[1921] Id. at 3.

> their elimination. Thus, the FSEIS assessment of alternatives is consistent with NRC guidance, 10 C.F.R. Part 51 regulations, and NEPA.[1922]

Entergy also argued that its "[e]mpirical analyses show that IPEC baseload generation would actually be replaced primarily by fossil-fueled generation, not renewable generation and additional conservation. As a result, according to Entergy, the FSEIS, if anything, likely underestimates the adverse environmental impacts of the no-action alternative."[1923]

Thus, Entergy's witnesses concluded that New York's testimony "contains nothing that substantively calls into question the NRC Staff's conclusion 'that the adverse environmental impacts of license renewal for IP2 and IP3 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable.'"[1924]

**D. NYS-37 Findings**

The question for this Board is whether the Staff met its NEPA and 10 C.F.R. § 51.91(a)(1) by taking a hard look at the environmental impacts of the no-action alternative and reasonably responding to the comments—regarding the no-action alternative—to the DSEIS within the FSEIS. In short, the answer is yes.

The Staff was not required to agree with or adopt any of New York's comments to the DESIS to be compliant with NEPA or 10 C.F.R. § 51.91(a)(1). That being said, the Staff is required to comply fully with the procedural edicts of NEPA and 10 C.F.R. § 51.91(a)(1), and we find that it did so.

First, as Mr. Stuyvenberg testified, "[t]he staff responded to approximately 1140 pages of public comments from more than 500 individuals and organizations," including the more than

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[1922] Entergy NYS-37 Testimony at 17 (Ex. ENT000479).

[1923] Entergy's Statement of Position on Contention NYS-37 at 43 (Ex. ENT000478).

[1924] Entergy NYS-37 Testimony at 116 (Ex. ENT000479) (quoting FSEIS at 9-8 (Ex. NYS00133C)).

100 pages of comments from New York.[1925] These extensive comments and responses—including responses to New York's comments criticizing the Staff's omissions in the no-action alternative section of the DSEIS—can be found in the 1,316 pages of Appendix A to the FSEIS and within Chapter 8 of the FSEIS.[1926] Thus, we find that the Staff met the requirement under 10 C.F.R. § 51.91(a)(1) to respond "to any comments on the draft environmental impact statement."

Second, contrary to New York's assertions that the Staff failed to consider New York's state-specific, aggressive energy conservation and efficiency,[1927] we find that the Staff did the direct opposite in response to New York's comments to the 2009 DSEIS.[1928] It "develop[ed] and evaluat[ed] alternatives not previously given serious consideration" in the DSEIS by considering, in Chapter 8 of the FSEIS, energy renewal and conservation as an alternative to license renewal for IP2 and IP3.[1929] The Staff ultimately determined in Chapter 8 of the FSEIS that the environmental "impacts of energy conservation 'are generally lower than those from other alternatives, including the proposed action [of renewing the licenses of IP2 and IP3].'"[1930]

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[1925] Andrew Stuyvenberg Testimony at 25, 27 (Ex. NRC000133); see also FSEIS at App. A (Exs. NYS00133C–I).

[1926] See FSEIS at 8-20 to -72, app. A (Exs. NYS00133C–I).

[1927] See State of New York Initial Statement of Position Contention NYS-9/33/37 ("NYS-37") (Dec. 14, 2011) at 4 (Ex. NYSR00045).

[1928] Andrew Stuyvenberg Testimony at 8 (Ex. NRC000133) (citing FSEIS at A-984 to -1043 (Ex. NYS00133G)).

[1929] See id. (citing FSEIS at 8-41 to -43 (Ex. NYS00133C)). The Staff analyzed energy conservation and efficiency as an alternative to license renewal in the FSEIS for IP2 and IP3 even though the Staff was not required to analyze the need for the power supplied by these reactors under NRC regulations. See 10 C.F.R. § 51.95(c)(2). The Staff does note, however, that it did not specifically analyze the need for the power IP2 and IP3 generate; instead it simply considered energy conservation and efficiency as an alternative to license renewal, which is sanctioned by the GEIS. See Andrew Stuyvenberg Testimony at 31–32 (Ex. NRC000133).

[1930] Id. at 8–9 (citing FSEIS at 8-73 (Ex. NYS00133C)).

Moreover, we find that the Staff reached its determination that energy efficiency and conservation can stand alone, or be combined with other energy sources, to replace Indian Point's energy production by relying on New York's comments about energy efficiency and conservation in the DSEIS. This includes the imposition of aggressive policies like the "45 by 15 clean energy goal," a goal the State has adopted to meet 45 percent of its electricity needs by 2015 through increased energy efficiency and renewable energy.[1931]

Similarly, we find credible Mr. Stuyvenberg's testimony that, contrary to New York's allegations that the Staff failed to account for New York's recently improved energy transmission capacity, the Staff's analysis did not count transmission capacity against any alternative presented in the FSEIS, including the conservation-and-efficiency alternatives.[1932] Along that same line, we find credible Mr. Stuyvenberg's testimony that the Staff assumed that any of the alternatives considered would not be constrained by transmission.[1933]

Furthermore, based on Mr. Stuyvenberg's testimony, we find: (1) that the Staff's determination of the extent and reliability of the State's renewable energy and energy efficiency policies and its transmission capabilities did not rely on the Shearon Harris FSEIS, the Three Mile Island FSEIS, or the outdated reports mentioned in the testimony of New York's experts, and (2) the FSEIS relied on New York's statements about the State's renewable energy and energy efficiency policies and transmission capabilities as those representations were made in New York's comprehensive comments to the 2009 DSEIS.

In sum, we conclude that, in compliance with NEPA, the NRC Staff has taken a reasonably hard look at the environmental effects of state-specific energy conservation and efficiency as a replacement alternative—both as a stand-alone alternative and as an element

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[1931] FSEIS at 8-43 (Ex. NYS00133C).

[1932] Tr. at 3213–14 (Mr. Stuyvenberg for the NRC Staff).

[1933] Id.

within combinations of alternatives—for the electric power produced by IP2 and IP3. We further conclude that the Staff did so, in compliance with 10 C.F.R. § 51.91(a)(1), by carefully analyzing and responding to New York's extensive comments to the DSEIS regarding state-specific energy conservation and efficiency as a replacement alternative.

Moreover, contrary to New York's argument that the "FSEIS . . . emphasizes the environmental costs of fossil fuel generation[,]"[1934] the Board finds that the FSEIS, in compliance with 10 C.F.R. § 51.91(a)(1)(iii), modified the DSEIS analysis of fossil fuel generation, specifically coal-fired power, as an alternative to relicensing Indian Point based on the comments it received from New York on the 2009 DSEIS.[1935] We thus agree with Mr. Stuyvenberg, and find that in the FSEIS the "Staff rejected coal-fired power based on [its] review of likely generating alternatives in New York in light of DSEIS comments and the existence of greenhouse-gas policies in New York."[1936]

Additionally, we find that the Staff, despite New York's assertions to the contrary, did not ignore energy market factors—such as the current low price of natural gas, the recent economic recession, or the reduced energy demand that resulted from the recession—in its FSEIS.[1937] Instead, the Staff found that electricity costs in New York's deregulated energy market are speculative, and thus competition for the sale of electricity may keep electricity costs manageable in the event that Indian Point is not relicensed.[1938] The Staff also concluded that market factors such as competition will drive the price of energy in New York's deregulated

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[1934] New York's Initial Statement of Position on Contention NYS-37 at 4 (Ex. NYSR00045).

[1935] Andrew Stuyvenberg Testimony at 15 (Ex. NRC000133).

[1936] Id. at 21 (citing FSEIS at 8-49 (Ex. NYS00133C)).

[1937] Tr. at 3222 (Mr. Stuyvenberg for the NRC Staff).

[1938] Id.

market, not the licensing of specific energy facilities or the preference for a particular energy source. The Board finds this FSEIS analysis and conclusion reasonable under NEPA.

As noted above, the Staff was not obligated under NEPA or 10 C.F.R. § 51.91(a)(1) to fully adopt, or agree with, all of New York's comments to the DSEIS regarding the no-action alternative. Instead, under NEPA, the Staff was required to take a reasonably hard look at the no-action alternative within the FSEIS and, under 10 C.F.R. § 51.91(a)(1), to respond reasonably to the comments on the DSEIS in one of the manners set forth in this regulation. The FSEIS complied with both of these procedural edicts, and thus we find that the Staff fulfilled its responsibilities under NEPA and 10 C.F.R. § 51.91(a)(1) by reasonably responding to New York's comments to the DSEIS regarding the no-action alternative. In doing so, the Staff took a hard look at the environmental impacts of energy alternatives that could reasonably replace energy created by IP2 and IP3 in the event that these units are not relicensed, and appropriately explained its analysis in Chapter 8 and Appendix A of the FSEIS.

**E. Conclusions of Law**

We find that a preponderance of the evidence submitted regarding this contention supports the conclusion that, in this case, the Staff adequately addressed comments made regarding the environmental impact of the no-action alternative and the FSEIS was reasonable and satisfies the requirements of 10 C.F.R. § 51.95 and NEPA. Accordingly, NYS-37 is resolved in favor of the NRC Staff and the issues raised by this contention do not prevent the Commission from issuing the requested renewal license.

# XI. NEPA CONTENTION CW-EC-3A (Environmental Justice)

## A. Statement of Contention CW-EC-3A

CW-EC-3A, a NEPA contention that challenges the environmental justice analysis performed by the NRC Staff, as litigated at the evidentiary hearing on October 23, 2012, reads as follows:

> Entergy's environmental report and the Final Supplemental Environmental Impact Statement contain seriously flawed environmental justice . . . analyses that do not adequately assess the impacts of relicensing Indian Point on the minority, low-income and disabled populations in the area surrounding Indian Point.[1939]

## B. CW-EC-3A Background

### 1. CW-EC-3A Procedural History

In its original form, CW-EC-3 alleged that "Entergy's Environmental Report [ER] containe[d] a seriously flawed environmental justice [EJ] analysis that d[id] not adequately assess the impacts of Indian Point on the minority, low-income, and disabled populations in the area surrounding Indian Point."[1940]

We admitted this contention, but limited its scope to Clearwater's allegation that "Entergy's ER is deficient because it does not supply sufficient information from which the Commission may properly consider, and publicly disclose, environmental factors that may cause harm to minority and low-income populations that would be disproportionate to that suffered by the general population."[1941] More specifically, we admitted this contention to explore the allegation that Entergy's ER failed to analyze whether a severe accident would negatively impact certain minority and low-income populations located near Indian Point ("potentially

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[1939] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 60 (unpublished).

[1940] Clearwater Petition at 31.

[1941] LBP-08-13, 68 NRC at 201 (internal quotation omitted).

affected EJ populations") differently than the general population.[1942] Upon admitting this contention, we emphasized that this "is a Part 51 Environmental Contention brought under NEPA[,] . . . not a Part 54 Safety Contention based on emergency planning."[1943]

On February 3, 2011, Clearwater moved to amend and extend CW-EC-3 based on alleged deficiencies in the December 2010 FSEIS.[1944] In support of its request to amend, Clearwater argued that, in admitting this contention, this Board recognized the potential for disparate impacts on potentially affected EJ populations, but that the FSEIS ignored this issue.[1945] In its request to extend the scope of CW-EC-3, Clearwater provided two grounds: (1) the FSEIS failed to provide an adequate assessment of the EJ impacts of the no-action alternative; and (2) the FSEIS similarly failed to provide an adequate assessment of EJ impacts of installing closed-cycle cooling at Indian Point.[1946]

The Board admitted those portions of CW-EC-3A that sought to update the contention as originally admitted to address the FSEIS. However, we rejected the proposed extended portions of the contention on timeliness and materiality grounds.[1947]

### 2. Legal Standards and Issues Related to CW-EC-3A

#### a. Environmental Justice

In February 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."[1948] This

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[1942] Id. at 200.

[1943] Id. at 201.

[1944] Motion for Leave to Amend and Extend Contention EC-3 Regarding Environmental Justice and Petition to Do So (Feb. 3, 2011).

[1945] Id. at 1; see also id. at 3, 19.

[1946] Id. at 1–2; see also id. at 3–10, 20–22.

[1947] Licensing Board Memorandum and Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) at 56 (unpublished).

Executive Order directed Federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human or environmental effects of its programs, policies, and activities on minority populations and low-income populations . . . ."[1949]

Independent Federal agencies, such as the NRC, were not required, but were requested, to comply with Executive Order 12898.[1950] In response to this request, the Chairman of the NRC sent a letter to President Clinton indicating that the NRC would carry out the measures laid out in Executive Order 12898 as part of the Agency's NEPA analyses.[1951]

In 1998, the Commission issued Louisiana Energy Services,[1952] its first decision addressing EJ. In this decision, the Commission held that "'disparate impact analysis is [the NRC's] principal tool for advancing environmental justice under NEPA. The NRC's goal is to identify and adequately weigh, or mitigate, effects on low-income and minority communities that become apparent only by considering factors peculiar to those communities."[1953] These holdings were reiterated in Private Fuel Storage,[1954] where the Commission stated that "[e]nvironmental justice, as applied to the NRC, . . . [m]eans that the agency will make an effort

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[1948] Exec. Order No. 12898, 59 Fed. Reg. 7629 (Feb. 11, 1994).

[1949] Id. at 7629.

[1950] See Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions, 69 Fed. Reg. 52,040, 52,040–41 (Aug. 24, 2004) (Ex. ENT000260).

[1951] See id. (citing Letter from Ivan Selin, NRC Chairman, to President Clinton (Mar. 31, 1994)).

[1952] La. Energy Servs., L.P., CLI-98-3, 47 NRC 77.

[1953] Id. at 100.

[1954] In the Matter of Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), CLI-02-20, 56 NRC 147, 156 (2002).

under NEPA to become aware of the demographic and economic circumstances of local communities . . . ."[1955]

The NRC requirement for plant-specific EJ reviews under NEPA is codified in Table B-1 in Appendix B to Subpart A of 10 C.F.R. Part 51, which is entitled "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant." Table B-1 classifies EJ as a "Category 2" issue. This means that "Environmental Justice was not addressed in NUREG-1437 GEIS and accordingly, EJ must be addressed in individual license renewal reviews."[1956] This analysis is governed by NEPA and the NRC's Part 51 regulations.[1957]

**b. NEPA**

CW-EC-3A calls into question the adequacy of the EJ analysis in the Staff's FSEIS.[1958] As indicated above, CW-EC-3A is a contention that arises under NEPA, which does not mandate substantive results, but rather imposes procedural obligations on agencies, requiring them to take a "hard look" at the environmental impacts of a proposed action and reasonable alternatives to that action.[1959] Accordingly, what is required is an informed discussion of the relevant issues.

As noted in more detail in earlier sections of this order, NEPA requires that before approving any major Federal action that may significantly affect the quality of the human environment, an agency prepare an EIS.[1960] The goal of NEPA is two-fold: (1) to ensure that

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[1955] Id.

[1956] 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1.

[1957] 42 U.S.C. §§ 4321–70; 10 C.F.R. pt. 51.

[1958] Motion for Leave to Amend and Extend Contention EC-3 Regarding Environmental Justice and Petition to Do So (Feb. 3, 2011).

[1959] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 87–88; see also Balt. Gas, 462 U.S. at 97–98 (holding that NEPA requires agencies to take a "hard look" at environmental consequences prior to taking major actions).

[1960] 42 U.S.C. § 4332(2)(C).

agency decisionmakers will have detailed information concerning significant environmental impacts of proposed projects when they make their decisions; and (2) to guarantee that such information will be available to the larger audience that may also play a role in the decision-making process.[1961]

However, in the event that a board finds that the Staff's analysis is insufficient, we need not require that the agency staff "go back to the drawing board" and amend or supplement the EIS. Rather, the Board's review and admitted exhibits are part of the environmental record upon which the Commission makes its ultimate balancing judgment. "The adjudicatory record and Board decision (and, of course, any Commission appellate decisions) become, in effect, part of the FEIS."[1962] Accordingly, "to the extent that any environmental findings by the Presiding Officer (or the Commission) differ from those in the FEIS, the FEIS is deemed modified by the decision."[1963]

NEPA and Part 51 require that as part of its environmental review the Staff prepare a "Record of Decision" to accompany any Commission decision on any action for which a final EIS has been prepared.[1964] Typically, the Staff prepares the record of decision,[1965] but when, as here, a hearing is held, the Board's initial decision constitutes the record of decision as to those

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[1961] Robertson, 490 U.S. at 349.

[1962] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 89.

[1963] Hydro Res., Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-4, 53 NRC 31, 53 (2001).

[1964] 10 C.F.R. § 51.102(a).

[1965] Id. § 51.102(b).

issues that were litigated during the hearing[1966] and the hearing can provide the public venting that the circulation of an amended EIS would otherwise provide.[1967]

But if modification of the FEIS by Staff testimony or the Board's decision is too substantial, recirculation of the FEIS would be required. "[I]n a given instance, the staff's evidence may depart so markedly from the positions espoused or information reflected in the [FEIS] as to require formal redrafting and recirculation for comment of the environmental statement (or at least those portions which are affected by the changes) before the licensing board gives any further consideration to the subjects involved."[1968]

### 3. Evidentiary Record Related to CW-EC-A

#### a. Identification of Witnesses Who Provided Testimony Relevant to CW-EC-3A

Entergy presented three witnesses to provide testimony on CW-EC-3A – Donald Cleary,[1969] Jerry Riggs,[1970] and Michael Slobodien.[1971] On March 29, 2012, Entergy filed the initial testimony of these witnesses regarding CW-EC-3A.[1972] On October 15, 2012, Entergy's testimony was admitted into evidence.[1973]

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[1966] La. Energy Servs., L.P. (National Enrichment Facility), LBP-06-8, 63 NRC 241, 260 (2006); Hydro Resources Inc., LBP-06-19, 64 NRC 53, 69 n.11 (2006).

[1967] Phila. Electric Co. (Limerick Generating Station, Units 1 and 2), 22 NRC 681, ALAB-819 (1985).

[1968] Allied-General Nuclear Servs. (Barnwell Nuclear Fuel Plant Separation Facility), ALAB-296, 2 NRC 671, 680 (1975).

[1969] Curriculum Vitae of Donald P. Cleary (Ex. ENT000133).

[1970] Curriculum Vitae of Jerry L. Riggs (Ex. ENT000008).

[1971] Curriculum Vitae of Michael J. Slobodien (Ex. ENT000262).

[1972] Testimony of Entergy Witnesses Donald P. Cleary, Jerry L. Riggs, and Michael J. Slobodien Regarding Contention CW-EC-3A (Environmental Justice) (Mar. 29, 2012) (Ex. ENT000258) [hereinafter Entergy CW-EC-3A Testimony].

[1973] Tr. at 1269 (Judge McDade).

The NRC Staff presented two witnesses to provide testimony on CW-EC-3A – Jeffrey Rikhoff[1974] and Patricia Milligan.[1975] On March 30, 2012, the NRC Staff filed the written testimony of these witnesses.[1976] On October 15, 2012, the Staff's testimony was admitted into evidence.[1977]

Clearwater presented nine witnesses to provide testimony on CW-EC-3A – Michael Edelstein,[1978] Dr. Andrew Kanter,[1979] Anthony Papa,[1980] Dr. Erik Larsen,[1981] John Simms,[1982] Aaron Mair,[1983] Dolores Guardado,[1984] Stephen Filler,[1985] and Manna Jo Greene.[1986] On

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[1974] Jeffrey J. Rikhoff, Statement of Professional Qualifications (Mar. 30, 2012) (Ex. NRC000082).

[1975] Patricia A. Milligan Statement of Professional Qualifications (Mar. 30, 2012) (Ex. NRC000064).

[1976] NRC Staff Initial Statement of Position Regarding Contention CW-EC-3A (Environmental Justice) (Mar. 30, 2012) at 1 (Ex. NRC000062).

[1977] Tr. at 1269 (Judge McDade).

[1978] Curriculum Vitae of Michael Edelstein (Ex. CLE000011).

[1979] Curriculum Vitae of Dr. Andrew Kanter (Ex. CLE000049).

[1980] Initial Pre-Filed Testimony of Anthony Papa in Support of Hudson River Sloop Clearwater, Inc's Contention Regarding Environmental Justice (EC-3A) (dated Oct. 11, 2011 and submitted on Dec. 22, 2011) [hereinafter Anthony Papa Testimony] (Ex. CLE000004).

[1981] Curriculum Vitae of Dr. Erik Larsen (Ex. CLE000020).

[1982] Testimony of John Simms in Support of Hudson River Sloop Clearwater, Inc.'s Contention Regarding Environmental Justice (dated Oct. 11, 2011 and submitted on Dec. 22, 2011) [hereinafter John Simms Testimony] (Ex. CLE000006).

[1983] Curriculum Vitae of Aaron Mair (Ex. CLE000021).

[1984] English Translation of Initial Prefiled Written Testimony of Dolores Guardado Regarding Clearwater's Environmental Justice Contention EC-3A (Dec. 22, 2011) [hereinafter Dolores Guardado Testimony] (Ex. CLE000008).

[1985] Initial Prefiled Written Testimony of Stephen Filler Regarding Clearwater's Environmental Justice Contention EC-3A (Ex. CLE000009).

[1986] Resume of Manna Jo Greene (Ex. CLE000024).

December 22, 2011, Clearwater submitted its initial statement of position and written testimony.[1987] Clearwater filed its rebuttal testimony on June 28, 2012.[1988] On October 15, 2012, Clearwater's testimony was admitted into evidence.[1989]

**b. Identification of Admitted Exhibits Relevant to CW-EC-3A**

Relevant to CW-EC-3A, Clearwater submitted 64 exhibits, the NRC Staff submitted 14 exhibits, and Entergy submitted 57 exhibits.[1990] All of these exhibits were admitted into the record on October 15, 2012.[1991]

**c. Relevant Guidance Documents**

1. Council on Environmental Quality's (CEQ) Environmental Justice Guidance Under the National Environmental Policy Act (1997) (Ex. ENT000266). In response to Executive Order

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[1987] Initial Statement of Position for Clearwater's Contention EC-3A Regarding Environmental Justice (Dec. 22, 2011) [hereinafter Clearwater Initial Statement of Position] (Ex. CLER00002); Testimony of Dr. Michael Edelstein in Support of Hudson River Sloop Clearwater, Inc.'s Contention Regarding Environmental Justice (Dec. 22, 2011) [hereinafter Dr. Edelstein Testimony] (Ex. CLE000003); Anthony Papa Testimony (Ex. CLE000004); Initial Prefiled Written Testimony of Erik A. Larsen, MD, FACEP Regarding Clearwater's Environmental Justice Contention EC-3A (Dec. 22, 2011) [hereinafter Dr. Larsen Testimony] (Ex. CLE000005); John Simms Testimony (Ex. CLE000006); Initial Prefiled Testimony of Aaron Mair Regarding Clearwater's Environmental Justice Contention (Dec. 22, 2011) [hereinafter Aaron Mair Testimony] (Ex. CLE000007); Dolores Guardado Testimony (Ex. CLE000008); Initial Prefiled Written Testimony of Stephen Filler Regarding Clearwater's Environmental Justice Contention EC-3A (Dec. 22, 2011) [hereinafter Stephen Filler Testimony] (Ex. CLE000009); Initial Prefiled Written Testimony of Manna Jo Greene Regarding Clearwater's Environmental Justice Contention EC-3A (Dec. 22, 2011) [hereinafter Manna Jo Greene Testimony] (Ex. CLE000010).

[1988] Rebuttal Testimony of Manna Jo Greene Regarding Clearwater's Environmental Justice Contention EC-3A (June 28, 2012) (Ex. CLE000046); Rebuttal Testimony of Dr. Michael Edelstein Regarding Clearwater's Environmental Justice Contention EC-3A (June 28, 2012) (Ex. CLE000047); Rebuttal Testimony of Dr. Andrew Kanter Regarding Clearwater's Environmental Justice Contention EC-3A (June 28, 2012) (Ex. CLE000048); Michael Edelstein, Ph.D. Rebuttal to Respondents to Testimony on the Environmental Justice Contention Report (June 28, 2012) (Ex. CLE000058); Michael Edelstein, Ph.D. Appendix to Rebuttal to Respondents to Testimony in the Environmental Justice Contention Report (June 28, 2012) (Ex. CLE000059).

[1989] Tr. at 1269 (Judge McDade).

[1990] See Appendix B - Partial Initial Decision.

[1991] Tr. at 1269 (Judge McDade).

12898, the CEQ, "in consultation with EPA and other affected agencies, . . . developed this guidance to further assist Federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed."[1992]

2. NRR Office Instruction – Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (2004) (Ex. ENT000261). On May 24, 2004, NRR issued this Change Notice to document its "procedure . . . for incorporating environmental justice into the licensing process . . . ."[1993]

3. Policy Statement on the Treatment of Environmental Justice matters in NRC Regulatory and Licensing Actions (Ex. ENT000260). The NRC Staff utilized the holdings in Louisiana Energy Services and Private Fuel Storage to create the "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions."[1994] In

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[1992] Council on Environmental Quality, Environmental Justice Guidance Under the National Environmental Policy Act 1 (1997) (Ex. ENT000266).

[1993] Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (May 24, 2004) at 6–7, app. D (Ex. ENT000261).

[1994] Statement on the Treatment of Environmental Justice Matters at 52,040–48 (Ex. ENT000260). It should be noted that:

> [t]he critical distinction between a substantive rule and a general statement of policy is the different practical effect that these two types of pronouncements have in subsequent administrative proceedings. A properly adopted substantive rule establishes a standard of conduct which has the force of law. In subsequent administrative proceedings involving a substantive rule, the issues are whether the adjudicated facts conform to the rule and whether the rule should be waived or applied in that particular instance. The underlying policy embodied in the rule is not generally subject to challenge before the agency.
>
> A general statement of policy, on the other hand, does not establish a 'binding norm.' It is not finally determinative of the issues or rights to which it is addressed. The agency cannot apply or rely upon a general statement of policy as law because a general statement of policy only announces what the agency seeks to establish as policy. A policy statement announces the agency's tentative intentions for the future. When the agency applies the policy in a particular situation, it must be prepared to support the policy just as if the policy statement had never been issued. An agency cannot escape its responsibility to present evidence and reasoning supporting its substantive rules by announcing binding precedent in the form of a general statement of policy. Pac. Gas Elec.

relevant part, this Policy Statement instructs that "[t]he goal of an EJ portion of the NEPA analysis is (1) [t]o identify and assess environmental effects on low-income and minority communities by assessing impacts peculiar to those communities; and (2) to identify significant impacts, if any, that will fall disproportionately on minority and low-income communities."[1995] In discussing the scope of an EJ analysis, this Policy Statement states that:

> it is expected that in addition to reviewing available demographic data, a scoping process will be utilized preceding the preparation of a draft EIS. This will assist the NRC in ensuring that minority and low-income communities, including transient populations, affected by the proposed action are not overlooked in assessing the potential for significant impacts unique to those communities.[1996]

4. NRR Office Instruction – Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues Revision 2 (2009) (Ex. ENT000264). On February 17, 2009, NRR issued this change notice to document its revised procedures for incorporating EJ into its licensing procedures.[1997] These procedures were amended to incorporate the Commission's August 24, 2004, Policy Statement on the Treatment of EJ Matters.[1998]

**d. Motions in Limine**

Entergy filed a motion in limine on January 30, 2012, seeking to exclude portions of Clearwater's written testimony and some corresponding exhibits in their entirety.[1999] In denying the motion, the Board reaffirmed that it is "capable of distinguishing between disparaging

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> Co. v. Fed. Power Comm'n, 506 F.2d 33, 38–39 (D.C. Cir. 1974) (citations omitted).

[1995] Statement on the Treatment of Environmental Justice Matters at 52,048 (Ex. ENT000260).

[1996] Id.

[1997] Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (Feb. 11, 2009) at C-6 to -7 (Ex. ENT000264).

[1998] Id. at C-1.

[1999] Entergy's Motion in Limine to Exclude Portions of Pre-Filed Testimony and Exhibits for Contention CW-EC-3A (Environmental Justice) (Jan. 30, 2012) at 7–24.

comments against Indian Point's emergency plans and Clearwater's witnesses' descriptions of how certain EJ populations will be adversely harmed by a severe accident compared to the general population."[2000] The parties were reminded that Clearwater's testimony would be restricted to the discussion of disparate impacts on those populations that are within the definition of an EJ population, and that the Board would disregard any non-conforming evidence in ruling on the merits of this contention.[2001]

Entergy then moved "to exclude: (1) portions of the rebuttal testimony of Dr. Michael Edelstein and Ms. Manna Jo Greene; (2) the entirety of Dr. Andrew S. Kanter's rebuttal testimony; (3) all or portions of Exhibits CLE000050 through CLE000059; and (4) portions of the Clearwater Rebuttal Statement Supporting Contention EC-3A."[2002] According to Entergy, this evidence was not admissible because it:

> (1) broadly challenge[d] the adequacy of emergency plans, contrary to the scope of CW-EC-3A and license renewal; (2) raise[d] issues concerning numerous non-EJ populations and vaguely-defined EJ subgroups, contrary to Commission precedent and NRC Staff guidance; or (3) raise[d] various other issues unquestionably outside the scope of CW-EC-3A and this proceeding, including irrelevant new claims concerning the evacuation-related environmental impacts from terrorist attacks.[2003]

The Staff also filed a motion in limine to exclude portions of rebuttal testimony and rebuttal exhibits proffered by Clearwater.[2004] The Staff asserted that the evidence it sought to exclude

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[2000] Licensing Board Order (Granting in Part and Denying in Part Applicant's Motion in Limine) (Mar. 6, 2012) at 35 (unpublished).

[2001] Id. at 34–35.

[2002] Entergy's Motion in Limine to Exclude Portions of Clearwater's Rebuttal filings on Contention CW-EC-3A (Environmental Justice) (July 30, 2012) at 1–2.

[2003] Id. at 2. Clearwater opposed this motion in limine. Id. at 18.

[2004] NRC Staff's Motion in Limine to Exclude Portions of Pre-Filed Rebuttal Testimony and Rebuttal Exhibits Regarding Contention CW-EC-3A (Environmental Justice) (July 30, 2012) at 1.

was "not reliable, relevant, or within the scope of this proceeding."[2005] The Board denied both these motions at the beginning of the Evidentiary Hearing on October 15, 2012.[2006]

### C. Discussion of Environmental Justice in the FSEIS

Environmental Justice is discussed primarily in Sections 4.4.6 and 8.2 of the FSEIS.[2007] Section 4.4.6 contains the Staff's discussion of the effects of continuing operation on the EJ population.[2008] Chapter 8, in part, contains the Staff's discussion of the effects of the alternatives to license renewal on the EJ population, with Section 8.2 addressing effects of shutting down the Indian Point plant.[2009]

According to the Staff's witnesses, the Staff's EJ analysis described in Sections 4.4.6 and 8.2, used a three-step-analysis process:

> (1) identify[] the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the license renewal term and refurbishment activities associated with license renewal, (2) determin[e] whether there would be any potential human health or environmental effects to these populations and special pathway receptors, and (3) determin[e] if any of the effects may be disproportionately high and adverse.[2010]

According to Mr. Rikhoff for the NRC Staff, "[m]inority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."[2011]

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[2005] Id. at 2.

[2006] Tr. at 1265–66 (Judge McDade).

[2007] FSEIS at 4-49 to -55, 8-26 (Exs. NYS00133B–C); see also Tr. at 2741–42 (Mr. Rikhoff for the NRC Staff).

[2008] FSEIS at 4-49 to -55 (Ex. NYS00133B).

[2009] Id. at 8-26, 8-36 to -37, 8-59, 8-67, 8-70 (Ex. NYS00133C).

[2010] NRC Staff CW-EC-3A Testimony at 11–12 (Ex. NRC000063).

[2011] Id. at 13.

To identify the location of minority populations in the 50 miles surrounding Indian Point, the Staff used the 2000 Census Block Group data to determine the percentage of the overall population within the 50-mile radius of Indian Point that is defined as minority.[2012] Mr. Rikhoff for the Staff indicated that the Staff used Census Block Group data instead of the more detailed Census Block data because Census Block Group data contains poverty and income data that is not contained in Census Block data.[2013] Mr. Rikhoff further testified that the Staff defines minority individuals as "[i]ndividuals who identify themselves [on a Census form] as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races . . . ."[2014] Based on the Census data, Staff witness Mr. Rikhoff stated that the Staff calculated that 20.7 percent of the total population within 50 miles of Indian Point is black and 20.5 percent is Hispanic.[2015] In total, 48.7 percent of the total population within the 50-mile radius of Indian Point self-identifies as belonging to a minority group.[2016]

Mr. Rikhoff also testified that after calculating the overall minority population within 50 miles of the plant, and determining that the minority population is slightly less than 50 percent, the Staff identified Census Block Groups within the 50-mile radius that are predominantly minority (in other words, Census Block Groups that have minority populations that exceed fifty

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[2012] See id. at 18–19; see also Tr. at 2748–49 (Mr. Rikhoff for the NRC Staff).

[2013] NRC Staff CW-EC-3A Testimony at 18 (Ex. NRC000063).

[2014] Id. at 13.

[2015] Tr. at 2745 (Mr. Rikhoff for the NRC Staff).

[2016] Id.

percent).[2017] The predominantly minority Census Block Groups were then designated as EJ populations for the purpose of the Staff's NEPA review.[2018]

According to Mr. Rikhoff, "[l]ow-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P60, on Income and Poverty[,]" and Census Block Group data.[2019] He said that this data was used to identify the predominantly low-income populations within 50 miles of Indian Point that, in turn, were designated as EJ populations.[2020]

Mr. Rikhoff testified that since Executive Order 12898 and the Commission's Environmental Justice Policy Statement as well as CEQ and NRC guidance documents do not designate prisoners, nursing-home patients, the mobility-impaired, or the elderly as members of the EJ population, the Staff properly did not include these groups in its EJ population for its NEPA analysis.[2021] Nevertheless, according to Staff witness Mr. Rikhoff, if a prisoner, nursing-home patient, mobility-impaired individual, or an elderly person were designated as a minority or low-income individual, he or she must be included in the EJ population for the purposes of the NRC's NEPA analysis.[2022] According to Mr. Rikhoff, minorities and low-income individuals in institutional facilities and inmates in correctional facilities—including detention centers, jails, and prisons (*e.g.*, Sing Sing Prison)—were included in the EJ findings set forth in the FSEIS because such minority and low-income populations are included in Census information.[2023]

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[2017] See Tr. at 2746 (Mr. Rikhoff for the NRC Staff).

[2018] See Tr. at 2748 (Mr. Rikhoff for the NRC Staff).

[2019] NRC Staff CW-EC-3A Testimony at 13 (Ex. NRC000063).

[2020] Id. at 18.

[2021] Id. at 20–21; see also Tr. at 2743–44 (Mr. Rikhoff for the NRC Staff).

[2022] See Tr. at 2744 (Mr. Rikhoff for the NRC Staff); NRC Staff CW-EC-3A Testimony at 21 (Ex. NRC000063).

[2023] NRC Staff CW-EC-3A Testimony at 21–22 (Ex. NRC000063).

Rather than comparing impacts between the EJ population and the non-EJ population during the PEO, the Staff, as documented in its FSEIS, considered whether minority and low-income populations within the 50-mile radius of IPEC would experience disproportionate and adverse environmental effects during the PEO compared to those effects they experienced during the original license period.[2024]

According to Mr. Rikhoff, after identifying the EJ populations within the 50-mile radius of Indian Point, the Staff determined that:

> [S]ocioeconomic conditions in minority and low-income populations and communities would not change as a result of renewing the IP2 and IP3 operating licenses. Employment levels and tax revenues generated by the continued operation of IP2 and IP3 would remain relatively unchanged, so direct and indirect employment opportunities and public services would remain unchanged. Therefore, there would be no additional socioeconomic impact (environmental effect) on minority and low-income populations during the license renewal term beyond what is currently being experienced.[2025]

He added that the Staff further determined that:

> [r]adiation doses from continued operations associated with this license renewal are expected to continue at current levels, and would remain within regulatory limits. Therefore, there would be no additional human health impact (human health effect) on minority and low-income populations during the license renewal term beyond what is currently being experienced.[2026]

The NRC Staff's witness testified that based on these determinations, the Staff concluded that since radiation doses from continued IP2 and IP3 reactor operations during the license renewal term were expected to continue at current levels, and would remain within regulatory limits, that "there would be no disproportionate and adverse impacts to minority and

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[2024] See Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (May 24, 2004) at 6–7, app. D, D-3 (Ex. ENT000261); Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues at 6–7, app. C, C-3 (Ex. ENT000264); see also Tr. 2751–52, 2476 (Mr. Rikhoff for the NRC Staff).

[2025] NRC Staff CW-EC-3A Testimony at 14 (Ex. NRC000063).

[2026] Id. (emphasis added).

low-income populations from continued operations of IP2 and IP3 during the license renewal term."[2027]

Mr. Rikhoff also emphasized that, in his opinion, the NRC Staff is "not required to consider the impacts of a severe accident at Indian Point and the impacts of evacuation on special needs populations and prisoners housed in facilities located within 50 miles of IP2 and IP3 in the license renewal environmental review."[2028] He supported this claim by citing Table B-1 within 10 C.F.R. Part 51, which states "'[t]he probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants.'"[2029] Thus, according to Mr. Rikhoff, the NRC Staff did "not conduct a detailed analysis of the consequences of an accident in [its] site-specific license renewal environmental reviews, because the nuclear plant is expected to operate safely during the renewal term."[2030]

Ms. Milligan testified that, as understood by the Staff,

> Clearwater's contention assumes that a radiological emergency will occur at Indian Point, causing the onsite and offsite emergency plans to take effect. Further Clearwater also assumes that the comprehensive emergency plans both onsite and in the counties surrounding Indian Point are deficient and that emergency response personnel will be unable to fulfill their duties or take actions necessary to mitigate a possible event.[2031]

According to Ms. Milligan, Clearwater's assumptions are unreasonable.[2032] She further testified that "[t]he NRC Staff reviews existing emergency preparedness plans throughout the life of any

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[2027] Id. at 16–17. The Staff's witness, Mr. Rikhoff, also testified that it did not "consider any mitigation measures to reduce the environmental impacts associated with license renewal on low-income and minority populations." Id. at 17.

[2028] Id. at 7.

[2029] Id. (quoting 10 C.F.R. pt. 51).

[2030] Id.

[2031] Id. at 7–8.

[2032] Id. at 8.

facility, keeping up with changing demographics and other site-related factors to ensure the adequate protection of public health and safety in the very unlikely event of an accident at the Indian Point Energy Center . . . ."[2033]

According to Ms. Milligan, if there were an accidental release of radiation from Indian Point, evacuation plans ensure that no member of the public, including those incarcerated or institutionalized, would receive more than ten rems of radiation within a period of four days.[2034] Ms. Milligan did acknowledge, however, that were there to be an accidental radiological release from Indian Point, members of the public who cannot self-evacuate may receive a higher dose of radiation than those who can self-evacuate.[2035] Nevertheless, she claimed that since this higher dose would be within EPA dose guidelines, it would not be a disproportionate dose.[2036] Thus, according to Staff witness Ms. Milligan, this higher dose does not create an adverse or disproportionate impact on those who cannot self-evacuate.[2037] She further testified that, in her opinion, the members of the EJ population who cannot self-evacuate would only experience an adverse and disproportionate impact if they were subjected to a dose of radiation from a severe accident at Indian Point that was "well outside federal guidelines . . . [and] that could potentially lead to some sort of health impact."[2038]

The testimony of Entergy's witnesses echoed that of the NRC's witnesses.[2039] They testified that:

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[2033] Id.

[2034] Tr. at 2760–64 (Ms. Milligan for the NRC Staff).

[2035] Tr. at 2760–63 (Ms. Milligan for the NRC Staff); NRC Staff CW-EC-3A Testimony at 34–35 (Ex. NRC000063).

[2036] Tr. at 2762–63 (Ms. Milligan for the NRC Staff).

[2037] Tr. at 2762–63, 2779 (Ms. Milligan for the NRC Staff).

[2038] Tr. at 2779 (Ms. Milligan for the NRC Staff).

[2039] See generally Entergy CW-EC-3A Testimony (Ex. ENT000258).

> Entergy, in the ER—and NRC Staff, in the FSEIS—properly identif[ied] and disclose[d] minority and low-income populations within a 50-mile radius of Indian Point using census Block Group data, consistent with NRC guidance. Because such census data specifically includes information about persons residing in institutionalized Group Quarters, as that term is defined in the census data, the populations inside correctional institutions and other facilities are inherently evaluated as part of the ER and FSEIS.[2040]

Entergy's witnesses also testified that it was their view that "Clearwater's disproportionate impact claim is contrary to NRC regulations and to the GEIS conclusion that for all plants, the probability weighted consequences from severe accidents are small."[2041] "'Small' is defined in NRC regulations as environmental impacts that 'are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.'"[2042] Thus, according to Entergy's witnesses, "[t]he Commission determined by regulation that the impacts from severe accidents are SMALL for all plants, which applies to all populations. . . . Accordingly, there can be no disproportionately high and adverse impact on minority and low-income populations due to a severe accident."[2043]

Moreover, these three witnesses reiterated that "Indian Point, state, and local emergency plans have been demonstrated, and approved by FEMA, to provide reasonable assurance that appropriate protective measures would be taken for all members of the public in the event of a radiological emergency, including any individuals in institutions such as prisons."[2044]

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[2040] Id. at 14–15.

[2041] Id. at 15.

[2042] Id. at 44 (citing 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1 § 3).

[2043] Id. at 45.

[2044] Id. at 15.

### D. Clearwater's Challenge to the FSEIS

Clearwater argued that the Staff's and Entergy's arguments "are not only incorrect, they are also immaterial."[2045] According to Clearwater, "[t]he most glaring flaw in the Staff's EJ analysis is that[,] after it obtained the nominal locations of the EJ populations, it did nothing to determine whether there was anything unusual about those populations."[2046] According to Clearwater:

> specific Commission guidance requir[es] detailed assessment of the locations that result from the initial screening analysis . . . [which] includes "considering factors peculiar to those communities." For example, for the EJ populations inside prisons, the peculiar factor is that the population is incarcerated. This factor should not have been hard to identify . . . . The Staff[, however,] does not claim it identified this peculiar factor but decided it was not important, instead the Staff tacitly admits that it failed to identify *any* factors that are peculiar to *any* identified EJ population.[2047]

Therefore, Clearwater contends that the "Board need not adjudicate any facts or novel legal issues to find that Clearwater prevailed on its contention. [According to Clearwater, t]he issue remaining for adjudication is how much further assessment of EJ the Staff would need to do after remand to satisfy NEPA."[2048]

Clearwater's witnesses dedicated their testimony to different sectors of the EJ population within the 50-mile radius of Indian Point. Clearwater witness, Dr. Michael Edelstein, focused his testimony on the prison population in Sing Sing Prison[2049] and the 25 other institutions similar to Sing Sing within the 50-mile radius of Indian Point.[2050] He testified that these institutionalized

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[2045] Hudson River Sloop Clearwater, Inc. Rebuttal Statement Supporting Contention EC-3A Regarding Environmental Justice (June 28, 2012) at 1 (Ex. CLE000045).

[2046] Id.

[2047] Id. at 1–2 (citation omitted).

[2048] Id. at 2.

[2049] See generally Dr. Edelstein Testimony (Ex. CLE000003); Tr. at 2786–803 (Dr. Edelstein for Clearwater).

[2050] Tr. at 2794 (Dr. Edelstein for Clearwater).

populations, which include a large minority and low-income population, are different from the remainder of the population within the 50-mile radius of Indian Point because those who are institutionalized lack the freedom to make their own decisions about evacuation in the event of a severe accident.[2051] Instead, they must trust those charged with making evacuation decisions for them.[2052]

Mr. Anthony Papa also focused his testimony on the EJ population incarcerated at Sing Sing prison.[2053] Mr. Papa, who was housed at Sing Sing for twelve years,[2054] testified that while at Sing Sing he was "keenly aware of Indian Point . . . [and] often worried about" whether or not he and his fellow prisoners would be evacuated in the event of a severe accident at the plant.[2055] He further stated that he was never informed about Sing Sing's evacuation procedure.[2056] Along that same line, he testified that Sing Sing did not conduct an evacuation drill throughout the time of his twelve-year incarceration.[2057] Moreover, Mr. Papa estimates that it would be extremely difficult to evacuate Sing Sing in a reasonable amount of time after a radiological release because the prison houses 1,700 maximum security prisoners who must be shackled before being transported to another suitable facility.[2058]

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[2051] See Tr. at 2795 (Dr. Edelstein for Clearwater).

[2052] Id.

[2053] See generally Anthony Papa Testimony (Ex. CLE000004).

[2054] Id. at 1.

[2055] Id.

[2056] Id. at 3.

[2057] Id.

[2058] Id.

Mr. Papa also testified that, in his estimation, Sing Sing prison is not a suitable location for prisoners to shelter-in-place.[2059] According to Mr. Papa, Sing Sing is an historic building that was built in 1826, with no effective ventilation system and defective windows.[2060] Therefore, Mr. Papa believes that the prison is not adequate for sheltering in place, and certainly is less adequate than "an average family house in Westchester."[2061]

Mr. Aaron Mair testified in his capacity as a former resident of Peekskill, New York (a town within the 50-mile radius of Indian Point) with extensive EJ experience.[2062] Mr. Mair stated that car ownership is rare among the low-income population in Peekskill and New York City (both of which are in the evacuation zone for Indian Point), which signifies that this group would be heavily reliant on public transportation to evacuate in the event of a severe accident at Indian Point, and thus could be greatly impeded in attempts to self-evacuate.[2063] Thus, he opined that, in his judgment, a severe accident at Indian Point would be similar to Hurricane Katrina in that "the wealthy will leave, [while] the poor, living in higher density, without transportation, will be trapped and forced to deal with the consequences."[2064]

Dr. Erik Larsen testified in his capacity as a physician with experience in emergency medical response.[2065] Dr. Larsen asserted that low-income populations would be at a disadvantage in the event of a severe accident at Indian Point because "ambulance service will be triaged, . . . [thus] people with access to personal transportation will be better able to get to a

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[2059] Id. at 4.

[2060] Id.

[2061] Id.

[2062] Aaron Mair Testimony at 1 (Ex. CLE000007).

[2063] See id. at 8–9.

[2064] Id. at 11.

[2065] Dr. Larsen Testimony at 1 (Ex. CLE000005).

hospital or reception center, than those who cannot afford their own vehicles."[2066] He also stated that while, by law, emergency medical services must be provided to all members of the population regardless of medical-insurance coverage, health care providers can, and do, refuse follow-up care once a patient's condition is stabilized.[2067] Thus, those in the low-income population surrounding Indian Point could receive disproportionate and adverse medical care in the event of injury or illness as a result of a severe accident at Indian Point.[2068]

Dr. Andrew Kanter testified that, in his opinion, although a severe accident is unlikely, it is reasonably foreseeable that those without the ability to self-evacuate "will be put at a higher risk of injury than those who have the ability to evacuate themselves."[2069] He opined that "the consensus of the medical establishment is that there is no cutoff under which there is no risk or danger of radiation, and that there is a linear relationship of radiation [exposure] to health risk and health damage."[2070]

Ms. Dolores Guardado testified as a member of the Hispanic population in Peekskill, New York.[2071] She stated that she, like many members of Peekskill's Hispanic community who do not speak English fluently, is aware of Indian Point's proximity to Peekskill, but is unaware of what to do in the case of a severe accident at the plant.[2072] She further testified that she does

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[2066] Id. at 3.

[2067] See id.

[2068] See id. This view was echoed by Dr. Kanter. See Rebuttal Testimony of Dr. Andrew S. Kanter, M.D. M.P.H. in Support of Hudson River Sloop Clearwater, Inc.'s Contention EC-3A Regarding Environmental Justice at 4–5 (Ex. CLE000048).

[2069] Id. at 2–4.

[2070] Tr. at 2855 (Dr. Kanter for Clearwater).

[2071] Dolores Guardado Testimony at 1 (Ex. CLE000008).

[2072] See generally id.

not know how to obtain, much less administer, potassium iodide to herself or her family to prevent thyroid cancer in the event of radiological release from Indian Point.[2073]

Ms. Guardado asserted that she has not received any information from Indian Point instructing her about evacuation procedures in the event of a severe accident.[2074] Moreover, despite her deep involvement in the Peekskill Hispanic community, she does not know where to obtain information about evacuating in the event of a severe accident at Indian Point.[2075]

Ms. Guardado also noted that the language barrier is of great concern to the Spanish speaking community.[2076] She fears that the Spanish speaking community will have difficulty understanding the instructions given by emergency personnel if evacuation is required.[2077] Furthermore, she is concerned about the Hispanic community's reliance on public transportation.[2078] In the event of a severe accident at Indian Point, Ms. Guardado testified that she does not know where to find public transportation out of Peekskill.[2079] Moreover, she stated that she does not know if there will be enough room on the public-transportation vehicles for all of the Hispanic population that is dependent on public transportation.[2080] This factor, combined with the language barrier and her lack of information about evacuation procedures, according to

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[2073] See id. at 3.

[2074] Id.

[2075] Id.

[2076] Id. at 4.

[2077] Id. at 4–5.

[2078] Id. at 5.

[2079] See id.

[2080] See id.

her testimony, demonstrates concern about the safety and welfare of her family and loved ones in the event of a severe accident at Indian Point.[2081]

Manna Jo Greene testified in her capacity as the Environmental Director of Clearwater.[2082] She asserted that through internal research, Clearwater has discovered that sixty-two percent of the EJ population frequently using public transportation does not have access to a car, whereas only fifteen percent of the non-EJ population frequently using public transportation does not have access to a car.[2083] She also noted that even though the Head Start Programs that provide early childhood education to low-income youth in the evacuation zone have emergency evacuation plans in place, not all staff members at Head Start facilities have familiarity with these procedures.[2084]

Ms. Greene understood that those residing in Section 8 affordable housing units for the low-income population within the evacuation zone lack adequate means to self-evacuate or administer potassium iodide in the event of a severe accident at Indian Point.[2085] According to Ms. Greene, the inmates housed in Rockland County Jail, a facility within the evacuation zone, do not have potassium iodide onsite despite the fact that it would take the jail eight to ten hours to evacuate in the event of a radiological emergency.[2086]

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[2081] Id.

[2082] Manna Jo Greene Testimony at 1 (Ex. CLE000010).

[2083] Id. at 4.

[2084] See id. at 6–12.

[2085] See id. at 24–26.

[2086] See id. at 27–29.

## E. CW-EC-3A Findings

As discussed earlier, the Commission has stated that "disparate impact analysis is [the NRC's] principal tool for advancing environmental justice under NEPA."[2087] So, the threshold question before the Board is whether the Staff took a hard look at whether relicensing the Indian Point plant would produce disparate impacts on the minority and low-income populations in the 50-mile radius surrounding this plant.[2088] As an initial matter, the Board emphasizes once again that this is an EJ contention under NEPA, not a safety contention questioning the adequacy of the Indian Point's emergency preparedness plans. Under 10 C.F.R. § 50.47(a)(1)(i) "no finding [of reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency] is necessary for issuance of a renewed nuclear power reactor operating license."[2089] Thus, the issue currently before us is not whether the emergency plan is adequate, but rather whether the Staff took a hard look under NEPA at whether relicensing Indian Point would cause disproportionate and adverse impacts on the minority and low-income populations within the 50-mile environmental impact area around the plant when compared to the impacts on the non-EJ population within that radius in the improbable, but not impossible, event of a severe accident at Indian Point that releases radiation into the natural environment. The simple answer is that the Staff did not take the requisite hard look at the relevant issue.

The Board finds the Staff did use a reasonable method for identifying minority and low-income populations within the 50-mile radius around Indian Point. As the Commission noted in Pilgrim, NEPA allows agencies "to select their own methodology as long as that methodology is

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[2087] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 100.

[2088] More specifically, Clearwater argued that Entergy and the NRC Staff did not take a hard look at whether the minority and low-income populations within a 50-mile radius of Indian Point might suffer a negative, disparate impact—in the form of exposure to a higher radiological dose than the non-EJ population within the 50-mile radius—in the event of a severe accident at Indian Point. See Clearwater Initial Statement of Position at 1–4 (Ex. CLER00002).

[2089] 10 C.F.R. § 50.47(a)(1)(i); see also 56 Fed. Reg. 64,943, 64,966–67 (Dec. 13, 1991).

reasonable."[2090] Census Block Groups are the smallest census geographical units that contain both income and minority information.[2091] While the Census Block geographical unit is smaller than the Census Block Group, it does not contain income information.[2092] Thus, it was reasonable for the NRC Staff to identify minority and low-income populations (*i.e.*, the populations that comprise the EJ population) using the smallest census geographical unit that contains both minority and income information.

While the Board finds that the Staff's internal procedure for analyzing EJ issues is sufficient to meet its requirement under NEPA, we also find that the Staff failed to follow its own internal procedure by omitting steps 2 and 3 of its analytic process to determine the possible disproportionate and adverse effects of a severe accident at Indian Point on the EJ population.[2093] The Staff neglected to (1) determine whether there would be any potential human health or environmental effects to the minority and low-income populations in the event of an accident that caused a radiological release from Indian Point, and (2) determine if any of the effects may be disproportionate and adverse when compared to the health and environmental effects to the general population.[2094]

More specifically, the Staff failed to: (1) determine whether the EJ population would suffer disproportionate and adverse effects during the PEO from relicensing Indian Point in

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[2090] Pilgrim, CLI-10-11, 71 NRC at 316 (quoting Town of Winthrop, 535 F.3d at 11–13).

[2091] See NRC Staff CW-EC-3A Testimony at 18 (Ex. NRC000063).

[2092] See id.

[2093] See Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (May 24, 2004) (Ex. ENT000261) (explaining the three-step analytic process used to determine the possible disproportionate and adverse effects of a severe accident at Indian Point on the EJ population).

[2094] See id.

comparison to those effects that the non-EJ population would experience during the PEO,[2095] and (2) determine if the members of the low-income population who cannot afford to, or do not have the freedom to, self-evacuate or effectively shelter-in-place due to substandard housing would be disparately and adversely impacted in comparison to those who have the freedom, financial means, and readily-available modes of transportation to self-evacuate or access adequate shelter.

In regards to the first item, we find that the Staff analyzed the wrong variables by comparing impacts of the EJ population during the PEO to the current impacts to this same group. The correct analysis would assess the effects of the PEO on the EJ population and non-EJ populations to ascertain any disparate impacts.

Relating to the second item, Staff Witness Ms. Milligan testified that "it is possible that special populations, such as those at Sing Sing[,] could receive radiation doses higher than other populations that are immediately able to self-evacuate[] . . . ."[2096] In the next breath Ms. Milligan stated that she, on behalf of the NRC, does not "specifically look at EJ populations in the context of emergency preparedness because . . . [the NRC prepares] for all populations, not just EJ populations."[2097]

The Board finds that this type of total population analysis without a specific EJ population analysis defeats the purpose of EJ analyses under NEPA. As the Commission made clear in Louisiana Energy Services, "[d]isparate impact analysis is [the NRC's] principal tool for advancing environmental justice under NEPA. The NRC's goal is to identify and adequately

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[2095] There was no EJ analysis completed before issuance of the original Indian Point operating licenses. See id. at 6–7, app. D, D-3; Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues at 6–7, app. C, C-3 (Ex. ENT000264). Accordingly, no comparison of the impacts of relicensing on the EJ population versus the impact on non-EJ populations was ever conducted by the NRC Staff.

[2096] Tr. at 2760–61 (Ms. Milligan for the NRC Staff).

[2097] Id.

weigh, or mitigate, effects on low-income and minority communities that become apparent only by considering factors peculiar to those communities."[2098] By failing to consider factors peculiar to the EJ community in the event of an accident, the Board finds that the Staff failed to identify and adequately weigh effects on low-income and minority communities surrounding Indian Point. Thus, we find that the Staff failed to take a reasonably hard look at environmental effects of relicensing Indian Point on the EJ population, and thus has failed to comply with its EJ obligations under NEPA.

Staff witness Mr. Rikhoff testified that the Staff did not evaluate the effects of a severe accident on the EJ population because Table B-1 within 10 C.F.R. Part 51 "concludes that the probability of a severe accident is small . . . ."[2099] Based on this finding the Staff summarily concluded, without analysis, that since the probability-weighted consequences of a severe accident are small for all populations, including the EJ population, there is no disproportionate and adverse impact on minority and low-income populations due to a severe accident.[2100] However, "[o]nly if the harm in question is so 'remote and speculative' as to reduce the effective probability of its occurrence to zero may the agency dispense with the consequences portion of the analysis."[2101] Here, Staff witness Mr. Rikhoff admitted it is possible that minority or low-income populations could be disproportionately affected in the event of a severe accident at Indian Point despite the fact that the probability weighted consequences of an accident are small.[2102] Entergy provided similar testimony.[2103]

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[2098] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 100.

[2099] Tr. at 2757 (Mr. Rikhoff for the NRC Staff).

[2100] See id. at 2756–58; NRC Staff CW-EC-3A Testimony at 17 (Ex. NRC000063) (referencing FSEIS, ch. 5 (Ex. NYS00133B)).

[2101] New York v. NRC, 681 F.3d 471, 482 (D.C. Cir. 2012) (citing Limerick Ecology Action, 869 F.2d at 739).

[2102] See Tr. at 2757–58 (Mr. Rikhoff for the NRC Staff).

While a regulation states that the probability weighted consequences of a severe accident at Indian Point are small,[2104] Staff witness Mr. Rikhoff conceded that there is no regulation exempting the Staff from considering the effects of a severe accident on the EJ population.[2105] Thus, the Board finds that there is no legal foundation for the Staff's failure to analyze the possible disproportionate and adverse impacts of a severe accident at Indian Point on the EJ population within the 50-mile radius of the plant.

The Board also notes that regulations, such as 10 C.F.R. § 50.47(a)(1)(i), require nuclear power reactors to have emergency plans in place to respond to accidents despite the fact that Table B-1 within 10 C.F.R. Part 51 concludes that the environmental impacts of both design basis and severe accidents at a nuclear reactor are small for all plants. This is a clear indication that the NRC, while cautiously optimistic that a potentially severe accident will not occur at a licensed nuclear reactor, believes it necessary to prepare for just such a possibility. Thus, it escapes logic that the NRC would use this finding – that the probability-weighted consequences of a severe accident at a nuclear reactor are small – as the basis to exempt itself from evaluating the possible disproportionate and adverse effects of a severe accident on the EJ population. Also, to accept this position would run counter to the NRC requirements that nuclear reactor licensees create plans and devote resources to protecting the public from the consequences of a severe accident. Therefore, the Board finds that the Staff's lack of EJ analysis regarding the possible disproportionate and adverse effects of an accident at Indian Point on the EJ population within the 50-mile radius of Indian Point fails to meet the NEPA reasonableness standard.

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[2103] Entergy CW-EC-3A Testimony at 15 (Ex. ENT000258).

[2104] 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1.

[2105] See Tr. at 2758 (Mr. Rikhoff for the NRC Staff).

**F. Resolution of CW-EC-3A**

In accordance with the Commission's holding in Louisiana Energy Services, the Staff is not necessarily required to amend or supplement its FSEIS despite our finding that the EJ sections are insufficient. Instead, our review of the EJ issue herein, through analysis of the written testimony and the testimony garnered at the evidentiary hearing, can remedy the deficiencies in the FSEIS.[2106]

As presented above, Clearwater's witnesses dedicated their testimony to different sectors of the EJ population within the 50-mile radius of Indian Point. From this, we conclude that while the risk to both the EJ and non-EJ population is small, the higher risk to the EJ population should be discussed in an adequate EJ analysis.

While the Staff had not done this in its FSEIS, the Board finds the testimony provided by Clearwater's witnesses sufficiently illustrated the potentially disproportionate and adverse impacts on the EJ population surrounding Indian Point in the event of a severe accident. As a result, there has been informed public participation and adequate analysis to foster informed decision-making, thus ensuring that the agency has met its NEPA requirements and will not act upon incomplete information.

In summary, Clearwater's witnesses did a thorough job of revealing the EJ population's concerns about relicensing Indian Point and the potential disproportionate and adverse impact this population may experience, in comparison to the non-EJ population, were there to be an accident at Indian Point. Thus, the record now contains evidence of informed public participation and adequate analysis to foster informed decisionmaking. Therefore, the NRC, despite the inadequate FSEIS, has met its NEPA burden with regards to the issues raised in CW-EC-3A.

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[2106] La. Energy Servs., L.P., CLI-98-3, 47 NRC at 89; see also La. Energy Servs., L.P., LBP-06-8, 63 NRC at 260; Hydro Resources, Inc., LBP-06-19, 64 NRC at 69 n.11.

## G. Conclusions of Law

In summary, the FSEIS was flawed because the Staff did not analyze the correct variables. Even though no EJ analysis was conducted at the time IP2 and IP3 were originally licensed, the Staff concluded the impact of continued operation of these reactors would be the same during the proposed period of extended operation as it had been during the initial license period. Even if true, this conclusion is irrelevant to the proper EJ analysis for license renewal. The federal action at issue here is the proposed relicensing of IP2 and IP3. Accordingly, what the Staff should have compared in its EJ analysis is the impact of extended operation on the EJ population against the impact of continued operation on the non-EJ population.

During the hearing Clearwater had the opportunity to, and in fact did, demonstrate how the ability of EJ populations near Indian Point to evacuate or shelter-in-place in the event of an accident differed from that of the non-EJ populations. Furthermore, the Board has now addressed these differences so that the ultimate decisionmaker regarding the relicensing of Indian Point can now make a properly informed decision. Accordingly, the hard look at the EJ aspects of relicensing having been taken, the Commission, without additional Staff action, can now with respect to the EJ issue, make an informed decision whether to grant the requested license.[2107]

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[2107] Limerick, ALAB-819, 22 NRC 681; La. Energy Servs., L.P., LBP-06-8, 63 NRC at 260. Having found that the NRC Staff compared the wrong variable in its EJ analysis (*i.e.*, impact on the EJ population during the initial licensing period versus the impact on the EJ population during the proposed period of extended operation as opposed to the impact during the period of extended operation on the general population) the Board considered returning this issue to the NRC Staff so that it could amend the FSEIS. Nevertheless, after reviewing the record as developed during the hearing, we conclude that disparate impact on the EJ population has been analyzed and, following the reasoning articulated in Louisiana Energy Services, CLI-98-3, 47 NRC 77, Limerick, ALAB-819, 22 NRC 681, and Hydro Resources, LBP-06-19, 64 NRC 53, we believe that, based on the record of this proceeding, the Commission and the public have been presented with the relevant EJ facts so that an informed decision can be made.

## XII. CONCLUSION AND ORDER

The Board has marked for identification the most recent version of each party's exhibit list (*i.e.*, Exs. ENTR14001, NRCR80001, CLER70001, NYSR22001, and RIVR11001) and strikes all earlier admitted versions of these lists. Having done so, we close the record for the Track 1 contentions. We again note that not all of the exhibits that have been listed by the parties have been admitted, and note that Appendix B to this initial decision lists all admitted exhibits that have been considered by the Board in resolving the Track 1 contentions.

Based on our review of the evidentiary record in this proceeding, the Board concludes that, with regard to the issues raised in contentions RK-TC-2, NYS-5, and NYS-6/7, Entergy has demonstrated that the effects of aging will be adequately managed during the PEO as required by 10 C.F.R. § 54.21(a)(3). The Board also concludes that, with regard to the issues raised in contentions NYS-12C, NYS-16B, NYS-17B, NYS-37, and CW-EC-3A, the NRC Staff has demonstrated that the Staff's FEIS complies with NEPA and with 10 C.F.R. Part 51. In regard to NYS-8, because we find transformers to be "passive" components, transformers fall with the scope of 10 C.F.R. Part 54 and must undergo AMR pursuant to 10 C.F.R. § 54.21(a)(1). Therefore, Entergy has not demonstrated that it will adequately manage the effects of aging on the relevant components as required by 10 C.F.R. §§ 54.21(a)(3). Accordingly, NYS-8 is resolved in favor of New York.

This partial initial decision shall constitute the final decision of the Commission, unless, within twenty-five (25) days of its service, a petition for review is filed in accordance with 10 C.F.R. §§ 2.1212 and 2.341(b).[2108] Filing a petition for review is mandatory for a party to

[2108] The time to file a petition for review under 10 C.F.R. § 2.341(b) was recently extended from fifteen (15) days to twenty-five (25) days. Amendments to Adjudicatory Process Rules and Related Requirements, Final Rule. 77 Fed. Reg. 46,561, 46,596 (Aug. 3, 2012).

exhaust its administrative remedies before seeking judicial review.[2109]

It is so ORDERED.

THE ATOMIC SAFETY
AND LICENSING BOARD

***/RA/***

Lawrence G. McDade, Chairman
ADMINISTRATIVE JUDGE

***/RA/***

Dr. Richard E. Wardwell
ADMINISTRATIVE JUDGE

***/RA/***

Dr. Michael F. Kennedy
ADMINISTRATIVE JUDGE

Rockville, Maryland
November 27, 2013

[2109] 10 C.F.R. § 2.341(b)(1).

APPENDIX A

(Summary of Admitted Contentions and Contentions Held in Abeyance)

| Contention(s) | Date Admitted | Status / Disposition of Contention(s) |
|---|---|---|
| NYS-5: LRA deficient because it lacks adequate AMP for buried pipes and tanks that contain radioactive fluid. | 07/31/08 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of Entergy. Entergy's AMP for buried pipes meets the requirements of 10 C.F.R. §§ 54.21(a)(3) and 54.29(a). |
| NYS-6/7: LRA deficient because it lacks AMP for non-EQ inaccessible medium- and low-voltage cables. | 07/31/08 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of Entergy. Entergy's AMP for non-EQ inaccessible medium- and low-voltage cables meets the requirements of 10 C.F.R. §§ 54.21(a)(3) and 54.29(a). |
| NYS-8: LRA deficient because it lacks AMP for certain electrical transformers. | 07/31/08 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of New York. As a passive component with no moving parts and no change in configuration, properties, or state, transformers must undergo AMR pursuant to 10 C.F.R. § 54.21(a)(1). Renewed licenses cannot be issued unless and until this deficiency is corrected. |
| NYS-9: LRA deficient because it fails to evaluate energy conservation as an alternative that could displace the energy production of IPEC. | 07/31/08 | Consolidated w/ NYS-33/37. See Licensing Board Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) (unpublished). |
| NYS-12C: LRA deficient because the Applicant's SAMA analysis underestimates the clean-up costs associated with severe accidents. | 07/06/11 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of the NRC Staff. Entergy's SAMA analysis is sufficiently site specific and Entergy's use of and the NRC's approval of the TIMDEC and CDNFRM values was reasonable and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L). |

| Contention(s) | Date Admitted | Status / Disposition of Contention(s) |
|---|---|---|
| NYS-16B: LRA deficient because the Applicant's SAMA analysis includes defective population projections. | 06/30/10 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of the NRC Staff. Entergy's estimate and the NRC's approval of the projected population is reasonable and satisfies the requirements under NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L). |
| NYS-17B: LRA deficient because it fails address the impact of IPEC's continued operation on off-site land use, including real estate values. | 07/06/11 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of the NRC Staff. The NRC Staff's approach to weighing the costs and benefits of plant shutdown on property values and the local community was reasonable and satisfies the requirements of NEPA and 10 C.F.R. § 51.95. |
| NYS-24: LRA deficient because Applicant has not conducted enhanced inspections to assess the integrity of the containment structures. | 07/31/08 | Contention settled in January 2012. See Licensing Board Order (Approving Settlement of Contention NYS-24) (Jan. 26, 2012) (unpublished). |
| NYS-25: LRA deficient because it fails to include an adequate AMP for embrittlement of the reactor pressure vessels and the associated internals. | 07/06/11 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. |
| NYS-26B: LRA deficient because it fails include an adequate AMP for metal fatigue on key reactor components. Consolidated for hearing with RK-TC-1B. LBP-08-13, 68 NRC 43 (2008). | 11/04/10 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. |
| NYS-33: LRA deficient because it fails to evaluate energy conservation as an alternative that could displace the energy production of IPEC. | 06/16/09 | Consolidated w/ NYS-9/37. See Licensing Board Order (Ruling on Pending Motions for Leave to File New and Amended Contentions) (July 6, 2011) (unpublished). |

| Contention(s) | Date Admitted | Status / Disposition of Contention(s) |
|---|---|---|
| NYS-35/36: The NRC Staff failed to require completion of cost analyses for the SAMAs that appear to be cost beneficial and to require Entergy either to implement mitigation alternatives when the benefits of those alternatives substantially outweigh costs or, in the alternative, to explain with a rational basis why the NRC Staff would allow Entergy's licenses to be renewed without the implementation of the cost-beneficial SAMAs. | 06/30/10 | Summary disposition granted in favor of New York. See LBP-11-17. The FSEIS does not articulate a rational basis for not requiring Entergy to complete its SAMA review and for not requiring the implementation of cost-beneficial SAMAs prior to the relicensing of IP2 and IP3 and, therefore, violates NRC regulations, NEPA, and the APA. Renewed licenses cannot be issued unless and until this deficiency is corrected. |
| NYS-37: LRA deficient because it fails to provide a meaningful analysis of energy alternatives. | 07/06/11 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of the NRC Staff. The NRC Staff fulfilled its responsibilities under NEPA and 10 C.F.R. § 51.91(a)(1) by reasonably responding to New York's comments to the DSEIS regarding the no-action alternative. |
| NYS-38: LRA deficient because Applicant fails to demonstrate that it has a program that will manage the effects of aging of several critical components or systems. Consolidated for hearing with RK-TC-5. LBP-08-13, 68 NRC 43 (2008). | 11/10/11 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. |
| NYS-39: FSEIS deficient because it does not include an analysis of the environmental impacts caused by the storage of nuclear waste at IPEC following the license renewal period nor an analysis of alternatives to proposed storage of spent fuel at IPEC in spent fuel pools. | N/A | Contention was held in abeyance at the direction of the Commission. See Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished) (citing Calvert Cliffs, CLI-12-16, 76 NRC at 68–69). |
| RK-TC-1B: LRA deficient because it fails include an adequate AMP for metal fatigue on key reactor components. Consolidated for hearing with NYS-26B. LBP-08-13, 68 NRC 43 (2008). | 11/04/10 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. |

| Contention(s) | Date Admitted | Status / Disposition of Contention(s) |
|---|---|---|
| RK-TC-2: LRA deficient because it lacks adequate AMP for flow accelerated corrosion. | 07/31/08 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of Entergy. Entergy's AMP for flow accelerated corrosion meets the requirements of 10 C.F.R. §§ 54.21(a)(3) and 54.29(a). |
| RK-TC-5: LRA deficient because Applicant fails to demonstrate that it has a program that will manage the effects of aging of several critical components or systems. Consolidated for hearing with NYS-38. LBP-08-13, 68 NRC 43 (2008). | 11/10/11 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. |
| RK-EC-3A: LRA deficient because it does not adequately assess new and significant information regarding the environmental impacts of the radioactive water leaks from spent fuel pools. | 07/06/11 | Contention settled in October 2012. See Licensing Board Order (Approving Settlement of Consolidated Contention Riverkeeper EC-3 and Clearwater EC-1) (Oct. 17, 2012) (unpublished). |
| RK-EC-8: FSEIS deficient because it does not include or consider the assessment of the National Marine Fisheries Service regarding impacts to endangered species due to incomplete Endangered Species Act consultation. | 07/06/11 | Currently pending, scheduled to be litigated during Track 2 evidentiary hearing. Motion by Riverkeeper to amend this contention is pending; Motion by Entergy to dismiss this contention is pending. |
| RK-EC-9: FSEIS deficient because it does not now include an analysis of the environmental impacts caused by the storage of nuclear waste at IPEC following the end of the requested operating licenses nor an analysis of alternatives to proposed storage of spent fuel at Indian Point for an indefinite period of time in spent fuel pools. | N/A | Contention was held in abeyance at the direction of the Commission. See Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished) (citing Calvert Cliffs, CLI-12-16, 76 NRC at 68–69). |
| CW-EC-1A: LRA deficient because it does not adequately assess new and significant information regarding the environmental impacts of the radioactive water leaks from spent fuel pools. | 07/06/11 | Contention settled in October 2012. See Licensing Board Order (Approving Settlement of Consolidated Contention Riverkeeper EC-3 and Clearwater EC-1) (Oct. 17, 2012) (unpublished). |

| Contention(s) | Date Admitted | Status / Disposition of Contention(s) |
|---|---|---|
| CW-EC-3A: FSEIS deficient because it contains flawed environmental justice analysis. | 07/06/11 | Litigated during the Track 1 evidentiary hearing. Resolved in favor of the NRC Staff. Despite the NRC Staff's failure to analyze the proper variables regarding environmental justice, given the information put forth at the evidentiary hearing, the hard look at the environmental justice aspects of relicensing have been taken. |
| CW-EC-10: FSEIS deficient because it does not now include an analysis of the environmental impacts caused by the storage of nuclear waste at IPEC following the end of the requested operating licenses nor an analysis of alternatives to proposed storage of spent fuel at Indian Point for an indefinite period of time in spent fuel pools. | N/A | Contention was held in abeyance at the direction of the Commission. See Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished) (citing Calvert Cliffs, CLI-12-16, 76 NRC at 68–69). |
| CW-SC-4: LRA deficient because it provides insufficient analysis of the aging management of the spent fuel pools that could be used to store waste onsite in the long-term. | N/A | Contention was held in abeyance at the direction of the Commission. See Licensing Board Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished) (citing Calvert Cliffs, CLI-12-16, 76 NRC at 68–69). |

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| | ) | Docket Nos. 50-247-LR |
| | ) | and 50-286-LR |
| (Indian Point Nuclear Generating, | ) | |
| Units 2 and 3) | ) | |

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing **BOARD ORDER LBP-13-13, PARTIAL INITIAL DECISION (Ruling on Track 1 Contentions)** have been served upon the following persons by Electronic Information Exchange.

U.S. Nuclear Regulatory Commission
Office of Commission Appellate Adjudication
Mail Stop O-7H4M
Washington, DC 20555-0001
ocaamail@nrc.gov

U.S. Nuclear Regulatory Commission
Office of the Secretary of the Commission
Mail Stop O-16C1
Washington, DC 20555-0001
hearingdocket@nrc.gov

U.S. Nuclear Regulatory Commission
Atomic Safety and Licensing Board Panel
Mail Stop T-3F23
Washington, DC 20555-0001

Lawrence G. McDade, Chair
Administrative Judge
lawrence.mcdade@nrc.gov

Richard E. Wardwell
Administrative Judge
richard.wardwell@nrc.gov

Michael F. Kennedy
Administrative Judge
michael.kennedy@nrc.gov

Carter Thurman, Law Clerk
carter.thurman@nrc.gov

Kathleen E. Oprea, Law Clerk
Kathleen.Oprea@nrc.gov

Edward L. Williamson, Esq.
Beth N. Mizuno, Esq.
David E. Roth, Esq.
Sherwin E. Turk, Esq.
Brian Harris, Esq.
Mary B. Spencer, Esq.
Anita Ghosh, Esq.
John Tibbetts, Paralegal
U.S. Nuclear Regulatory Commission
Office of the General Counsel
Mail Stop O-15D21
Washington, DC 20555-0001
sherwin.turk@nrc.gov;
edward.williamson@nrc.gov
beth.mizuno@nrc.gov; brian.harris.@nrc.gov
david.roth@nrc.gov; mary.spencer@nrc.gov
anita.ghosh@nrc.gov; john.tibbetts@nrc.gov

OGC Mail Center
OGCMailCenter@nrc.gov

William C. Dennis, Esq.
Assistant General Counsel
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601
wdennis@entergy.com

William B. Glew, Jr.
Organization: Entergy
440 Hamilton Avenue, White Plains, NY 10601
wglew@entergy.com

Elise N. Zoli, Esq.
Goodwin Proctor, LLP
Exchange Place, 53 State Street
Boston, MA 02109
ezoli@goodwinprocter.com

Daniel Riesel, Esq.
Victoria Shiah Treanor, Esq.
Adam Stolorow, Esq.
Jwala Gandhi, Paralegal
Natoya Duncan, Paralegal
Counsel for Town of Cortlandt
Sive, Paget & Riesel, P.C.
460 Park Avenue
New York, NY 10022
driesel@sprlaw.com; vtreanor@sprlaw.com
astolorow@sprlaw.com; jgandhi@sprlaw.com;
nduncan@sprlaw.com

Kathryn M. Sutton, Esq.
Paul M. Bessette, Esq.
Martin J. O'Neill, Esq.
Raphael Kuyler, Esq.
Lena Michelle Long, Esq.
Laura Swett, Esq.
Lance Escher, Esq.
Mary Freeze, Legal Secretary
Antoinette Walker, Legal Secretary
Doris Calhoun, Legal Secretary
Morgan, Lewis & Bockius, LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004
ksutton@morganlewis.com
martin.oneill@morganlewis.com
rkuyler@morganlewis.com;
llong@morganlewis.com;
lswett@morganlewis.com
lescher@morganlewis.com
mfreeze@morganlewis.com
awalker@morganlewis.com
dcalhoun@morganlewis.com

Phillip Musegaas, Esq.
Deborah Brancato, Esq.
Ramona Cearley, Secretary
Riverkeeper, Inc.
20 Secor Road
Ossining, NY 10562
phillip@riverkeeper.org;
dbrancato@riverkeeper.org
rcearley@riverkeeper.org

Melissa-Jean Rotini, Esq.
Assistant County Attorney
Office of Robert F. Meehan,
Westchester County Attorney
148 Martine Avenue, 6th Floor
White Plains, NY 10601
mjr1@westchestergov.com

Clint Carpenter, Esq.
Bobby Burchfield, Esq.
Matthew Leland, Esq.
McDermott, Will and Emergy LLP
600 13th Street, NW
Washington, DC 20005
ccarpenter@mwe.com; bburchfield@mwe.com
mleland@mwe.com

Matthew W. Swinehart, Esq.
Covington & Burling LLP
1201 Pennsylvania Avenue, NW
Washington, DC 20004
mswinehart@cov.com

Edward F. McTiernan, Esq.
New York State Department
of Environmental Conservation
Office of General Counsel
625 Broadway
14th Floor
Albany, NY 12233-1500
efmctier@gw.dec.state.ny.us

Manna Jo Greene, Environmental Director
Steven C. Filler
Hudson River Sloop Clearwater, Inc.
724 Wolcott Ave.
Beacon, NY 12508
mannajo@clearwater.org;
stephenfiller@gmail.com

Robert D. Snook, Esq.
Assistant Attorney General
Office of the Attorney General
State of Connecticut
55 Elm Street
P.O. Box 120
Hartford, CT 06141-0120
robert.snook@po.state.ct.us

Richard Webster, Esq.
Public Justice, P.C.
For Hudson River Sloop Clearwater, Inc.
1825 K Street, NW, Suite 200
Washington, D.C. 20006
rwebster@publicjustice.net

Michael J. Delaney, Esq.
Director, Energy Regulatory Affairs
NYC Department of Environmental Protection
59-17 Junction Boulevard
Flushing, NY 11373
mdelaney@dep.nyc.gov

John J. Sipos, Esq.
Charles Donaldson, Esq.
Assistant Attorneys General
Office of the Attorney General
of the State of New York
Elyse Houle, Legal Support
The Capitol, State Street
Albany, New York 12224
john.sipos@ag.ny.gov
charlie.donaldson@ag.ny.gov
elyse.houle@ag.ny.gov

Janice A. Dean, Esq.
Kathryn Liberatore, Esq.
Assistant Attorney General
Office of the Attorney General
of the State of New York
120 Broadway, 26th Floor
New York, New York 10271
janice.dean@ag.ny.gov
kathryn.liberatore@ag.ny.gov

Sean Murray, Mayor
Kevin Hay, Village Administrator
Village of Buchanan
Municipal Building
236 Tate Avenue
Buchanan, NY 10511-1298
smurray@villageofbuchanan.com
administrator@villageofbuchanan.com

[Original signed by Brian Newell ]
Office of the Secretary of the Commission

Dated at Rockville, Maryland
this 27th day of November, 2013