### UNITED STATES NUCLEAR REGULATORY COMMISSION

### ATOMIC SAFETY AND LICENSING BOARD

-----x In re:

Docket Nos. 50-247-LR; 50-286-LR

License Renewal Application Submitted by

Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. ASLBP No. 07-858-03-LR-BD01

DPR-26, DPR-64

March 22, 2013

## STATE OF NEW YORK'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW FOR CONTENTION NYS-12/12A/12B/12C ("NYS-12C")

Office of the Attorney General for the State of New York The Capitol State Street Albany, New York 12224

## Page

GLO	SS.	ARY OF TERMS, ACRONYMS, & ABBREVIATIONS	G-i
I.	Π	NTRODUCTION	1
II.	Р	ROCEDURAL HISTORY	4
A.		New York State Contention 12	4
B.		NRC Staff's DSEIS	7
C.		New York State Contention 12A	7
D.		Entergy's December 2009 SAMA Reanalysis	8
E.		New York State Contention 12B	8
F.		Staff's December 3, 2011 FSEIS	9
G.		New York State Contention 12C	10
H.		Pre-Filed Submissions and Motions in Limine	11
	1.	New York State Pre-filed Submissions	11
	2.	Entergy's January 2012 Motion in Limine for NYS-12C	11
	3.	Entergy and NRC Staff Pre-filed Submissions	13
	4.	New York State Rebuttal Submissions	13
	5.	Entergy's July 2012 Motion Seeking Leave to File Written Sur-rebuttal Testimony for NYS-12C	14
	6.	Entergy and NRC Staff's July 2012 Motions in Limine for NYS-12C	16
	7.	The State's September 2012 Motion Seeking Leave to File an Additional Exhibit for NYS-12C	17
I.		The October 2012 Hearing	18
III.	L	EGAL STANDARDS	19
A.		NEPA's Requirements	19
	1.	NEPA Obligates the NRC to Consider the Environmental Impacts of License Renewal	19

# Page

2.	NEPA Requires NRC to Take a Hard Look at Environmental Impacts, Analyze a Reasonable Range of Alternatives, Thoroughly Discuss Mitigation Measures, and Rely Upon High Quality and Accurate Scientific Information	1
B.	Requirement to Complete a SAMA Analysis	3
1.	NRC Must Perform a Site-Specific SAMA Analysis for Indian Point as Part of Its Environmental Analysis Under NEPA	:3
2.	The SAMA Analysis is the Only Site-Specific Analysis of Severe Accidents at Indian Point Considered in the Context of Entergy's License Renewal Application	5
C.	Burden of Proof for NEPA Contentions	6
D.	Evidentiary Standards for this Relicensing Proceeding	8
IV. V	WITNESSES AND QUALIFICATIONS	9
А.	State of New York's Witness	9
B.	Entergy's Witnesses	1
C.	NRC Staff's Witnesses	4
V. (	OVERVIEW	8
А.	The SAMA Analysis: A Site-Specific Analysis of Mitigation Alternatives	8
B.	The MACCS2 Code: A Code Designed to Calculate the Costs Associated With a Severe Accident Based on Site-Specific Inputs	-2
1.	Development of the MACCS2 Code 4	-2
2.	The MACCS and MACCS2 User Guides As Well As Industry Guidance NEI-05-01 Underscore the Importance of Using Site-Specific Input Values	.3
3.	The MACCS2 Code's 50-Mile Grid 4	.5
4.	The CHRONC Module of the MACCS2 Code 4	.7
5.	Costs Not Taken Into Account by the MACCS2 Code5	0
6.	Release Categories and MACCS2 Outputs5	0
VI. E	ENTERGY FAILED TO DEVELOP SITE-SPECIFIC MACCS2 CHRONC INPUTS	2

A.	Entergy Used Example Inputs Instead of Developing Site-Specific Inputs for Indian Point	52
	1. Developing Site-Specific Inputs to the MACCS2 Code Is Particularly Important for Indian Point	52
	2. Entergy Relied Upon Sample Problem A Values for Inputs to the CHRONC Module of the MACCS2 Code	54
B.	NRC Staff Accepted Entergy's Failure to Develop Site-Specific Inputs in the FSEIS	57
VII.	NUREG-1150 LACKS "PEDIGREE" AND DOES NOT JUSTIFY THE USE OF SAMPLE PROBLEM A	58
A.	Sample Problem A's Decontamination Cost Values Are Based Upon a Document That Does Not Appear to Have Been Published, Let Alone Subject to Peer Review	58
B.	Sample Problem A's Decontamination Time Values Are Based Upon a Document That Contains Unrealistic Assumptions and Is Inconsistent With NUREG-1150	65
C.	Instead of Condoning the Use of Example Values, NUREG-1150 Supports Developing Site-Specific Cost Estimates	67
D.	Internal NRC Documents Question the "Pedigree" of NUREG-1150	69
E.	The Fact that Other Plants Have Used Sample Problem A Does Not Justify Its Use at Indian Point	71
VIII.	NRC HAS CONDUCTED A SITE-SPECIFIC ANALYSIS AT INDIAN POINT THAT DID NOR RELY UPON SAMPLE PROBLEM A	72
IX.	NEITHER NRC STAFF NOR ENTERGY COMPARED THE SAMPLE PROBLEM A VALUES TO MORE RECENT, RELEVANT DATA	77
X.	THE SAMPLE PROBLEM A VALUES ARE UNREASONABLE FOR INDIAN POIN BECAUSE THEY DO NOT ACCURATELY INCORPORATE AVAILABLE DECONTAMINATION DATA, AND THE POPULATION AND BUILDING CHARACTERISTICS OF THE AREA SURROUNDING INDIAN POINT	NT 78
A.	The ISR Report and Dr. Lemay's Testimony Demonstrate that the SAMA Analysis Underestimated the Economic Costs of a Severe Accident at Indian Point Because the SAMA Analysis Generic Assumptions	79
B.	ISR's Sensitivity Analysis Honed in on the Parameters that Most Affect Costs	80

# Page

C.		ISR's Analysis Used the Same Dose Reduction Factors Entergy Used	82
D.		The Nonfarm Decontamination Costs (CDNFRM) Entergy Used and Staff Accepted Are Not Rationally Related to Indian Point	84
	1.	Approach A: Site Restoration/Survey of Costs	87
	2.	Approach B: Reichmuth	89
	3.	Approach C: CONDO	90
	4.	Approach D: RISO	91
	5.	Response to Entergy and NRC Staff Criticisms of ISR's Approaches to Calculating CDNFRM	92
E.		The Decontamination Times (TIMDEC) Entergy Used and NRC Staff Accepted Are Not Rationally Related to Indian Point	99
F.		The ISR Report Discloses Flaws in Other CHRONC Parameters	. 103
G.		Using Sample Problem A Inputs in Lieu of Site-Specific Inputs Results in a Severe Underestimation of the Costs Associated With a Severe Accident at Indian Point	. 104
Н.		ISR's Analysis Is Not Based on a Worst-Case Scenario	. 104
XI.	N N A	EITHER ENTERGY NOR NRC STAFF ANALYZED THE EFFECTS OF NYS-12C ALONE, OR IN COMBINATION WITH NYS-16B, ON THE SAMA ANALYSIS	. 107
XII.	С	ONCLUSIONS OF LAW	. 109
A.		The SAMA Analysis Must Be Site-Specific	. 109
B.		The FSEIS Violates NEPA, NRC Regulations, and CEQ Regulations Because It Accepts a SAMA Analysis Predicated on Economic Cost Estimates That Are Not Site-Specific to Indian Point	. 110
	1.	NRC Staff Failed to Meet Its Burden of Showing that Entergy's Failure to Develop Site-Specific Cost Estimates Was Reasonable	. 114
	2.	NRC Staff's Reliance on Entergy's Unreasonable Cost Estimates Prevents NRC Staff from Accurately Discussing and Reasonably Evaluating Mitigation Alternatives and Taking the Requisite "Hard Look" at Mitigating Severe Accidents Under NEPA	. 115

## Page

	3.	By Accepting Entergy's Unreasonable Cost Estimates in the FSEIS, NRC Staff Has Relied Upon and Presented Inaccurate Information to the Public, Violating the Requirement that the FSEIS Contain Accurate Scientific Information
	4.	NUREG-1150's "Pedigree" Does Not Justify the Use of Sample Problem A or Render the SAMA Analysis Reasonable Under NEPA
	5.	It Was Unreasonable for NRC Staff and Entergy to Rely Upon Sample Problem A Because NRC Has Conducted A Site-Specific Analysis At Indian Point
	6.	It Was Unreasonable for NRC Staff and Entergy to Rely Upon Sample Problem A Values Without Comparing Them to More Recent Data
	7.	The State Has Easily Met Its Prima Facie Evidentiary Burden in this Proceeding Through Its Pre-Filed Expert Testimony, Expert Report, Exhibits and Dr. Lemay's Hearing Testimony, and the Board Should Resist Any Attempt By NRC Staff to Delegate Its NEPA Obligations
	8.	NRC Staff Failed to Adequately Respond to New York's Comments Regarding Entergy's Unreasonable SAMA Analysis in Violation of NEPA
C.		The Board Should Afford No Weight to the Unqualified Testimony, and Unsupported Allegations and Conclusions, of Entergy and NRC Staff
D.		NRC Staff Should Be Required to Supplement the FSEIS 129
	1.	Under NEPA, the Appropriate Remedy for a Deficient Environmental Impact Statement is for the Atomic Safety and Licensing Board to Remand the Matter to NRC Staff to Perform a Reanalysis of Site-Specific Environmental Impacts and Prepare a Revised and Supplemental Environmental Impact Statement
	2.	The Errors Identified in NYS-12C Necessitate a Supplement to the FSEIS
E.		NYS-12C and NYS-16 Are Related, and In Evaluating NRC Staff's NEPA Compliance and Fashioning an Appropriate Remedy, the Board Can Consider Them Together
XIII.	P	ROPOSED ORDER

## **GLOSSARY OF TERMS, ACRONYMS, & ABBREVIATIONS**

ASLB or Board	Atomic Safety and Licensing Board	
CDNFRM	MACCS2 input parameter for the nonfarmland decontamination cost	
CEQ	Council on Environmental Quality	
DOE	Department of Energy	
DSEIS	Draft Supplemental Environmental Impact Statement	
EIS	Environmental Impact Statement	
Entergy SOP	ENT000449 Entergy's Statement of Position Regarding Consolidated Contention NYS-12C (Mar. 30, 2012)	
Entergy Test.	ENT000450 Pre-filed Testimony of Entergy Experts Potts, O'Kula, and Teagarden on Consolidated Contention NYS- 12C (Mar. 30, 2012)	
FSEIS	Final Supplemental Environmental Impact Statement	
GEIS	Generic Environmental Impact Statement	
ISR	International Safety Research, Inc.	
Lemay Initial Test.	NYS000241 Pre-filed Testimony of NYS Expert Lemay on Contention NYS-12C (Dec. 21, 2011)	
Lemay Rebuttal Test.	NYS000420 Pre-filed Rebuttal Testimony of NYS Expert Lemay on Contention NYS-12C (June 29, 2012)	
MACCS2	MELCOR Accident Consequence Code Systems Version 2	
MELCOR	Methods for Estimation of Leakages and Consequences of Releases	
NEI 05-01	NYS000287 NEI 05-01, Rev. A, SAMA Analysis Guidance Document (Nov. 2005)	
NEPA	National Environmental Policy Act	
NRC	Nuclear Regulatory Commission	
NUREG-1150	NUREG-1150, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (Dec. 1990) (NYS00252A- NYS00252D)	

## **GLOSSARY OF TERMS, ACRONYMS, & ABBREVIATIONS**

NYS-12C	Consolidated Contention 12/12A/12B/12C	
NYS Revised SOP	NYS000419 State of New York Revised Statement of Position on NYS-12C (June 29, 2012)	
OECR	Offsite Economic Cost Risk	
Os84	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	
SAMA	Severe Accident Mitigation Alternatives	
Sandia	Sandia National Laboratories	
Sandia Site Restoration	NYS000249 D. Chanin & W. Murfin, SAND96-0957, Site Restoration: Estimation of Attributable Costs From Plutonium-Dispersal Accidents (May 1996)	
SOARCA	State-of-the-Art Reactor Consequence Analysis	
Staff SOP	NRC000039 NRC Staff's Initial Statement of Position on Consolidated Contention NYS-12C (Mar. 30, 2012)	
Staff Test.	NRC000041 Pre-filed Testimony of NRC Staff Experts Bixler, Ghosh, Jones, and Harrison on NYS-12/16 (Mar. 30, 2012)	
Tawil 1990	NYS000424A-NYS000424BB NUREG/CR-5148 Property- Related Costs of Decontamination," J. J. Tawil and and F.C. Bold (Feb. 1990)	
DECON reference	NYS000425A-NYS000425G NUREG/CR-3413 Off-Site Consequences of Radiological Accidents: Methods, Costs and Schedules for Decontamination, J.J. Tawil, et al. (Aug. 1985)	
TIMDEC	MACCS input parameter for the time required for completion of decontamination levels	
Tr.	Transcript	

### THE STATE OF NEW YORK'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW AS TO CONTENTION NYS-12C

1. In accordance with 10 C.F.R. § 2.1209 and the January 15, 2013 Order issued by the Atomic Safety and Licensing Board ("Board"), the State of New York ("State") submits its proposed Findings of Fact and Conclusions of Law on the State's admitted Consolidated Contention 12/12A/12B/12C ("NYS-12C").

2. At issue in this contention is whether NRC Staff's acceptance of Entergy's Severe Accident Mitigation Alternative ("SAMA") analysis in the Final Supplemental Environmental Impact Statement ("FSEIS") violates the National Environmental Policy Act ("NEPA").

3. These proposed findings support the Board's determination, under 10 C.F.R. §§ 51.20(b)(2) and 54.29(b), that renewed operating licenses should not be issued authorizing Entergy to operate the Indian Point nuclear power plants for additional 20-year terms.

## I. INTRODUCTION

4. In violation of the NEPA, NRC regulations, and CEQ regulations, Entergy and NRC Staff have ignored their obligation to conduct a site-specific SAMA analysis, vastly underestimating the costs associated with a severe accident and the benefits associated with severe accident mitigation measures (known as SAMA candidates) by relying on data developed for a site in rural Virginia (known as Sample Problem A).

5. The SAMA analysis is crucial. It is the only time that NRC Staff evaluates the environmental impacts associated with a severe accident at Indian Point before deciding whether to grant Entergy's license renewal application. The SAMA analysis informs Staff and Entergy's

selection of SAMA candidates to implement at Indian Point as well Staff's evaluation of alternatives in deciding whether to relicense the plants.

6. Accurate cost estimates are especially important for Indian Point because the site sits 24 miles from New York City and 38 miles from the financial center of this country and the population density surrounding the site is higher than that surrounding any other nuclear power plant in the United States such that "a severe release of radioactive materials at Indian Point could have more serious consequences than that same release at virtually any other NRC-licensed site." *Consolidated Edison Co. of N.Y.* (Indian Point, Unit 2) *and Power Authority of the State of New York* (Indian Point, Unit 3), CLI-85-6, 21 N.R.C. 1043, 1049-50 (1985).

7. Entergy and NRC Staff significantly underestimate the costs associated with a severe accident used to determine whether mitigation measures are cost beneficial in the SAMA analysis. Entergy used the MELCOR Accident Consequence Code Systems Version 2 ("MACCS2") to estimate costs. Despite compelling evidence that site-specific inputs would yield up to a seven-fold increase in the costs of a severe accident, Entergy and NRC Staff chose to use decades-old information in Sample Problem A for the SAMA analysis for Indian Point. Sample Problem A was developed for the Surry reactor in rural Virginia in the SAMA analysis for Indian Point.

8. Entergy and NRC Staff's use of Sample Problem A to estimate the costs associated with a severe accident at Indian Point is unsound, unreasonable, and deprives millions of New Yorkers and others living around Indian Point of the potential benefits of mitigation measures that could protect them in the event of a severe accident. This is a NEPA violation with potential real world consequences, and one that the Board should not countenance.

9. Neither NRC Staff nor Entergy have explained why it was reasonable, under NEPA, to rely upon Sample Problem A in lieu of site-specific inputs. They argue that the "pedigree" of Sample Problem A supports its continued use because its values were sourced from NUREG-1150, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (Dec. 1990) (NYS00252A-NYS00252D). But the decontamination cost estimates in Sample Problem A are based upon a reference that was never published, nor peer-reviewed. Similarly, the Sample Problem A decontamination time values fare no better; the ultimate source of those values makes assumptions that, if applied to Indian Point, would support the 90-day decontamination scenario set forth in Sample Problem A *only* if 1.5 million people were deployed to clean up following a severe accident and did so in a careful and thorough manner.

10. In addition to relying upon unsupported data, NRC Staff failed to disclose—in the FSEIS or in disclosures for this relicensing proceeding—a site-specific case study of the consequences of a severe accident at Indian Point that NRC conducted in the 1980s. Thus, while NRC has claimed that there is no reasonable way to conduct a site-specific severe accident analysis at Indian Point, NRC itself had actually done such an analysis and buried it in a finalized, but never published, NUREG.

11. Rather than defending their own lack of site-specific data inputs, NRC Staff and Entergy attempt to find fault with the State's evidence. The State shows, however, that its expert's conclusion that the costs associated with a severe accident at Indian Point were significantly underestimated is not countered by Entergy or NRC Staff's claims.

Based on the pre-filed testimony and exhibits submitted by the parties, and the testimony provided during the evidentiary hearing held in Tarrytown, New York on October 17, 18, and 22, 2012, and for the reasons set forth below, Entergy's relicensing application should be

denied. NRC Staff should be directed to conduct a reasonable site-specific SAMA analysis using up-to-date, accurate data, and to include an explanation of that analysis in a further supplement to the FSEIS subject to public review and comment.

#### II. PROCEDURAL HISTORY

13. Indian Point Unit 2 and Unit 3's current 40-year operating licenses expire in 2013 and 2015, respectively.

14. On April 23, 2007, Entergy submitted an application to the NRC to renew the Unit 2 and Unit 3 operating licenses (License Nos. DPR-26 and DPR-64) for an additional 20 years. The NRC issued a Commission Hearing Notice stating that any person whose interest may be affected by this proceeding and who wishes to participate as a party in the proceeding must file a petition for leave to intervene in accordance with the provisions of 10 C.F.R. § 2.309. 72 Fed. Reg. 42,134 (Aug. 1, 2007); *see also* 72 Fed. Reg. 55,834 (Oct. 1, 2007) (extending the period for filing requests for hearing in this matter).

15. After reviewing Entergy's Environmental Report, the State filed various contentions, including Contention 12 and Contention 16 concerning the SAMA analysis. The State updated the contention following the release of the Draft Supplemental Environmental Impact Statement ("DSEIS") in Contention 12A, Entergy's 2009 SAMA Reanalysis in Contention 12-B, and the FSEIS in Contention 12C.

As explained below, Contentions 12, 12A, 12B, and 12C were consolidated as
 NYS-12C. The bases for NYS-12C are set forth below.

#### A. New York State Contention 12

17. On November 30, 2007, the State submitted Contention 12, which asserted that Entergy had not, in its Environmental Report, accurately modeled the cleanup and

decontamination costs for a severe accident in the area surrounding Indian Point, which includes the New York City Metropolitan Area. *New York State Notice of Intention to Participate and Petition to Intervene*, at 140-45 (Nov. 30, 2007) (ML073400187). Contention 12 reads in its entirety:

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).

*Id.* at 140.

18. The bases for Contention 12 were that Entergy's SAMA analysis depends upon an accurate calculation of severe accident costs, but Entergy's use of the MACCS2 code did not provide an accurate calculation of those costs. *Id.* The State's bases explained that Entergy's use of the MACCS2 code does not take into account costs associated with decontaminating an urban/suburban area such as the area within the 50-mile Emergency Planning Zone for Indian Point. *Id.* at 141. Additionally, the State's bases asserted that the MACCS2 code's calculation of cleanup costs did not accurately take into account the characteristics of the particles likely to be released from a nuclear power plant accident. *Id.* at 140-141. This resulted in an underestimation of the cleanup costs. *Id.* at 141.

19. The State specifically referenced the need for an appropriate SAMA analysis for Indian Point "to determine the present and future value of decontamination costs for the four counties in the 10-mile Emergency Planning Zone as well [as] other cities and towns in the New York City-Connecticut-New Jersey metropolitan area that are within [the] 50-mile Emergency Planning Zone." *Id.* at 142.

20. Following oral argument, the Board admitted Contention 12 on July 31, 2008. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Memorandum and Order (Ruling on Petitions to Intervene and Requests for Hearing), LBP-08-13 at 82-83, 68 N.R.C. 43, 100-103 (July 31, 2008) (ML082130436). In admitting the contention, the Board found that "the contention challenges the cost data for decontamination and clean up used by MACCS2." *Id.* at 64.

21. In admitting Contention 12, the Board further found that the State "is questioning whether 'specific inputs' and 'assumptions' made in [the] MACCS2 SAMA analyses are correct for the area surrounding Indian Point." *Id.* The Board noted that "Entergy concedes that while the code itself would not be subject to challenge in this proceeding, it would be possible to make a particularized challenge to specific input parameters in the code or how the Applicant uses the code." *Id.* at 64, n.305.

22. Contention 12 mirrors the State's NEPA scoping comments, which were submitted to NRC on November 30, 2007. The scoping comments discuss how Entergy underestimated economic costs associated with a severe accident at Indian Point and failed to recognize the type of particles released following a nuclear reactor accident. For example, in its scoping comments, the State asserted that, "as part of its analysis, the NRC should [consider] . . . the densely populated and developed New York City area, incorporate the region's property values, and ensure that the resulting financial costs are expressed in present value." *New York State Supplemental Comments Regarding Scope of NEPA Analysis Application for Relicensure by Entergy Nuclear Indian Point LLCs for Operating Licenses Nos. DPR-26 and DPR-64*, at 2-4 (Nov. 30, 2007) (ML073600658).

#### **B.** NRC Staff's DSEIS

23. In December 2008, NRC Staff released the DSEIS, which failed to address any of the issues raised in Contention 12 or scoping comments, and accepted Entergy's severe accident cost estimates and SAMA analysis. *See* NYS00132B at 5-4 – 5-12; NYS00132D at G-18 – G-19.

#### C. New York State Contention 12A

24. After reviewing the DSEIS, the State submitted Contention 12A on February 27, 2009, which asserted that NRC Staff's DSEIS adopted the same flawed modeling contained in Entergy's Environmental Report, and therefore, also underestimated the true cost of decontamination and cleanup in the event of a severe accident. *State of New York Contentions Concerning NRC Staff's Draft Supplemental Environmental Impact Statement* (Feb. 27, 2009) (ML090690303).

25. The bases for Contention 12A were the same as the bases for Contention 12, but updated in light of NRC's publication of the DSEIS. *Id.* 

26. Contention 12A mirrors the State's comments on the DSEIS, which were submitted on March 18, 2008 and discussed how NRC Staff failed to address in the DSEIS Entergy's underestimation of the economic costs associated with a severe accident at Indian Point and failure to recognize the type of particles released following a nuclear reactor accident. For example, the State's DSEIS comments asserted that "as part of its analysis, the NRC should [consider] . . . the densely populated and developed New York City area, incorporate the region's property values, and ensure that the resulting financial costs are expressed in present value." NYS000134 (*Comments Submitted by the New York State Office of the Attorney General on the* 

DSEIS Prepared by Staff on the NRC for the Renewal of the Operating Licenses for Indian Point Units 2 and 3, Mar. 18, 2009) at 46.

27. The Board admitted Contention 12A on June 16, 2009, and consolidated it with Contention 12. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Order (Ruling on New York State's New and Amended Contentions) (June 16, 2009) (unpublished) (ML091670435).

#### D. Entergy's December 2009 SAMA Reanalysis

28. On December 14, 2009, Entergy submitted a revised SAMA analysis which used revised meteorological data. ENT000464 (Entegy, Re-analysis of MACCS2 Models for IPEC, IP-CALC-09-00265, Dec. 2, 2009). Entergy stated, "[t]he re-analysis is required to address an error found in methodology used to derive five year average wind direction input into the computer code, MACCS2, used for the SAMA evaluations." *Id.* at 6. As a result of this error, additional mitigation measures, *i.e.*, SAMA candidates, were determined to be cost-beneficial while other mitigation measures became more beneficial.

#### E. New York State Contention 12B

29. On March 11, 2010, the State filed Amended Contention 12B, challenging Entergy's revised SAMA analysis. *State of New York's Mot. for Leave to File New and Amended Contentions Concerning the December 2009 Reanalysis of SAMAs* (Mar. 11, 2010) (ML100780366).<sup>1</sup>

30. The bases for Contention 12B were the same as the bases for Contentions 12 and12A, but updated in light of Entergy's 2009 SAMA reanalysis. *Id*.

<sup>&</sup>lt;sup>1</sup> At the same time, the State filed contentions NYS-16B, NYS-35, and NYS-36. *State of New York's Mot. for Leave to File New and Amended Contentions Concerning the December 2009 Reanalysis of SAMAs* (Mar. 11, 2010) (ML100780366).

31. On June 30, 2010, the Board admitted Contention 12B, and consolidated it with Contentions 12 and 12-A. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Memorandum and Order (Ruling on the Admissibility of New York's New and Amended Contentions 12B, 16B, 35, and 36), LBP-10-13, 71 N.R.C. 673, 682-85 (June 30, 2010) (ML101810344).

#### F. Staff's December 3, 2011 FSEIS

32. On December 3, 2011, NRC Staff released its FSEIS. NRC000004<sup>2</sup>
(NYS00133A-NYS00133J) (NUREG-1437, Volumes 1-3: Supplement 38: Generic
Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Indian Point
Nuclear Generating Unit Nos. 2 and 3 – Final Report, Dec. 2010).

33. In Appendix G to the FSEIS, NRC Staff, for the first time, in response to Contentions 12, 12A, and 12B, addressed the State's concern that the economic costs of a severe accident at Indian Point have been significantly underestimated. NYS00133I at G-22 – G-24. Appendix G explains that Staff required the technical assistance of Sandia National Laboratories ("Sandia") to review issues related to Contention 12/12A/12B and one of the State's other SAMA contentions, NYS-16B. *Id.* at G-22.

34. In two short pages of analysis, Staff concluded that although Entergy used "MACCS2 Sample Problem A values . . . [which were] primarily developed for the Surry plant analysis in NUREG-1150 and represent best estimate information for that site and time[,] . . . . Entergy's decontamination cost estimates are consistent with those used in accepted SAMA analyses performed for other nuclear power plants." NYS00133I at G-23 – G-24.

<sup>&</sup>lt;sup>2</sup> NRC000004 is a one-page exhibit that "[i]ncorporates New York Exhibit NYS000133A-J."

#### G. New York State Contention 12C

35. On February 3, 2011, the State filed Amended Contention 12C, updating the State's previously submitted contentions by asserting that the FSEIS underestimates decontamination and cleanup costs associated with a severe accident, in violation of NEPA, NRC regulations implementing NEPA, and CEQ regulations. *State of New York's Mot. for Leave to File New and Amended Contention 12C Concerning NRC Staff's December 2010 FSEIS & the Underestimation of Decontamination & Clean Up Costs Associated with a Severe Reactor Accident in the New York Metropolitan Area (Feb. 3, 2011) (ML110680212).* 

36. The bases for Contention 12C were the same as the bases for 12, 12A, and 12B, but updated in light of NRC Staff's acknowledgement of, and partial response to, the issues raised by the State in 12, 12A, and 12B. *Id.* The State's bases asserted that Entergy's use of the MACCS2 code relies on "inaccurate and inapplicable data input" and underestimates severe accident costs by failing to account for the "densely populated and developed New York City metropolitan area" and the particles dispersed from a nuclear power plant accident. *Id.* at Contention 12C, 5-7.

37. In Contention 12C, the State also noted that the FSEIS relied on undisclosed and unidentified work from Sandia National Laboratories ("Sandia"), consultants to NRC Staff. *Id.* at 7. The State spent several months repeatedly and unsuccessfully requesting the documents detailing work performed by Sandia and another lab as part of NRC Staff's NEPA review. On April 22, 2011, the State filed a motion to compel. *State of New York Mot. to Compel NRC Staff to Produce Documents Relied Upon in Staff's FSEIS* (Apr. 22, 2011) (ML11132A149). On May 19, 2011, the Board heard oral argument on the State's motion. Tr. 904-954. On May 25, 2011 NRC Staff finally agreed to produce some documents in response to the State's motion to

compel. *See* May 25, 2011 letter from NRC Staff to the Board (ML11146A077); May 25, 2011 letter from NRC Staff to New York State (ML11146A058).

38. On July 6, 2011, the Board admitted Contention 12C and consolidated it with NYS-12/12A/12B as Consolidated NYS-12C. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Order, NYS-12-C, 8-9 (July 6, 2011) (unpublished) (ML111870344).

39. The Board reiterated "the basic allegation found in the consolidated contention that NYS-12C [sought] to amend – namely, that Entergy's and NRC Staff's use of the MACCS2 code leads to an underestimation of the cleanup costs from a severe accident" and characterized it as the "overarching aspect of this contention." *Id.* at 7-8.

#### H. Pre-Filed Submissions and Motions in Limine

#### 1. <u>New York State Pre-filed Submissions</u>

40. On December 21, 2011, the State of New York filed its initial statement of position (NYS000240), expert report of International Safety Research, Inc. ("ISR") (NYS000242), pre-filed expert testimony (NYS000241), and exhibits (NYS00132A-NYS00132D, NYS00133A-NYS00133J, NYS000243-NYS000292) for consolidated Contention NYS-12C.

## 2. Entergy's January 2012 Motion in Limine for NYS-12C

41. On January 30, 2012, Entergy filed a motion in limine seeking to exclude portions of the pre-filed testimony, report, and exhibits as outside the scope of New York's admitted Consolidated Contention NYS-12C. *Applicant's Mot. in Limine to Exclude Portions of the Prefiled Test., Report, and Exs. Filed By New York State & Dr. François Lemay in Supp. of Consolidated Contention NYS-12C* (Jan. 30, 2012) (ML12030A216). Entergy also argued that

two minor modifications the State's expert made to allow site-specific values to be input to the MACCS2 code should be excluded. *Id.* at 14-15. On February 9, 2012, NRC Staff filed an answer in support of Entergy's motion in limine. *NRC Staff's Answer to Applicant's Mot. in Limine to Exclude Portions of the Prefiled Test., Report, and Exs. Filed by New York State & Dr. François Lemay in Supp. of Consolidated Contention NYS-12C (Feb. 9, 2012) (ML12040A239).* 

42. On February 17, 2012, the State submitted an answer and declaration from the State's expert Dr. François Lemay opposing Entergy's motion in limine. *State of New York's Answer to Entergy's Mot. in Limine to Exclude Portions of Pre-Filed Test. and Exs. for Consolidated Contention NYS-12C* (Feb. 17, 2012) (ML12048B412); *Decl. of Dr. François J. Lemay* (Feb. 17, 2012) (ML12048B413). The State's answer explained that Dr. Lemay's pre-filed testimony, report, and exhibits all fall squarely within the scope of NYS-12C. *Id.* at 6-21. Relying upon Dr. Lemay's declaration, the State explained that the modifications to the MACCS2 code were two minor changes that allowed the State's experts to enter site-specific inputs for Indian Point. *Id.* at 21-24. The changes were necessary to conduct the site-specific analysis presented by the State's experts. *Id.* 

43. On March 6, 2012, the Board denied Entergy's motion in limine as to NYS-12C finding that "[i]ssues like those delineated in New York's testimony relating to decontamination and clean up costs are the heart of NYS-12C, and all of the evidence filed by New York is within the scope of the admitted Contention's reasonably inferred bounds." *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), Order (Granting in Part and Denying in Part Applicant's Motions in Limine) at 6 (Mar. 6, 2012) (unpublished) (ML12066A170). The Board further found that "One can hardly say the contested inputs are outside the scope of NYS-12C when they, in fact, go to the core of the question of property values and how they might be

affected by a radionuclide-releasing accident at IPEC and the resulting decontamination process." *Id.* at 7. With respect to Dr. Lemay's modifications of the MACCS2 code, the Board found that "Dr. LeMay's [sic] source code modifications illustrate the effect of varying MACCS2's assumptions to address alternative inputs – something that was conceptualized by the Contention as described in the original Board Memorandum and Order admitting it." *Id.* 

#### 3. Entergy and NRC Staff Pre-filed Submissions

44. On March 30, 2012, NRC Staff filed its statement of position (NRC000039) and exhibits for NYS-12C (NRC000042-NRC000061). NRC Staff filed joint pre-filed expert testimony (NRC000041) for contentions NYS-12C and NYS-16B, noting that "[t]he Staff's testimony and exhibits filed with respect to consolidated contention NYS-16B and NYS-12C are identical due to the substantial overlap of issues between the MELCOR Accident Consequence Code System 2 ('MACCS2') and Severe Accident Mitigation Alternatives ('SAMA') analysis." NRC000039 at 1, n.1.

45. Also on March 30, 2012, Entergy filed its statement of position (ENT000449), pre-filed expert testimony (ENT000450), and exhibits for NYS-12C (ENT00004, ENT00005, ENT00007, ENT000451-ENT000477).

### 4. <u>New York State Rebuttal Submissions</u>

46. The State then submitted a revised statement of position (NYS000419), pre-filed rebuttal testimony (NYS000420<sup>3</sup>), and additional exhibits (NYS000421-NYS000432) on June 29, 2012. As is explained in both the State's revised statement of position and the pre-filed

<sup>&</sup>lt;sup>3</sup> In the State's June 29, 2012 submissions, Dr. Lemay's Rebuttal Pre-filed Testimony (NYS000420) was mislabeled as NYS000241. After realizing this error, on August 15, 2012, the State submitted a correctly labeled version of NYS000420. *See* Aug. 15, 2012 Cover Letter from Janice Dean to ASLB transmitting corrected versions of exhibits, including NYS000420 (ML12228A657, ML12228A655).

rebuttal testimony of Dr. Lemay, in the course of developing a response to Entergy and NRC Staff's arguments, the State's experts discovered a site-specific case study commissioned by the NRC to estimate the costs associated with a severe accident at Indian Point, which the State submitted as exhibit NYS000424A-NYS000424BB (NUREG/CR-5148 Property-Related Costs of Decontamination, Feb. 1990 ("Tawil 1990")). *See* NYS000419 at 14-16; NYS000420 Pre-filed Rebuttal Testimony of NYS Expert Lemay on Contention NYS-12C ("Lemay Rebuttal Test.") at 26-28.

47. Notably, Entergy and the federal government (including NRC Staff and the national laboratories) did not disclose this document.

## 5. <u>Entergy's July 2012 Motion Seeking Leave to File Written Sur-rebuttal</u> <u>Testimony for NYS-12C</u>

48. On July 12, 2012, Entergy filed a motion seeking leave to prepare and file surrebuttal pre-filed testimony to discuss Tawil 1990 (NYS000424A-NYS000424BB), along with two other State exhibits: NYS000425A-NYS000425G (another NUREG/CR authored by Dr. Tawil) and NYS000426 (May 2, 2012 email exchange between the State's experts and Dr. Tawil). *Applicants' Mot. for Leave to File Surrebuttal Test. on Consolidated Contention NYS-12C* (Jul. 12, 2012) (ML12194A724).<sup>4</sup> These exhibits are discussed in more detail in VIII. below.

<sup>&</sup>lt;sup>4</sup> In connection with its motion in limine, Entergy submitted a declaration from Donald P. Cleary. *See* Declaration of Donald P. Cleary Related to Entergy's Motion in Limine on Contention NYS-12C (July 30, 2012) (Attachment 2 to ML12212A416). Entergy has neither disclosed Mr. Cleary as a witness for NYS-12C nor submitted pre-filed testimony for Mr. Cleary on NYS-12C. Mr. Cleary did not appear as a witness on NYS-12C at the hearing in Tarrytown, New York. Thus, Mr. Cleary's declaration regarding Entergy's Motion in Limine on NYS-12C is not part of the evidentiary record and, therefore, it should not be used in reaching any conclusions regarding NYS-12C. Should Entergy or NRC Staff seek to bring in any of that declaration or Mr. Cleary in support of their opposition to NYS-12C, the State believes they

49. Entergy reported that "NRC Staff counsel stated that the Staff does not oppose Entergy's Motion, and that if the Board grants the Motion, then the Staff would like to have the opportunity to file sur-rebuttal testimony and a revised position statement in response to New York's filing as well, should the Staff decide to do so, at the same time as Entergy." *Id.* at 7.

50. On July 23, 2012, the State opposed Entergy's motion. *State of New York's Answer in Opp'n to Entergy's Mot. for Leave to File Sur-Rebuttal Test. on Consolidated Contention NYS-12C* (Jul. 23, 2012) (ML12205A361). The State explained that the exhibits were properly submitted as rebuttal evidence in direct response to arguments in Entergy and NRC Staff's statements of position and pre-filed testimony on NYS-12C. *Id.* 

51. The State noted that, in response to the State's arguments that reliance on Sample Problem A was unreasonable, Entergy faulted the State for "not acknowledg[ing] the source and pedigree of the inputs used by Entergy." ENT000450 Pre-filed Testimony of Entergy Experts Potts, O'Kula, and Teagarden on Consolidated Contention NYS-12C ("Entergy Test.") at A76 (O'Kula, Teagarden. Potts) (Mar. 30, 2012). NRC Staff made a similar claim. *See* NRC000041 Pre-filed Testimony of NRC Staff Experts Bixler, Ghosh, Jones, and Harrison on NYS-12/16 ("Staff Test.") at A39 (Jones, Bixler) ("NUREG-1150 …was subjected to an extensive peer review and public comment.").

52. The State also explained that Tawil 1990 was discovered in course of researching Entergy and NRC's "pedigree" argument about NUREG-1150. NYS000419 at 14; NYS000420 Lemay Rebuttal Test. at 26, 28. In its revised statement of position, the State argued that Tawil 1990 shows that "NRC has actually conducted a site-specific analysis of the decontamination

would have to seek leave of the Board by motion and that the State would have the opportunity to file a brief in opposition and seek discovery of Mr. Cleary.

costs associated with a severe accident at Indian Point, without using NUREG-1150 values, and, therefore, without relying upon Sample Problem A." NYS000419 at 15. Thus, Tawil 1990 "shows that a site-specific analysis was not only required under NEPA and NRC's regulations, but eminently possible and had been completed in conjunction with NUREG/CR-5148 [Tawil 1990]." *Id.* 

53. On August 2, 2012, the Board denied Entergy's motion for sur-rebuttal, finding that the issues raised by the State's exhibits could be adequately addressed at the upcoming October 2012 hearing. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Memorandum and Order (Denying Applicant's Motion for Leave to File Surrebuttal Testimony on NYS-12C) at 3-4 (Aug. 2, 2012) (unpublished) (ML12215A160).

6. Entergy and NRC Staff's July 2012 Motions in Limine for NYS-12C

54. On July 30, 2012, Entergy and NRC Staff filed motions in limine, seeking to exclude Tawil 1990 (NYS000424A-NYS000424BB), NYS000425A-NYS000425G (another NUREG/CR authored by Dr. Tawil) and NYS000426 (May 2, 2012 email exchange between the State's experts and Dr. Tawil). *Entergy's Mot. in Limine to Exclude Portions of New York State's Rebuttal Filings on Contention NYS-12C* (Jul. 30, 2012) (ML12212A416); *NRC Staff's Mot. in Limine to Exclude Portions of the Pre-filed Rebuttal Test.* & *Rebuttal Exs. Filed by the State of New York Concerning Consolidated Contention NYS-12C (SAMAs)* (Jul. 30, 2012) (ML12212A403). These three exhibits were previously the subject to Entergy's motion for surrebuttal. Additionally, Entergy and NRC Staff sought to exclude portions of Dr. Lemay's rebuttal testimony discussing these exhibits, and Entergy sought to exclude portions of the State's revised statement of position discussing these exhibits.

55. On August 8, 2012, the State opposed the motions, explaining that in the course of developing a response to Entergy's and NRC Staff's arguments on NYS-12C, the State's experts discovered NUREG/CR-5148 (NYS000424A-NYS000424BB), only becoming aware of its existence after reaching out to a former NRC-contractor via email (NYS000426). *State of New York's Combined Answer Concerning NYS-12C (SAMAs)* at 1-2 (Aug. 8, 2012)

(ML12222A449) (citing NYS000419 at 14-16; Lemay Rebuttal Test. at 26-28). Thus, the State argued the exhibits are relevant, the proper subject of rebuttal testimony, and were timely disclosed. *Id.* 

56. The Board denied Entergy and NRC Staff's motion in limine at the evidentiary hearing on October 15, 2012. Tr. 1265:23-1266:12 (J. McDade).

## 7. <u>The State's September 2012 Motion Seeking Leave to File an Additional</u> <u>Exhibit for NYS-12C</u>

57. On September 10, 2012, the State became aware of an NRC document, which directly contradicts the central argument raised by NRC Staff and Entergy in NYS-12C to support the use of Sample Problem A. This document was never disclosed by either NRC Staff or Entergy. The document appeared to be an attachment to an email chain that includes Tina Ghosh, Staff witness in this proceeding, and Sherwin Turk, Staff counsel in this proceeding. The substance and importance of the document is discussed in further detail below in VII.E., and (like Tawil 1990) it related directly to NRC Staff and Entergy's arguments regarding the pedigree of the NUREG-1150 values.

58. On September 18, 2012, the State filed a motion seeking leave to have this recently-discovered document entered as an exhibit for NYS-12C and to submit additional cross-examination questions on the exhibit. *State of New York Mot. For Leave to File an Additional Exh. And Additional Cross Examination Questions Concerning NYS-12C* (Sept. 18, 2012)

(ML12262A547). Entergy did not oppose the State's motion for leave to submit the document as an exhibit, but did oppose the request to submit additional cross-exam questions. NRC Staff opposed the motion in its entirety. *NRC Staff's Answer to State of New York's Mot. For Leave to File an Additional Exh. and Additional Cross-Questions Concerning NYS-12C* (Sept. 28, 2012) (ML12272A353, ML12272A352).

59. On October 4, 2012, the Board granted the State's motion and entered the document as NYS000441.<sup>5</sup> *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Order (Granting New York's Motion for Leave to File an Additional Exhibit and Additional Cross-Examination Questions) (Oct. 4, 2012) (unpublished) (ML12278A046).

#### I. The October 2012 Hearing

60. On October 17 and 18, 2012, the Board heard live testimony from the State's witness, Dr. François Lemay, Ph.D. of International Safety Research ("ISR"); Staff's witnesses Mr. Donald G. Harrison, Dr. S. Tina Ghosh, Dr. Nathan E. Bixler, and Mr. Joseph A. Jones; and Entergy's witnesses Ms. Lori Potts, Dr. Kevin O'Kula, and Mr. Grant Teagarden.

61. Following the hearing, the State, Entergy, and NRC Staff conferred and submitted proposed transcript errata to the Board.

62. In a December 27, 2012 order, the Board adopted the parties' proposed corrections for NYS-12C, stating "[p]ursuant to 10 C.F.R. § 2.327(d), the Office of the Secretary will 'make the necessary physical corrections in the official transcript, so that it will incorporate

<sup>&</sup>lt;sup>5</sup> The Board also admitted an attorney declaration as NYS000442, but that exhibit was withdrawn after the State explained that the declaration was not proffered as an evidentiary exhibit in support of a contention, but instead it was proffered in support of the motion for leave to file an additional exhibit and cross-examination questions. *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), Order (Granting New York's Unopposed Motion to Modify the Board's October 4, 2012 Order) at 1-2 (Oct. 5, 2012) (unpublished) (ML12279A257).

the changes ordered."" *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), Order (Adopting Proposed Transcript Corrections with Minor Edits) at 2 (Dec. 27, 2012) (unpublished) ("Dec. 27, 2012 Board Order") (ML12362A278).

### III. LEGAL STANDARDS

### A. NEPA's Requirements

1. <u>NEPA Obligates the NRC to Consider the Environmental Impacts of License Renewal</u>

63. Contention NYS-12C asserts deficiencies in the FSEIS under NEPA (42 U.S.C.

§§ 4321-35), the NRC regulations implementing the agency's responsibilities pursuant to NEPA (10 C.F.R. Part 51), and the Council on Environmental Quality ("CEQ") regulations implementing federal agencies' NEPA obligations (40 C.F.R. §§ 1500-08).

64. NEPA is our "basic national charter for protection of the environment." 42 U.S.C. §§ 4321-35; 40 C.F.R. § 1500.1(a). NRC must comply with NEPA. *Calvert Cliffs Coordinating Comm. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109 (D.C. Cir. 1971) (holding that NEPA applies to NRC's predecessor agency).

65. NEPA requires an agency to prepare an environmental impact statement ("EIS") for "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). NRC's renewal of a nuclear power plant's operating license is a major Federal action triggering this NEPA requirement. 10 C.F.R. § 51.20(b)(2); *see also Massachusetts v. United States*, 522 F.3d 115, 119 (1st Cir. 2008) (citing 10 C.F.R. § 51.20).

66. The preparation of an EIS advances NEPA's goals in two ways: first, it causes the agency to take the requisite "hard look" at the environmental impacts of the proposed action; and second, by making the relevant information publicly available, it allows the public to participate in the decision-making process. *See Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 768 (2004);

Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989); Hughes River Watershed Conservancy v. Glickman, 81 F.3d 437, 443 (4th Cir. 1996).

67. The first purpose ensures that an agency, "in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts." *Robertson*, 490 U.S. at 349. The second purpose "guarantees that the relevant information [concerning environmental impacts] will be made available to the larger audience," including the public, "that may also play a role in the decisionmaking process and the implementation of the decision." *Id.* 

68. An environmental analysis is not simply meant to create paperwork for the agency but, instead, to inform the NRC's decision. *See* 40 C.F.R. § 1500.1(c) ("Ultimately, of course, it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment.").

69. "[G]rudging, pro forma compliance [with NEPA] will not do." *Lathan v. Brinegar*, 506 F.2d 677, 693 (9th Cir.1974) (en banc). Courts have cautioned that NEPA review "must not [be] reduce[d] . . . to a 'rubber-stamp' of agency action." *N.C. Wildlife Federation v. N.C. Dep't of Transp.*, 677 F.3d 596, 601 (4th Cir. 2012) (citing *Fed. Mar. Comm'n v. Seatrain Lines, Inc.*, 411 U.S. 726, 745–46 (1973)).

70. In furtherance of NEPA's goal of informing agency decision-making, NRC's NEPA regulations require "analysis of significant problems and objections raised by other Federal, State, and local agencies, by any affected Indian tribes, and by other interested persons."

10 C.F.R. § 51.71(b). The FSEIS must respond to "any comments on the draft environmental impact statement or on any supplement to the draft environmental impact statement." 10 C.F.R. § 51.91(a)(1); *see also* 40 C.F.R. § 1503.4(a).

2. <u>NEPA Requires NRC to Take a Hard Look at Environmental Impacts,</u> <u>Analyze a Reasonable Range of Alternatives, Thoroughly Discuss</u> <u>Mitigation Measures, and Rely Upon High Quality and Accurate Scientific</u> <u>Information</u>

71. In preparing an EIS, NEPA requires that the NRC take a "hard look" at potential environmental impacts, consider a reasonable range of alternatives, and provide a rational basis for rejecting alternatives that are decidedly cost-effective. See Methow Valley, 490 U.S. at 350-352; 40 C.F.R. § 1502.14. While NEPA does not require analysis of a so-called "worst-case scenario" (ENT000449 Entergy's Statement of Position Regarding Consolidated Contention NYS-12C (Mar. 30, 2012) ("Entergy SOP") at 21), NEPA's "hard look" requirement obligates the agency to evaluate "reasonable foreseeable significant adverse impacts on the human environment." San Luis Obispo Mothers for Peace v. NRC, 449 F.3d 1016, 1033 (9th Cir. 2006), cert. denied, 549 U.S. 1166 (2007). Such impacts "include[] impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." 40 C.F.R. § 1502.22(b)(4); cf. New York v. NRC, 681 F.3d 471, 482 (D.C. Cir. 2012) ("Only 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 [NEPA] analysis.").

72. NRC must "[r]igorously explore and objectively evaluate all reasonable alternatives" to a proposed action. 40 C.F.R. § 1502.14(a). Consideration of alternatives is "the heart of the environmental impact statement," mandating that the NRC "present the

environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." *Id.* § 1502.14. NRC must "to the *fullest* extent possible . . . consider alternatives to its action which would reduce environmental damage." *Calvert Cliffs*', 449 F.2d at 1128 (emphasis in original). The consideration of alternatives requirement

seeks to ensure that each agency decision maker has before him and takes into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance . . . [and] . . . allows those removed from the initial process to evaluate and balance the factors on their own.

*Id.* at 1114. Absent this comparative analysis, decisionmakers and the public can neither assess environmental trade-offs nor avoid environmental harms. *See id; Methow Valley*, 390 U.S. at 351-52.

73. An EIS must also contain a detailed discussion of possible mitigation measures and the extent to which adverse effects can be avoided. *Id.* at 351-52. The discussion of adverse effects must not improperly minimize negative side effects. *Western Watersheds Project v. Kraayenbrink*, 632 F.3d 472, 491 (9th Cir. 2011) (quoting *Earth Island Inst. v. U.S. Forest Serv.*, 442 F.3d 1147, 1159 (9th Cir. 2006), *abrogated on other grounds by Winter v. Natural Res. Def. Council, Inc.*, 555 U.S. 7 (2008)). The "omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA. Without such a discussion, neither the agency nor other interested groups and individuals can properly evaluate the severity of the adverse effects." *Robertson*, 490 U.S. at 351-52.

74. An EIS must contain "high quality" information and "accurate scientific analysis." 40 C.F.R. § 1500.1(b); *Lands Council v. Powell*, 395 F.3d 1019, 1031-32 (9th Cir.

2005); *Conservation Northwest v. Rey*, 674 F. Supp. 2d 1232, 1249 (W.D. Wash. 2009) (citing *Ctr. for Biological Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1167 (9th Cir. 2003)).

#### **B.** Requirement to Complete a SAMA Analysis

### 1. <u>NRC Must Perform a Site-Specific SAMA Analysis for Indian Point as</u> Part of Its Environmental Analysis Under NEPA

75. The SAMA analysis is the vehicle by which NRC Staff considers, in the FSEIS, the environmental impacts of a severe accident and alternative mitigation measures to reduce those impacts. 10 C.F.R. § 51.53(c)(3)(ii)(L); Part 51, Subpart A, Appendix B, Table B-1. The purpose of a SAMA analysis is "to ensure that any plant changes—in hardware, procedures, or training—that have a potential for significantly improving severe accident safety performance are indentified and assessed." *Duke Energy Corp.* (McGuire Nuclear Station, Units 1 and 2), CLI-02-17, 56 N.R.C. 1, 5 (2002).

76. The SAMA requirement is rooted in *Limerick Ecology Action, Inc. v. U.S. Nuclear Regulatory Comm'n,* 869 F.2d 719 (3d Cir. 1989), which held that NEPA requires NRC to examine the environmental effects of significant accidents at nuclear power plants and measures to mitigate those effects. The *Limerick* court recognized that SAMA analyses must be site-specific "[b]ecause the potential consequences [of a severe accident] will largely be the product of the location of the plant." *Id.* at 738.

77. Following the Third Circuit's 1989 decision and mandate in *Limerick*, in 1996 NRC promulgated regulations outlining the procedure for evaluating the risk of severe accidents on a site-specific basis in a SAMA analysis, but deferred that analysis until a reactor sought to extend its initial operating license. Under 10 C.F.R. § 51.53(c)(3)(ii)(L), "if the [S]taff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a

consideration of alternatives to mitigate severe accidents must be provided." Because Indian Point Units 2 and 3 were not subject to the SAMA analysis requirement when they received permission to operate in 1973 and 1975,<sup>6</sup> a SAMA analysis is required for relicensing.

78. The applicant must first complete a SAMA analysis as part of its Environmental Report. 10 C.F.R. § 51.53(c)(3)(ii)(L). *See generally* Tr. 1925:3-24 (J. McDade/Teagarden) (discussing applicant's requirement to complete a SAMA analysis). Then, Staff reviews the applicant's SAMA analysis, and presents the results of its review in its supplemental environmental impact statement (*i.e.*, DSEIS and FSEIS). 10 C.F.R. § 51.95(c)(4); 10 C.F.R. §§ 51.53(c)(3)(ii)(L) and 51.71(d). *See also* NUREG-1555 Standard Review Plans for Environmental Reviews of Nuclear Power Plants, Supplement 1: Operating License Renewal

<sup>&</sup>lt;sup>6</sup> See 21 Fed. Reg. 3,085 (May 9, 1956), 31 Fed. Reg. 13,616-02 (Oct. 21, 1966), 34 Fed. Reg. 13,437-04 (Aug. 20, 1969) (issuance of construction licenses for Indian Point facilities). According to AEC and NRC documents, Consolidated Edison received the following construction permits and operation licenses on the following dates:

	CONSTRUCTION PERMIT ISSUED	OPERATING LICENSE ISSUED
IP Unit 1	May 4, 1956	March 26, 1962
IP Unit 2	October 14, 1966	September 28, 1973
IP Unit 3	August 13, 1969	December 12, 1975

*See* 21 Fed. Reg. 3,085 (May 9, 1956); 31 Fed. Reg. 13,616-17 (Oct. 21, 1966); 34 Fed. Reg. 13,437 (Aug. 20, 1969) (issuance of construction permits for Indian Point facilities); NUREG-1350, Volume 20, *2008 - 2009 Information Digest*, at 103, 113 (Aug. 2008) (providing dates of construction permits and operating licenses for Indian Point facilities). Of the three reactors at the site, only Indian Point Unit 2 and Indian Point Unit 3 continue to operate. AEC issued Indian Point Unit 1 one of the first (provisional) operating licenses in the country (DPR-005) and the reactor operated sporadically for approximately 12 years from August 1962 until October 31, 1974. In 1974, the plant was shut down because its emergency core cooling system did not meet regulatory requirements, and NRC later withdrew its operating license. *See generally Consolidated Edison Co. of New York, Inc.* (Indian Point Units 1 and 2), *Power Authority of the State of New York* (Indian Point Unit No. 3), DD-80-5, 11 N.R.C. 351, 1980 NRC LEXIS 149 at \* 5-8 (Feb. 11, 1980).

(October 1999) (NYS000220) at 5.1.1-1 ("This environmental standard review plan (ESRP) directs the [S]taff's analysis and assessment of the severe accidents for the applicant's plant. . . . The intent is to identify additional cases that might warrant either additional features or other actions that would prevent or mitigate the consequences of serious accidents").

79. According to the Board, "[T]he FSEIS must demonstrate that the NRC [S]taff has received sufficient information to take a hard look at SAMAs as required by 10 C.F.R. § 51.53(c)(3)(ii)(L), has in fact taken that hard look, and has adequately explained its conclusions." *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), (Ruling on Motion and Cross-Motions for Summary Disposition of NYS-35/36), LBP-11-17, 74 N.R.C. 11, 27 (Jul. 14, 2011). In drafting the FSEIS, NRC Staff may draw upon the SAMA analysis submitted by the applicant in its Environmental Report; however, NRC Staff must comply with NEPA by ensuring that the applicant's analysis is reasonably based on accurate severe accident cost estimates for the specific site. 10 C.F.R. § 51.70(b).

## 2. <u>The SAMA Analysis is the Only Site-Specific Analysis of Severe</u> <u>Accidents at Indian Point Considered in the Context of Entergy's License</u> <u>Renewal Application</u>

80. NRC examined the impacts of severe accidents on a generic basis seventeen years ago. NRC000002<sup>7</sup> (NYS00131A-NYS00131I) (NUREG-1437, Volumes 1-2: Generic Environmental Impact Statement for License Renewal of Nuclear Plants, May 1996) at Chapter 5; Part 51, Subpart A, Appendix B, Table B-1); 10 C.F.R. § 51.53(c)(3)(ii)(L). Therefore, the only site-specific analysis of severe accidents at Indian Point—and the only way NRC complies

<sup>&</sup>lt;sup>7</sup> NRC000002 is a one-page exhibit that "[i]ncorporates New York Exhibit NYS00131A-NYS00131I."

with *Limerick Ecology*'s mandate—is the SAMA analysis.<sup>8</sup> Ultimately, the SAMA analysis and NRC Staff's review of the SAMA analysis is crucial to determining "whether the Commission has taken all practical measures within its jurisdiction to avoid or minimize environmental harm from the alterative selected, and if not, to explain why those measures were not adopted." 10 C.F.R. § 51.103(a)(4).

## C. Burden of Proof for NEPA Contentions

81. The burden of complying with NEPA lies with NRC Staff alone.<sup>9</sup> By placing the

burden on NRC Staff, NEPA "insures the integrity of the agency process by forcing it to face those stubborn, difficult-to-answer objections without ignoring them or sweeping them under the rug" and serves as an "environmental full disclosure law so that the public can weigh a project's benefits against its environmental costs." *See Sierra Club v. U.S. Army Corps of Eng'rs*, 772 F.2d 1043, 1049 (2d Cir. 1985) (citing *Silva v. Lynn*, 482 F.2d 1282, 1284-85 (1st Cir. 1973)).

<sup>&</sup>lt;sup>8</sup> See also NYS00133B at 5-3 to 5-4 ("The NRC staff has not identified any new and significant information with regard to the consequences from severe accidents during its independent review of the IP2 and IP3 ER (Entergy 2007a), the site visit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of severe accidents beyond those discussed in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS). However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for IP2 and IP3. The results of its review are discussed in Section 5.2 of this draft SEIS.")

<sup>&</sup>lt;sup>9</sup> See, e.g., Progress Energy Florida, Inc., (Combined License Application, Levy County Nuclear Power Plant, Units 1 and 2), Nuclear Reg. Rep. P 31605, 2010 WL 87737, \*5 (2010) (Commission recognizes that "the ultimate burden with respect to NEPA lies with the NRC Staff"); *Duke Power Co.* (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 N.R.C. 1041, 1049 (1983) (as the proponent of the agency action at issue, an applicant generally has the burden of proof in a licensing proceeding, *see* 10 C.F.R. § 2.325, when NEPA contentions are involved, the burden shifts to NRC Staff, because the NRC, not an applicant, has the burden of complying with NEPA); 10 C.F.R. § 51.70(b) (NRC Staff must "independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement.").

Thus, NRC Staff's "responsibility is not simply to sit back, like an umpire, and resolve adversary contentions at the hearing stage." *Calvert Cliffs*', 449 F.2d at 1119.

82. Staff cannot shift the burden of ensuring that its environmental analysis is adequate to intervenors. *See Harlem Val. Transp. Ass'n v. Stafford*, 500 F.2d 328, 336 (2d Cir. 1974) (An agency cannot be "content to place the burden on intervenors whose resources might be limited to challenge any environmental statements that the [applicants] might make in their applications . . . "); Greene County Planning Board v. Federal Power Comm'n, 455 F.2d 412, 419-20 (2d Cir. 1972), *cert. denied*, 409 U.S. 849 (1972) (a federal agency cannot abdicate its responsibility to independently evaluate federal actions proposed to it by other, non-federal entities).

83. Nor can NRC Staff shift the burden onto the applicant. "NEPA establishes environmental protection as an integral part of the Atomic Energy Commission's basic mandate. The primary responsibility for fulfilling that mandate lies with the Commission." *Calvert Cliffs*', 449 F.2d at 1119; *Pub. Citizen*, 541 U.S. at 765 ("Admittedly, the agency bears the primary responsibility to ensure that it complies with NEPA."); *Vermont Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc.*, 435 U.S. 519, 553 (U.S. 1978) ("NEPA places upon an agency the obligation to consider every significant aspect of the environmental impact of a proposed action"); *Greene County*, 455 F.2d at 420.

84. While the applicant can participate in the adjudicatory proceeding and advocate that the NRC Staff complied with its NEPA obligations, the compliance obligations remain with NRC Staff alone. Post-hoc analyses conducted by the applicant's witnesses cannot substitute for the hard look required by Staff, nor can they meet Staff's burden of showing that the FSEIS complies with NEPA. *Cf. Dubois v. U.S. Dep't of Agriculture*, 102 F.3d 1273, 1289 (1st Cir.

1996) ("[*P*]*ost hoc* rationalizations are inherently suspect, and in any event are no substitute for the agency's following statutorily mandated procedures.").

#### D. Evidentiary Standards for this Relicensing Proceeding

85. After a party's contention has been admitted, that party has the burden of introducing sufficient evidence to establish a prima facie case. The burden then shifts to NRC Staff to prove by a preponderance of the evidence that it complied with the requirements of NEPA. See Progress Energy Florida, Inc., (Combined License Application, Levy County Nuclear Power Plant, Units 1 and 2), Nuclear Reg. Rep. P 31605, 2010 WL 87737, \*5 (2010) (Commission recognizes that "the ultimate burden with respect to NEPA lies with the NRC Staff"); Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 N.R.C. 1041, 1049 (1983) (as the proponent of the agency action at issue, an applicant generally has the burden of proof in a licensing proceeding, see 10 C.F.R. § 2.325, when NEPA contentions are involved, the burden shifts to NRC Staff, because the NRC, not an applicant, has the burden of complying with NEPA); cf. Louisiana Power and Light Co., 17 N.R.C. 1076, 1093 (quoting Consumers Power Co. (Midland Plant, Units 1 and 2), ALAB-123, 6 A.E.C. 331, 345 (1973) ("Once [intervener] has introduced sufficient evidence to establish a prima facie case, the burden then shifts to the applicant who, as part of his overall burden of proof, must provide a sufficient rebuttal to satisfy the Board that it should reject the contention as a basis for denial of the permit or license.").

86. Under NRC's regulations, "[o]nly relevant, material, and reliable evidence which is not unduly repetitious will be admitted." 10 C.F.R. § 2.337(a). Throughout this proceeding, rather than exclude evidence, this Board has generally opted to "give all evidence its appropriate weight at evidentiary hearing in the context of evaluating the specific issue before [it]." *Entergy*
*Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Licensing Board Order (Granting in Part and Denying in Part Applicant's Motions in Limine) at 20 (Mar. 6, 2012) (unpublished) (ML12066A170); *see also id.* at 24. Now that the Board is evaluating the evidence presented, it is important to note that "unsupported reasoning and computations, are insufficient" and should be afforded little or no weight. *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-11, 71 N.R.C. 287, 315 (Mar. 26, 2010).

87. Lastly, there is nothing that prevents the Board from evaluating related contentions—such as NYS-16B and NYS-12C—together. Indeed, Boards often consider related contentions jointly. *See, e.g., Duke Energy Corp.* (Catawba Nuclear Station, Units 1 and 2), 59 N.R.C. 129, 149-150 (Mar. 5, 2004) (considering contentions with overlapping factual and technical questions together, as a group); *Consumers Power Co.* (Midland Plant, Units 1 and 2), 16 N.R.C. 571, 579 (Aug. 14, 1982) (where similar considerations govern the disposition of multiple contentions, those contentions will be reviewed together); *Niagara Mohawk Power Corp.* (Nine Mile Point, Unit 2), 7 A.E.C. 1046, 1079 (June 14, 1974) (considering closely related contentions together). NRC Staff itself noted that "[t]he Staff's testimony and exhibits filed with respect to consolidated contention NYS-16B and NYS-12C are identical due to the substantial overlap of issues between the MELCOR Accident Consequence Code System 2 ('MACCS2') and Severe Accident Mitigation Alternatives ('SAMA') analysis." NRC000039 at 1, n.1.

## IV. WITNESSES AND QUALIFICATIONS

#### A. State of New York's Witness

88. The State provided one witness on NYS-12C: Dr. François Lemay, Ph.D. of ISR.Dr. Lemay submitted an ISR expert report and both direct and rebuttal written testimony. ISR

Report: Review of Indian Point Off Site Consequence Analysis ("ISR Report") (Dec. 21, 2011) (NYS000242); Initial Pre-filed Written Testimony of New York State Expert Dr. François Lemay of ISR regarding Contention NYS-12C ("Lemay Initial Test.") (Dec. 21, 2011) (NYS000241); Rebuttal Pre-filed Testimony of New York State Expert Dr. François Lemay of ISR regarding Contention NYS-12C ("Lemay Rebuttal Test.") (June 29, 2012) (NYS000420). Dr. Lemay testified in person at the evidentiary hearing in Tarrytown, New York, on October17 and 18, 2012. Tr. 1780-2083.

89. Dr. Lemay is a professional engineer with a Ph.D. in Physics of Nuclear Reactors from the University of Birmingham, United Kingdom. NYS000241 Lemay Initial Test. at 2; NYS000291 (Curriculum Vitae of François J. Lemay, Ph.D., Dec. 2011) at 1. Dr. Lemay has over 28 years of experience in safety analysis, emergency response planning, procedures and systems, radiation protection, radiation transport, risk assessment, environmental impact assessment, standards and guidelines, audits and evaluations, emergency exercises, courses and training and international projects. *Id.* Dr. Lemay is currently the Vice President of ISR. *Id.* 

90. Dr. Lemay has "extensive experience with the MACCS and MACCS2 codes, including using the codes to calculate the consequences to the population for several accident scenarios in the context of the Nanticoke New Build Project for Bruce Power in Ontario." NYS000241 Lemay Initial Test. at 2; NYS000291 at 1; Tr. 1945:6-9 (J. Kennedy/Lemay). Dr. Lemay also has extensive experience with COSYMA, a code from the European Union that is similar to MACCS, and he has performed similar calculations for ESKOM in South Africa, Hydro-Quebec and New Brunswick Power in Canada, and the Canadian Navy. Lemay Initial Test. at 2-3; NYS000291 at 1. Additionally, Dr. Lemay used COSYMA to calculate the cost of accidents near Darlington and Gentilly for the Canadian Department of Natural Resources.

Lemay Initial Test. at 3; NYS000291 at 1. Dr. Lemay offers an advanced level course on MACCS2 and COSYMA. Lemay Initial Test. at 3; NYS000291 at 1. Dr. Lemay has also worked with the International Atomic Energy Agency. For example, he has been invited by the International Atomic Energy Agency to serve as an expert on the consequences of severe accidents in CANDU-600 reactors. NYS000291 at 4.

91. Based on his education, training, professional credentials, and experience, Dr. Lemay is qualified to testify as an expert witness in nuclear physics and engineering. With respect to the issues in NYS-12C, Dr. Lemay is qualified as an expert witness on subjects such as the MACCS2 code, SAMA analyses, and estimation of consequences associated with severe nuclear reactor accidents.

### **B.** Entergy's Witnesses

92. Entergy presented three witnesses regarding NYS-12C: (1) Ms. Lori Potts; (2) Dr. Kevin O'Kula; and (3) Mr. Grant Teagarden. These witnesses provided pre-filed written testimony and testified in person at the evidentiary hearing in Tarrytown, New York, on October 17, 18, and 22, 2012.<sup>10</sup> Each of these witnesses offered pre-filed and live testimony on NYS-16B in addition to NYS-12C.

93. Ms. Potts has a B.S. in nuclear engineering and testified that she has "over 30 years of experience as a technical professional in the nuclear industry in the areas of safety analysis, PRA, deterministic and probabilistic accident and consequence analysis, materials aging management, reactor engineering, and systems engineering." ENT000450 Entergy Test. at 2 (A3) (Potts); ENT000004 (Curriculum Vitae of Lori A. Potts, Mar. 2012). She is a senior

<sup>&</sup>lt;sup>10</sup> On March 22, 2012, with the agreement of all parties, Dr. O'Kula departed the hearing prior to cross-examination. Tr. 2520:8-2521:9.

consulting engineer to Entergy in the areas of SAMA analysis and fire probabilistic risk assessment. ENT000450 Entergy Test. at 1 (A2) (Potts). Ms. Potts is one of the authors of the Nuclear Energy Institute's industry guidance document for performing SAMA analyses: NYS000287 (NEI 05-01, Rev. A, Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document, Nov. 2005) ("NEI 05-01"). Entergy Test. at 2 (A3) (Potts).

94. Although Ms. Potts has "been involved in all of Entergy's SAMA analyses," which includes "nine different units," she admitted that she has never developed MACCS2 site-specific economic cost input parameters (other than population) and that "all of them used the 1150 values [adjusted with the Consumer Price Index] that we've been discussing, that are also used in Sample Problem A." Tr. 2062:4-2063:20 (J. Wardwell/Potts);<sup>11</sup> *accord* NYS000242 ISR Report at 31, Table 12 (providing a comparison of publicly-available MACCS2 input values from plants other than Indian Point, and concluding that "no matter the specific location or attributes of the facility, the input values appear to be taken from Sample Problem A.").

95. Dr. O'Kula has a B.S. in Applied and Engineering Physics and a M.S. and Ph.D. in Nuclear Engineering. ENT000450 Entergy Test. at 4 (A7) (O'Kula); ENT000005 (Curriculum Vitae of Kevin R. O'Kula, Mar. 2012). He is an Advisory Engineer with URS Safety Management Solutions, LLC and testified that he has "over 20 years of experience using and applying the MACCS2 code and its predecessor, the MACCS computer code." ENT000450 Entergy Test. at 3 (A6), 4 (A7) (O'Kula). Dr. O'Kula has taught MACCS2 training courses for the Department of Energy ("DOE") and its contractors, and was the lead author of a DOE guidance document on the use of MACCS and MACCS2 for DOE safety analysis applications. ENT000450 Entergy Test. at 4 (A7) (O'Kula).

<sup>&</sup>lt;sup>11</sup> Ms. Potts' use of the term "1150" refers to NUREG-1150.

96. Mr. Teagarden is a Manager for Consequence Analysis for ERIN Engineering & Research, Inc. and testified that he has fourteen years of experience in the nuclear field. *Id.* at 6 (A11, A12) (Teagarden). He has a B.S. in Mechanical Engineering and training in the U.S. Navy nuclear program. *Id.* at 6 (A12) (Teagarden); ENT000007 (Curriculum Vitae of Grant Teagarden, Jan. 1, 2012). He testified that he has "substantial experience using the MACCS2 computer code and preparing Level 3 PRA models for commercial nuclear power plants in the United States." *Id.* at 6 (A12) (Teagarden). Although Mr. Teagarden testified that he has "performed or overseen the performance of MACCS2 modeling in support of SAMA analyses for ten nuclear power plant sites," (*id.* at 6 (A12) (Teagarden)), he clarified at the hearing, "I have not performed any SAMAs for Entergy" (Tr. 2061:13-14 (Teagarden)).

97. According to the December 2009 SAMA Reanalysis (ENT000464), the following employees worked on the reanalysis: K. Hong, M. Golshani, and C. Yeh. However, Entergy did not present them as witnesses at the evidentiary hearing. *See* Tr. 2528:19-2529:9 (Sipos/Potts).

98. There is no indication in the testimony or exhibits that any of Entergy's witnesses have ever attempted to develop site-specific cost inputs (other than population and farm/nonfarm wealth) to the CHRONC module of the MACCS2 code which calculates off site consequences associated with a severe accident. Instead, all the testimony indicates that Entergy's witnesses have only ever used Sample Problem A values, escalated using the Consumer Price Index. By contrast, Dr. Lemay and ISR have experience developing site-specific inputs and, in fact, analyzed how site-specific inputs should be developed for Indian Point. *See generally* NYS000242 ISR Report; NYS000241 Lemay Initial Test.; NYS000420 Lemay Rebuttal Test. Because Entergy's witnesses have never endeavored to develop site-specific inputs for the Indian Point SAMA analysis or for other reactor sites that have sought license renewals, they have a

knowledge and experience gap. Thus, their testimony on methodologies to develop site-specific inputs should be afforded little or no weight. *See Duke Energy Corp.* (Catawba Nuclear Station, Units 1 and 2), 60 N.R.C. 21, 29 (2004) ("Gaps in specific knowledge may go to the 'weight' of the expert testimony rather than to its admissibility.").

### C. NRC Staff's Witnesses

99. NRC Staff filed joint pre-filed expert testimony for contentions NYS-12C and NYS-16B, noting that "[t]he Staff's testimony and exhibits filed with respect to consolidated contention NYS-16B and NYS-12C are identical due to the substantial overlap of issues between the MELCOR Accident Consequence Code System 2 ('MACCS2') and Severe Accident Mitigation Alternatives ('SAMA') analysis." NRC000039 at 1, n.1.

100. NRC Staff presented four witnesses on NYS-12C and NYS-16B: (1) Mr. Donald G. Harrison; (2) Dr. S. Tina Ghosh; (3) Mr. Joseph A. Jones; and (4) Dr. Nathan E. Bixler. These witnesses provided pre-filed written testimony. All four witnesses testified in person at the evidentiary hearing on NYS-12C in Tarrytown, New York, on October 17 and 18, 2012. All except Mr. Harrison also testified in person at the evidentiary hearing on NYS-16B in Tarrytown, New York, on October 22, 2012.<sup>12</sup>

101. Mr. Harrison has a B.S. in nuclear engineering. NRC000045 (Curriculum Vitae of Donald G. Harrison, Mar. 2012). He testified that he has worked for the NRC for twelve years and is currently the Branch Chief in the Probabilistic Risk Assessment Licensing Branch at NRC. NRC000041 Staff Test. at 2 (A1d) (Harrison). In his role as Branch Chief he "supervises technical staff; facilitates resolution of policy, technical, and administrative issues; plans and

<sup>&</sup>lt;sup>12</sup> Tr. 2402:14-18 (Harris) ("As we discussed before the break last week, Mr. Harrison is not available now. But we're still prepared to go forward with New York-16.").

executes work activities; and communicates effectively with internal and external stakeholders." NRC000045 at 1. Dr. Harrison's branch has responsibility for reviewing the Indian Point license renewal SAMA review and corresponding portions of the FSEIS. NRC000041 Staff Test. at 2 (A1d), 4 (A2d), 5 (A3b) (Harrison).

102. Dr. Ghosh has a B.S.E. in civil engineering and operations research, an S.M. in technology and policy, and a Ph.D. in nuclear engineering. NRC000043 (Curriculum Vitae of S. Tina Ghosh, Mar. 2012). She testified that she has worked for the NRC for seven years and is currently a Senior Program Manager. NRC000041 Staff Test. at 1 (A1b) (Ghosh). She has experience reviewing SAMA analyses in support of nuclear power plant license renewal applications and writing the corresponding portions of the NRC's supplemental environmental impact statements. Staff Test. at 3 (A2b) (Ghosh). She was not, however, involved in NRC Staff's review of the SAMA analysis for Indian Point Unit 2 and Unit 3. *Id.* at 5 (A3b) (Ghosh). Her role with respect to Indian Point involved providing some input for the FSEIS in the form of responses to public comments on the postulated accidents and SAMA portions of the DSEIS. *Id.* 

103. Dr. Bixler has a B.S. and Ph.D. in chemical engineering. NRC000042 (Curriculum Vitae of Nathan E. Bixler, Mar. 2012). He has worked for Sandia for over 28 years as an engineer and computer software researcher in the areas of accident analysis and fluid mechanics, and currently serves in the lead role for development and application of the MACCS2 code for the NRC. NRC000041 Staff Test. at 1(A1a), 2 (A2a) (Bixler). He has also taught trainings on the use of the MACCS2 code system for estimating health and economic consequences. NRC000042 at 1.

104. Dr. Bixler was "was not directly involved in the Staff's review of the LRA." NRC000041 Staff Test. at 5 (A3a) (Bixler). His first involvement was in connection with

Contention 16/16A in 2009 when NRC Staff asked him to assess the State's August 2009 motion for summary disposition on the element of Contention 16/16A concerning Entergy's air dispersion model.<sup>13</sup> Dr. Bixler "discovered a potential error in the wind rose used in the MACCS2 portion of the analysis which resulted in an NRC staff request for additional information to Entergy" and, ultimately, resulted in Entergy performing a SAMA reanalysis in December 2009. Staff Test. at 5 (A3a) (Bixler); Tr. 2346:24-2347:17 (J. McDade/Jones/ Sipos/Harris) (Dr. Bixler discovered the error in the wind direction calculations during Sandia's review). With respect to NYS-12C, NRC Staff only involved Dr. Bixler in this proceeding to review Contention 12, and Staff relied upon his work in FSEIS, Appendix G. Staff Test. at 5 (A3a) (Bixler).

105. Mr. Jones has a B.S. in civil engineering and experience in the areas of "radiological emergency preparedness, consequence management, and radioactive materials cleanup activities." NRC000044 (Curriculum Vitae of Joseph A. Jones, Mar. 2012) at 1; NRC000041 Staff Test. at 1 (A1c) (Jones). He has worked for Sandia for twenty-three years. Staff Test. at 1 (A1c) (Jones). Like Dr. Bixler, although Mr. Jones "was not directly involved in the Staff's review of the LRA," he testified that "NRC staff relied on my review of contentions 12 and 16 in their evaluation of the issues related to those contentions in the FSEIS, Appendix G." Staff Test. at 5 (A3c) (Jones).

106. In his testimony, Mr. Jones explains that his expertise, as related to NYS-12C issues, is "in the area of radiological decontamination" including "cost estimating,

<sup>&</sup>lt;sup>13</sup> See NRC Staff's Unopposed Request for an Extension of Time to Respond to the State of New York's Motion for Partial Summary Disposition of NYS Contention 16/16A at 4 (Sept. 11, 2009) (ML092570780); see also Affidavit of Joseph A. Jones and Dr. Nathan E. Bixler Concerning the State of New York's Motion for Partial Summary Disposition of NYS Contention 16/16A (Oct. 12, 2009) (ML092870215).

decontamination techniques, and technologies for decontamination after a nuclear power plant accident." NRC000041 Staff Test. at 1 (A4c) (Jones). There is no evidence to suggest that Mr. Jones has experience running the MACCS2 code, developing MACCS2 inputs, or reviewing SAMA analyses. Hence, NRC Staff has not shown that Mr. Jones is qualified to testify on these topics. *See Pub. Serv. Elec. & Gas Co., Atlantic City Elec. Co.* (Hope Creek Generating Station, Units 1 And 2), 7 N.R.C. 642, 647 n.8 (1978) ("Mr. Caccia . . . has claimed no expertise in the area of flammable gas tanker traffic. We do not, therefore, accord the weight to his opinion that we do to the opinion of Commander Henn."); *Nimely v. City of New York*, 414 F.3d 381, 399, n.3 (2d Cir. 2005) ("But it is worth emphasizing that, because a witness qualifies as an expert with respect to certain matters or areas of knowledge, it by no means follows that he or she is qualified to express expert opinions as to other fields.").

107. Demonstrating his lack of MACCS2 knowledge and experience, at several points in the testimony, Mr. Jones referred to Dr. Bixler for additional explanation. *See* Tr. 1968:8-10 (Jones) ("T'll start with a whack at it, and then Dr. Bixler can probably join in because he's very familiar with these, as well."); Tr. 2123:21-22 (Instead of responding to Board's question, stating "I would like to let Dr. Bixler answer that more precisely."); Tr. 2143:16-17 (Jones) (In response to the Board's question about whether MACCS2 conserves mass, "Absolutely, and I would like Dr. Bixler to explain precisely how."). Also, Dr. Bixler had to correct inaccurate or incomplete testimony provided by Mr. Jones on technical aspects of the operation of the code. Tr. 1993:8-18 (Bixler) (correcting earlier, incomplete testimony by Mr. Jones at Tr. 1990:16-1991:8 (Jones) regarding how the MACCS2 model takes shielding into account).

108. Especially when compared to Dr. Lemay's qualifications and expertise, Mr. Jones' testimony should be rejected or afforded little weight. *See Duke Energy Corp.*, 60 N.R.C.

at 29 (2004) ("Gaps in specific knowledge may go to the 'weight' of the expert testimony rather than to its admissibility."); *Pub. Serv. Elec. & Gas Co., Atlantic City Elec. Co.* (Hope Creek Generating Station, Units 1 And 2), 7 N.R.C. 642, 647 n.8 (1978) ("Mr. Caccia . . . has claimed no expertise in the area of flammable gas tanker traffic. We do not, therefore, accord the weight to his opinion that we do to the opinion of Commander Henn.").

### V. OVERVIEW

## A. The SAMA Analysis: A Site-Specific Analysis of Mitigation Alternatives

109. The NRC defines an accident as "any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment." NRC000002/NYS00131C (NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants Vol. 1, "GEIS," May 1996) at p. 5-1.<sup>14</sup> Accidents are categorized as either "design basis" or "severe." *Id.* A design basis accident is one "the plant is designed specifically to accommodate." *Id.* A severe accident is one "involving multiple failures of equipment or function and therefore, whose likelihood is generally lower than design-basis accidents but whose consequences are much higher." *Id. See also* NYS000241 Lemay Initial Test. at 10; Tr. 1903:21-1904:8 (Teagarden).

110. Entergy used a SAMA analysis to evaluate alternatives to mitigate a severe accident at Indian Point. NYS000241 Lemay Initial Test. at 10. The purpose of a SAMA analysis is to identify those mitigation measures that are cost-beneficial, *i.e.*, those mitigation measures whose cost of implementation is less than their benefit, which is the reduction in severe accident costs achieved by mitigation. NYS000287 at 1; *see also* Tr. 1900:9-23 (Teagarden). As

<sup>&</sup>lt;sup>14</sup> The 1996 GEIS (NRC00002) was submitted by the State as NYS00131A-NYS00131I. NRC000002 is a one page document incorporating NYS00131A-NYS00131I.

will be explained in more detail below (V.B.6), to perform the SAMA analysis, the costs associated with a severe accident are quantified into dollars per year using the MACCS2 code.

111. The alternative mitigation measures evaluated in a SAMA analysis are called SAMA candidates. NYS000241 Lemay Initial Test. at 10. SAMA candidates typically either reduce the frequency, or likelihood, that a severe accident would occur, reduce the consequences associated with a severe accident, or both. Id; see also Tr. 1910:18-23 (Teagarden); Tr. 1915:8-15 (J. Kennedy/Teagarden); 1915:17-1916:23 (J. Kennedy/O'Kula).<sup>15</sup> SAMA candidates could include plant modifications (e.g., the use of additional engineering safety features) or operational changes (e.g., improved procedures and augmented training of control room and plant personnel). Lemay Initial Test. at 10. While many SAMA candidates reduce the frequency of particular types of accidents, Entergy "did have SAMA candidates that do not just impact the frequency. We did have a few that changed the release profile." Tr. 1932:21-23 (Potts).<sup>16</sup> Mr. Teagarden described a "water curtain that runs down the outside of [the] containment dome" as a theoretical example of a candidate that could reduce the consequences of an accident. Tr. 1914:13-18 (Teagarden). Such a "SAMA candidate would potentially impact . . . the radiological release" and, thus, potentially mitigate the consequences of an accident. Tr. 1914:21-1915:1 (Teagarden).<sup>17</sup>

112. The SAMA analysis is a four-step process. ENT000011 (NUREG-1850,

Frequently Asked Questions on License Renewal of Nuclear Power Reactors (Mar. 2006)) at 4-

<sup>&</sup>lt;sup>15</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 19.

<sup>&</sup>lt;sup>16</sup> Ms. Potts was correcting Mr. Teagarden's testimony that "[f]or the Entergy analysis I don't believe any of the SAMA candidates required that they had a separate run of the MACCS2 code." Tr. 1931:22-25 (Teagarden).

<sup>&</sup>lt;sup>17</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 19.

33, Fig. 4.1. The MACCS2 code is used in the Level 3 PRA to calculate the costs associated

with a severe accident, which is the focus of NYS-12C. NYS000420 Lemay Rebuttal Test. at 8-

9; Tr. 1913:15-21 (J. Wardwell/Teagarden); Tr. 1919:16-21 (J. Wardwell/Lemay).

- <u>Step 1:</u> Use a "a plant-specific PSA study" that identifies "system failures and human errors" that could cause a severe accident to "characterize overall plant risk and the leading contributors to the risk." ENT000011 at 4-32. There are three PRA levels:
  - <u>PRA Level 1:</u> The evaluation of the combinations of plant failures, like equipment failures and human failures, that can lead to core damage.
  - <u>PRA Level 2</u>: For each core-damage sequence identified in Level 1, the evaluation of core damage progression and possible containment failure resulting in a radiological release. These are called release categories, which are discussed in more detail in V.B.6, below.
  - <u>PRA Level 3:</u> The evaluation of the consequences that would result from the set of radiological releases identified in Level 2, which include offsite population dose, offsite economic cost, onsite population does, and onsite cost.

*See* NYS000420 Lemay Rebuttal Test. at 8-9; Tr. 1901:12-1902:19, 1907:19-25, 1908:8-21 (J. Wardwell/Teagarden).

- <u>Step 2:</u> Create a list of potential SAMA candidates by looking at "[i]mprovements identified in other NRC and industry studies, as well as SAMAs analysis for other plants." ENT000011 at 4-32; *see also* Tr. 222123-2222:4 (Potts).
  - Remove candidates that are not applicable to the plant design, have already implemented, are similar to or have been combined with another candidate, or do not have a significant safety benefit. ENT000011 at 4-33, Fig. 4.1.
- <u>Step 3:</u> "quantify the risk-reduction potential and the implementation cost" for each SAMA candidate. *Id.* at 4-33.
  - Calculate the maximum attainable benefit using the MACCS2 code, which is the dollar value of the benefit if the risk could be reduced to zero. *Id.*
  - Remove from further consideration SAMA candidates whose implementation costs are greater than the maximum attainable benefit. *Id.*
  - o Estimate, in detail, costs and benefits for the remaining candidates. *Id.*

• <u>Step 4:</u> "determine whether implementation of any of the improvements is justified" by evaluating the SAMA candidates for, among other things, "whether the improvement is cost-beneficial, in other words, whether the estimated benefit is greater than the estimate of the implementation cost of the SAMAs." *Id;* Tr. 1919:8-14 (J. Kennedy/Teagarden).

113. One goal of the SAMA analysis is to provide sufficient information about mitigation alternatives for NRC Staff to adequately analyze mitigation alternatives under NEPA and determine whether to require particular accident mitigation alternatives. *See Entergy Nuclear Operations* (Indian Point Nuclear Generating Units 2 and 3), LBP-11-17, 74 N.R.C. at 27 ("under NRC Regulations, the 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 result 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.").

114. In addition, the SAMA analysis is also useful and important for the applicant. As Ms. Potts explained, "Entergy would take these items, these proposed, potentially cost beneficial SAMAs, and they would put them into the process that they have in place that may also have suggestions made by system engineers, plant engineers, for ways to make improvements that would provide benefit to the plant or to safety to the public." Tr. 1923:18-24 (Potts). Ms. Potts further explained that Entergy would then "make a decision on the aggregate of those changes as to which ones that they would want to make." Tr. 1923:24-25 (Potts).

115. Increases in costs associated with a severe accident affect the SAMA analysis in important ways. As the costs associated with a severe accident increase, additional SAMA candidates may be identified as cost-beneficial. Additionally, as the costs associated with a

severe accident increase, the already cost-beneficial candidates actually become more costbeneficial. Tr. 2333:9-24 (Liberatore/Ghosh). Ms. Potts testified that, as the SAMA candidates become more cost-beneficial, the probability that Entergy will implement them increases. Tr. 2335:9-19 (J. McDade/Liberatore/Potts).

# **B.** The MACCS2 Code: A Code Designed to Calculate the Costs Associated With a Severe Accident Based on Site-Specific Inputs

## 1. <u>Development of the MACCS2 Code</u>

116. NRC and Entergy use a computer modeling tool, known as the MACCS2 model, to determine the cost of a plant's severe accident risk. Tr. 1913:7-8 (Teagarden). Most, if not all, LRAs to date have used MACCS2 in the SAMA analysis. Tr. 1913:7-8 (Teagarden). The State is not challenging Entergy and NRC Staff's use of the MACCS2 code for the Indian Point SAMA analysis. *See* NYS000420 Lemay Rebuttal Test. at 6 ("ISR has not commented on the use of the MACCS2 code itself or any limitations of the MACCS2 code."); Tr. 2175:10-16 (Lemay).<sup>18</sup>

117. Released in 1997, the MACCS2 code is a computer modeling tool developed by
Sandia to evaluate impacts of severe accidents at nuclear power plants on the surrounding public.
NYS000242 ISR Report at 4; NYS000241 Lemay Initial Test. at 12. It can be run on a laptop.
Tr. 2272:13-15 (J. Wardwell/Teagarden).

118. The MACCS2 code simulates the atmospheric release of radioactivity following a severe accident based on meteorological inputs, and calculates radiological health and economic impacts based on user-defined inputs for various parameters. NYS000242 ISR Report at 4;

<sup>&</sup>lt;sup>18</sup> The State notes that NRC has not promulgated a regulation pursuant to the APA rulemaking procedures that mandates the use of the MACCS2 code. *See* Tr. 2339:4-2340:10 (J. McDade/Liberatore/Harrison/Ghosh).

NYS000241 Lemay Initial Test. at 12. The MACCS2 code can model, among other things, economic costs of an accident. *Id*.

119. The latest of a series of computer modeling tools developed for this purpose, the MACCS2 code is an improved version of the MACCS code, which itself replaced the earlier CRAC2 code. NYS000242 ISR Report at 4; NYS000241 Lemay Initial Test. at 12-13. MACCS and MACCS2 incorporate many advancements in modeling flexibility in comparison to earlier codes such as CRAC2. *Id.* Although the underlying models of the two codes are largely similar, the main difference between them is that a number of parameters are "hard-wired" and, thus, cannot be changed in the CRAC2 code, while in MACCS and MACCS2 those same parameters are user-defined and, thus, can be derived from site-specific data. *Id;* Tr. 2271:2-6 (Bixler) ("Some of the older code versions, going back to CRAC particularly, didn't even allow a lot of the user inputs that are now available to the user as inputs. They were just hard-wired in the code.").

# 2. <u>The MACCS and MACCS2 User Guides As Well As Industry Guidance</u> <u>NEI-05-01 Underscore the Importance of Using Site-Specific Input Values</u>

120. The MACCS and MACCS2 User Guides make clear that the user is responsible for selecting appropriate input values. NYS000243 (NUREG/CR-6613, SAND97-0594, Vol. 1, Code Manual for MACCS2: User's Guide (May 1998) ("MACCS2 User Guide")) at p. 1-7; NYS000288 (NUREG/CR-4691, SAND86-1562, Vol. 2, MACCS, Feb. 1990) at xii. In the forward to the MACCS User Guide, NRC noted that "code flexibility, so that virtually all model parameters can now be provided by the user via input" was a major new and useful feature of MACCS. NYS000288 at xii. The User Guide warned, "[h]owever, that the user now has to prepare much more data, involving multiple disciplines, for input. . . . [which] introduces the

potential of an inexperienced user to produce distorted results because of improper or

inconsistent data." Id.

121. NEI 05-01, Rev. A (NYS000287),<sup>19</sup> which provides guidance to applicants on how to perform a SAMA analysis, emphasizes that the MACCS2 user should define site-specific inputs for many of the MACCS2 parameters. In taking the Board through NEI-05-01 (NYS000287 at 13-14) at the hearing, Dr. Lemay pointed out:

Section 3.4 discusses the level three PSA model and specifically MACCS2. And it describes some of the sections... that you need to make site-specific. For example, the population distribution [is] correctly described by ... site-specific ... data. And then below that at 3.4.2 there is economic data and a description of the kind of economic estimates that need to be site-specific, the cost of evacuation, the cost of temporary relocation, the cost of decontamination of buildings. And then if we move to the next page we discuss the lost return of investment, the cost of repairing, interdicted property, the value of crops, the value of farmland. Section 3.4.3 describes the radionuclide releases that should be plant-specific.

Tr. 1946:4-19 (Lemay).<sup>20</sup>

122. Without referring to any guidance documents or other exhibits, Dr. Bixler and Dr. O'Kula provided examples of a limited number of inputs that would be applicable to all plants and could therefore be described as generic or default values. Tr. 1941:8-17 (Bixler) (discussing atmospheric dispersion); Tr. 1943:23-25 (Bixler) (discussing wet deposition); Tr. 1944:11-1945:4 (O'Kula) (describing the breathing rate of downwind populations and dose conversion factors). When the Board provided Dr. Lemay with an opportunity to comment, he explained in an exchange with Judge Wardwell that NEI-05-01 also discusses default values for certain input parameters:

<sup>&</sup>lt;sup>19</sup> This document was prepared by the nuclear industry and endorsed by NRC. *See* ENT000451 (72 Fed. Reg. 45,466 (Aug. 14, 2007)).

<sup>&</sup>lt;sup>20</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 19.

DR. LEMAY: [A]t the end at the bottom of the page [NYS000287 at 14] they say that MACCS default values are acceptable for other parameter inputs such as inhalation, skin protection factors, acute and chronic exposure effects and long-term protective data. And I think this is consistent with what your experts have mentioned.

JUDGE WARDWELL: Yes, that's excellent. And I like the phrase "default value" as opposed to generic. I think that's a good characterization of it.

Tr. 1946:20-1947:5 (J. Wardwell/Lemay).

# 3. <u>The MACCS2 Code's 50-Mile Grid</u>

123. The MACCS2 code utilizes a polar-coordinate spatial grid for all of its

calculations. NYS000243 MACCS2 User Guide at p. 3-2. As shown below, Indian Point Units

2 and 3 are at the center of the grid and the surrounding 50 mile radius is divided into divided

into sections, often referred to as grid elements. ENT000450 Entergy Test. at 31-32 (A46)

(O'Kula, Teagarden, Potts); Tr. 1929:10-24 (Teagarden). At the hearing, Entergy agreed that for

the area surrounding Indian Point, the wind blows predominantly from the north to the south. Tr.

2294:1-20 (J. Wardwell/Lemay/O'Kula).



**Region within 50 miles of Indian Point<sup>21</sup>** 

<sup>&</sup>lt;sup>21</sup> Source: NYS000209 (Expert Report of Dr. Stephen C. Sheppard, Dec. 16. 2011).



# MACCS2 Polar Coordinate Grid, Centered Around Analyzed Facility<sup>22</sup>

124. Although Entergy's "figure doesn't show it," Entergy pointed out at the hearing that "within the 10 mile ring we actually have 10 additional rings for a final resolution in close to the plant." Tr. 1933:2-4 (Potts).

125. For each grid element, the user inputs the population, the fraction of each grid element that is land (as opposed to lakes, oceans, etc.), and whether that land is farmland or not. Tr. 1931:13-16 (Teagarden) ("Each grid element would have a population value associated with it that would be different than the grid element next door to it"); Tr. 2259:12-15 (Lemay) (for "the grid elements, we have very little information. There is not much we can say. We can say if it's land, if it's farm or if it's something else, or water. So that's the extent of the land use.);<sup>23</sup> *see also* NYS000243 MACCS2 User Guide at A-12 to A-13; Tr. 1959:8-10 (Teagarden) ("for

<sup>&</sup>lt;sup>22</sup> Source: ENT000450 Entergy Test. at 32, Fig. 3 (based on NYS000243 MACCS2 User Guide at p. 2-5, Fig. 2-1).

<sup>&</sup>lt;sup>23</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 26.

each of those grid elements there is a proportion that would be listed as farmland versus non-farmland."); Tr. 2301:14-18 (J. McDade/Teagarden). Thus, the MACCS2 input files do not account for other land characteristics such as building density, the type of building (commercial, residential), or land use (parks, paved areas).<sup>24</sup>

## 4. <u>The CHRONC Module of the MACCS2 Code</u>

126. The MACCS2 model is executed in three steps: (1) ATMOS calculates air and ground concentrations, plume size, and timing information for all plume segments as a function of downwind distance; (2) EARLY calculates the consequences due to exposure to radiation in the first seven days, which is the emergency phase of the accident; and (3) CHRONC calculates the consequence of the long-term effects of radiation and computes the decontamination and economic impacts incurred due to the accident. NYS000242 ISR Report at 4; NYS000241 Lemay Initial Test. at 13-14.

127. The MACCS2 code determines the economic cost of a severe accident primarily on the basis of the CHRONC input parameters, which is the focus of NYS-12C. NYS000242 ISR Report at 4; NYS000241 Lemay Initial Test. at 13-14. Thus, all of the inputs Entergy used in its SAMA analysis that are associated with decontamination and long-term economic costs are found in the CHRONC module of the code. *Id.* The following costs are calculated by the MACCS2 code:

- Food and lodging costs for short-term relocation of people who are evacuated or relocated during the emergency phase of the accident;
- Decontamination costs for property that can be returned to use if decontaminated;

<sup>&</sup>lt;sup>24</sup> In contrast, a code like DECON, discussed in VIII. below, explicitly takes into account these characteristics when calculating the cost of decontamination.

- Economic losses incurred while property, both farm and nonfarm, is temporarily interdicted by a period of time following decontamination to allow for radioactive decay to reduce ground contamination to acceptable levels;
- Economic losses resulting from milk and crop disposal; and
- Economic losses due to condemnation of property.

NYS000242 ISR Report at 5; NYS000241 Lemay Initial Test. at 15-16.

128. CHRONC employs a mitigative actions module to determine what mitigative actions need to be used in the event for a severe accident. NYS000242 ISR Report at 5; NYS000241 Lemay Initial Test. at 16-17. Mitigative actions are measures taken to reduce the radiation dose to the population after the emergency phase of an accident and hinge on the habitability criterion. ISR Report at 5; Lemay Initial Test. at 16-17. The habitability criterion is the maximum long-term dose that a person would receive if he or she continued to live in the contaminated area. ISR Report at ix; Lemay Initial Test. at 17-18.<sup>25</sup> There are three possible outcomes to habitability decision-making: "(1) land is immediately habitable, (2) land will be habitable after decontamination, and (3) land will be habitable after a combination of decontamination and interdiction." NYS000243 MACCS2 User Guide at p. 7-3.

129. The mitigative actions the MACCS2 module employs are based upon decontamination levels and their corresponding dose reduction factors and costs, which are discussed in more detail in X.C., below. NYS000242 ISR Report at viii; NYS000243 MACCS2 User Guide at pp. 7-9 to 7-10. Up to three levels of decontamination can be defined, but applicants typically use two: one for light decontamination and one for heavy decontamination. NYS000243 MACCS2 User Guide at p. 7-9; Tr. 1982:16-18 (Teagarden).

<sup>&</sup>lt;sup>25</sup> The habitability criterion recommended by the U.S. Environmental Protection Agency is 0.04 Sieverts in 5 years. *See* NYS00245A-B (Office of Radiation Programs, U.S. Environmental Prptection Agency, Manual of Protective Action Guides, May 1992).

130. With two decontamination levels, light and heavy, the MACCS2 model employs five mitigative actions:

- No mitigative action;
- Decontaminate areas using light decontamination;
- Decontaminate areas using heavy decontamination;
- Decontaminate areas using heavy decontamination and implement temporary interdiction for up to 30 years; or
- Condemn the area (if the cost of decontamination and interdiction is greater than the cost of condemning).

NYS000242 ISR Report at 5; NYS000241 Lemay Initial Test. at 18-19.

131. The code relies upon meteorological data input by the user to model the movement of the plume in the event of different severe accident scenarios. Tr. 1935:16-1936:3 (O'Kula). As the plume moves, some grid elements may not be affected by deposition of radioactive material, and for that reason the mitigative actions model will stop at the first step and no mitigative actions will need to be employed. *Id.* For grid elements that do experience deposition of radioactive material, the code will go through the mitigiative actions model described above to determine which, if any, mitigative action(s) to employ. *See* Tr. 1986:6-14 (Teagarden) ("if you imagine a plume, a kind of almost a cigar shape or a little cone coming out from the site kind of overlaid on the polar grid that we had earlier, at the edges of the cone there would be areas where no decontamination is needed. A little bit within the cone there would be areas where decontamination might be needed, dose reduction to a factor of 3, and conceivably some to a dose reduction factor of 15 would need to be applied.").<sup>26</sup>

<sup>&</sup>lt;sup>26</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 20.

## 5. Costs Not Taken Into Account by the MACCS2 Code

132. The economic cost model of the MACCS2 code is intended to estimate the direct offsite costs from a severe nuclear accident. If other indirect costs were included such as medical expenses, adverse health effects, permanent income loss, costs of disposal of contaminated wastes, and economic impact of losing a resource—including the loss of drinking water and replacement for reservoirs during interdiction, the total economic cost would increase. *See, e.g.*, Tr. 2278:7-8 (Bixler) (MACCS2 code "does not consider the migration through the ground water."); Tr. 2284:6-10 (Bixler) (MACCS2 code "does not account any economic value to the loss of the water. I think what would probably happen in reality is that people would buy bottled water in that area, and consume that. . . . [but it] is not factored in."); Tr. 2285:5-8 (Ghosh) ("[A]re we accounting for the economic impact of losing some resource? I just want to comment on that. Certainly, MACCS does not do that."); Tr. 1975:9-20 (J. McDade/Bixler) (While an input parameter called per capita cost of long-term relocation (POPCST) does address unemployment for 20 weeks under Sample Problem A, it does not address permanent salary loss.).

## 6. <u>Release Categories and MACCS2 Outputs</u>

133. The applicant selects eight different categories of severe accidents to model, called release categories. NYS000420 Lemay Rebuttal Test. at 11; Tr. 1905:2-6 (Teagarden) ("We have eight bins, so to speak, release categories postulated as part of the SAMA analysis for Indian Point of different types of releases that could occur to the environment."); Tr. 1907:7-9 (Teagarden) (the SAMA analysis must examine both "[t]he high consequence events with very low probability, [and] the low consequence events that had a higher probability or frequency

associated with those."). Each release category has a frequency<sup>27</sup> associated with it. Lemay Rebuttal Test. at 11. The release categories represent a range of severe accidents, from lower consequence/higher frequency accidents to higher consequence/lower frequency accidents. *Id.* 

134. The MACCS2 code outputs offsite economic cost consequence values and offsite population dose values for each release category. *See* NYS000420 Lemay Rebuttal Test. at 11, 33. The applicant then adds the offsite economic cost and offsite population dose for each of the eight release categories, after weighting them by their respective frequencies, to determine the off-site economic cost risk ("OECR") and the population dose risk ("PDR"). *Id*; ENT000464 at 11; ENT000450 Entergy Test. at 45 (A59) (O'Kula, Teagarden, Potts); Tr. 2191:20-22 (Teagarden) ("MACCS does not actually multiple the frequency, you do that yourself at the end."). Together, the PDR and OECR represent the frequency-averaged offsite costs associated with a severe accident at Indian Point in dollars per year without implementing any SAMA candidates.<sup>28</sup> ENT000464 at 11; Tr. 1913:9-13 (Teagarden).

<sup>&</sup>lt;sup>27</sup> The frequency of a release category represents the likelihood that the release category is postulated to occur within one year. Essentially, frequency is a probability expressed on a per year basis.

<sup>&</sup>lt;sup>28</sup> The OECR is in units of dollars/year and the PDR is in units of person-rem/year. The PDR is converted to dollars by multiplying it by \$2000/person-rem. NYS000041 Staff Test. at 35 (A31) (Bixler).

# VI. ENTERGY FAILED TO DEVELOP SITE-SPECIFIC MACCS2 CHRONC INPUTS

# A. Entergy Used Example Inputs Instead of Developing Site-Specific Inputs for Indian Point

1. <u>Developing Site-Specific Inputs to the MACCS2 Code Is Particularly</u> <u>Important for Indian Point</u>

135. Developing site-specific inputs to the CHRONC module of the MACCS2 code is

of the utmost importance since these inputs are used in calculating the economic cost outputs.

As Dr. Lemay testified,

Inputs to the MACCS2 code are dependent on the location 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.

NYS000241 Lemay Initial Test. at 19-20.

136. The area surrounding Indian Point has the greatest population density of any 50-

mile Emergency Planning Zone for any reactor site in the United States.<sup>29</sup> Consolidated Edison,

21 N.R.C. at 1049-50. In fact, because the 50-mile radius includes the New York City

Metropolitan area, some portions of the 50-mile radius differ markedly even from typical urban

areas, which consist of mixed commercial and residential suburbs surrounding a downtown core.

NYS000241 Lemay Initial Test. at 20.

137. In addition to a very high population density, parts of the 50-mile radius have uniquely high building density, mostly consisting of high-rise buildings. NYS000241 Lemay Initial Test. at 20.

<sup>&</sup>lt;sup>29</sup> As the State explains in NYS-16B, Entergy has also underestimated the population surrounding Indian Point, and NRC Staff accepted its unreasonable estimate in the FSEIS.

138. Judge Kennedy stated, "I'm almost concerned that somewhere between the 25 story or 100 story high rise and the one or two story building with a complexity of decontamination that I don't know how that's accounted for." Tr. 2128:2-6 (J. Kennedy). In response, Dr. Bixler explained that site-specific decontamination cost parameters could take such attributes into account. Tr. 2128:15-17 (Bixler) ("I think the way that you would account for it in terms of applying the code is simply the way the number that come up with for the decontamination cost.").

139. Entergy and NRC Staff's response to Judge Kennedy's statement is that because the decontamination cost parameter (CDNFRM) is entered in units of dollars per person, the only necessary site-specific input is population. *See* Tr. 2166:18-20 (Teagarden) ("[T]he cost for the non-farm decontamination is site-specific as we apply the population density."). As Dr. Lemay explains, however, the idea that decontamination costs increase linearly with population does not hold true for the area surrounding Indian Point:

I think that whoever came up with the decontamination cost per person it's a brilliant insight because you think okay. One house costs so much. It has 2.7 people in it. If I have 30 houses, I have 2.7 times 30 people. And so if you start with a site with individual dwellings and you just increase the density of these individual dwellings, I think that what MACCS is doing is exactly right. But where you start to question the approach is when you start to get into big buildings, high rise and the kind of city we have in New York and then you say, "Hm. You can't just keep extrapolating that line to that building."

Tr. 2136:2-15 (Lemay).

140. In sum, the unique attributes of the 50-mile radius underscore the necessity of developing site-specific CHRONC inputs using available data.

## 2. <u>Entergy Relied Upon Sample Problem A Values for Inputs to the</u> <u>CHRONC Module of the MACCS2 Code</u>

141. Dr. Bixler, Sandia expert witness for NRC Staff, explained that Entergy should use "the best value that you think you have for that particular parameter." Tr. 1937:11-12 (Bixler). Entergy and the State agree with a "best estimate" approach to developing MACCS2 input values. Tr. 1937:2-3 (Teagarden), Tr. 1937:18-19 (Lemay).

142. Despite the agreement on using a "best estimate" approach, for all but three of its MACCS2 inputs related to decontamination, Entergy—with NRC Staff's approval—relied upon example inputs from Sample Problem A found in the MACCS2 User Guide. NYS00133I at G-23; NYS000242 ISR Report at 7-8; NYS000241 Lemay Initial Test. at 21. The value of nonfarm wealth along with the value of farm wealth and the long-term exposure period were the only CHRONC input parameter values Entergy did not derive from Sample Problem A.<sup>30</sup> *Id.* The only adjustment Entergy made to the Sample Problem A inputs was to accelerate the values from their 1986-based dollars to the 2005-based dollars of the Entergy's SAMA analysis using the Consumer Price Index. NYS000242 ISR Report at 12-13; NYS000241 Lemay Initial Test. at 23.

143. Sample Problem A is one of fourteen sample problems containing example sets of inputs included in the MACCS2 User Guide. NYS000242 ISR Report at 7-8; NYS000241 Lemay Initial Test. at 21-23. The User Guide's sample problems were never intended to be used as default values; rather, they were provided so that a user could test whether the MACCS2 code was installed and running properly. *Id;* Tr. 2059:23-2060:7 (Teagarden).

144. David Chanin, a developer of the MACCS2 code, explained how he and the other developers purposely avoided providing default values: "We went so far as to scrupulously avoid

<sup>&</sup>lt;sup>30</sup> The value of nonfarm wealth input parameter is discussed in more detail below in X.F.

using the common 'default value' in referring to the code's [provided Sample Problem] input data. 'Sample data' and 'example usage' were the terms used to remind the analyst that they, and they alone, were responsible for reviewing MACCS and MACCS2 input data and resultant code outputs to ensure appropriateness for their application." NYS000247 at 3.<sup>31</sup> Likewise, NEI-05-01 provides only "[s]ample MACCS2 economic data." NYS000287 at 14.

145. The Sample Problem A values were developed in connection with NUREG-1150 (NYS00252A-NYS00252D). NYS000243 MACCS2 User Guide at p. 2-11; *see also* NYS000242 ISR Report at 7; NYS000241 Lemay Initial Test. at 21-22. The NUREG-1150 studies predated the 1996 promulgation of 10 C.F.R. § 51.53(c)(3)(ii)(L) that required applicants to complete a SAMA analysis. The NUREG-1150 authors chose five commercial nuclear plants of different designs to estimate the risks of a severe accident. NYSS00252A-NYS00252D. One of these, the Surry reactor, is located in rural Virginia. NYS000241 Lemay Initial Test. at 22. The Surry site in Virginia is largely surrounded by farmland and, thus, differs dramatically from Indian Point. *Id.* 

146. Although Ms. Potts testified, "I'm confident that the analysts that did it looked at the reasonableness of them" when discussing Entergy's evaluation of the appropriateness of the NUREG-1150 for Indian Point, she went on to admit, "I don't believe I can point to it written down in a review that they did." Tr. 2067:25-2068:3 (Potts).<sup>32</sup> Ms. Potts further explained, "The analysts and reviewers like myself looked to see if it passes the smell test, if you will, you know, some values that Mr. Teagarden quoted earlier about how much it would cost to decontaminate a

<sup>&</sup>lt;sup>31</sup> D. Chanin, *The Development of MACCS2: Lessons Learned*, Energy Facilities Contractor Operating Group Safety Analysis Working Group, Annual Workshop, Apr. 29-May 5, 2005, Santa Fe, NM, 2005.

<sup>&</sup>lt;sup>32</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 21.

household of four, or a house apartment of 200." Tr. 2068:9-24 (Potts). Ms. Potts concluded that "But as far as having it written down that we did that, I don't believe it's written anywhere. It's just understood that you do that." Tr. 2068:25-2069:3.

147. After Ms. Potts testimony explaining that there was not a written review, counsel for Entergy offered, "She may have Entergy Exhibit 460 in mind, which is an RAI response. I would refer the Board and the parties to page 37 of 59." Tr. 2070:23-25 (O'Neil). Although Ms. Potts revised her testimony to state that "[t]his discussion is reiterating a lot of what we said earlier today, that the key input data from NUREG-1150 was judged by us to be applicable to the Indian Point SAMA analysis" (Tr. 2080:15-19 (Potts)), this document contains nothing more than conclusory, circular sentences relying on the pedigree of NUREG-1150.<sup>33</sup> *See* ENT000460 at 37 ("development of the indicated offsite economic cost risks was in accordance with applicable NRC guidance. These economic cost parameters were developed based on assumptions of cost related to averages developed from the regions studied by the NRC and its contractors. However, these costs are reasonable for the Indian Point region because the initial development included heavily populated regions."). As discussed in VII. below, Entergy's argument that the pedigree of NUREG-1150 justifies the use of Sample Problem A values fails.

148. Moreover, Entergy did not present K. Hong, M. Golshani, and C. Yeh, the individuals who performed the MACCS2 SAMA analysis. *See* Tr. 2528:19-2529:9 (Sipos/Potts).

<sup>&</sup>lt;sup>33</sup> Ms. Potts later confirmed that ENT000460 is the only written record of the review. Tr. 2326:13-21 (Potts/Liberatore); Tr. 2327:2-20 (Potts/Liberatore).

# B. NRC Staff Accepted Entergy's Failure to Develop Site-Specific Inputs in the FSEIS

149. In the FSEIS, NRC Staff accepted Entergy's use of Sample Problem A example

inputs instead of requiring Entergy to develop site-specific inputs:

In the MACCS2 input files, Entergy used decontamination cost parameters that were typically higher than the MACCS2 Sample Problem A values by a factor of 1.7. (Sample Problem A values were primarily developed for the Surry plant analysis in NUREG-1150 and represent best estimate information for that site and time.) As described in the ER, the values were obtained by adjusting the generic Sample Problem A economic data with the consumer price index of 195.3, which accounts for inflation between 1986 and 2005. Farm and nonfarm values for Indian Point were based on site-specific data and were not extrapolated from Sample Problem A.

NYS00133I at G-23. The factor of 1.7 was solely attributable to Entergy's escalation of the

dollar values of the Sample Problem A inputs using the Consumer Price Index. Tr. 1962:20-22,

1963:23-1964:3 (J. Wardwell/Teagarden).

150. NRC Staff acknowledged in the FSEIS that the Sample Problem A values,

sourced from NUREG-1150, incorporate site-specific data for the Surry site in Virginia.

NYS00133I at G-23 ("Sample Problem A values were primarily developed for the Surry plant

analysis in NUREG-1150 and represent best estimate information for that site and time.").

151. Nonetheless, NRC Staff found Entergy's decontamination cost calculations and

estimates to be reasonable, acceptable, and consistent with those performed for other nuclear power plants. NYS00133I at G-24.

152. During this proceeding NRC Staff tried to argue the uncertainty factor used in other parts of the PRA somehow accounts for issues with Entergy's MACCS2 inputs. *See, e.g.*, NRC000041 Staff Test. at A6b (Ghosh).<sup>34</sup> Aside from the fact that this argument was not discussed in the FSEIS, it is incorrect because, as Dr. Lemay explains, "[t]he uncertainty factor

<sup>&</sup>lt;sup>34</sup> Additional examples of testimony of this topic are set forth in XII.C. below.

of eight accounts for external events such as seismic events and the uncertainty in the Level 1 and Level 2 [PRA]." Tr. 2324:13-16 (Lemay), 2324:17-20 (Liberatore/Lemay). There is no evidence to suggest it can account for other uncertainties as well.

# VII. NUREG-1150 LACKS "PEDIGREE" AND DOES NOT JUSTIFY THE USE OF SAMPLE PROBLEM A

153. Entergy argues that using Sample Problem A was reasonable because its values are taken from NUREG-1150 and, thus, have "have a long-established and appropriate technical basis, are widely accepted within the PRA community, and continue to be used today in PRAs and SAMA analyses." ENT000449 Entergy SOP at 29. *See also* Entergy SOP at 5; ENT000450 Entergy Test. at 12-16 (A26), 21-22 (A35), 55-58 (A72), 59-60 (A76), 61-62 (A78), 129 (A160) (O'Kula, Teagardem, Potts); Tr. 2018:19-2019:25 (J. Wardwell/Teagarden); Tr. 2054:2 (Teagarden).

154. The testimony submitted by NRC Staff makes a similar claim. *See* NRC000041 Staff Test. at 44-46 (A39) (Jones, Bixler) ("NUREG-1150 . . . was subjected to an extensive peer review and public comment.")' Tr. 2158:13-17 (Harrison) ("the Applicant mentioned NUREG-1150 as being -- I believe it was referred to as a seminal study at that time. The staff looks at it as even more than that and even more than just providing the best available information.").

155. As will be described in more detail below, the ultimate source of NUREG-1150's cost values does not exist and NUREG-1150's assumptions upon which its time values are based lack a rational basis. NYS000420 Lemay Rebuttal Test. at 16-25.

# A. Sample Problem A's Decontamination Cost Values Are Based Upon a Document That Does Not Appear to Have Been Published, Let Alone Subject to Peer Review

156. Nonfarm Decontamination Cost ("CDNFRM") is a MACCS2 input that defines the cost of decontaminating land that is not farmland. NYS000242 ISR Report at 13;

NYS000241 Lemay Initial Test. at 30. MACCS2 requires the user to input a CDNFRM value in dollars per person for each dose reduction factor specified by the user. NYS000242 ISR Report at 13; NYS000241 Lemay Initial Test. at 30.

157. Entergy used values of \$5,184/person for a dose reduction factor of 3 and \$13,824/person for a dose reduction factor of 15. NYS000242 ISR Report at 11; NYS000241 Lemay Initial Test. at 30. Entergy obtained these values by adjusting Sample Problem A values from NUREG-1150 of \$3,000/person and \$8,000/person by the Consumer Price Index change from 1986 to 2005.

158. NUREG-1150 contains a gaping hole—the source of the decontamination cost parameters in NUREG-1150, and thus the source of the decontamination cost parameters used in Sample Problem A, simply does not exist. Tr. 2015:13-15 (O'Kula) (admitting "there is not the tie to a citation trail that we can point very crisply" for documenting the Sample Problem A decontamination costs Entergy relied upon);<sup>35</sup> Tr. 2038:12-15 (O'Kula) ("And as all parties in this proceeding have affirmed, the initial starting point to the \$3,000 level and \$8,000 level, that document trail, that starting point is not available."). Neither NUREG-1150 itself nor its companion, NUREG/CR-4551 (NRC000057), explain how the Sample Problem A costs were obtained. Tr. 2004:17-2005:24 (J. Wardwell/Lemay). NUREG/CR-4551 cites NUREG/CR-3673 (NRC00058), as a reference for the Sample Problem A decontamination cost values, but NUREG/CR-3673 states only that:

The 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) [Os84].

NRC00058 at p. 4-15.

<sup>&</sup>lt;sup>35</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 20.

159. "Os84" is listed 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*," in NUREG/CR-3673's references section. NRC00058 at p. 8-8 (emphasis added).

160. NRC Staff has not produced Os84 and in fact has admitted that this document does not exist, at least in any available form. *See* NYS000421 ("[T]he Staff's experts from Sandia and the Staff searched for but were not able to locate the requested article (Ostmeyer, R.M. and G.E. Runkle, An Assessment of Decontamination Costs and Effectiveness for Accident Radiological Releases, Sandia National Laboratories to be published)"); *see also* Tr. 2009:21-25 (J. McDade/Jones) (explaining that Os84 "could not be located."); Tr. 2010:1-2011:5 (J. McDade/Liberatore/Jones/Ghosh) (discussing various unfruitful efforts to locate Os84 including searching public libraries, internal NRC libraries, and Sandia libraries).

161. Thus, Os84 appears to have never been published, nor peer-reviewed. Ironically, Entergy faulted the State for "not acknowledg[ing] the source and pedigree of the inputs used by Entergy," ENT000450 Entergy Test. at 60 (A76) (O'Kula, Teagarden, Potts), when the State's research reveals that neither Entergy nor NRC Staff had investigated the lineage of NUREG-1150 (NYS000420 Lemay Rebuttal Test. at 23-25).

162. Providing an explanation of why Os84 is not available, Dr. Ghosh tells the Board that

It's been almost 30 years since those reports were produced. We would have to assume that at the time that this report was published they did have a copy, but unfortunately in the intervening 28 years, I guess we lost track of that report, and we couldn't locate it today. But we certainly expect that they would have had it at the time that this report was published.

Tr. 2010:18-25 (Ghosh).

163. After admitting that no copy of Os84 is available, NRC Staff unconvincingly argues that Entergy's use of the decontamination values purportedly explained in Os84, but nowhere else, is still reasonable.

164. As Dr. Lemay points out, even if Os84 did still exist, the author of NUREG/CR-

3673 (which cites to Os84) made it clear that "these were tentative results." Tr. 2017:18-20

(Lemay). Dr. Lemay explains further that "They were at the time the best they could, but they

really expected people to continue to improve these things." Tr. 2017:20-21 (Lemay). Dr.

Lemay cited the following language from NUREG/CR-3673:

Little data exist which are directly applicable to the small particle sizes  $(0.1-10 \,\mu\text{m})$  and soluble materials which are anticipated in releases from the LWR accidents. The cost and effectiveness estimates for decontamination contain large uncertainties, and results of future experimentation with decontamination techniques should be used to update models for decontamination.

NRC00058 at p. 4-15.

165. Indeed, NRC Staff's witness, Mr. Jones, testified that better data exists today than

in the 1980s that "would give us excellent insights on how to derive applicable values for

something more urban." Tr. 2022:8-10 (Jones). Mr. Jones provided some examples of relevant

data that would be available today to develop decontamination input parameters:

[W]ithin the Department of Energy complex over the last decade and a half, a lot of facilities have been closed down, decontaminated such as Rocky Flats in Colorado, Fernald in Ohio, and Mound. These sites were very large decontamination projects where cesium was encountered, *so there is data available today*. That data would not have been available in 1984 because those types of activities had not begun. But today there is actual data available . . . .

Tr. 2021:5-14 (Jones) (emphasis added). Despite touting the significance of this newer

decontamination data, Mr. Jones conceded that the Sample Problem A values Entergy used

"were developed for NUREG-1150. And the origin of those is the late '80s. So, [the newer data] is not included in those values." Tr. 2023:1-3 (Jones).<sup>36</sup>

166. No one knows the origin of the NUREG-1150 decontamination cost values, other than a cryptic description that they were based upon "national average statistics." ENT000466 (NUREG/CR-3673) at p. 4-17. *See also* Tr. 2244:11-17 (O'Kula); Tr. 2245:5-23 (J. Kennedy); Tr. 2303:2-14 (J. Wardwell/Teagarden); Tr. 2324:21-2325:9 (Liberatore/Teagarden).

167. Still, NRC Staff and Entergy provided conflicting, speculative testimony on the source of Sample Problem A values. Towards the beginning of the hearing on NYS-12C, NRC Staff's witnesses strongly contended that the Sample Problem A inputs taken from NUREG-1150 were based upon data relevant to nuclear reactor accidents (where cesium is the radionuclide of primary concern) as opposed to nuclear weapons releases (where plutonium is the radionuclide of primary concern).<sup>37</sup>

168. Dr. Bixler contended that "NUREG-1150 does suggest . . . decontamination factors . . . . based on a typical source term that you would have from a nuclear reactor. So, it is -- these values come from a source that are based on the type of source term that's of interest for this problem that we're dealing with here." Tr. 2000:19-2001:1 (Bixler).

169. Dr. Bixler also stated in response to a Board question, "this NUREG-1150 doesn't deal with the plutonium dispersal accident that I think you're describing. It deals with a nuclear

<sup>&</sup>lt;sup>36</sup> Mr. Jones attempted to clarify his statement the following day: "I may have left the impression that there is a library of cesium data available from the cleanup of the Department of Energy Weapons Complex. And that is not what I intended to convey." Tr. 2098:20-23 (Jones).

<sup>&</sup>lt;sup>37</sup> Decontamination following any radioactive release will vary considerably in cost and time depending on the radionuclides of primary concern, which differ for nuclear reactor accidents (cesium) and nuclear weapons (plutonium). NYS000242 ISR Report at 17-18; NYS000241 Lemay Initial Test, at 36-40. Further discussion on these differences, and their relevance, can be found below in the discussion below of Sandia *Site Restoration* in X.D.1

reactor accident. So, here we're talking about a source for this information that's consistent with

this application." Tr. 2001:16-21 (Bixler).

170. Mr. Jones held to the belief that NUREG-1150 was based on nuclear reactor

accident data when discussing Os84:

MR. JONES: I checked with our librarians, as well, and we were unable to locate [Os84].

JUDGE McDADE: Okay. Does that leave us in a position as we sit here right now not knowing whether or not this basically was looking at plutonium, or cesium, or any other kind of radioactive contaminant?

MR. JONES: No, Your Honor. I believe that the team, Ostmeyer and Runkle, were part of – working with Sandia. These documents were all coming together at about the same time, and I have no reason to believe they would have introduced a plutonium source in a nuclear power plant analyses, because it just wouldn't even be considered in that context.

Tr. 2011:3-17 (J. McDade/Jones).

171. Dr. Ghosh appeared to agree with Mr. Jones when she stated, "If we went back to

the text where the report was referenced, that paragraph actually describes a little bit about what

that [Os84] reference presumably has. And it does talk about severe accidents, so I guess we

would have no reason to assume that they were looking at a different composition than what a

severe reactor accident would produce." Tr. 2011:19-25 (Ghosh).

172. After Dr. Lemay pointed out the public comments on a draft of NUREG-1150,

that "Decontamination costs used in the calculations may be based on decontamination of test

sites in deserts instead of agricultural, residential, and commercial property" (Tr. 2025:3-6

(Lemay) (citing NYS00252D at D-32 (emphasis added)), Mr. Jones seemed to refine his

position.

JUDGE McDADE: Okay. Would the language there, maybe based on *decontamination of test sites in deserts* suggest to the Staff that maybe what they

were talking about here are decontamination costs where plutonium was the principal radioactive material?

MR. JONES: This is Joe Jones of the Staff. I would interpret it that way knowing the tests that were conducted in the deserts. But there could have been cesium tests conducted out there that I'm not aware of.

JUDGE McDADE: But what this does is leave us with a degree or uncertainty as to exactly what the source was for the contaminants that are referred to. It may have been plutonium, it may have been more consistent with a nuclear reactor, it may have been a combination of the two, but at this point there's no way for us to really be sure of that. Is that a correct interpretation, Mr. Jones, or Dr. Bixler?

MR. JONES: I'm unable to trace the origin, so I could agree with that.

Tr. 2025:20-2026:14 (J. McDade/Jones). See also Tr. 2037:1-2038:1 (O'Kula/Harrison).

173. Dr. Ghosh noted "I just want to note that in the response there's no confirmation that these comments have a basis. It may be pure speculation in the Point 6. I don't know where the person might have gotten the idea where the costs were coming from because it doesn't explain." Tr. 2026:20-25 (Ghosh).

174. On the second day of testimony, Mr. Jones clarified his testimony from the first day and admitted, "I am not aware of any specific cesium-related characterization or cost data." Tr. 2100:16-18 (Jones).

175. In any event, Entergy's argument for the use of the decades-old Sample Problem A values from NUREG-1150 amounts to nothing more than speculation: "these are the best values that we know of, the only values that are available, and it is irrational to think that the authors of 1150 would have used them for all five of the plants in that study if they were not applicable." Tr. 2043:25-2044:4 (Potts). As Dr. Lemay points out, while there are many valuable, important aspects of NUREG-1150,

what NUREG-1150 doesn't do is validate the input parameters that were used in the Indian Point SAMA analysis. And you can search all the volumes of NUREG-1150. I certainly did. The only references to decontamination costs are the two references I
found [NUREG/CR-3673 and Os84]. So it leads me to believe that that's a very specific part of the economic cost assessment was not peer reviewed, at least in the sense that U.S. NRC staff defines it.

Tr. 2175:17-25 (Lemay).

# B. Sample Problem A's Decontamination Time Values Are Based Upon a Document That Contains Unrealistic Assumptions and Is Inconsistent With NUREG-1150

176. As Entergy and NRC Staff note, NUREG-1150 itself does not provide analysis to support the Sample Problem A decontamination time (*i.e.*, TIMDEC) inputs. Tr. 2242:10-14 (Teagarden) ("NUREG-1150, Your Honor, I don't think [NUREG-1150] has much discussion on this particular point. It's more just that we see in evidence that within NUREG-1150, they selected the 60 days and the 120 days"); NRC000041 Staff Test. at 68-69 (A61) (Jones).

177. TIMDEC is a MACCS2 input parameter used by the code to account for the time it would take to decontaminate following a severe accident. NYS000242 ISR Report at 24-25; NYS000241 Lemay Initial Test. at 51-55. Site-specific characteristics such as building and population density as well as the type of radionuclides released during a severe reactor accident influence the time it takes to decontaminate and, thus, influence TIMDEC. *Id.* The MACCS2 code requires users to input two decontamination times: one for light decontamination (the lower dose reduction factor of 3); and one for heavy decontamination (the higher does reduction factor of 15). *Id.* 

178. TIMDEC "is strictly the decontamination effort," while "[t]he cost borne by society and by the people that have been relocated or that cannot return to their home is captured in other parameters in this table [NYS000430, Table 13], POPCST [per capita cost of long-term relocation] and DPRATE in row six and eight." Tr. 2115:6-11 (Lemay).

179. Once again, Entergy took its inputs directly from NUREG-1150 values in Sample Problem A for TIMDEC. Tr. 2186:19-23, 2187:20-23 (Teagarden). Entergy's inputs are 60 days for a light decontamination and 120 days for heavy decontamination. ENT000450 Entergy Test. at 49, Table 3. NUREG-1150 directs a "reader seeking extensive discussion of the methods used" to NUREG/CR-4551 (NRC000057). NYS00252A at p. 2-20. But NUREG/CR-4551 also fails to provide a detailed explanation for decontamination times.

180. Therefore, NRC Staff appears to rely upon NUREG/CR-3673, "Economic Risks of Nuclear Power Reactor Accident" (NRC000058) for support. NRC000041 Staff Test. at 89-90 (A81) (Harrison, Ghosh). NUREG/CR-3673 does not provide the necessary support.

181. NUREG/CR-3673 describes a timeline and explains its assumptions for the duration of decontamination, however, it is based upon unreasonable assumptions and is inconsistent with NUREG-1150. NYS000420 Lemay Rebuttal Test. at 21-23. ISR has determined that applying the assumptions used for the cleanup scenario in NUREG/CR-3673 to Indian Point would require deployment of 1.5 million workers for 90 days, which is entirely unreasonable. NYS000420 Lemay Rebuttal Test. at 22; *see also* NYS000431 (describing the assumptions contained in NUREG/CR-3673 in detail). Even extending the cleanup to one year would require 363,000 workers, which is also unreasonable. NYS000420 Lemay Rebuttal Test. at 23. As Dr. Lemay explained at the hearing, "If you get the value of 1.5 million, clearly you've compressed the time scale so much that you need an incredible number of people that are clearly not available. If you allow the time to spread over several years, then you get a reasonable number of people." Tr. 2114:1-6 (Lemay).<sup>38</sup>

<sup>&</sup>lt;sup>38</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 22.

182. Moreover, internal inconsistencies in the timelines for decontamination in NUREG/CR-3673 and NUREG-1150 render them unreliable. NYS000420 Lemay Rebuttal Test. at 21-23 (explaining how in NUREG/CR-3673's timeline, decontamination begins 30 days after the severe accident while NUREG-1150's timeline starts only seven days after the accident). Even Entergy recognized these inconsistencies. *See* Tr. 2242:14-20<sup>39</sup> (Teagarden) ("When you go back to the Burke document [NUREG/CR-3673], there's just a discussion of the model development, where they explore how the model is developed. They use a basis of 90 days. But then when it's carried forward in the NUREG-1150, that's modified to reflect the 60 days and the 120 days.").

# C. Instead of Condoning the Use of Example Values, NUREG-1150 Supports Developing Site-Specific Cost Estimates

183. Although Entergy argues that NUREG-1150 supports its use of Sample Problem

A, the comments received on a draft of NUREG-1150 suggest that its authors expected that site-

specific estimates of decontamination costs would be developed. NUREG-1150 states:

[PUBLIC] COMMENT: The models used in calculating the cost of a severe accident lack many factors that should be taken into account. Many of the assumptions are questionable and unfounded. The models have not been benchmarked. Some interpretations and conclusions that were made in draft NUREG-1150 are questionable. The cost estimates need to be more thoroughly documented to understand and evaluate the calculations.

[NRC] RESPONSE: The present version of NUREG-1150 provides a limited set of risk-reduction calculations, principally related to the potential benefits of accident management strategies in reducing core damage frequency. *It does not assess the cost of these or other improvements. Such analyses are more properly considered in the context of specific regulatory action.* 

\* \* \*

<sup>&</sup>lt;sup>39</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 25.

[PUBLIC] COMMENT: Decontamination costs used in the calculations may be based on decontamination of test sites in deserts instead of agricultural, residential, and commercial property.

[NRC] RESPONSE: The draft NUREG-1150 cost/benefit analyses reflected the conventional NRC methods for assessing costs and benefits. *Because cost/benefit analyses are more properly considered in the context of specific regulatory activities, they are not provided in this version of NUREG-1150.* 

NYS00252D at D-31 - D-32 (emphasis added). See also Tr. 2023:15-2024:13, 2025:3-19

(Lemay) (noting the importance of discussing NUREG-1150 reviewer comments, as well as

NRC's response, and quoting these comments/responses).

184. These comments support the State's point: reliance on Sample Problem A instead

of developing site-specific inputs for this relicensing proceeding is patently unreasonable.

185. Dr. Ghosh attempted to discredit these comments by labeling them as public

comments as opposed to expert comments, but the Board correctly noted that Dr. Lemay's point

in citing the comment was the substance of the NRC response:

DR. GHOSH: I suspect this was a public comment. The only other point I want to make is that there were two formal peer review[s], expert peer reviews that were performed for NUREG-1150. I believe this is public comment, not an expert peer review comment.

JUDGE WARDWELL: But, Dr. Ghosh, didn't the NRC respond as Dr. Lemay points out to this comment by saying we don't have any answer, basically. It should be handled on a regulatory action basis.

DR. GHOSH: Yes, that is what the response said. Unfortunately, I would say Staff practice, we generally are more rigorous in responding to expert peer review comments versus public comments. But, yes, that was the response in this case.

Tr. 2028:10-23 (J. Wardwell/Ghosh).

186. Dr. O'Kula attempted to explain the comments by stating that "Now it's

important to note that in the second draft, and subsequently the final draft of NUREG-1150,

economic costs were not calculated, because [the] NRC report indicated that at least the

discussion, as we understand it goes, that cost-benefit analyses are more properly considered in the context of specific regulatory activities . . . ." Tr. 2035:15-22 (O'Kula).<sup>40</sup> The fact that the final version of NUREG-1150 removed the calculation of economic costs actually supports Dr. Lemay's argument—that economic costs should be calculated on a site-specific basis.

## D. Internal NRC Documents Question the "Pedigree" of NUREG-1150

187. An internal NRC email chain and what appeared to be an attachment<sup>41</sup> expresses views contrary to the positions taken by NRC Staff and Entergy that the NUREG-1150 values are reasonable due to their pedigree. *See* NYS000441 (Jan. 10, 2011 e-mail string, Subject: FW: Action YT-2011-0003: Request Parallel Concurrence on Document: Agency Long-Term Research Activities for Fiscal Year 2013) ("FY13 Long-Term Research Plan"). The FY13 Long-Term Research Plan is "a staff proposal for long-term research." Tr. 2287:2-4 (Ghosh). After explaining that "applicants often begin with input values that are found in 'Sample Problem A' . . . taken from a calculation for Surry done for NUREG-1150, which was published in 1990," the document reveals, "*The pedigree of some of those input values is not known*." NYS000441 at 5 (emphasis added). The text, in context, is reproduced below.

<sup>&</sup>lt;sup>40</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 20.

<sup>&</sup>lt;sup>41</sup> Dr. Ghosh clarified that "what looked like an attachment to an email that in fact wasn't an attachment to an email. It was a separate document that was all bundled together in an ADAMS package, as part of a FOIA information request." Tr. 2286:21-25 (Ghosh).

### New Improved MELCOR Accident Consequence Code System (MACCS)

There is a need to review, and update or upgrade as necessary, certain input values often used in the MACCS2 for off-site radiological and economic consequences of severe accidents, such as reported in Severe Accident Management Alternative (SAMA) or Severe Accident Management Design Alternative (SAMDA) analyses submitted as part of combined operating license applications and standard reactor design certification applications. For instance, applicants often begin with input values that are found in "Sample Problem A" that is distributed with the MACCS2 code (NUREG/CR-6613). The values in Sample Problem A were taken from a calculation for Surry done for NUREG-1150, which was published in 1990. The pedigree of some of those input values is not known.

### NYS000441 at 5.

188. Despite the fact that the FY13 Long-Term Research Plan is directly relevant to the arguments Entergy and NRC Staff raised in defense of Sample Problem A, it was never disclosed. The email chain includes Tina Ghosh, Staff witness in this proceeding, and Sherwin Turk, Staff counsel in this proceeding. NYS000441 at 2-3. Additional email addressees include Michael Johnson, NRC senior manager who briefed the Commission on Fukushima Lessons Learned; Scott Flanders, an NRC Attorney; Gary Holahan, Deputy Director of NRC's Office of New Reactors; Eric Leeds, Director of NRC's Nuclear Reactor Regulation; and Charles Miller, Leader of the Near-Term Task Force for Review of Insights from the Fukushima Dai-Ichi Accident. *Id.* at 1-3. The State did not discover the document's existence until the evening of September 10, 2012. *See State of New York Mot. For Leave to File an Additional Exh. and Additional Cross Examination Questions Concerning NYS-12C* (Sept. 18, 2012) at 5-6 (ML12262A547).

189. At the hearing, Dr. Ghosh explained that this pedigree project was proposed as part of the "Long-Term Research Program, where we try to identify research projects that will be useful to the NRC five to ten years down the line, to fulfill some critical knowledge gap or maybe up and coming technology that's going to be coming down the pike." Tr. 2287:5-10

(Ghosh).<sup>42</sup> Although Dr. Ghosh noted, "That particular proposal was submitted by a staff person who unfortunately is deceased at this point, so we could not have him clarify what he meant by that line," (Tr. 2287:20-23 (Ghosh)), the plain language of the document calls into question the pedigree of the Sample Problem A values taken from NUREG-1150 and provides further support that Entergy's reliance upon those values was unreasonable.

# E. The Fact that Other Plants Have Used Sample Problem A Does Not Justify Its Use at Indian Point

190. Although NRC Staff concluded without further explanation that Entergy's "decontamination cost estimates are consistent with those used in accepted SAMA analyses performed for other nuclear power plants" (NYS00133I FESIS at G-24), it appears Entergy's values are only "consistent" because other nuclear power plants rely upon Sample Problem A input values. NYS000242 ISR Report at 30-31; NYS000241 Lemay Initial Test. at 62-63.

191. ISR gathered MACCS2 code input data for other U.S. power plants and found that that—no matter the specific location or attributes of the facility—the input values remain constant because all CHRONC inputs were derived from Sample Problem A with the exception of the value for nonfarm wealth. NYS000242 ISR Report at 30-31, Table 12. Entergy went even further in discussing the widespread use of Sample Problem A: "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." Tr. 1951:13-16 (Teagarden).

<sup>&</sup>lt;sup>42</sup> According to Dr. Ghosh, the committee that reviewed the proposals ranked this proposal as "one of the lowest" (Tr. 2287:24-2288:2) (Ghosh)), but the documents describing the committee's review are not part of the record in this proceeding. Dr. Ghosh explained that those documents are "Official Use Only" and contain "internal budget formulation information [that] is typically non-public." Tr. 2331:1-5 (Ghosh).

192. Entergy and NRC Staff also attempt to find support for the Sample Problem A values in the State-of-the-Art Reactor Consequence Analysis ("SOARCA") study, ENT000455 (NUREG-1935, SOARCA Draft Report for Public Comment, Jan. 2012). ENT000450 Entergy Test. at 62 (A78) (O'Kula, Teagarden, Potts); Tr. 1951:17-21 (Teagarden). Yet the language Entergy quotes from the SOARCA project (Draft NUREG-1935) makes it clear that while "[v]alues from NUREG-1150 provide the basis for decontamination parameters, .... *[t]his report does not consider costs associated with a reactor accident*; however, these parameters do affect decisions on whether contaminated areas can be restored to habitability and therefore affect predicted doses and risk of health effects." Entergy Test. at 62 (A78) (O'Kula, Teagarden, Potts) (quoting ENT000455 Draft NUREG-1935 at 63) (emphasis in quote added by the State).

193. Because the SOARCA project did not examine costs associated with a severe accident, it was not a SAMA analysis. Additionally, SOARCA did not evaluate Indian Point—it only evaluated the five plants from NUREG-1150 including Surry. *See* ENT000455 Draft NUREG-1935.

194. Whether or not it was appropriate for other sites, or the SOARCA study, to rely upon Sample Problem A has no bearing on whether it is reasonable to use Sample Problem A for Indian Point, which is located in the most densely populated area of any American nuclear reactor site. *See* VI.A.1. above.

# VIII. NRC HAS CONDUCTED A SITE-SPECIFIC ANALYSIS AT INDIAN POINT THAT DID NOR RELY UPON SAMPLE PROBLEM A

195. Entergy argues that it was reasonable to use Sample Problem A because NUREG-1150 is the only source of data "readily available to licensees to use in a SAMA analysis to satisfy the purposes of NEPA." ENT000450 Entergy Test. at 57 (A72) (O'Kula, Teagarden).

196. But, in the 1980s, NRC commissioned a site-specific case study to estimate the costs associated with a severe accident at Indian Point—Tawil 1990 (NUREG/CR-5148) (NYS000424A-NYS000424BB). Not only did the NRC commission the Indian Point site-specific study, but NRC also failed to disclose it in the FSEIS or this proceeding. The NRC's site-specific case study is described in Chapter 5 of Tawil 1990 (NUREG-5148). NYS000424H.

197. Donald P. Cleary, a former NRC Staff member and witness for Entergy on other contentions in this proceeding, is on the distribution list for this report. *See* NYS0424BB at p. 4.

198. It was in researching the pedigree of NUREG-1150 that the State's experts discovered Tawil 1990. First, the State's experts reviewed a NUREG-1150 reference that describes a database and computer code called DECON. NYS000420 Lemay Rebuttal Test. at 25-27 (citing NYS000425A-NYS000425G (NUREG/CR-3413 Off-Site Consequences of Radiological Accidents: Methods, Costs and Schedules for Decontamination, J.J. Tawil, et al. (Aug. 1985) ("DECON reference")).

199. An NRC contractor developed the DECON code to conduct decontamination analyses of a large, radiologically contaminated areas. NYS000420 Lemay Rebuttal Test. at 26, 28. The DECON code was designed to be used with CRAC2, a predecessor to the MACCS2 code, and appears to be similar to CONDO, which is one of the methodologies that Entergy could have used to calculate site-specific costs (*see* X.D.3 below). NRC Staff and Entergy criticized ISR's of the CONDO methodology. *See* Lemay Rebuttal Test. at 26, 28; Tr. 2256:25-2257:5 (Lemay).

200. After reviewing the DECON reference, the State's experts emailed one of the authors, Dr. Tawil, noting that they found the DECON code "very detailed and quite frankly, very well put together." NYS000426 at 1. Explaining that they could not find any "use or

mention of the DECON code past the mid eighties," the State's experts asked Dr. Tawil what became of the code. *Id.* In response to ISR's email, Dr. Tawil, revealed that NRC Staff was concerned about the results of a site-specific study at Indian Point. *Id.* Dr. Tawil wrote:

I think the primary difficulty was that my last project for the NRC was to characterize the off-site consequences of reactor accidents... for three reactor sites, one of which was Indian Point .... I think the NRC was a little shocked at the magnitude of the off-site consequences of an SST-5 at Indian Point and decided not to publish the report.

*Id.* (emphasis added).<sup>43</sup>

201. Using the information in Dr. Tawil's email as a starting point, the State's library located a copy of the site-specific study that Dr. Tawil was referencing: Tawil 1990 (NUREG/CR-5148). NYS000420 Lemay Rebuttal Test. at 27.

202. The results of Tawil 1990 disclose that NRC has actually conducted a site-specific analysis of the decontamination costs associated with a severe accident at Indian Point, without using NUREG-1150 values, and, therefore, without relying upon Sample Problem A. *See generally* NYS000424A-BB.

203. Unlike the generic Sample Problem A values that provide the MACCS2 code with two decontamination costs, one for land that's farmland and land that's not farmland (*see* V.II.A., V.B.3 above), Tawil 1990 contains detailed analysis of land use and decontamination techniques to produce site-specific decontamination costs. NYS00424G at 4.23 – 4.35. The following table, Figure 4.4, lists Tawil 1990's analysis of surface types *for a single grid element* that lies in Westchester County with a population of just over 1,000 and a "pre-accident real

<sup>&</sup>lt;sup>43</sup> SST events are "siting source term events" that were used by Sandia to develop its 1982 guidance for siting future reactors. ENT000455 at 6. SST events range from SST5, "[1]imited core damage" and "[c]ontainment functions as designed with minimal leakage," to SST1, "[s]evere core damage" and "[a]ll safety systems and containment are lost after 1.5 hours." *Id.* 

property value estimated at \$65 million." Id. at 4.32. Tawil 1990 explains each column and each surface description in detail. Id. at 4.32 - 4.35. Tawil notes that "although this particular report applies to a grid element, a similar report can be generated for an exposure area. Id. at 4.32.

> DETAILED SURFACE RESULTS FOR GRID ELEMENT 8, FOR PERIOD 30.

#### \*\*\* EXTERNAL PATHWAY \*\*\*

SURFACE	AREA	EXPOSURE	METH	RESIDUAL	AVG.COST	TOT.COST	RATE
	(ha) 1/	(Sv)	2/ 3/	(Sv)	(\$/ha)	(\$) (	m**2/hr)
AGRICULTURAL FIELDS	5.91E+00	9.63E+00	Tx	5.39E-02	9.14E+04	5.40E+05	8.75E+02
ORCHARDS	2.90E-01	9.63E+00	TRX	9.24E-02	1.24E+05	3.60E+04	9.80E+01
VACANT LAND	3.42E+01	9.63E+00	TNX	5.39E-02	1.34E+05	4.59E+06	5.20E+01
WOODED LAND	2.54E+01	9.63E+00	T~	8.67E+00	1.21E+04	3.07E+05	5.60E+03
ASPHALT STRTS/PRKNG	8.70E+00	9.63E+00	vCF	1.58E-01	2.11E+04	1.84E+05	4.30E+03
OTHER PAVED ASPHALT	5.88E-01	9.63E+00	vCF	1.58E-01	2.19E+04	1.29E+04	2.15E+03
CNCRETE STRTS/PRKNG	6.08E+00	9.63E+00	VCF	1.58E-01	2.11E+04	1.29E+05	4.30E+03
OTHER PAVED CNCRETE	2.35E+00	9.63E+00	VC #	1.85E-01	2.04E+04	4.79E+04	2.15E+03
LAWNS	5.03E+01	9.63E+00	R	1.93E-01	1.42E+05	7.13E+06	4.00E+01
RESERVOIRS	9.53E+00	9.63E+00	rxr	1.54E-01	9.38E+04	8.94E+05	6.56E+02
ROOFS	8.16E+01	9.63E+00	R	9.63E-02	4.71E+05	3.85E+07	2.40E+01
EXT, WOOD WALLS	1.17E+01	9.63E-01	W	1.44E-01	2.43E+03	2.84E+04	2.03E+02
EXT. BRICK WALLS	2.48E+00	9.63E-01	W	1.44E-01	2.43E+03	6.04E+03	2.03E+02
EXT. CONCRETE WALLS	1.54E+01	9.63E-01	W	1.06E-01	2.43E+03	3.75E+04	2.03E+02
INT'R WOOD/PL WALLS	3.69E+01	4.81E-01	٧	2.41E-02	4.76E+03	1.76E+05	6.90E+01
INT'R CNCRETE WALLS	7.58E+00	4.81E-01	٧	1.69E-01	4.76E+03	3.61E+04	6.90E+01
CARPETED FLOORS	7.22E+00	4.82E+00	VTR	2.60E-02	4.41E+05	3.19E+06	3.70E+00
LINOLEUM FLOORS	8.56E+00	4.82E+00	v	1.81E-01	9.52E+03	8.14E+04	6.90E+01
WOOD FLOORS	2.03E+00	4.82E+00	vF	1.73E-01	3.13E+04	6.35E+04	4.00E+01
CONCRETE FLOORS	1.17E+01	4.82E+00	vF	1.85E-01	3.13E+04	3.66E+05	4.00E+01
HARD-SURF FURNSHINGS	3.56E+03	4.82E+00	VR	1.44E-01	2.02E+04	7.21E+07	8.00E-03
SOFT-SURF FURNSHINGS	2.42E+03	4.82E+00	VR	6.50E-02	4,49E+03	1.09E+07	1.59E-01
ELECTRONIC EQUIP	3.97E+03	4.81E-01	٧	1.69E-01	1.99E+02	7.90E+05	2.19E-01
PAPER PRODUCTS	3.78E+03	9.63E-01	k	1.93E-02	1.95E+03	7.35E+06	1.50E-01
AUTO EXTERIORS	8.91E+02	9.63E+00	ŤJJ	6.93E-02	4.82E+02	4.30E+05	2.50E-01
AUTO INTERIORS	8.91E+02	2.89E+00	٧z	8.67E-02	7.60E+02	6.77E+05	1.25E-01
AUTO TIRES, (PER 4)	8,91E+02	9.63E+00	R	9.63E-03	3.19E+02	2.84E+05	1.00E+00
AUTO ENG/DRV TRAIN	8.91E+02	9.63E+00	IEE	1.01E-01	2.56E+02	2.28E+05	1.00E+00

#### NOTES:

1/ Area measures do not apply to autos and building contents; values are

- the number of automobiles and the number of building contents units.
- 2/ ---- = Decontamination not required //// = Unable to decontaminate surface
- 3/ + = Method is required \ = Restricted operation is in effect
  Quick-Vac: # = in effect \* = w/restricted operation ~ = w/required method

Figure 4.4 Detailed Surface Analysis Report

*Id.* at 4.33.

204. At the hearing, Dr. Lemay pointed out that "it is true that many sources of [Tawil 1990's] data are from the West Coast and other places, but they used site data, they used the population density, they used the land use around Indian Point to calculate the cost" Tr. 2256:13-17, 2257:19-24 (Lemay). Thus, Mr. Jones' argument that Tawil 1990 is not site-specific because it used datat from the "West Coast" or on a "national level" (Tr. 2254:3-2255:2 (Jones)) rings hollow because Tawil 1990 used relevant data to describe the site-specific characteristics of the area surrounding Indian Point in great detail, on a grid element basis, as shown in Figure 4.4. reproduced above.

205. Tawil 1990 supports the approach ISR discussed in its expert report. For example, in urban areas—unlike the rural Virginia area used to create Sample Problem A—the cost of decontaminating the contents of a building can exceed the cost of decontaminating land and structures. NYS00424G, Figure 4.3, at 4.26 - 4.28. Additionally, Tawil 1990 makes the point that decontaminating building contents is labor intensive and labor costs constitute a large portion of the cost of decontamination. NYS00424B-NYS00424E at 2.8 - 2.71.

206. NRC has had Tawil 1990 for 22 years. It is unclear whether Tawil 1990 was released for publication. What we do know is that the site-specific Indian Point study was requested and authorized by the NRC and funded by the U.S. taxpayers. It has a formal a "NUREG/CR" number and was preserved by NRC in its microfiche collection. Although the State's revised statement of position identifies the document being "circulated in final draft form" (NYS000419 NYS Revised SOP at 14-15), upon further examination it appears that the document is not a draft. There are no "draft" markings or any other designation to indicate that Tawil 1990 is a draft.

# IX. NEITHER NRC STAFF NOR ENTERGY COMPARED THE SAMPLE PROBLEM A VALUES TO MORE RECENT, RELEVANT DATA

207. Neither Entergy nor NRC Staff performed any bounding or benchmarking to determine whether relying upon Sample Problem A was scientifically reasonable. As Dr. Lemay explains, "benchmarking consists of establishing points of reference by comparing one's current practices with what others in the field are doing." NYS000420 Lemay Rebuttal Test. at 7. "In the nuclear industry, benchmarking is an essential exercise because it provides for an important exchange of information amongst experts in the field, leading to the use of the best data and methodologies." *Id.* With respect to the Sample Problem A values, Dr. Lemay explains

the Applicant said that the input values that are used, they believe were calculated on the basis of mixed land use, with different types of buildings, different types of land uses. We really have no way of knowing it, but how could we find out if it's possible? I think the only way to do it would be to actually do similar calculations and benchmark them against what we have as an unsupported and undocumented value. I think that's the way we would decide if these values effectively included mixed type of buildings or farmland or desert or whatever.

Tr. 2176:3-14 (Lemay);<sup>44</sup> see also Tr. 2176:15-22 (Lemay).

208. Neither Entergy nor NRC Staff explain why they did not perform a benchmarking analysis for the Level 3 probabilistic risk assessments ("PRA")—the final level of the SAMA analysis where the MACCS2 code is used to calculate the costs associated with a severe accident. NYS000420 Lemay Rebuttal Test. at 8-10. This is especially troublesome, considering Entergy conducted extensive peer reviews and benchmarking to verify the reasonableness and robustness of the Level 1 and Level 2 PRA. Lemay Rebuttal Test. at 9-10 (citing ENT000460 (Attachment I to NL-08-028). The Level 3 PRA analysis is further

<sup>&</sup>lt;sup>44</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 24.

complicated by NRC Staff's incorrect, conclusory claim that "existing margin in the SAMA analysis [] account[s] for uncertainties." NRC000041 Staff Test. at 14 (A6b) (Gosh).

209. As Dr. Lemay explains, it is unreasonable for Entergy and NRC Staff to "expend[] considerable effort to verify the source term and core damage frequency used in accident assessment—Level 1 and Level 2," only to rely upon generic Sample Problem A values in Level 3 without any verification or benchmarking. NYS000420 Lemay Rebuttal Test. at 9. As Dr. Lemay explains, "Entergy's SAMA analysis is not defensible" because "[w]ithout this benchmarking, Entergy and NRC have not quantified the reasonableness and the uncertainty of the key parameters they used to calculate the OECR [offsite economic cost risk]." *Id.* at 10.

# X. THE SAMPLE PROBLEM A VALUES ARE UNREASONABLE FOR INDIAN POINT BECAUSE THEY DO NOT ACCURATELY INCORPORATE AVAILABLE DECONTAMINATION DATA, AND THE POPULATION AND BUILDING CHARACTERISTICS OF THE AREA SURROUNDING INDIAN POINT

210. At the hearing in Tarrytown, New York as well as in its filings in this proceeding and in scoping comments and comments on the DSEIS, the State emphasized that a fundamental problem with the SAMA analysis is the underestimation of the costs associated with a severe accident due to the failure develop site-specific inputs. *See, e.g., New York State Supplemental Comments Regarding Scope of NEPA Analysis Application for Relicensure by Entergy Nuclear Indian Point LLCs for Operating Licenses Nos. DPR-26 and DPR-64*, at 2-4 (Nov. 30, 2007) (ML073600658); NYS000134 (New York State Attorney General, Comments on the Draft Supplemental Environmental Impact Statement, Indian Point Units 2 and 3, Mar. 18, 2009, ML090771328) at 42-43; New York State Notice of Intention to Participate and Petition to *Intervene*, at 142 (Contention 12, Bases 11) (Nov. 30, 2007) (ML073400187). 211. Entergy and ultimately NRC Staff chose to ignore this criticism. In support of NYS-12C, the State has submitted unprecedented and extensive technical justification for its conclusions that developing site-specific MACCS2 inputs is not only possible, but also the only reasonable way of estimating the costs associated with an accident at Indian Point.

212. The ISR Report and Testimony were never intended to be, nor did it need to be, an independent SAMA analysis. Instead, the ISR Report shows that Entergy and NRC Staff's analyses are unreasonable because developing site-specific MACCS2 inputs is technically feasible, scientifically defensible, and ultimately results in much higher costs for a severe accident at Indian Point. Lemay Rebuttal Test. at 5; *see* Tr. 2110:2-8 (Lemay) ("So first it is a demonstration that it is possible to create site-specific decontamination cost. The second point is that when you look at the literature out there and you try to derive site-specific decontamination cost, they tend to be higher than the one used by Entergy and not by a small factor, by a significant factor."). ISR's work also provides a range of calculations that provide some bounding of the magnitude of that understatement. *Id*.

# A. The ISR Report and Dr. Lemay's Testimony Demonstrate that the SAMA Analysis Underestimated the Economic Costs of a Severe Accident at Indian Point Because the SAMA Analysis Generic Assumptions

213. Entergy and NRC Staff's reliance on Sample Problem A is unreasonable when site-specific inputs are available from many data sources outside of NUREG-1150. The State's expert analysis described below relies on several data sources and concludes that, by failing to use site-specific input values, Entergy has underestimated offsite economic cost risk by up to a factor of 7.

214. ISR's results are summarized in the following table. The first column shows each input parameter ISR evaluated, the second column includes a description of each input

parameter, the third column includes Entergy's values, and the fourth column includes ISRcalculated values, which represent a range of site-specific values for Indian Point. *See* Tr. 2103:11-2104:25 (Lemay). The final column shows the impact of varying that input parameter on OECR. *Id.* The second to last row of the table shows the impact on OECR when all the sitespecific input values are used. *Id.* 

Parameter	Description	Entergy's value	ISR's proposed input value		ISR's calculated OECR (\$/yr) and ratio <sup>a</sup>	
			Minimum	Maximum	Minimum	Maximum
CDNFRM (DF=3)	Per capita cost of nonfarm light decontamination	\$5,184	\$15,000	\$184,000	3.68E+05	1.18E+06
CDNFRM (DF=15)	Per capita cost of nonfarm heavy decontamination	\$13,824	\$71,000	\$418,000	(1.74)	(5.57)
TIMDEC (DF=3)	Time required for light decontamination	60 d	1 у	15 y	4.43E+05	1.20E+06
TIMDEC (DF=15)	Time required for heavy decontamination	120 d	2 у	30 y	(2.09)	(5.66)
VALWNF	Per capita value of nonfarm wealth (2004 USD)	\$208,838	\$284,189		2.51E+05 (1.18)	
DPRATE	Depreciation rate	20%	20%		2.12E+05 (1)	
DSRATE	Societal discount rate for property	12%	5%	7%	1.87E+05 (0.88)	1.95E+05 (0.92)
POPCST	Per capita cost of long-term relocation	\$8,640	\$10,640	\$49,857	2.23E+05 (1.05)	4.41E+05 (2.08)
FRNFIM	Nonfarm wealth improvements fraction	80%		90%	2.19E+05 (1.03)	
Using all of ISR's proposed input values					6.34E+05 (2.99)	1.47E+06 (6.93)
Notes: <sup>a</sup> The ratio shown in brackets is the ratio of the ISR-calculated OECR to the Entergy-calculated OECR (\$2.12E+05/yr).						

Table 13: Summary of ISR proposed inputs and calculated OECRs (costs in 2005 USD)

NYS000430 at 6, Table 13.

# B. ISR's Sensitivity Analysis Honed in on the Parameters that Most Affect Costs

215. Before evaluating Entergy's MACCS2 inputs and developing ranges of

appropriate site-specific inputs for Indian Point, ISR performed a sensitivity analysis to

determine which MACCS2 input parameters have the greatest effect on economic costs, *i.e.*,

OECR. NYS000242 ISR Report at 9-10; NYS000241 Lemay Initial Test. at 23-27; Tr. 2018:7-18 (Lemay) (explaining the importance of performing a sensitivity analysis); Tr. 2073:14-2074:7 (Lemay) (describing the sensitivity analysis ISR performed).

216. ISR then focused its efforts on evaluating each of these parameters to determine whether Entergy's input value was reasonable for the site-specific conditions at Indian Point. NYS000242 ISR Report at 11; NYS000241 Lemay Initial Test. at 27; Tr. 2075:1-23 (Lemay). ISR's evaluation focused on the buildings, land uses, and population surrounding Indian Point as well as the properties of the types of particles released during a severe nuclear reactor accident.

217. Although Entergy claims that ISR should have considered not only OECR, but also the changes in PDR (ENT000450 Entergy Test. at 63 (A82) (O'Kula, Teagarden)), as Dr. Lemay explained, the State provided Entergy and NRC Staff with all of the MACCS2 output files, which also contain their population dose results for the calculations of PDR. NYS000420 Lemay Rebuttal Test. at 33. While changes to some input parameters may affect PDR differently than OECR, the change in PDR as calculated in ISR's MACCS2 runs had no appreciable impact on ISR's conclusions because the PDR changed by less than 4%. *Id.* at 33-34.

218. Although NRC Staff argues that ISR's conclusions apply only to Indian Point Unit 2 and ignore differences between Indian Point Units 2 and 3 (NRC000041 Staff Test. at 32-33 (A27, A28) (Bixler)), as Dr. Lemay explains, ISR ran the MACCS2 code for Unit 2 to illustrate how site-specific inputs change the calculated OECR (NYS000420 Lemay Rebuttal Test. at 34-35). Using Unit 2 as an example was reasonable because, despite some differences between Units 2 and 3, the resulting OECR values for Units 2 and 3 are comparable. *Id.* 

# C. ISR's Analysis Used the Same Dose Reduction Factors Entergy Used

219. Dose reduction factor is a MACCS2 input parameter defined as "the effectiveness of the various decontamination levels in reducing dose." NYS000243 MACCS2 User Guide at p. 7-11. The MACCS2 code allows a user to define up to three decontamination levels, but applicants typically chose to define two levels as Entergy has here: light and heavy decontamination. NYS000243 MACCS2 User Guide at p. 7-9; Tr. 1982:16-18 (Teagarden).

220. Entergy used a dose reduction factor of 3 for light decontamination and 15 for heavy decontamination. ENT000450 Entergy Test. at 54, Table 4. *See* Tr. 1998:5-15 (Bixler) ("[y]ou have some finite set of things you can do to decontaminate. You can't -- it may be difficult to achieve a whole graded scale of decontamination factors. You have certain things that you can do that will achieve a lower level of decontamination. You have some other things that maybe would achieve a moderate level, and some things that would achieve a higher level. So, it's up to the user to select those in a reasonable way and assign a cost to them.").

221. The dose reduction factor is the ratio of the radiological dose before decontamination to the dose after decontamination. NYS000243 MACCS2 User Guide at p. 7-11. Thus, a dose reduction factor of 3 means the population dose is 1/3 of what it would have been without decontamination, *i.e.*, a 67% decrease in population dose. *Id.* And a dose reduction factor of 15 means the dose is 1/15 of what it would have been, *i.e.*, a 93% decrease. *Id.* 

222. As Dr. Lemay explained, "Light decontamination uses techniques that will lead to a dose reduction factor of three. And these have been lumped together. . . . [W]e are talking about things like vacuuming, cleaning. You have to understand that contamination is very fine radioactive dust that is not visible to the naked eye." Tr. 2105:22-2106:3 (Lemay).

223. Dr. Lemay also explained that moderate and heavier decontamination would include methods like removal of roofing and landscape material, and emptying interiors of buildings of all removable contents including items such as desks, chairs, and personal items. NYS000242 ISR Report at 12; NYS000242 Lemay Initial Test. at 28-29.

224. Dose reduction factor is similar to, but not the same as the decontamination factor. NYS000242 ISR Report at viii, 11-12; NYS000241 Lemay Initial Test. at 17. Tr. 2301:23-25 (J. McDade/Teagarden).

225. Entergy (ENT000449 Entergy SOP at 30-31) and NRC Staff (NRC000039 NRC Staff's Initial Statement of Position on Consolidated Contention NYS-12C (Mar. 30, 2012 ("Staff SOP") at 10) raise various points about differences between dose reduction factor and decontamination factor. This discussion is irrelevant because ISR used the same dose reduction inputs, *i.e.*, 3 for light decontamination and 15 for heavy decontamination, as Entergy in its analysis.<sup>45</sup> NYS000420 Lemay Rebuttal Test. at 30-31; Tr. 2304:21-2305:5 (J.

Wardwell/Teagarden).

226. Decontamination cost parameters, including nonfarm decontamination cost and decontamination time, are associated with the dose reduction factor selected. NYS000242 ISR Report at 12-13; NYS000241 Lemay Initial Test. at 29-30. This means that the nonfarm decontamination cost and decontamination time must correspond to the costs and time it takes to

<sup>&</sup>lt;sup>45</sup> Additionally, NRC Staff takes issue with the proposition that decontamination factors greater than 10 cannot be achieved without full demolition. NRC000039 Staff SOP at 10. Whether or not this is true does not affect ISR's conclusion, but NRC Staff misquotes the State. The ISR Report states that cited references suggest "decontamination of an entire building to a level greater than 10 *may not be possible*[,]" not that it definitively is not possible. ISR Report at 12 (citing NYS000249, NYS000250, NYS000251) (emphasis added). Furthermore, while the references cited in the ISR Report demonstrate that using a decontamination factor of 15 is likely not reasonable, ISR's analysis used the same decontamination factors as Entergy for purposes of comparison. NYS000420 Lemay Rebuttal Test. at 30-31; Tr. (J. Wardwell/Teagarden).

carry out light and heavy decontamination following a severe accident. *Id.* As discussed in the following sections, Entergy's inputs fail to do so.

# D. The Nonfarm Decontamination Costs (CDNFRM) Entergy Used and Staff Accepted Are Not Rationally Related to Indian Point

227. Neither Entergy nor NRC Staff supplied a rationale for reliance on Sample

Problem A for CDNFRM. NYS000242 ISR Report at 12-13; NYS000241 Lemay Initial Test. at

30. ISR developed a methodology and four approaches to calculate site-specific

decontamination cost (CDNFRM) input values for Indian Point as a way of showing how site-

specific values could vary from values that rely upon Sample Problem A values. To obtain site-

specific decontamination costs in dollars per person (which are the units MACCS2 requires), Dr.

Lemay explains that "ISR calculated the decontamination cost for the 50 mile area and we

divided by the population by the 50 mile area. So we get an average cost per person." Tr.

2137:15-18 (Lemay).<sup>46</sup> The results is "a site-specific value that is based on the kind of mix of

building and building density that we observe in New York" as opposed to the Sample Problem

A value "that nobody knows where it comes from." Tr. 2137:21-25 (Lemay).

228. ISR described its methodology and approaches for determining CDNFRM in the

ISR expert report:

(1) ISR divided the spatial grid defined in the Entergy MACCS2 site input file into two discrete areas within the 50 mile radius of IP for the purpose of evaluation. ISR called these the "NYC Metropolitan Area" and "the areas outside of the NYC Metropolitan Area."

(2) For each of these two areas, ISR calculated the costs of light and/or heavy decontamination using the per square kilometer decontamination costs obtained from the following four sources:

<sup>&</sup>lt;sup>46</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 23.

- Approach A is based on data from Sandia *Site Restoration*<sup>47</sup> as modified by Luna's *Survey of Costs*<sup>48</sup> which describe the results from U.S. plutonium dispersal tests;
- Approach B relies upon data from Barbara Reichmuth's presentation of results from radiological dispersal device economic consequence analysis in the U.S.;<sup>49</sup>
- Approach C uses CONDO,<sup>50</sup> a decontamination cost estimation tool from the United Kingdom ("UK") National Radiological Protection Board, and its database;
- Approach D relies upon data from RISO<sup>51</sup> presenting results from decontamination analyses completed by RISO National Laboratory in Denmark.

(3) For each approach, ISR calculated a single total cost for the 50-mile radius area surrounding the IP power plant for light and/or heavy decontamination;

(4) For each approach, ISR divided the total cost by the total population, as reported by Entergy, in the 50-mile radius area surrounding the IP power plant to obtain a per capita cost for both light and heavy decontamination; and

(5) ISR updated the per capita cost for each approach to 2005 dollars, using the Consumer Price Index.

NYS000242 ISR Report at 13-14, Figure 3 (methodology flowchart); NYS000241 Lemay Initial

Test. at 31-32.

<sup>&</sup>lt;sup>47</sup> NYS000249 (D. Chanin & W. Murfin, SAND96-0957, *Site Restoration: Estimation of Attributable Costs From Plutonium-Dispersal Accidents* (May 1996)) ("Sandia Site Restoration").

<sup>&</sup>lt;sup>48</sup> NYS000255 (R. Luna, H. Yoshimura & M. Soo Hoo. *Survey of Costs Arising from Potential Radionuclide Scattering Events*, WM2008 Conference, Feb. 24-28, 2008, Phoenix AZ) ("Luna *Survey of Costs*").

<sup>&</sup>lt;sup>49</sup> NYS000256 (B. Reichmuth, S. Short, T. Wood, *Economic Consequences of a Rad/Nuc Attack: Cleanup Standards Significantly Affect Risk*, Pacific Northwest Laboratory, Working Together Conference, Apr. 28, 2005, Boston, MA.) ("Reichmuth").

<sup>&</sup>lt;sup>50</sup> NYS000250 (*CONDO: Software for estimating the consequences of decontamination options, Report for CONDO version 2.1*, T Charnock, J Brown, AL Jones, W Oatway and M Morrey, NRPB-W43, May 2003 ("CONDO").

<sup>&</sup>lt;sup>51</sup> NYS000251 (J. Roed, K.G. Anderson, H. Prip. 1995. *Practical Means for Decontamination 9 Years after a Nuclear Accident*. RISO National Laboratory, Roskilde, Denmark. RISO-R-828(EN), Dec. 1995) ("RISO").

229. ISR's calculation of CDNFRM values is presented to show various data sources that could be used to calculate site-specific CDNFRM values. ISR updated its CDNFRM calculations to incorporate comments received in Entergy and NRC Staff's pre-filed submission. *See* NYS000430 at 5, Table 11. Even after incorporating NRC Staff and Entergy comments, no matter what method ISR used, the resulting CDNFRM values was always much higher than Entergy's value based on Sample Problem A. *Id.* at 6, Table 13.

230. For every approach, the range of decontamination costs ISR calculated by using the four approaches, described in more detail below, are much higher than the decontamination costs calculated by Entergy using Sample Problem A. ISR did not expect this result. As Dr. Lemay explained, "I had a team of nuclear engineers working on this independently on each calculation method but when we saw the result, we noticed that none of the bracketed value is lower than the value used by Entergy. In all cases, they seem to be higher. And I was a little surprised by that because I did not expect that result." Tr. 2107:23-2108:4 (Lemay).

231. Because the MACCS2 code restricts decontamination costs (CDNFRM) to a maximum of \$100,000/person, ISR modified the source code to increase the upper bound of CDNFRM to \$2,000,000/person to allow for the greater decontamination costs calculated using the four methodologies discussed below. NYS000242 ISR Report at 22, 24. It is not clear why the MACCS2 code has this limitation, but the limitation is likely related to helping the user identify clerical errors. *See* Tr. 2276:6-12 (Lemay) ("I think they just picked a value and said well, part of the reason for [a] bounding value is to make sure that if the user makes a typo, and types the wrong number. We're trying to help him locate that mistake. . . . I don't think it has any impact on the model."); Tr. 2275:6-13 (J. Wardwell/Bixler) ("That limitation [on CDNFRM inputs], I would believe, is somewhat more related to just reasonable bounds, that the original

authors of the code thought should be applied to those parameters, and not that they necessarily would modify the functionality of the code itself."). ISR's modest modification did not alter the algorithms used by the MACCS2 code. *Decl. of Dr. François J. Lemay* at ¶ 15 (Feb. 17, 2012) (ML12048B413). The modification was necessary to evaluate the effect site-specific decontamination cost inputs would have on OECR and, thus, was reasonable.

### 1. Approach A: *Site Restoration/*Survey of Costs

232. Using approach A, *Site Restoration/Survey of Costs*, ISR modified the cost of decontamination values from Sandia's *Site Restoration* using information from Luna's *Survey of Costs* and U.S. Census data to calculate CDNFRM. NYS000242 ISR Report at 16; NYS000241 Lemay Initial Test. at 34. *Survey of Costs* used the Sandia *Site Restoration* data and analysis for Albuquerque, New Mexico, as a basis for calculating the cost of cleanup of the hyper-dense population area of New York City. NYS000241 Lemay Initial Test. at 34. ISR modified the analysis in *Survey of Costs* and *Site Restoration* using U.S. Census data to better account for the actual building density.<sup>52</sup> *Id.* The methodology, analysis, and results are explained in detail in the ISR Report and Dr. Lemay's testimony. NYS000242 ISR Report at 16-18; NYS000241 Lemay Initial Test. at 34-40.

233. Decontamination following any radioactive release will vary considerably in cost and time depending on level of decontamination (light or heavy) and the radionuclide involved. NYS000242 ISR Report at 17-18; NYS000241 Lemay Initial Test. at 36-40. *Site Restoration* used historical data from various actual releases of plutonium and other radionuclides to derive the costs of a cleanup following plutonium dispersal in Albuquerque. *Id.* But cesium is the

<sup>&</sup>lt;sup>52</sup> Consequently, in NRC Staff's analysis of *Site Restoration* in the FSEIS ignores the fact that New York City has a much higher building density than Albuquerque. NYS000242 ISR Report at 40; NYS000241 Lemay Initial Test. at 69.

radionuclide of primary concern in the event of a severe nuclear reactor accident. *Id.* Unlike the larger-sized plutonium particles, the small-sized cesium particles are soluble and have the ability to ion exchange with sodium and potassium present in materials such as concrete. *Id.* Thus, cesium will migrate rapidly in porous materials such as concrete. *Id.* This migration increases with time and, therefore, decontamination of cesium is more difficult as more time passes after the release. *Id.* 

234. Because *Site Restoration* derived the costs of a cleanup following a plutonium dispersal, ISR determined that it needed to adjust the *Site Restoration* values to account for the fact that cesium, and not plutonium, would be the radionuclide of primary concern in a severe nuclear accident at Indian Point. *Id.* The details of this analysis are set forth in the testimony and report. *Id.* 

235. In the FSEIS, NRC Staff discusses the difference between plutonium and cesium, noting that plutonium is an alpha emitter that is more difficult and expensive to characterize and verify in the field than gamma emitters like cesium. NYS00133I FSEIS Appendix G at G-24. Also, NRC Staff states that plutonium is primarily an inhalation hazard with a much longer half-life than cesium, which is primarily an external health hazard. *Id.* Thus, NRC Staff claims the need for evacuating the public is much greater with plutonium because if inhaled, the health consequences can be severe. *Id.* 

236. ISR points out that, by discussing the expense associated with detecting and characterizing plutonium following a severe accident, NRC Staff implies that radionuclide detection and characterization is a large part of the decontamination costs. NYS000242 ISR Report at 36-37; NYS000241 Lemay Initial Test. at 65-66. ISR asserts that, while detection and characterization of plutonium may be more costly than for cesium, it comprises a small part of

decontamination costs, less than 1% of the decontamination costs, according to *Site Restoration*. *Id.* The main cost of decontamination is not radionuclide detection/characterization, but decontamination, removal, transport, and storage of waste and/or building demolition. Lemay Initial Test. at 65-66. Additionally, NRC Staff's discussion of the need for evacuation is inappropriate because public evacuation and the associated costs are not part of the MACCS2 code's assessment of economic costs. *Id.* The SAMA analysis includes the costs of longer-term dose reduction measures such as permanent relocation and decontamination. *Id.* It is the cost of these measures that should be assessed for plutonium and cesium. *Id.* 

237. ISR also addresses NRC Staff's claim in the FSEIS that, based on work done by Sandia, the activities in *Site Restoration* required to support clean-up of moderate plutonium contamination align more closely with clean-up activities for heavy cesium contamination. NYS000242 ISR Report at 37-39; NYS000241 Lemay Initial Test. at 66-68. In support of this claim, Sandia uses an example of decontaminating a road, claiming that complete removal of a road is needed for plutonium, but not for cesium decontamination. *Id.* After a detailed explanation, ISR concludes that any effective decontamination technique will result in some removal of cesium, plutonium, and any other radionuclides—all of which are present, albeit plutonium in small quantities, after a severe nuclear reactor accident. *Id.* ISR explains that, using the example of road decontamination presented by Sandia, if complete removal of the road is justified for plutonium, it will also result in the full decontamination of cesium. *Id.* 

### 2. <u>Approach B: Reichmuth</u>

238. Using approach B, ISR determined decontamination costs using current U.S. data from studies conducted by Barbara Reichmuth, Senior Research Engineer at Pacific Northwest National Laboratory. NYS000242 ISR Report at 18-19; NYS000241 Lemay Initial Test. at 41-

42. Reichmuth's studies were commissioned by the U.S. Department of Homeland Security and the U.S. EPA to identify the economic extent of the threat of a cesium-based radiological dispersal device ("RDD"), and to determine the efficacy of novel decontamination methods on cesium-contaminated surfaces. *Id.* Reichmuth has conducted many of these studies evaluating the economic consequences of nuclear weapons and RDD effects on major metropolitan centers in the United States and Canada, including New York City and Vancover. *Id.* 

239. ISR determined that Reichmuth's work with RDDs involving cesium can be used to determine a range of CDNFRM values for Indian Point. NYS000242 ISR Report at 18-19; NYS000241 Lemay Initial Test. at 41-42. The details of ISR's analysis are set forth in the ISR Report and Dr. Lemay's testimony. *Id*.

#### 3. <u>Approach C: CONDO</u>

240. Using approach C, ISR derived decontamination costs using CONDO, a software tool for estimating the consequences of decontamination options. NYS000242 ISR Report at 19-21; NYS000241 Lemay Initial Test. at 42-45. CONDO was developed by the UK National Radiological Protection Board and is linked to a database that supplies decontamination levels and associated cost and labor values for the decontamination of cesium and plutonium using various decontamination techniques. *Id*.

241. At the hearing, Dr. Lemay testified that "The CONDO method is very appropriate. It has been used in the UK. It is specifically for reactor accident. It includes a computer code that Entergy could run on its own data to create a site-specific decontamination cost just like we did. So CONDO is definitely probably the most appropriate method in this whole set of data." Tr. 2108:8-14 (Lemay).

242. CONDO can be used to develop site-specific values, as Dr. Lemay explains:

In the CONDO program, you enter the density of population. You can enter the density of building, sector by sector. And you can also enter the mix of buildings in each sector. Are we talking about high rise or single home residential dwellings? Are we talking about industrial building? What's the fraction of the streets? What's the fraction of parks and recreational areas? And the code can take all this information that's site-specific and look at all the [decontamination] techniques that you apply specifically for this type of building or surface area or land use and come up with the cost that's representative for this area.

# Tr. 2111:6-18 (Lemay).

243. The ISR report and Dr. Lemay's testimony describe how ISR used CONDO to calculate CDNFRM values for the New York City Metropolitan Area, which is comprised of both urban and hyper-urban population densities and areas outside the New York City Metropolitan Area, which is comprised of both urban and suburban population densities. NYS000242 ISR Report at 19-21; NYS000241 Lemay Initial Test. at 42-45; Tr. 2149:25-2151:2 (Lemay). In sum, using CONDO, ISR obtained a range of decontamination values for light decontamination (Entergy's does reduction factor of 3), and heavy decontamination, Entergy's (dose reduction factor of 15). *Id.* The values obtained from CONDO are for decontamination of cesium and were derived using population densities and decontamination techniques relevant to the remediation of an accident at Indian Point. *Id.* 

# 4. <u>Approach D: RISO</u>

244. Using approach D, ISR repeated the methodology used for the CONDO approach, but substituted the costs reported by the Riso National Laboratory ("RISO") for the costs reported in the CONDO dataset. NYS000242 ISR Report at 21-22; NYS000241 Lemay Initial Test. at 46-48. Like CONDO, the values ISR obtained from RISO are for decontamination of cesium and were derived using population densities and decontamination techniques relevant to the remediation of an accident at Indian Point. *Id.* All of the RISO decontamination techniques are only recommended for light decontamination, so ISR calculated a CDNFRM input value for

light decontamination. *Id.* Details concerning the RISO method and calculations are provided in the ISR Report and Dr. Lemay's testimony. *Id.* 

# 5. <u>Response to Entergy and NRC Staff Criticisms of ISR's Approaches to</u> <u>Calculating CDNFRM</u>

245. Instead of explaining why it is reasonable to rely upon Sample Problem A in light of the State's evidence, Entergy and NRC Staff focus their efforts on critiquing ISR's analysis of decontamination costs.

246. As described below and in further detail in Dr. Lemay's testimony, most of Entergy and NRC Staff's criticisms do not alter ISR's overall conclusion. In some instances, however, ISR re-ran its calculations to determine whether the ultimate calculation of OECR would change based on the assumptions Entergy and NRC Staff provided in their testimony. NYS000420 Lemay Rebuttal Test. at 35-37; Tr. 2151:3-7 (Lemay) (explaining that relevant Entergy and NRC Staff comments were incorporated into ISR's rebuttal testimony because "I'm actually interested to get as close as possible to the truth."). ISR concluded that, even when these assumptions were taken into consideration, Entergy has still underestimated OECR by at least a factor of 7. NYS000420 Lemay Rebuttal Test. at 3.

247. In sum, Entergy and NRC Staff miss the fundamental issue—failure to develop site-specific costs estimates is unreasonable when site-specific inputs are available from many data sources other than NUREG-1150.

## a. <u>Sandia Site Restoration/Reichmuth</u>

248. Entergy and NRC Staff criticize the State for relying on studies and reports that deal with the release from a nuclear weapons accident or "dirty bomb," in the Sandia *Site Restoration* report and the Reichmuth papers. *See* ENT000449 Entergy SOP at 28; ENT000450 Entergy Test. at 13 (A26) (O'Kula, Teagarden, Potts); NRC000039 Staff SOP at 10-12. But as

the ISR Report and Dr. Lemay's testimony explain, these studies are relevant sources of data.

NYS000242 ISR Report at 16-19; NYS000420 Lemay Rebuttal Test. at 34-42.

249. At the hearing, Dr. Lemay admitted that Sandia Site Restoration is not a perfect

data source, but that it is a robust source of important information:

JUDGE KENNEDY: And is that reference [Sandia *Site Restoration*] applicable to reactor-type accidents, in your opinion?

DR. LEMAY: It's not ideal, but it's a very well put together description of decontamination techniques. It describes in great detail how you go about assessing the cost of decontamination by looking at buildings, looking at streets, and it explains how you do that. Obviously, it would be ideal if it was dealing with decontamination activities near Indian Point, but it's not.

Tr. 2012:11-20 (J. Kennedy/Lemay);<sup>53</sup> see also Tr. 2108:5-8 (Lemay) ( "The site restoration

report gives a very complete and very descriptive way of calculating the cost of decontamination

but it is for plutonium so that is a weakness of that method.").

250. The detailed, valuable information from Sandia Site Restoration can be utilized,

as ISR did, to benchmark the Sample Problem A values Entergy used. Tr. 2012:21-2013:24 (J.

Kennedy/Lemay).

251. ISR was always straightforward about the nature of Sandia Site Restoration,

which used historical data (from various actual releases of plutonium and other radionuclides) to derive the costs of a cleanup following plutonium dispersal in an urban area." NYS000242 ISR Report at 16. In rebuttal pre-filed testimony, Dr. Lemay explained that the ISR Report responds directly to NRC Staff's arguments regarding cesium and plutonium (NRC000039 Staff SOP at 11) and explains why NRC Staff's dismissal of Sandia *Site Restoration* is untenable, especially in light of NRC Staff and Entergy's chosen alternative, Sample Problem A. NYS000420 Lemay

<sup>&</sup>lt;sup>53</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 22.

Rebuttal Test. at 39-40. Moreover, ISR explains how Reichmuth is an important data source because it actually addresses decontamination in major metropolitan centers in the U.S. NYS000242 ISR Report at 18.

252. *Site Restoration* and Reichmuth data are appropriate sources for radiological decontamination costs, even though the data are not from a severe nuclear reactor accident. NYS000242 ISR Report at 17 ("Because *Site Restoration* derived the costs of a cleanup following a plutonium dispersal, ISR determined that an appropriate multiplicative factor for the overall costs shown for plutonium in Table 2 is required to estimate the costs of the decontamination of cesium, which is the radionuclide of primary concern in a severe nuclear accident."); NYS000242 ISR Report at 18-19 ("While the mechanisms for dispersal differ between a reactor accident and an RDD event, the key factor in determining cost is removal of cesium from porous substances, such as concrete, found in urban areas."). A reasonable SAMA analysis would have considered references like *Site Restoration* and Reichmuth.

### b. <u>RISO</u>

253. With respect to RISO, Entergy alleges that ISR erred in its application of decontamination techniques and costs. ENT000449 Entergy SOP at 37-40. A detailed explanation of the RISO approach was provided in the ISR Report. NYS000242 ISR Report at 19-22. Dr. Lemay's testimony rebuts, in specific and technical detail, Entergy's allegations and explains why the use of RISO was sound. NYS000420 Lemay Rebuttal Test. at 42-47.

## c. <u>CONDO's Hyper-Urban Designation</u>

254. Generally, Dr. Lemay's testimony rebuts, in specific and technical detail, Entergy's allegations and explains why the use of CONDO methodology was sound. NYS000420 Lemay Rebuttal Test. at 42-47. Furthermore, as discussed above in VIII., the

document uncovered by the State which discusses NRC's site-specific analysis for Indian Point (Tawil 1990) uses a methodology called DECON, which is very similar to the CONDO methodology. *Id.* at 26.

255. Entergy alleged that the State fails to recognize that the SAMA analysis "estimates average consequence results for the entire 50-mile radius region around the IPEC site ..., not just the comparatively small region of New York City." ENT000449 Entergy SOP at 27-28. Entergy's criticism is misplaces. As explained in more detail in Dr. Lemay's testimony, ISR applies different costs to the relatively small area that represents New York City than it does to the remainder of the 50-mile radius of Indian Point. NYS000420 Lemay Rebuttal Test. at 32-33. At the hearing Dr. Lemay explained to the Board that "[]he metropolitan area of New York City is four percent [of the 50-mile radius]. The semi-urban area is 76 percent. And the other 20 percent accounts for water and farmland that's not included in the [nonfarm decontamination] calculation." Tr. 2143:3-6 (Lemay).<sup>54</sup>

256. In his redirect testimony at the hearing, after the State's opportunity for crossexamination was complete, Dr. O'Kula raised for the first time a new criticism of the hyperurban category ISR used in its CONDO approach:

MS. STOLLEY: So one would *assume* that they could use [CONDO] for analyzing a situation in London, correct?

DR. O'KULA: It would be -- *not knowing specifically the building density and population* exactly to the tee in London, but it would be *my assumption* that it should work for a situation such as London.

MS. STOLLEY: And there is no hyper-urban category in the CONDO code, correct?

<sup>&</sup>lt;sup>54</sup> Although New York City represents a smaller percentage of the 50-mile radius, it is important to note that, for the area surrounding Indian Point, the wind blows predominantly from the north to the south. Tr. 2294:1-20 (J. Wardwell/Lemay/ O'Kula).

DR. O'KULA: As far as I can tell from the CONDO documents, there was not a defined density that was used as hyper-urban.

MS. STOLLEY: And presumably, if it did exist, it would be used in an analysis of a plant accident outside of London, which is comparable in size to New York City, right?

DR. O'KULA: That would be *my understanding*.

Tr. 2368:2-20 (Stolley/O'Kula) (emphasis added).

257. There is no evidence in the record to show whether CONDO was used for London let alone evidence to show how CONDO would be used for London. As such, Dr. O'Kula's testimony consists on unsupported assumptions and conclusions, and should be afforded no weight.

# d. <u>CONDO and Conservation of Mass</u>

258. Mr. Jones argued that ISR's use of CONDO does not follow the rules of

conservation of mass, and essentially decontaminates more radiation than is deposited on buildings. *See* Tr. 2116:20-2118:12, 2118:25-2119:20 (Jones). Mr. Jones argues that "the reason the application of [CONDO] did not conserve mass is that buildings were assumed to be decontaminated at a heavy decontamination level without the consideration of dispersion of the contaminant, you know, the equalization of the contaminant around all the sides, interior and exterior of the building." Tr. 2147:21-2148:2 (Jones); *see also* Tr. 2124:7-14 (Bixler); Tr: 2156:1-4 (O'Kula).

259. As explained in more detail below, ISR was justified in using the CONDO methodology to estimate the decontamination costs of interior and exterior surfaces of buildings because decontamination of buildings is more complicated, and costlier, than decontamination of a field or residential dwellings; and furthermore, in reality there is more to decontaminate in an

urban setting because the deposition velocity is greater and, thus, more contamination is

deposited over urban areas.

260. Dr. Lemay explained how decontamination of a building would likely occur in the real world:

I would argue that if you send a crew of people in white suits to say "Go decontaminate this building," they would probably apply some technique uniformly first. And then they would check if they've left hot spots of contamination and go back to clean those. I don't think they will go square centimeter by square centimeter to determine which techni[que] they're going to use in that particular wall. So I think that the approach of saying we have contamination, we have to send crews in, they will do their job and then this has a cost is reasonable. And that's what people have done when they've tried to come up with these costs.

Tr. 2133:19-2134:7 (Lemay); *see also* NYS000420 Lemay Rebuttal Test. at 46 ("It is more likely that bulk decontamination, such as hosing or vacuuming, would take place first followed by verification for hot spots. Our assumption is reasonable given the likely operational efforts and strategies which would be employed in the event of a severe accident.").

261. With respect to deposition velocity, Dr. Lemay then explained that the deposition velocity, also called the "transfer coefficient[,] depends on the chemistry of the contaminant. It depends on the type of surface. It depends on the roughness of the topography. And it depends on the size of the particles." Tr. 2132:15-20 (Lemay); *accord* Tr. 2144:4-7 (Bixler) ("The deposition onto the ground as in part explained by Dr. Lemay you have a transfer coefficient called a deposition velocity and you have a surface area."); *see also* ENT000472 at 791-92 ("Since the dry deposition velocity . . . depend[s] on the type of surface, . . . . surface classification . . . including '[u]rban areas', might be very suitable for the calculation of the dry deposition velocities."); Tr. 2132:5-14 (Lemay); Tr. 2267:4-13 (Lemay); Tr. 2361:2-9 (Lemay). The following table from NYS000244 also demonstrates that surface roughness, and thus deposition velocity, is greater for urban areas:

Surface Type	Surface Roughness Length z <sub>0</sub> (cm)	Roughness Factor (Eqn. 10)	Scaling Factor for Dilution Factor
Tall Grass, Cropland	10-15	1.27 - 1.38	0.79 - 0.72
Countryside	30	1.58	0.63
Suburban	100	2.02	0.50
Forests	20-200	1.46 - 2.32	0.68 - 0.43
Urban	100 - 300	2.02 - 2.51	0.50 - 0.40

Table A-4. Surface Roughness Lengths for Characteristic Surface Types (See Jow (1990) – Volume 2. MELCOR Accident Consequence Code System (MACCS), Model Description, NUREG/CR-4691, SAND86-1562, Sandia National Laboratories, Albuquerque, NM (1990).

NYS000244 at A-20. Even the SOARCA analysis recognized this fact. See, e.g., ENT000457

(SOARCA Volume 2: Surry Integrated Analysis) at 330-31. The fact that the deposition velocity

increases with surface roughness has been known to NRC for a long time.

262. That the deposition velocity is greater over urban areas, and more contamination

is deposited over urban areas, justifies ISR's use of CONDO to decontaminate multiple building

surfaces-there's just more contamination to decontaminate relative to the average value that

MACCS2 calculates:

MACCS uses an average deposition velocity to contaminate the ground. That's a single value that is average. But it's a known fact that deposition [] velocity increases with surface roughness. So as the surface goes from a plane of water, to a plowed field, to a forest, to a city, the deposition velocity increases. So we use an average, which is appropriate on average. *That means that in some areas, the actual contamination would be lower than the average, and in the cities, it would be higher than the average. So although MACCS uses that uniform average value, we're justified to spread the contamination, because that's what's going on, and the actual value would be higher.* And that's just the way MACCS works. It's using this average, and it is understood by everybody using it that that's an approximation. In some areas, it will overestimate; in some area it will underestimate, and it comes out in the wash.

Tr. 2264:9-2265:4 (Lemay) (emphasis added);<sup>55</sup> *see also* Tr. 2361:8-11 (Lemay) ("in the case of the urban area we tend to get more deposition, more contamination. This is not captured by MACCS, but we can use it when we distribute the activity over many surfaces [in CONDO]."); *see also* Tr. 2361:12-15 (Lemay) ("we cannot try to make MACCS do things that it was not meant to do. But we can use our knowledge of what is going on to interpret the results."); Tr. 2265:10-17 (Lemay); Tr. 2357:23-2358:10 (Lemay); Tr. 2359:20-2361:15 (Lemay/Stolley).

263. In conclusion, ISR's use of the CONDO methodology did not violate mass balance in the MACCS2 code and, in fact, is consistent with realistic deposition velocities over urban areas.

# E. The Decontamination Times (TIMDEC) Entergy Used and NRC Staff Accepted Are Not Rationally Related to Indian Point

264. After developing approaches to calculate site-specific values for CDNFRM, ISR evaluated the next sensitive MACCS2 input parameter related to decontamination costs: Decontamination Time or TIMDEC. By comparing Entergy's inputs to two actual severe accidents—Fukushima and Chernobyl—ISR determined that Entergy's TIMDEC inputs are unreasonable estimates of the time it would take to decontaminate following a severe accident at Indian Point.<sup>56</sup> NYS000420 Lemay Rebuttal Test. at 3; NYS000241 Lemay Initial Test. at 52.

265. Dr. Lemay explains, "The accident at Fukushima gives us the most recent information available on the timeline and the magnitude of decontamination efforts following a severe accident." NYS000420 Lemay Rebuttal Test. at 49; *see also* Tr. 2182:3-16 (Lemay). Although decontamination following the Fukushima nuclear accident has barely begun, some

<sup>&</sup>lt;sup>55</sup> This testimony reflects corrections to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 26.

<sup>&</sup>lt;sup>56</sup> See NYS000264, NYS000265, NYS000266, NYS000267, NYS000268, NYS000269, NYS000428, NYS000263.

estimates suggest that the decontamination could last for decades. NYS000241 Lemay Initial Test. at 53. According to reports, full-scale decontamination for the outer edges of the plume deposition began one year after the accident. NYS000420 Lemay Rebuttal Test. at 13. Since it is on the outer edges of the plume deposition, it is representative of light decontamination. *Id.* Amongst other things, delays have been caused by the lengthy time it has taken to develop a decontamination plan, which is dependent on detailed radiation surveys and procurement of suitable and efficient decontamination equipment and materials, and by the time it has taken to gain approval of the supplementary budget by the government. *Id.* Another reason for the delay is the need to secure approval from the local communities for storage sites for decontamination waste. *Id;* NYS000265. In fact, it has taken one year to finalize plans and budgets for remediation efforts in the Fukushima Prefecture. NYS000420 Lemay Rebuttal Test. at 41.

266. These delays would be expected following a severe accident at IP and have nothing to do with the direct damage caused by the Tsunami.<sup>57</sup> NYS000420 Lemay Rebuttal Test. at 49; Tr. 2205:3-14 (J. McDade/Lemay).

267. For Chernobyl, large-scale decontamination of the area affected by the accident terminated four years after the accident. NYS000242 ISR Report at 24; NYS000241 Lemay Initial Test. at 54.

268. It is difficult to develop a precise estimate of the time it would take to decontaminate a large urban area after a severe nuclear accident, given the fact that the given estimates that the Fukushima clean-up could last several decades and Chernobyl clean-up was

<sup>&</sup>lt;sup>57</sup> At the hearing, Mr. Jones pointed out the costs associated with clean up following Fukushima in NYS000428. Tr. 2206:25-2207:14 (Jones). This discussion, however, is irrelevant because ISR did not rely upon Fukushima data for decontamination costs. Tr. 2207:25-2208:10 (Jones). ISR only relied upon Fukushima data for decontamination time, which is separate from decontamination costs. *See id.*
stopped after four years. NYS000241 Lemay Initial Test. at 54-55. The TIMDEC parameter represents the average time from evacuation of a population to return to their original home in a given grid element. NYS000420 Lemay Rebuttal Test. at 50. "[I]t doesn't matter if the people are away because they were temporarily relocated, because decontamination took time, or because there was interdiction following the decontamination. Whatever the cause of the delay for people returning to their house, that's what drives the cost associated with TIMDEC." Tr. 2208:4-10 (Lemay); see also Tr. 2240:10-15 (Teagarden). It is possible that within that grid element, some people will return to their property more quickly than TIMDEC, and that decontamination efforts may continue long after TIMDEC. NYS000420 Lemay Rebuttal Test. at 50; Tr. 2181:5-16 (Lemay).<sup>58</sup> Given the large uncertainty in determining this time, and in order to assess the impact of longer decontamination times more generally, ISR initially calculated the OECR using a range of 2 to 15 years for light decontamination and a range of 4 to 30 years for heavy decontamination. NYS000242 ISR Report at 24-25; NYS000241 Lemay Initial Test. at 54-55. After reviewing Fukushima data that was released after the State's initial filings, ISR adjusted its TIMDEC ranges to 1 to 15 years for light decontamination and 2 to 30 years for heavy decontamination. NYS000420 Lemay Rebuttal Test. at 49-50; NYS000430 at 6, Table 13; Tr. 2205:20-2206:5 (Lemay).

269. The impact of changing TIMDEC alone is striking. Changing decontamination time to 1 year for light decontamination and 2 years for heavy decontamination—while using Entergy's values for all other inputs—more than doubles the OECR. NYS000430 at 6, Table 13; Tr. 2181:23-25 (Lemay).

<sup>&</sup>lt;sup>58</sup> This testimony reflects a correction to the transcript adopted by the Board. *See* Dec. 27, 2012 Board Order at 24.

270. The MACCS2 code limits decontamination times to a maximum of one year. NYS000242 ISR Report at 24; NYS000241 Lemay Initial Test. at 54. Thus, ISR had to modify the source code to allow for the likelihood that decontamination would take longer than the values from Sample Problem A and longer than one year. *Id;* Tr. 2268:17-2269:2 (Lemay). ISR's modest modification did not alter the algorithms used by the MACCS2 code. *Decl. of Dr. François J. Lemay* at ¶ 15 (Feb. 17, 2012) (ML12048B413). The modification was necessary to evaluate the effect site-specific decontamination time inputs would have on OECR and, thus, was reasonable.

271. Although Dr. Bixler could not cite any documentation that explains where the MACCS2 code's limitations on TIMDEC (and CDNFRM discussed in X.D. above) come from (Tr. 2272:24-2273:3) (J. Wardwell/Bixler)),<sup>59</sup> he took issue with ISR's modifications to the MACCS2 code. Both NRC Staff and Entergy argue that the discussion of decontamination time in ISR's report is inconsistent with the intention of the MACCS2 decontamination model. NRC000039 Staff SOP at 13; ENT000449 Entergy SOP at 31-33. ISR, however, explains why it is reasonable to look at a range of values for decontamination time based on real-world experience with actual severe accidents such as Fukushima and Chernobyl. NYS000420 Lemay Rebuttal Test. at 50. For example, ISR examined the current experience in the Fukushima Prefecture and determined it is reasonable that the minimum time between evacuation and returning home is one year for areas requiring light decontamination and two years for areas requiring heavy decontamination. *Id.* at 51.

<sup>&</sup>lt;sup>59</sup> Dr. Bixler did agree that a one year time frame is within the timeframes the MACCS2 code can consider. Tr. 2202:2-5 (J. Kennedy/Bixler).

272. What is not reasonable is for Entergy and NRC Staff to ignore real-world experience in favor of the Sample Problem A values of 60 days for light and 120 days for heavy decontamination following a severe accident. The Sample Problem A values in NUREG-1150 create an unrealistic decontamination scenario and there is no justification for Entergy and Staff's use of those values at Indian Point.

### F. The ISR Report Discloses Flaws in Other CHRONC Parameters

273. The ISR Report and Dr. Lemay's testimony discuss other input variables that should be adjusted to account for the specifics of Indian Point and the radionucildes that would be released during a severe accident at Indian Point. NYS000242 ISR Report at 25-30; NYS000241 Lemay Initial Test. at 55-62.

274. One such input parameter is the value of nonfarm wealth, for which Entergy erroneously relied in part upon non-Consumer Price Index adjusted 1997 data, and another is the per capita cost of long-term relocation, which assumes too short an unemployment period. NYS000241 ISR Report at 25-26; NYS000241 Lemay Initial Test. at 55-60. Tr. 2212:4-2214:16 (J. Wardwell/Lemay) (discussing value of nonfarm wealth (VALWNF) and per capita cost of long-term relocation (POPCST).

275. Entergy's use of Sample Problem A inputs other than CDNFRM and TIMDEC sometimes led Entergy to overestimate the OECR and sometimes led Entergy to underestimate the OECR. *See* NYS000430 at 6, Table 13. However, nowhere does Entergy or Staff present an adequate justification for the use of values based upon Sample Problem A.

## G. Using Sample Problem A Inputs in Lieu of Site-Specific Inputs Results in a Severe Underestimation of the Costs Associated With a Severe Accident at Indian Point

276. NRC Staff's analysis ignores the requirement that SAMA analyses be sitespecific. For Indian Point, simply relying upon Sample Problem A values adjusted by the Consumer Price Index results in a significant underestimation of the costs associated with a severe accident. By way of example, if all of the ISR proposed inputs are used, the OECR is determined to up to 7 times the currently calculated Entergy value. NYS000340 at 6, Table 13.

277. Thus, Entergy's inputs to the MACCS2 code, as approved by NRC Staff, are unrealistic given current known decontamination data and the complexities of an urban to hyperurban area such as that surrounding Indian Point.

## H. ISR's Analysis Is Not Based on a Worst-Case Scenario

278. Entergy and NRC Staff claim that ISR's analysis improperly used a worst-case, scenario to develop MACCS2 inputs. ENT000449 Entergy SOP at 5; NRC000039 Staff SOP at 13. That claim is incorrect for several reasons, including the fact that Fukushima is well within the range of severe accidents Entergy chose to model for the SAMA analysis. NYS000420 Lemay Rebuttal Test. at 12-15; Tr. 2183:18-20 (Lemay).

279. Although NRC Staff faults ISR for considering the severe accident at Fukushima and claims that it represents a worst-case scenario (NRC000039 Staff SOP at 13), in its SAMA analysis, Entergy itself modeled accidents that would release more radiation than the severe nuclear reactor accident at Fukushima released. NYS000420 Lemay Rebuttal Test. at 13. Of the eight release categories Entergy selected to model in the MACCS2 code, one release category is six to ten times higher than Fukushima and two other categories are similar to Fukushima. *Id.* This is shown in the following bar chart comparing the release categories modeled by Entergy

(*i.e.*, NCF, Early High, Early Medium, etc.) to Fukushima, which is represented by the dotted purple line. *Id.* at  $12.^{60}$ 



NYS000420 Lemay Rebuttal Test. at 12. *See also* Tr. 2184:6-2185:5 (Lemay) (explaining the bar chart).

280. Since Entergy itself—with NRC Staff's approval—has chosen to model severe accidents with greater releases than Fukushima for the Indian Point SAMA analysis, Entergy and NRC Staff have no basis for labeling Fukushima a worst-case scenario and dismissing it as irrelevant to a discussion of appropriate MACCS2 inputs for Indian Point.

<sup>&</sup>lt;sup>60</sup> The source of the Fukushima release used for the bar chart's dotted purple line are NYS00422A-NYS00422C (Reports by the Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company, Chapter 5, Dec. 26, 2011) and NYS000423 (Institut de Radioprotection et de Sûreté Nucléaire, Note d'information, 22 mars 2011).

281. Additionally, the State's analysis does not "combine[] all the worst case scenarios for deposition, clean-up costs, and decontamination times," as argued by NRC Staff. NRC000039 Staff SOP at 8. As Dr. Lemay explained at the hearing, the MACCS2 input values should be "be best estimate appropriate for the release category we're trying to simulate." Tr. 1937:20-21 (Lemay). As explained above in V.B.6., the OECR used in the SAMA analysis is a frequency-averaged cost comprised of the total offsite economic cost for each of the eight release categories, weighted by their respective frequencies. NYS000420 Lemay Rebuttal Test. at 11, 14-15; *see also* Tr. 2178:17-2179:14 (Lemay). Some release categories contribute to OECR more than others and, thus, it is not correct to use input parameters that represent an average of all the release categories, as NRC suggests (Staff Test. at A6d.). Lemay Rebuttal Test. at 15-16. Dr. O'Kula's statement that "The focus by ISR and New York State has been on one release category source term the early high" is simply not the case. Tr. 2153:25-2154:2 (O'Kula).

282. Some of the eight release categories have a relatively small economic impact, while some have a relatively large economic impact. NYS000420 Lemay Rebuttal Test. at 11, 14. Table 5 and the pie chart, reproduced below, show the contribution of each release category to the total OECR for Indian Point Unit 2.

			Offsite	Population	Offsite
		Population	Economic	Dose Risk	Economic Cost
Release	Frequency	Dose	Cost	(PDR)	Risk (OECR)
Mode	(/yr)	(person-sv)*	(\$)	(person-rem/yr)	(\$/yr)
NCF	1.19E-05	4.75E+01	9.98E+04	5.64E-02**	1.18E+00
EARLY HIGH	6.50E-07	6.51E+05	2.05E+11	4.23E+01	(1.33E+05)
EARLY MEDIUM	4.23E-07	1.94E+05	5.87E+10	8.21E+00	2.48E+04
EARLY LOW	1.11E-07	7.93E+04	6.39E+09	8.81E-01	7.10E+02
LATE HIGH	6.88E-07	1.63E+05	4.64E+10	1.12E+01	3.19E+04
LATE MEDIUM	3.43E-06	6.87E+04	6.06E+09	2.36E+01	2.08E+04
LATE LOW	6.43E-07	1.61E+04	6.59E+08	1.04E+00	4.24E+02
LATE LOWLOW	5.82E-08	1.38E+04	5.62E+08	8.04E-02	3.27E+01
		<u> </u>	Totals	8,74E+01	2.12E+05

 Table 5 IP2 Mean PDR and OECR Using Year 2000 Meteorological Data



NYS000420 Lemay Rebuttal Test. at 14-15. *See also* Tr. 2196:14-20 (Lemay) (explaining table and chart).

283. As can be seen from the numbers circled in red and the pie charts, release category "EARLY HIGH" contributes over 60% to the total OECR for IP2 and IP3. "EARLY HIGH," "EARLY MEDIUM," and "LATE HIGH," contribute over 90% to the total OECR. NYS000420 Lemay Rebuttal Test. at 14. On the other hand, release categories "NCF," "EARLY LOW," "LATE LOW," and "LATE LOWLOW" combined contribute less than 1% to the total OECR for IP2 and IP3. *Id*.

284. Accordingly, in the case of Indian Point, because the more severe release categories make the largest contribution to the total OECR, the values for input parameters should more closely align with the accidents that are relatively more severe. NYS000420 Lemay Rebuttal Test. at 15-16; Tr. 2179:18-23 (Lemay).

## XI. NEITHER ENTERGY NOR NRC STAFF ANALYZED THE EFFECTS OF NYS-12C ALONE, OR IN COMBINATION WITH NYS-16B, ON THE SAMA ANALYSIS

285. Neither Entergy nor NRC Staff undertook an analysis to determine the effects that ISR's calculated ranges of reasonable, site-specific input values would have on the SAMA

analysis, (Tr. 2226:22-2227:8 (J. Wardwell/Teagarden)), let alone what effect the combined errors identified in NYS-12C and NYS-16B would have.

286. Entergy did, however, purport to analyze the effect that population flaws discussed in NYS-16B would have on the required SAMA analysis. *See* ENT000006 (G. Teagarden, MACCS2 IP2 Population Sensitivity Case, Jan. 2012); ENT000589 (MACCS2 Sensitivity Analysis for NYS-16 Using Dr. Sheppard's Proposed Data, Oct. 9, 2012).

287. Entergy's analysis focuses on IP2 SAMA 025, a SAMA candidate that Entergy determined was not cost-beneficial. ENT000003 Entergy NSY-16B Test. at 49-50 (A89) (O'Kula, Teagarden, Potts). According to Entergy, "[c]ompared to the other SAMA candidates that are not cost-effective, at 11%, IP2 SAMA 025 has the smallest margin between the current benefit and the increased benefit to become cost effective." *Id.* at 49-50 (A89) (O'Kula, Teagarden, Potts).

288. During the hearing on NYS-12C, the Board sustained Entergy's objection when the State attempted to question Entergy's witnesses on the how the conclusions in their purported sensitivity analysis for NYS-16B would apply to NYS-12C. Tr. 2335:20-2339:2 (J. McDade/ Sutton/Bessette/Liberatore). At the hearing on NYS-12C, in response to questions inquiring as to whether increasing the OECR by a factor of 7 would render IPS SAMA 025 cost-beneficial, Entergy's witnesses stated that they would need to conduct additional analysis including MACCS2 runs. *See* Tr. 2525:20-2527:21 (J. McDade/Potts/Teagarden/Liberatore).

289. Thus, neither Entergy nor NRC Staff have analyzed the effect site-specific inputs to the CHRONC module of the MACCS2 code would have on the SAMA cost-benefit analysis.

#### XII. CONCLUSIONS OF LAW

#### A. The SAMA Analysis Must Be Site-Specific

290. The SAMA analysis is the vehicle by which NRC Staff considers, in the FSEIS, the environmental impacts of a severe accident and alternative mitigation measures to reduce those impacts. 10 C.F.R. § 51.53(c)(3)(ii)(L); Part 51, Subpart A, Appendix B, Table B-1.

291. Following the Third Circuit's decision and mandate in *Limerick*, in 1996 NRC promulgated regulations outlining the procedure for evaluating the risk of severe accidents on a site-specific basis in a SAMA analysis, but deferred that analysis until a reactor sought to extend its initial operating license. Under 10 C.F.R. § 51.53(c)(3)(ii)(L), "if the [S]taff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." Because Indian Point Units 2 and 3 were not subject to the SAMA analysis requirement when they received permission to operate in 1973 and 1975, a SAMA analysis is required for relicensing.

292. The applicant must first complete a SAMA analysis as part of its Environmental Report. 10 C.F.R. § 51.53(c)(3)(ii)(L).

293. According to the Board, "[T]he FSEIS must demonstrate that the NRC [S]taff has received sufficient information to take a hard look at SAMAs as required by 10 C.F.R. § 51.53(c)(3)(ii)(L), has in fact taken that hard look, and has adequately explained its conclusions." *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), (Ruling on Motion and Cross-Motions for Summary Disposition of NYS-35/36), LBP-11-17, 74 N.R.C. 11, 29 (Jul. 14, 2011). In drafting the FSEIS, NRC Staff may draw upon the SAMA analysis submitted by the applicant in its Environmental Report, however, NRC Staff must comply with

NEPA by ensuring that the applicant's analysis is reasonably based on accurate severe accident cost estimates. *See* 10 C.F.R. 51.14(a) ("Environmental report means a document submitted to the Commission by an applicant for . . . renewal of a permit, license or other form of permission . . . , in order to aid the Commission in complying with section 102(2) of NEPA.") and 10 C.F.R. 51.70(b) ("The NRC staff will independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement.").

294. Furthermore, according to the Board, "Entergy's licenses cannot be renewed unless and until the NRC Staff reviews Entergy's completed SAMA analyses and either incorporates the result 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." *Entergy Nuclear Operations*, LBP-11-17, 74 N.R.C. at 29.

## B. The FSEIS Violates NEPA, NRC Regulations, and CEQ Regulations Because It Accepts a SAMA Analysis Predicated on Economic Cost Estimates That Are Not Site-Specific to Indian Point

295. NRC must comply with NEPA in determining whether or not to grant Entergy's application for renewal of its combined operating license. *Calvert Cliffs*', 449 F.2d at 1119; 10 C.F.R. § 51.20(b)(2); *Massachusetts*, 522 F.3d at 119. NRC Staff must "independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement." 10 C.F.R. § 51.70(b). NRC Staff cannot shift the burden of ensuring that its environmental analysis is adequate to Entergy or intervenors. *See, e.g., Progress Energy Florida, Inc.*, (Combined License Application, Levy County Nuclear Power Plant, Units 1 and 2), Nuclear Reg. Rep. P 31605, 2010 WL 87737, \*5 (2010); *Duke Power Co.* (Catawba Nuclear

Station, Units 1 and 2), CLI-83-19, 17 N.R.C. 1041, 1049 (1983); *Harlem Val. Transp. Ass'n v. Stafford*, 500 F.2d 328, 336 (2d Cir. 1974); *Greene County*, 455 F.2d at 419-20.

296. In evaluating NEPA compliance, the Board must "engage in a 'searching and careful' inquiry of the record," so that we may "consider whether the agency considered the relevant factors and whether a clear error of judgment was made." *Citizens To Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416 (1971), *abrogated in part by Califano v. Sanders*, 430 U.S. 99, 105 (1977) (abrogating *Overton* to the extent it recognized the APA as an independent grant of federal court subject matter jurisdiction).

297. Ultimately, if NRC's NEPA compliance is challenged in federal court, it will be challenged under the Administrative Procedure Act's arbitrary and capricious standard, which amounts to a determination of whether NRC acted reasonably. *See Marsh v. Oregon Natural Res. Council*, 490 U.S. 360, 377 n.23 (1989) (noting courts' adoption of "arbitrary and capricious" and "reasonableness" standards under the APA, and explaining that difference between the two "is not of great pragmatic consequence").

298. Almost a quarter century ago, *Limerick* mandated that NRC consider severe accident mitigation measures on a site-specific basis at each individual nuclear plant. *Limerick Ecology Action, Inc. v. U.S. Nuclear Regulatory Comm'n*, 869 F.2d 719 (3d Cir. 1989). Severe accident mitigation must be examined on a plant-specific basis "[b]ecause the potential consequences [of a severe accident] will largely be the product of the location of the plant." *Id.* at 738-79. Therefore "the risk will vary tremendously across all plants. As the NRC itself has noted, 'the population distribution in the vicinity of the site affects the magnitude and location of potential consequences from radiation releases.' 48 Fed. Reg. at 16,020. This is particularly true for plants . . . which were built near densely populated areas." *Id.* at 738-79.

299. The only site-specific analysis of severe accidents at Indian Point—and the only way NRC complies with *Limerick Ecology*'s mandate—is the SAMA analysis that is taking place in this proceeding. *See* 10 C.F.R. § 51.53(c)(3)(ii)(L); Part 51, Subpart A, Appendix B, Table B-1. If the SAMA analysis as accepted by NRC Staff and incorporated into the FSEIS is inaccurate and unreasonable as it is here, NRC has violated NEPA.

300. It is particularly important that NRC rely on accurate economic costs estimates in this relicensing proceeding, given the fact that the Commission has recognized that the population density surrounding Indian Point is higher than that surrounding any other plant in the United States, and "that a severe release of radioactive materials at Indian Point could have more serious consequences than that same release at virtually any other NRC-licensed site." *Consolidated Edison Co. of N.Y.* (Indian Point, Unit 2) *and Power Authority of the State of New York* (Indian Point, Unit 3), CLI-85-6, 21 N.R.C. 1043, 1049-50 (1985).

301. NEI 05-05, which provides guidance to applicants on how to perform a SAMA analysis, emphasizes that the MACCS2 user should define site-specific inputs for many of the MACCS2 economic cost input parameters, including decontamination costs. NYS000287 at 13-14. NEI 05-01 was developed by the industry, but has been endorsed by NRC. *See* ENT000451 (72 Fed. Reg. 45,466, Aug. 14, 2007).

302. Although NEI-05-01 instructs that while "[d]escription of the method [used to calculate economic costs] may be no more than a reference to the document describing the method. . . . [,] the various input parameters and associated assumptions must still be described." NEI SAMA Guidance at p. 13. NEI-05-01 is clear that its Table 5 (NYS000287 at 37), which includes Sample Problem A Values adjusted for inflation, provides only "[s]ample MACCS2 economic data." NYS000287 at 13.

303. Also, given that there are costs which the MACCS2 code does not take into account such as medical expenses, adverse health effects, permanent income loss, costs of disposal of contaminated wastes, and economic impact of losing a resource, including the loss of drinking water and replacement for reservoirs during interdiction (*see* V.B.5 above), it is even more important to provide a "best estimate" of the costs the code does consider in evaluating mitigation alternatives.

304. Entergy's SAMA analysis underestimates the costs associated with a severe accident at Indian Point, consequently understating the benefits of implementing a SAMA candidate. Despite the plain unreasonableness of Entergy's use of Sample Problem A, and despite the fact that the use of Sample Problem A renders Entergy's SAMA analysis inaccurate and unreasonable, Staff uncritically accepted Entergy's cost estimates and incorporated them into the December 2010 FSEIS. As such, the FSEIS is legally deficient, in violation of NEPA and incapable of supporting a decision on license renewal.

305. Because NRC Staff accepted Entergy's unreasonable cost estimate, the public lacks an accurate estimate of the potential costs associated with a severe accident at Indian Point and a complete list of cost-beneficial SAMA candidates that could mitigate against the risk of a severe accident. Hence, the FSEIS fails as a public information document in violation NEPA. *See, e.g., Robertson,* 490 U.S. at 349 (One of the dual purposes of NEPA "guarantees that the relevant information [concerning environmental impacts] will be made available to the larger audience," including the public, "that may also play a role in the decisionmaking process and the implementation of the decision.").

306. Because NRC Staff accepted Entergy's unreasonable cost estimate, NRC lacks an accurate estimate of the costs associated with a severe accident and a complete list of cost-

beneficial SAMA candidates. Thus, the FSEIS violates NEPA because it cannot provide the basis for an informed evaluation of the environmental consequences of relicensing Indian Point and, thus, frustrates the purpose of NEPA to inform agency decision-making. *See* 40 C.F.R. § 1500.1(c) (NEPA's purpose is not to create more paperwork for NRC but instead, to promote sound environmental decision-making by the agency); *Sierra Club v. U.S. Army Corps of Eng'rs*, 701 F.2d 1011, 1030 (2d Cir.1983) (An EIS that lacks a reasonably adequate compilation of relevant information or that sets forth statements that are inaccurate cannot provide the basis for an informed evaluation or a reasoned decision).

#### 1. <u>NRC Staff Failed to Meet Its Burden of Showing that Entergy's Failure to</u> <u>Develop Site-Specific Cost Estimates Was Reasonable</u>

307. Even though NRC Staff's "responsibility is not simply to sit back, like an umpire, and resolve adversary contentions at the hearing stage," *Calvert Cliffs*', 449 F.2d at 1119, the FSEIS fails to adequately explain why it was reasonable for Entergy—and Staff—to rely upon Sample Problem A in lieu of site-specific inputs.

308. NRC Staff's conclusory statement in the FSEIS that Entergy's SAMA analysis was "consistent" with that of other plants (NYS00133 at G-24) is insufficient under NEPA, especially given the uniqueness of the Indian Point site. While the State has not developed any opinion about the appropriateness of using Sample Problem A for other plants, it is unreasonable to rely upon it for Indian Point, which is located in the most densely populated area of any American nuclear reactor site. *See Nw. Ecosystem Alliance v. Rey*, 380 F. Supp. 2d 1175, 1196 (W.D. Wash. 2005) (the fact that older data had been used for a previous NEPA analysis is not a justification for its continued use where more recent data dictated a different result) (citing *Friends of the Clearwater v. Dombeck*, 222 F.3d 552, 557 (9th Cir. 2000) ("The agency must be alert to new information that may alter the results of its original environmental analysis")).

309. NRC Staff's conclusory FSEIS statements come as no surprise since Entergy itself did not adequately document the source of its economic cost estimates.

310. NRC Staff's sanctioning of Entergy's unreasonable, cavalier attitude towards the economic costs used to evaluate mitigation measures does not meet NEPA standards. *See* Tr. 2068:9-24 (Potts) ("The analysts and reviewers like myself looked to see if it passes the smell test").

311. Entergy's failure to develop site-specific cost estimates is unreasonable under NEPA, regardless of whether it is consistent with what other plants have done.

312. The FSEIS and the evidentiary record in this proceeding reflect that NRC Staff was not "alert to new information that may alter the results of its original environmental analysis" and its acceptance of Sample Problem A for the Indian Point site.

2. <u>NRC Staff's Reliance on Entergy's Unreasonable Cost Estimates Prevents</u> <u>NRC Staff from Accurately Discussing and Reasonably Evaluating</u> <u>Mitigation Alternatives and Taking the Requisite "Hard Look" at</u> <u>Mitigating Severe Accidents Under NEPA</u>

313. Because the economic costs associated with a severe accident are used to evaluate the costs and benefits of implementing each SAMA candidate, Entergy's underestimated costs prevent NRC Staff from accurately discussing and reasonably evaluating mitigation measures in violation of NEPA. *See, e.g., Robertson,* 490 U.S. at 351-52 (the "omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA."); *Calvert Cliffs*', 449 F.2d at 1114 (discussing the importance of studying, developing, and describing alternatives to comply with NEPA).

314. Given the fact that a severe accident at Indian Point would likely implicate an extraordinary array of public resources, basing the SAMA analysis on unreasonable economic assumptions does not foster reasonable consideration of mitigation measures under NEPA. *Cf.* 

*Robertson*, 490 U.S. at 352 ("An adverse effect that can be fully remedied by, for example, an inconsequential public expenditure is certainly not as serious as a similar effect that can only be modestly ameliorated through the commitment of vast public and private resources.").

315. Likewise, NRC Staff's failure to accurately and reasonably evaluate mitigation measures in light of the underestimated costs prevents the Staff from determining "whether the Commission has taken all practical measures within its jurisdiction to avoid or minimize environmental harm from the alterative selected, and if not, to explain why those measures were not adopted" under 10 C.F.R. § 51.103.

316. By accepting Entergy's cost estimates used in the SAMA analysis, NRC Staff has failed to take a "hard look" at the consequences of severe accidents and to accurately evaluate whether SAMA candidates are cost-beneficial. *See Methow*, 490 U.S. at 350 ("The sweeping policy goals announced in § 101 of NEPA are thus realized through a set of 'action-forcing' procedures that require that agencies take a 'hard look' at environmental consequences, and that provide for broad dissemination of relevant environmental information." (internal citations omitted)); *Limerick Ecology*, 869 F.2d at 737 ("[T]he [Final Environmental Impact Statement] must contain sufficient discussion of the relevant issues and opposing viewpoints to enable the decisionmaker to take a 'hard look' at the environmental factors and to make a reasoned decision."); *see also Entergy Nuclear Operations*, LBP-11-17, 74 N.R.C. at 29 ("The FSEIS must demonstrate that the NRC [S]taff has received sufficient information to take a hard look at SAMA candidates as required by 10 C.F.R. § 51.53(c)(3)(ii)(L), has in fact taken that hard look, and has adequately explained its conclusions ....").

3. <u>By Accepting Entergy's Unreasonable Cost Estimates in the FSEIS, NRC</u> <u>Staff Has Relied Upon and Presented Inaccurate Information to the Public,</u> <u>Violating the Requirement that the FSEIS Contain Accurate Scientific</u> <u>Information</u>

317. By failing to develop site-specific input values and allowing Entergy to rely upon the decades-old Sample Problem A values, NRC Staff has failed to ensure that the FSEIS contains accurate information. *See Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 964-65 (9th Cir. 2005) (NEPA requires that agencies rely on high quality data and accurate scientific analysis); 40 C.F.R. § 1500.1(b) (same), § 1502.24 ("Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements"); *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), LBP-11-17, at 11-12 (citing *ShieldAlloy Metallugical Corp. v. NRC*, 624 F.3d 489, 492-93 (D.C. Cir. 2010)) ("NRC would be acting arbitrarily and capriciously if it did not look at relevant data and sufficiently explain a rational nexus between the facts found in its review and the choice it makes as a result of that review.").

318. By accepting Entergy's failure to develop site-specific severe accident cost estimates for Indian Point, NRC Staff did not ensure that the FSEIS is based on high quality data and accurate scientific analysis. As a result, NRC Staff presented to the public an inaccurate and unreasonable evaluation of the environmental consequences of relicensing the Indian Point facility in violation of NEPA. Additionally, the unreasonable cost estimate deprives NRC of the ability to take a "hard look" at environmental impacts in evaluating SAMA candidates. *See Methow*, 490 U.S. at 350, and *Entergy Nuclear Operations*, LBP-11-17, 74 N.R.C. at 29 ("[T]he FSEIS must demonstrate that the NRC Staff has received sufficient information to take a hard look at SAMAs as required by 10 C.F.R. § 51.53(c)(3)(ii)(L) . . . ").

## 4. <u>NUREG-1150's "Pedigree" Does Not Justify the Use of Sample Problem</u> <u>A or Render the SAMA Analysis Reasonable Under NEPA</u>

319. As explained above, Entergy and NRC Staff argue that the Sample Problem A values were reasonable due to the "pedigree" of NUREG-1150. *See* VII. This argument utterly fails because the documentation upon which NUREG-1150's cost values were based does not exist and the assumptions upon which its time values are based lack a rational basis. Indeed, Entergy and NRC Staff's claim regarding NUREG-1150 amounts to a "conclusory statement 'unsupported by empirical or experimental data, scientific authorities, or explanatory information of any kind[,]" which constitutes a violation of NEPA. *Silva*, 482 F.2d at 1285 (citing *Natural Res. Def. Council, Inc.*, 355 F. Supp. at 287).

320. Sample Problem A's decontamination cost values are based upon a document that does not appear to have been published, nor subject to peer review: Os84. *See* VII.A. Reliance upon such data is unreasonable under NEPA, and undermines its fundamental goal of ensuring that environmental values are fully considered in the agency's decision-making process. *See Balt. Gas & Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 97 (1983); *San Luis Obispo Mothers for Peace*, 449 F.3d at 1020.

321. The complete absence of support for Sample Problem A also made it impossible for the FSEIS to set forth sufficient information which would allow the general public to make an informed evaluation of the environmental consequences of an action. *Sierra Club v. U.S. Army Corps of Eng'gs*, 701 F.2d 1011, 1029 (2d Cir.1983). *See also Town of Huntington v. Marsh*, 859 F.2d 1134, 1143 (2d Cir. 1988) (agency violated NEPA because, among other things, evaluating the merits of proposed project "was made difficult or impossible by the lack of sufficient data in the EIS submitted"). 322. Sample Problem A's decontamination time values are based upon a document that contains unrealistic assumptions regarding the time it would take to clean up after a severe accident and is inconsistent with NUREG-1150. *See* VII.B. Reliance upon such inaccurate scientific data is unreasonable under NEPA.

323. It was unreasonable to rely upon Sample Problem A because NUREG-1150 itself supports developing site-specific cost estimates. *See* VII.C. (discussing NRC's statement in NUREG-1150 (NYS00252D at D-32) that "[b]ecause cost/benefit analyses are more properly considered in the context of specific regulatory activities, they are not provided in this version of NUREG-1150.").

324. Furthermore, internal documents including an email chain and a research planning document (discussed above in VII.E.) questioning the pedigree of NUREG-1150 support a finding that reliance on those values is unreasonable. To add insult to injury, these documents were never disclosed by NRC Staff and, the failure to disclose the highly relevant email—which is in conflict with its arguments regarding the pedigree of NUREG-1150—violates not only NEPA, but also its disclosure obligations in this proceeding. By failing to disclose this document, NRC Staff prejudiced the State's preparation of this contention. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Licensing Board Order (Granting in Part and Denying in Part State of New York and Riverkeeper's Motion to Compel) at 10 (Mar. 16, 2012) (unpublished) ("[I]f the NRC Staff has in its possession documents that provide support for or opposition to its expert testimony, then those documents must be disclosed. Intervenors will then have ample opportunity to prepare rebuttal testimony, to propose questions for the Board to ask these witnesses, or to move for the ability to cross-examine these witnesses.").

# 5. <u>It Was Unreasonable for NRC Staff and Entergy to Rely Upon Sample</u> <u>Problem A Because NRC Has Conducted A Site-Specific Analysis At</u> <u>Indian Point</u>

325. As explained above, in the 1980s, NRC commissioned a site-specific analysis of the decontamination costs associated with a severe accident at Indian Point, without using NUREG-1150 values, and, therefore, without relying upon Sample Problem A. *See* VIII. Thus, a site-specific analysis was not only required under NEPA and NRC's regulations, but eminently possible and had been completed in conjunction with Tawil 1990 (NUREG/CR-5148). *See Limerick Ecology Action, Inc.*, 869 F.2d at 729-31 (holding that NEPA requires NRC to examine, on a site-specific basis, the environmental effects of significant accidents at nuclear power plants). Indeed, Twail 1990 (NUREG/CR-5148) actually supports the approach ISR discussed in its expert report.

326. In failing to discuss or even acknowledge Tawil 1990 (NUREG/CR-5148) in the FSEIS, NRC Staff decided not to "face those stubborn, difficult-to-answer" issues of estimating the costs of a severe accident at Indian Point and decided instead to "ignore[e] them or sweep[] them under the rug," in violation of NEPA. *Sierra Club v. U.S. Army Corps of Eng'rs*, 772 F.2d 1043, 1049 (2d Cir. 1985) (citation omitted). The FSEIS did not reference this document, let alone provide an explanation as to why the NRC Staff chose not to use it, thus preventing decision makers and the public from considering it. *See Found. on Econ. Trends v. Heckler*, 756 F.2d 143, 147 (D.C. Cir.1985) ("NEPA's dual mission is thus to generate federal attention to environmental concerns and to reveal that federal consideration for public scrutiny").

327. Moreover, NRC Staff's failure to disclose Tawil 1990 (NUREG/CR-5148)—its own site-specific study of the consequences of a severe accident at Indian Point—violates not only NEPA, but also its disclosure obligations in this proceeding. This Board has put Staff on

notice of Staff's disclosure obligations. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Licensing Board Order (Granting in Part and Denying in Part State of New York and Riverkeeper's Motion to Compel) at 10 (Mar. 16, 2012) (unpublished) ("[I]f the NRC Staff has in its possession documents that provide support for or opposition to its expert testimony, then those documents must be disclosed. Intervenors will then have ample opportunity to prepare rebuttal testimony, to propose questions for the Board to ask these witnesses, or to move for the ability to cross-examine these witnesses."). By failing to disclose this document, NRC Staff prejudiced the State's preparation of this contention, and confirmed that Staff did not take a hard look at the site-specific environmental impacts posed by the two Indian Point reactors.

### 6. <u>It Was Unreasonable for NRC Staff and Entergy to Rely Upon Sample</u> <u>Problem A Values Without Comparing Them to More Recent Data</u>

328. As discussed above, an EIS must also contain "high quality" information and "accurate scientific analysis." 40 C.F.R. § 1500.1(b). *See also Lands Council v. Powell*, 395 F.3d 1019, 1031-32 (9th Cir. 2005); *Conservation Northwest v. Rey*, 674 F. Supp. 2d 1232, 1249 (W.D. Wash. 2009) (citing *Ctr. for Biological Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1167 (9th Cir. 2003)).

329. Despite this NEPA requirement, neither Entergy nor NRC Staff performed any bounding or benchmarking to determine whether relying upon Sample Problem A was scientifically reasonable. As Dr. Lemay explains, "benchmarking consists of establishing points of reference by comparing one's current practices with what others in the field are doing." NYS000420 Lemay Rebuttal Test. at 7. "In the nuclear industry, benchmarking is an essential exercise because it provides for an important exchange of information amongst experts in the field, leading to the use of the best data and methodologies." *Id*.

330. It is unreasonable that neither Entergy nor NRC Staff explain why they did not perform a benchmarking analysis for the Level 3 PRA—the final level of the SAMA analysis where the MACCS2 code is used to calculate the costs associated with a severe accident. *See* NYS000420 Lemay Rebuttal Test. at 8-10.

331. This is especially troublesome, considering Entergy conducted extensive "peer reviews and benchmarking to verify the reasonableness and robustness of the Level 1 and Level 2 PRA." *Id.* It is unreasonable for Entergy and NRC Staff to "expend[] considerable effort to verify the source term and core damage frequency used in accident assessment—Level 1 and Level 2," only to rely upon generic Sample Problem A values in Level 3 without any verification or benchmarking. NYS000420 Lemay Rebuttal Test. at 9.

332. NRC Staff did not require a benchmarking, which was unreasonable under NEPA, especially given the regulatory requirement that applicant's perform a site-specific SAMA analysis. At bottom, "Entergy's SAMA analysis is not defensible" because "[w]ithout this benchmarking, Entergy and NRC have not quantified the reasonableness and the uncertainty of the key parameters they used to calculate the OECR [offsite economic cost risk]." NYS000420 Lemay Rebuttal Test. at 10.

 The State Has Easily Met Its Prima Facie Evidentiary Burden in this Proceeding Through Its Pre-Filed Expert Testimony, Expert Report, Exhibits and Dr. Lemay's Hearing Testimony, and the Board Should Resist Any Attempt By NRC Staff to Delegate Its NEPA Obligations

333. In support of NYS-12C, the State submitted unprecedented and extensive technical justification for its conclusions that developing site-specific MACCS2 inputs is not only possible, but also the only reasonable way of estimating the costs associated with an accident at Indian Point. Entergy and NRC Staff focus their submissions to the Board on criticizing ISR's analysis and conclusions rather than proving that the use of Sample Problem A

was reasonable. But it is NRC Staff—not intervenors—who bears the burden of performing a reasonable SAMA analysis under NEPA.

334. The ISR Report and Testimony did not need to be an independent SAMA analysis. Instead, the ISR Report shows that Entergy and NRC Staff's analyses are unreasonable because developing site-specific MACCS2 inputs is technically feasible, scientifically defensible, and ultimately results in much higher costs for a severe accident at Indian Point.

335. NEPA obligates NRC Staff to ensure that the FSEIS takes a "hard look" at environmental impacts, evaluates a reasonable range of alternatives, and appropriately considers mitigation measures. As part of its NEPA obligations, NRC Staff must review and independently verify that the SAMA analysis performed by Entergy for Indian Point is reasonable. NRC Staff cannot shift the burden of ensuring that its environmental analysis is adequate onto Entergy, intervenors, or any other entity. *See Harlem Val. Transp. Ass'n v. Stafford*, 500 F.2d 328, 336 (2d Cir. 1974) (An agency cannot be "content to place the burden on intervenors whose resources might be limited to challenge any environmental statements that the [applicants] might make in their applications . . . [Such a] passive approach . . . shifts to intervenors a large part of the burden of evaluating environmental issues which Congress placed on agencies of the government"); *Greene County*, 455 F.2d at 419-20 (a federal agency cannot abdicate its responsibility independently to evaluate federal actions proposed to it by other, nonfederal entities).

336. The State's burden on this contention is to bring forth evidence demonstrating that the SAMA analysis for Indian Point is unreasonable. *See Louisiana Power and Light Co.*, 17 N.R.C. 1076, 1093 (quoting *Consumers Power Co.* (Midland Plant, Units 1 and 2), ALAB–123, 6 A.E.C. 331, 345 (1973)) (after a party's contention has been admitted, that party has the burden

of introducing sufficient evidence to establish a prima facie case. The burden then shifts to NRC Staff to prove by a preponderance of the evidence that it complied with the requirements of NEPA.) It is not the State's burden to perform an independent SAMA analysis.

337. The State easily meets its evidentiary burden by demonstrating that the SAMA analysis underestimated the economic costs of a severe accident at Indian Point through the use of generic assumptions concerning decontamination costs that are not applicable to the densely populated area surrounding Indian Point. The result of ISR's work is a detailed explanation of reasonable approaches that Entergy and NRC Staff could have used to develop site-specific decontamination cost, decontamination time, and other sensitive MACCS2 inputs. The hearing transcript demonstrates that additional relevant data, beyond the four example methods that ISR proposed, may exist upon which a site-specific SAMA analysis could have been conducted. Therefore, the State has shown that Entergy's economic costs are significantly underestimated.

338. As explained above in X.E., Entergy and NRC Staff's technical arguments regarding decontamination time do not affect the ultimate conclusion that the SAMA analysis unreasonably underestimates the costs associated with a severe accident at Indian Point.

339. As explained above in X. D. 5., Entergy and NRC Staff's technical arguments regarding decontamination costs do not affect the ultimate conclusion that the SAMA analysis unreasonably underestimates the costs associated with a severe accident at Indian Point.

## 8. <u>NRC Staff Failed to Adequately Respond to New York's Comments</u> <u>Regarding Entergy's Unreasonable SAMA Analysis in Violation of NEPA</u>

340. As discussed above in II. Procedural History, the State brought the issue of Entergy's underestimation of the costs associated with a severe accident at Indian Point to Staff's attention well before publication of the FSEIS. In addition to filing Contentions 12 and 16, the State also submitted NEPA comments. Yet NRC Staff failed to adequately address any of the

State's comments, providing only a cursory and conclusory response in Appendix G to the FSEIS. NRC Staff's failure to fully consider and respond to the State's comments violates NEPA, NRC regulations, and CEQ regulations that require NRC Staff to respond, in the FSEIS, to comments on the DSEIS or any supplement to it. *See* 10 C.F.R. § 51.91(a)(1); 40 C.F.R. § 1503.4(a) (requiring agencies to assess and respond to comments in FSEISs); *Sierra Club v. U.S. Army Corps of Eng'rs*, 701 F.2d 1011, 1030-1031 (1983) (finding an FEIS inadequate for failing to respond in good faith to critical comments on DEIS).

341. In responding to comments, NRC Staff must make factual corrections, if called for, or explain why the comments do not warrant further response, citing sources, authorities, or reasons for such a conclusion. *See* 10 C.F.R. § 51.91(a)(1)(iv) & (v) and 40 C.F.R. § 1503.4(a)(1)-(5). Appendix G does not even come close to meeting this requirement. This does not constitute an adequate response to comments.

#### C. The Board Should Afford No Weight to the Unqualified Testimony, and Unsupported Allegations and Conclusions, of Entergy and NRC Staff

342. As a general matter, NRC Staff and Entergy's witnesses have never endeavored to develop site-specific inputs for the Indian Point SAMA analysis or for other reactor sites that have sought license renewals. *See* IV.B., IV.C., above. Consequently, they have a knowledge and experience gap. Thus, their testimony on methodologies to develop site-specific inputs should be afforded little or no weight. *See Duke Energy Corp.* (Catawba Nuclear Station, Units 1 and 2), 60 N.R.C. 21, 29 (2004) ("Gaps in specific knowledge may go to the 'weight' of the expert testimony rather than to its admissibility.").

343. Additionally, both NRC Staff's witnesses and Entergy's witnesses present unsupported assumptions and conclusions that should also be afforded little or no weight, and are insufficient evidence in defense of Entergy's SAMA analysis. *See Entergy Nuclear Generation* 

*Co.* (Pilgrim Nuclear Power Station), CLI-10-11, 71 N.R.C. 287, 315 (Mar. 26, 2010) ("unsupported reasoning and computations, are insufficient" and should be afforded little or no weight); 10 C.F.R. § 2.377(a) ("Only relevant, material, and reliable evidence which is not unduly repetitious will be admitted."); *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Licensing Board Order (Granting in Part and Denying in Part Applicant's Motions in Limine) at 20, 24 (Mar. 6, 2012) (unpublished) (ML12066A170) (this Board has generally opted to "give all evidence its appropriate weight at evidentiary hearing in the context of evaluating the specific issue before [it].").

344. The Board should reject NRC Staff's baseless claims that the existing SAMA analysis is sufficient because it already identifies cost-beneficial SAMA candidates. In addition to the fact that this claim is entirely absent from the FSEIS and NRC Staff's pre-filed submissions and exhibits, NRC Staff's hearing testimony regarding this claim amounts to nothing more than a series of "educated guesses" that lack a foundation in fact and are unsupported by analysis or any other documentation. See *Duke Cogema Stone & Webster*, 61 N.R.C. 71, 88-89 (N.R.C. 2005) (where an expert 'concedes that [she] was making an "educated guess[,]' . . . the Board must focus on whether the experts' opinions are sufficiently grounded upon facts.). For example, Dr. Ghosh stated "with everything we've seen, we don't see a deficiency in what is in our FSEIS with respect to what have we missed in terms of what potentially cost beneficial SAMAs might have been revealed had one of these cost elements been slightly higher." Tr. 2225:3-7 (Ghosh). This statement and others like it should be afforded no weight. *See, e.g.*, Tr. 2164:14-22 (Ghosh); Tr. 2224:19-24 (Ghosh); Tr. 2226:12-19 (Harrison); Tr. 2235:19-22 (Ghosh).

345. Likewise, NRC Staff's conclusory testimony that "existing margin in the SAMA [] analysis account[s] for uncertainties," consists of allegations that were not supported by any calculations, spreadsheets, expert reports, or any other analysis. *See, e.g.*, NRC000041 Staff Test. at 14 (A6b) (Ghosh); Tr. 2230:19-2233:3 (Ghosh) (conjecturing that there's "some degree of cushion" due to an "uncertainty multiplier" and stating "I think we feel that to some extent the existing conservatisms and uncertainty accounting in the analysis may provide the boon to consider the possibility of this type of sensitivity," but ultimately noting "[t]his is all hypothetical"); Tr. 2235:6-10 (Ghosh) ("the ISR New York State analysis introduces some uncertainty and into particular elements of the benefit calculation. And I believe that the existing margin in the analysis can accommodate this uncertainty already.").

346. This testimony on "uncertainty" utterly lacks a foundation and should be afforded no weight. *See South Carolina Elec. & Gas Co.* (Virgil C. Summer Nuclear Station, Unit 1), 14 N.R.C. 1140, 1163 (1981) ("in all circumstances the Board has the right, indeed the duty, to satisfy itself that the conclusions expressed by expert witnesses on significant safety or environmental questions have a solid foundation"); *Cf. Amorgianos v. Amtrak*, 303 F.3d 256, 266 (2d Cir. 2002) ("Thus, when an expert opinion is based on data, a methodology, or studies that are simply inadequate to support the conclusions reached, . . . [the testimony is] unreliable opinion testimony.").

347. Also, Dr. Ghosh characterized Mr. Jones' evaluation of ISR's methodologies as a "guess," so Jones' testimony on ISR methodologies should be disregarded:

I think we've talked a lot about what we think about the methodology that went into developing these alternate inputs and why we think that they in some cases were inappropriate, for example, the mass conservation problem of applying the CONDO method. And in our testimony I believe Mr. Jones *tried to guess* what the effect of that might be if you took away that improper application to the MACCS code.

Tr. 2163:12-20 (Ghosh) (emphasis added).

348. With respect to TIMDEC, Dr. Bixler argued against longer decontamination times because "the MACCS framework the entire cost of decontamination is attributed as if it occurred in Year 1. If we're talking about expending money over 30 years, that doesn't make any sense." Tr. 2200:15-19 (Bixler). He went on to state, "For example, if you assume that you spent the money over a 30-year time period, that means the value in current dollars is only 27 percent of what it would have been if you'd spent it all in Year 1. So if you spent it over 30 years, it's 27 percent in current value." Tr. 2200:25-2201 (Bixler). Nowhere is there any analysis or documentation to support this conclusion and, therefore, the Board should afford it little weight.<sup>61</sup>

349. Additionally, the "informal look" Dr. O'Kula conducted in criticism of ISR's suggestion that CONDO is a source for site-specific data (Tr. 2365:4-16; 2366:4-12; 2366:23) is should be afforded no weight. In his testimony, Dr. O'Kula presented no data or analysis to support this opinion. Furthermore, Entergy did not disclose this opinion in any of its pre-filed submissions. Instead, Entergy waited until it had an opportunity to redirect Dr. O'Kula—after the State's opportunity to cross Dr. O'Kula had passed. Overruling an objection from the State, the Board allowed this testimony.

350. Further Dr. O'Kula's speculation regarding CONDO's use for London should be disregarded by the Board. There is no evidence in the record to show whether CONDO was used for London let alone evidence to show how CONDO would be used for London. As such, Dr.

<sup>&</sup>lt;sup>61</sup> Furthermore, Dr. Lemay explained that Dr. Bixler's conclusions ignore realities about labor costs: "if we need to decontaminate over a longer period of time, it is not like buying a piece of equipment. We're dealing with people and presumably the costs would continue to escalate over time as they get the increases, so I think these two effects cancel each other. So I would question the idea that the costs would be 27 percent if you do it over 30 years." Tr. 2202:15-22 (Lemay).

O'Kula's testimony consists of unsupported assumptions and conclusions, and should be afforded no weight. *See Phila. Elec.* (Limerick Generating Station, Units 1 and 2), 22 N.R.C. 681, 735 (1985) ("where an asserted expert witness can supply no scientific basis for his statements (other than his 'belief') and disparages his own testimony, a board would be remiss in giving such testimony any weight whatsoever.").

351. Lastly, Entergy has offered no analysis or documentation to support Mr. Teagarden's assertion that "If you were to do an average basis of how many workers are needed to achieve the average accident, we calculate numbers of the order of 60,000 to 80,000 people . . ..." Tr. 2191:2-6 (Teagarden). This testimony should be disregarded.

352. In conclusion, unsupported assumptions and baseless conclusions cannot refute ISR's criticism of the cost estimates in used in the SAMA analysis. *See Monroe County Conservation Council v. Volpe*, 472 F.2d 693, 697 (2d Cir. 1972)); *Natural Res. Def. Council v. Callaway*, 524 F.2d 79, 93 (2d Cir.1975). To the contrary, the State has shown ample evidence regarding the unreasonableness of failing to develop site-specific cost estimates for Indian Point, and NRC Staff must now conduct additional environmental analysis to address these deficiencies in the FSEIS.

## D. NRC Staff Should Be Required to Supplement the FSEIS

1. <u>Under NEPA, the Appropriate Remedy for a Deficient Environmental</u> <u>Impact Statement is for the Atomic Safety and Licensing Board to</u> <u>Remand the Matter to NRC Staff to Perform a Reanalysis of Site-Specific</u> <u>Environmental Impacts and Prepare a Revised and Supplemental</u> <u>Environmental Impact Statement</u>

353. The assertion by Entergy and NRC Staff that a deficient FSEIS can be cured after the fact by submissions of NRC Staff, the applicant, or interveners during the adjudicatory hearing pursuant to Atomic Energy Act ("AEA") § 189 (42 U.S.C. § 2239) is incorrect. First, the suggestion is inconsistent with federal regulations that emphasize the importance of the EIS document itself, as well as the public's right to review and participate in the process. Nor does any NRC regulation expressly authorize licensing boards themselves to fix or supplement a deficient FSEIS. Moreover, NRC regulations provide a specific means to supplement an FSEIS—a process similar to that used to prepare an EIS in the first instance. 10 C.F.R. § 51.92. Having promulgated a regulation for supplementing an FSEIS, NRC is bound by it. Further, the Commission's deliberate elimination of an earlier regulation that permitted licensing boards to "modify the content" of an EIS precludes any suggestion that *post hoc* supplementation by the Board might be available to cure deficiencies in the challenged FSEIS. Finally, federal courts have consistently recognized that when an EIS is deficient, NEPA requires it be remedied by remanding the proceeding to the administrative agency to re-initiate the EIS process.

354. NEPA directs agencies contemplating "major [f]ederal actions significantly affecting the quality of the human environment" to prepare an EIS demonstrating agency consideration of the reasonably foreseeable environmental effects. *Brodsky v. U.S. Nuclear Regulatory Comm'n*, 704 F.3d 113, 119 (2d Cir. 2013) (*citing* 42 U.S.C. § 4332(2)(C)). The statute's implementing regulations "identify public scrutiny as an 'essential' part of the NEPA process, 40 C.F.R. § 1500.1(b) ('Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA')." *Brodsky*, 704 F.3d at 120. Accordingly, NEPA regulations "provide that 'NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken." *Brodsky*, 704 F.3d at 120 (*quoting* 40 C.F.R. § 1500.1(b)). "In addition to providing crucial information to the decisionmaker, NEPA also 'guarantees that the relevant information will be made available to the larger audience that may also play a role in both the

decisionmaking process and the implementation of that decision." *Sierra Club v. Watkins*, 808F. Supp. 852, 858 (D.D.C. 1991) (*quoting Robertson v. Methow Valley Citizens Council*, 490U.S. 332, 349 (1989)). That "larger audience" clearly includes the public. *Id.* 

355. NRC's regulations show that an environmental impact statement is of critical importance in an environmental review under NEPA. 10 C.F.R. § 51.70 (general requirements for draft EIS); 10 C.F.R. § 51.71 (describing contents of draft EIS); 10 C.F.R. § 51.72 (supplement to draft EIS); 10 C.F.R. § 51.73 (comments on draft EIS); 10 C.F.R. § 51.74 (distribution of draft EIS); 10 C.F.R. § 51.90 (preparation of final EIS after receipt of comments on draft EIS); 10 C.F.R. § 51.91 (contents of final EIS); 10 C.F.R. § 51.92 (supplementation of final EIS); 10 C.F.R. § 51.93 (distribution of final EIS); 10 C.F.R. § 51.94 (Commission obligated to consider the final EIS); 10 C.F.R. § 51.95(a) (supplement to final EIS "will include a request for comments as provided in § 51.73"); 10 C.F.R. § 51.95(c) (EIS for license renewal stage); 10 C.F.R. § 51.100(a)(1)(i),(ii) (prohibiting Commission action until after draft or final EIS filed with the Environmental Protection Agency). NRC's regulations further recognize that "[a]n appendix to an environmental impact statement [itself] will . . . . [n]ormally consist of material which substantiates any analysis fundamental to the impact statement." 10 C.F.R. Part 51, Subpart A, Appendix A, 9(b) (format for presentation of material in EIS).

356. Nothing in the NRC's regulations expressly permits testimony or exhibits from an adjudicatory hearing to supplement an environmental impact statement. To the contrary, regulatory history confirms that the Agency lacks the power to "deem modified" an otherwise inadequate EIS. In 1980, NRC initiated a comprehensive revision to the NEPA regulations, which it "inherited" from the Atomic Energy Commission. *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions and Related Conforming* 

Amendments, 45 Fed. Reg. 13,739 (Mar. 3, 1980). As part of that regulatory revision, NRC

eliminated an earlier version of 10 C.F.R. § 51.52, which had provided that:

an initial decision of the presiding officer may include findings and conclusions which affirm or modify the content of the final environmental impact statement prepared by the staff. To the extent that findings and conclusions different from those in the final environmental statement prepared by the staff are reached, *the statement will be deemed modified* to that extent and the initial decision will be distributed as provided in § 51.26(c).

10 C.F.R. § 51.52 (1975 version) (emphasis added). The rulemaking was finalized in 1984. *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions and Related Conforming Amendments*, 49 Fed. Reg. 9,352 (Mar. 12, 1984).

357. NRC's current NEPA-implementing regulations require a formal supplement to the FSEIS: "NRC staff will prepare a supplement to a final environmental impact statement . . . if . . . [t]here are new and significant circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 10 C.F.R. § 51.92(a)(2). The regulations require that a draft supplement be circulated for public review and comment and that NRC Staff must address the comments before NRC Staff may issue a final document. *See* 10 C.F.R. § 51.92(d) ("The supplement to a final environmental impact statement will be prepared in the same manner as the final environmental impact statement except that a scoping process need not be used."); § 51.92(f)(1) ("A supplement to a final environmental impact statement will be accompanied by or will include a request for comments . . . ."). "[J]udicial 'review of administrative choices under NEPA . . . focuses primarily on the procedural regularity of the decision,' rather than on its substance." *Brodsky*, 704 F.3d at 118 (*quoting Sierra Club v. U.S. Army Corps of Eng'rs*, 772 F.2d 1043, 1055 (2d Cir. 1985)).

358. Thus, when NRC established an Atomic Safety and Licensing Board ("ASLB") under AEA § 189 and referred the Indian Point relicensing to that Board, the referral cited to 10

C.F.R. §§ 2.104, 2.300, 2.303, 2.309, 2.311, 2.318, and 2.321—provisions which give the Board no authority to amend, modify, or correct NRC Staff's FSEIS. *Establishment of Atomic Safety and Licensing Board*, 72 Fed. Reg. 60,394 (Oct. 24, 2007). Rather, the Board is charged with ruling on, among other things, whether or not the Staff complied with NEPA in the FSEIS.

359. Courts have consistently held that a supplemental NEPA analysis, prepared by agency staff and open to public comment, is the appropriate remedy for a NEPA violation. Materials prepared after the FSEIS are not a substitute for supplementation and recirculation for public comment. "[S]tudies [prepared after the EIS was finalized] could not cure these particular inadequacies because they were [not included in an EIS supplement and were] not circulated for review and comment in accordance with procedures established to comply with NEPA." *I-291 Why? Ass'n v. Burns*, 517 F.2d 1077, 1081 (2d Cir. 1975); *accord Brodsky*, 704 F.3d at 120 ("'NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.'") (*quoting* 40 C.F.R. § 1500.1(b)).

360. Likewise, the First Circuit has found "no indication in the [NEPA] statute that Congress contemplated that studies or memoranda contained in the administrative record, but not incorporated in any way into an EIS, can bring into compliance with NEPA an EIS that by itself is inadequate." *Grazing Fields Farm v. Goldschmidt*, 626 F.2d 1068, 1072 (1st Cir. 1980) (finding that even if agency staff made an informed, good faith decision to reject a proposed alternative, staff had nonetheless violated NEPA's procedural mandate by failing to explain that decision in the EIS). The Ninth Circuit, too, has made clear that "a non-NEPA document . . . cannot satisfy a federal agency's obligations under NEPA." *South Fork Band Council of W. Shoshone v. U.S. Dep't of Interior*, 588 F.3d 718, 726 (9th Cir. 2009) (*citing Klamath-Siskiyou* 

*Wildlands Ctr. v. BLM*, 387 F.3d 989, 998 (9th Cir. 2004)). And the Tenth Circuit declined to consider an affidavit concluding that environmental impacts were adequately analyzed because "no such conclusion was recorded in any NEPA document prior to the [agency action]" and it "is a post hoc analysis that does not satisfy the NEPA." *Pennaco Energy v. U.S. Dep't of Interior*, 377 F.3d 1147, 1159 (10th Cir. 2004).

361. Furthermore, when an EIS is found deficient, courts often enjoin the agency action at issue until the supplement is completed, in order to ensure that the agency takes the supplemental information into consideration in its final decision. In *Natural Resources Defense Council v. Callaway*, the Second Circuit held:

The Navy should not be permitted to proceed with further dumping at the New London site until . . . the serious deficiencies in the EIS [are] remedied. *Otherwise application of a "rule of reason" would convert an EIS into a mere rubber stamp for post hoc rationalization of decisions already made.* If the spirit as well as the letter of NEPA is to have any real meaning in this case, the Navy should prepare and circulate for consideration and comment a supplemental statement . . . .

524 F.2d 79, 94-95 (2d Cir. 1975) (emphasis added). Hence, at a minimum, if the FSEIS is

found deficient, NRC Staff must revise and supplement it before the Board can make a decision

on the license renewal application.

362. Although few federal agencies have internal administrative procedures for adjudicating or appealing NEPA decisions, one such example is the Interior Board of Land Appeals ("IBLA") within the Department of Interior ("DOI").<sup>62</sup> Like the federal courts, the IBLA has required that a deficient EIS be remedied through a formal supplement to the EIS.

<sup>&</sup>lt;sup>62</sup> The IBLA is an appellate review body that exercises the delegated authority of the Secretary of the Interior to issue final decisions for the Department of the Interior. Located within the Department's Office of Hearings and Appeals, IBLA is separate and independent from the Bureaus and Offices whose decisions it reviews.

*See, e.g., Wyoming Outdoor Council*, 158 IBLA 155 (IBLA 2003) (reversing the Bureau of Land Management's project approval because staff failed to take a "hard look", and remanding for further NEPA analysis). Moreover, the IBLA has found that the relevant record for determining NEPA compliance is the record at the time of the agency action, not the record as supplemented by material prepared after the NEPA document is complete.<sup>63</sup>

363. Nor can Determinations of NEPA Adequacy ("DNAs")—which DOI staff use to evaluate the adequacy of previous NEPA assessments—be used to supplement a formal review after the fact. *See Ctr. for Native Ecosystems*, 170 IBLA 331, 332 (IBLA 2006) (DNAs cannot be used to supplement previous Environmental Assessments or EISs, or "to address site-specific environmental effects not previously considered in them."). In *Center for Native Ecosystems*, because new and significant information developed after the initial NEPA statements were completed, a new NEPA statement was required. *Id*; *see also Wyoming Wilderness Assoc.*, 158 IBLA 155, 171-72 (2003) (New information showed that the agency did not take the required "hard look," "[a]ccordingly, these cases must be remanded to BLM for an expanded examination of the water quality impacts"); *Biodiversity Conservation Alliance*, 171 IBLA 313, 321 (IBLA 2007) ("'The DNA cannot supplement what is not sufficient in NEPA documentation") (*quoting Native Ecosystems*, 170 IBLA at 332).

<sup>&</sup>lt;sup>63</sup> For example, after an 18-day hearing in *National Wildlife Federation, et al. v. Bureau of Land Management*, 140 IBLA 85 (IBLA 1997), in which the National Wildlife Federation presented evidence of the environmental impacts of grazing, the administrative law judge ("ALJ") found that regardless of which route the agency chose to go, an adequate environmental review is required. *Id.* at 95-96. Because the agency wrongfully determined that the action would not significantly affect the quality of the human environment, the ALJ stated that the agency was prohibited from going forward with that action until an adequate EIS was prepared and considered. *Id.* 

364. The administrative cases upon which NRC Staff and the applicant rely either do not support their claim or are wrongly decided. In Louisiana Energy Services (Nat'l Enrichment Facility [New Mexico]), CLI-06-15, 63 N.R.C. 687, 707 n.91 (2006), the Commission affirmed two ASLB decisions in which intervenors raised challenges under NEPA. Both ASLB decisions involved the environmental impacts of near-surface disposal of depleted uranium. But all of the disposal sites under consideration were regulated by states or by the Department of Energy; none were regulated by the Commission. Id. at 691. Therefore, NRC Staff had no obligation to conduct "a full-scale site-specific review, an inquiry in the purview of the responsible licensing agency." Id. at 690 (internal quotations omitted). After expressing its concern "that the Board (and the underlying FEIS) may not have fully explored potential long-term effects from disposing of depleted uranium – whose radiological hazard gradually *increases* over time," the Commission affirmed the Board decisions "as supplemented by our decision today." Id. at 689-90. In a final footnote, the Board observed that "[a]djudicatory findings on NEPA issues, including our own in this decision, become part of the environmental 'record of decision' and in effect supplement the FEIS." Id. at 707 and n.91. Here, however, no "adjudicatory findings" could cure the defect in NYS-12CB. NRC Staff's failure to require Entergy to develop sitespecific inputs to the CHRONC module of the MACCS2 code cannot be remedied by "adjudicatory findings."

365. Moreover, in reviewing a subsequent petition for judicial review, the District of Columbia Circuit considered only whether the Board's supplementation of the FEIS by the hearing record violated the Atomic Energy Act's requirement (at 42 U.S.C. § 2243) that the EIS be prepared before the administrative hearing was completed. It did not determine whether the Commission's method of supplementing the EIS violated the Commission's NEPA regulations, a
question the court itself made clear was not at issue in the case. *See Nuclear Info. & Res. Serv. v. NRC*, 509 F.3d 562, n.1 (D.C. Cir. 2007) ("Petitioners have not argued that the NRC's method of supplementing the EIS violated its regulations implementing NEPA. *See* 10 C.F.R. § 51.92.").<sup>64</sup>

366. To the extent that *Philadelphia Electric Co.* (Limerick Generating Station, Units 1 and 2), ALAB-819, 22 N.R.C. 681, 705-07 (1985) and *Louisiana Energy Services*, L.P. (Claiborne Enrichment Center [Louisiana]), CLI-98-3, 47 N.R.C. 77, 94 (1998) suggest that a licensing board may supplement an environmental impact statement with the hearing record, they are inconsistent with 10 C.F.R. § 51.102(c) and NEPA's goals.

367. Section 51.102(c) provides that, in a contested proceeding, the record of decision is comprised of "the initial decision of the presiding officer or the final decision of the Commissioners acting as a collegial body." However, neither the "initial decision" of the presiding officer nor the Commissioners' "final decision" includes testimony or exhibits from the adjudicatory proceeding. Nor does 10 C.F.R. § 51.103(c), which provides that "[t]he record of decision may incorporate by reference material contained in a final environmental impact

<sup>&</sup>lt;sup>64</sup> Moreover, the legal framework, procedural history, and petitioner's legal claims distinguish Louisiana Energy Services ("LES") from the present situation. NRC's review of LES's application to operate an uranium enrichment facility was controlled by a highly specific and specialized amendment to the Atomic Energy Act, 42. U.S.C. § 2243. That provision required NRC to hold a single adjudicatory hearing (*id.* at § 2243(b)(1)), declared that the issuing of such a license "shall be considered a major Federal action" under NEPA thereby necessitating the preparation of an environmental impact statement (id. at § 2243 (a)(1)), and directed NRC to prepare that environmental impact statement before the adjudicatory hearing (*id.* at § 2243(a)(2)). Indeed, this special provision of the AEA seems to anticipate only one EIS, only one hearing, and that Staff's work on the EIS would be complete before the hearing. Petitioners' single NEPA challenge was limited to a claim that NRC did not adequately address the environmental consequences of disposing the waste generated by the facility. Nuclear Info., 509 F.3d at 566. In the LES proceeding, NRC staff released the draft EIS for public review in September 2004 and then issued the final EIS in July 2005-well before both the NRC's principal rulings on petitioners' contentions and the "mandatory hearing" in March 2006 on the remaining, uncontested issues. Id. at 568.

statement," make any similar provision for the incorporation by reference of testimony or exhibits in an adjudicatory hearing.

368. The situations in which courts have allowed board supplementation are distinguishable from this matter. In one case, NRC Staff was relying upon the opinion of another agency and the environmental report had been revised by the applicant.<sup>65</sup> In another, the parties stipulated to add additional detail to the EIS, but not to change its conclusions.<sup>66</sup> Neither of those circumstances is present here.

369. Permitting deficiencies in the December 2010 FSEIS to be "deemed supplemented" by the hearing record or by Board [or Commission] order is fraught with problems. First, it would not be clear to the decision-makers or the public which part of the "record as a whole" was curing the NEPA deficiency. Second, the information that was deemed to supplement the FSEIS would not necessarily have been analyzed in a meaningful way, or at all, by NRC Staff. Third, the procedure would be inconsistent with the notice, comment, and response requirements in NRC and CEQ regulations. 10 C.F.R. § 51.92(f)(1); 40 C.F.R. § 1502.9(b). Fourth, all the pertinent environmental information would no longer appear in one

<sup>&</sup>lt;sup>65</sup> New England Coal. on Nuclear Pollution v. N.R.C., 582 F.2d 87, 93-94 (1st Cir. 1978) (NRC did not violate NEPA when it required the applicant to revise its environmental report to reflect a new location for a cooling water intake tunnel, but did not redo its own FEIS, because EPA had decided that the new location would have a smaller impact on the aquatic environment than the original location and NRC was entitled to rely on the EPA conclusion.). As the text of the decision makes clear, this holding was based on the earlier—and subsequently eliminated—version of § 51.52.

<sup>&</sup>lt;sup>66</sup> *Citizens for Safe Power, Inc. v. N.R.C.*, 524 F.2d 1291, 1294, n.5 (D.C. Cir. 1975) (Where a stipulation entered into by the parties refined portions of an EIS, and those refinements were deemed to be included in the EIS and published in the Federal Register as part of the Board's decision, the court stated: "Not questioning the importance of full disclosure and the necessity of real opportunity for public input under NEPA, we believe in the circumstances that there was no departure from either the letter or spirit of the Act."). This decision was decided during the tenure of the superseded version of § 51.52.

document that contains the agency's analysis of that information. *See Minn. Pub. Interest Research Group v. Butz*, 541 F.2d 1292, 1300 (8th Cir. 1976) ("The detailed statement serves to gather in one place a discussion of the relative impact of alternatives so that the reasons for the choice of alternatives are clear."). Indeed, CEQ regulations direct federal agencies to "adopt procedures for introducing a supplement into its formal administrative record..." 40 C.F.R. § 1502.9(c)(3). In sum, allowing the FSEIS to be "deemed supplemented" by the hearing record would undermine the very purpose of conducting an environmental analysis in an EIS that is circulated for public comment. 10 C.F.R. § 51.92(f)(1) ("A supplement to a final environmental impact statement will be accompanied by or will include a request for comments . . ."); *see also* 40 C.F.R. § 1500.1(b) ("public scrutiny [is] essential to implementing NEPA.").

2. <u>The Errors Identified in NYS-12C Necessitate a Supplement to the FSEIS</u>

370. This Board has implicitly recognized that remand to NRC Staff is the appropriate remedy when the Board concludes that the FSEIS is deficient. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Memorandum and Order (Ruling on Motion and Cross-Motions for Summary Disposition of NYS-35/36), CLI-11-17, 74 N.R.C. 11, at \* 27 (Jul. 14, 2011) (ML111950712). In the same way, for NYS-12C, the proper remedy is a remand to NRC Staff. NRC Staff would either conduct the review itself or direct Entergy to perform a SAMA reanalysis to cure the MACCS2 input deficiencies identified by the State. NRC Staff would then evaluate the SAMA Reanalysis in a supplement to the FSEIS that is circulated for public comment. In finalizing the supplement to the FSEIS, NRC Staff must respond to public comments. Only then would the NEPA deficiencies identified in NYS-12C be cured.

371. The State has proffered evidence that shows that the NRC Staff's environmental analysis in the FSEIS is inadequate, inaccurate, incomplete, and/or entirely missing. By contrast,

139

NRC Staff and the applicant have presented evidence intended to convince the Board that the FSEIS complies with NEPA. Ultimately, the Board has only two options: It may rule that the December 2010 FSEIS satisfies NEPA, or it may conclude that it does not, and remand to Staff to correct the deficiencies.

## E. NYS-12C and NYS-16 Are Related, and In Evaluating NRC Staff's NEPA Compliance and Fashioning an Appropriate Remedy, the Board Can Consider Them Together

372. NYS-12C and NYS-16B both concern inputs to the MACCS2 code and the

reasonableness of Entergy's SAMA analysis under NEPA, so the Board can view them together. In submitting joint testimony on both contentions, NRC Staff recognized the connection between them, noting that "[t]he Staff's testimony and exhibits filed with respect to consolidated contention NYS-16B and NYS-12C are identical due to the substantial overlap of issues between the MELCOR Accident Consequence Code System 2 ('MACCS2') and Severe Accident Mitigation Alternatives ('SAMA') analysis." NRC000039 at 1, n.1.

373. There is nothing that prevents the Board from evaluating related contentions such as NYS-16B and NYS-12C—together. Indeed, Boards often consider related contentions jointly. *See, e.g., Duke Energy Corp.*, 59 N.R.C. at 149-50 (considering contentions with overlapping factual and technical questions together, as a group); *Consumers Power Co.*, 16 N.R.C. at 579 (where similar considerations govern the disposition of multiple contentions, those contentions will be reviewed together); *Niagara Mohawk Power Corp.*, 7 A.E.C. at 1079 (considering closely related contentions together).

## XIII. PROPOSED ORDER

For the foregoing reasons, the State of New York's Contention NYS-12C is resolved in favor of the State of New York. Accordingly, the Director of Nuclear Reactor Regulation is not

authorized to issue, and may not issue, renewed operating licenses for the Indian Point nuclear power plants Units 2 and 3.

In accordance with 10 C.F.R. § 2.341(b)(1), any party to this proceeding may file a petition for review of this Initial Decision with the Commission within twenty-five (25) days after service of this initial decision. In accordance with 10 C.F.R. § 2.340(g) and § 2.1210, this Initial Decision shall constitute the final decision of the Commission forty (40) days after its issuance, unless there is a petition for Commission review filed, or the Commission decides to review this Initial Decision under 10 C.F.R. § 2.1210(a)(2) or (3).

Respectfully submitted,

Signed (electronically) by

Kathryn M. Liberatore Assistant Attorney General Office of the Attorney General for the State of New York 120 Broadway New York, New York 10271 (212) 416-8482

March 22, 2013

Signed (electronically) by

John J. Sipos Assistant Attorney General Office of the Attorney General for the State of New York The Capitol Albany, New York 12224 (518) 402-2251