UNITED STATES
NUCLEAR REGULATORY COMMISSION

BEFORE COMMISSIONERS
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GEORGE APOSTOLAKIS, AND
WILLIAM C. OSTENDORFF AND
CHAIRPERSON ALLISON M. MACFARLANE

ON PETITION FOR REVIEW OF
LBP-13-13 PURSUANT TO 10 C.F.R. § 2.341

In re:	Docket Nos. 50-247-LR; 50-286-LR
License Renewal Application Submitted by	ASLBP No. 07-858-03-LR-BD01
Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc.	DPR-26, DPR-64 February 14, 2014

STATE OF NEW YORK PETITION FOR REVIEW OF ATOMIC SAFETY AND LICENSING BOARD DECISION LBP-13-13 WITH RESPECT TO CONSOLIDATED CONTENTION NYS-12C

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GLOSSARY OF TERMS, ACRONYMS, & ABBREVIATIONS

AEC	Atomic Energy Commission
Board	Atomic Safety and Licensing Board
CDNFRM	MACCS2 input parameter for the nonfarmland decontamination cost
CEQ	Council on Environmental Quality
ConEd	Consolidated Edison Company
Decision	Partial Initial Decision, *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-13-13, 78 N.R.C. _, slip op. (Nov. 27, 2013) (ML13331B465).
DSEIS	Draft Supplemental Environmental Impact Statement NUREG-1437, *Draft Supplemental Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Indian Point Units 2 and 3, Supplement 38, Volumes 1 and 2* (Dec. 2008) (NYS00132A-D)
EIS	Environmental Impact Statement
Entergy Test.	Pre-filed Testimony of Entergy Witnesses Potts, O'Kula, and Teagarden on Consolidated Contention NYS-12C (Mar. 30, 2012) (ENT000450)
FSEIS	Final Supplemental Environmental Impact Statement 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) (NRC000004)[1] (NYS00133A-J)
GEIS	NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Vol. 1-2* (May 1996) (NRC000002)[2] (NYS00131A-I)
ISR	International Safety Research, Inc.

[1] NRC000004 is a one-page exhibit that "[i]ncorporates New York Exhibit NYS000133A-J."

[2] NRC000002 is a one-page exhibit that "[i]ncorporates New York Exhibit NYS00131A-I."

GLOSSARY OF TERMS, ACRONYMS, & ABBREVIATIONS

Lemay Initial Test.	Pre-filed Testimony of NYS Expert Lemay on Contention NYS-12C (Dec. 21, 2011) (NYS000241)
Lemay Rebuttal Test.	Pre-filed Rebuttal Testimony of NYS Expert Lemay on Contention NYS-12C (Jun. 29, 2012) (NYS000420)
Limerick	*Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719 (3d Cir. 1989)
MACCS2	MELCOR Accident Consequence Code Systems Version 2
MELCOR	Methods for Estimation of Leakages and Consequences of Releases
NEI 05-01	NEI 05-01, Rev. A, *SAMA Analysis Guidance Document* (Nov. 2005) (NYS000287)
NEPA	National Environmental Policy Act
NCF	Non-Containment Failure
NRC	Nuclear Regulatory Commission
NUREG-1150	NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (Dec. 1990) (NYS00252A-D)
NUREG/CR-3673	NUREG/CR-3673, *Economic Risks of Nuclear Power Reactors Accidents* (May 1984) (NRC000058)
NYS-12C	Consolidated Contention NYS-12/12A/12B/12C
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"
PRA	probabilistic risk assessment
SAMA	Severe Accident Mitigation Alternatives
Sandia	Sandia National Laboratories
Sandia *Site Restoration*	D. Chanin & W. Murfin, SAND96-0957, *Site Restoration: Estimation of Attributable Costs From Plutonium-Dispersal Accidents* (May 1996) (NYS000249)

GLOSSARY OF TERMS, ACRONYMS, & ABBREVIATIONS

Staff Test.	Pre-filed Testimony of NRC Staff Witnesses Bixler, Ghosh, Jones, and Harrison on NYS-12/16 (Mar. 30, 2012) (NRC000041)
State Proposed Findings	State of New York's Proposed Findings of Fact and Conclusions of Law for Contention NYS-12/12A/12B/12C ("NYS-12C") (Mar. 22, 2013) (ML13081A757)
State Reply Findings	State of New York's Reply to NRC Staff's and Entergy's Proposed Findings of Fact and Conclusions of Law for Contention NYS-12/12A/12B/12C ("NYS-12C") (May 3, 2013) (ML13123A467)
Tawil 1990	NUREG/CR-5148, *Property-Related Costs of Decontamination*, J. J. Tawil & F.C. Bold (Feb. 1990) (NYS000424A-BB)
TIMDEC	MACCS input parameter for the time required for completion of decontamination levels
Tr.	Transcript of Evidentiary Hearing before Atomic Safety and Licensing Board, Docket Nos. 50-247-LR & 50-286-LR, ASLBP No. 07-858-03-LR-BD01

TIMELINE OF SELECTED EVENTS AND REFERENCES

1975 – WASH-1400, *Calculation of Reactor Accident Risks*, Appendix VI, Nuclear Regulatory Commission (1975).

1979 March – Three Mile Island Unit 2 accident.

1984 – NUREG/CR-3673, R. P. Burke and D. C. Aldrich, N.C. Rasmussen, *Economic Risks of Nuclear Power Reactor Accidents*, Sandia National Laboratories, Albuquerque, NM (Apr. 1984).

1986 April – Chernobyl Unit 4 accident

1987 – NUREG-1150, *Reactor Risk Reference Document (Draft for Comment)* - Main Report (Volume 1), Appendices A-I (Volume 2), and Appendices J-O (Volume 3) (Feb. 1987).

1989 – NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (Second Draft for Peer Review)* - Summary Report (Volume 1), Appendices (Volume 2), (Jun. 1989).

1990 – NUREG/CR-5148, PNL-6350, J. Tawil, F. Bold, *Property-Related Costs of Radiological Accidents,* (Pacific Northwest Laboratory, Richland, WA (Feb. 1990).

1990 – NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* — Final Summary Report (Volume 1), Appendices A, B, and C (Volume 2), Appendices D and E (Volume 3) (Dec. 1990) (ML040140729).

1990 – NUREG/CR-4551, J. L. Sprung, et al., *Evaluation of Severe Accident Risks: Quantification of Major Input Parameters – MACCS Input*, Volume 2, Revision 1, Part 7, Sandia National Laboratories, Albuquerque, NM (Dec. 1990) (NRC PDR microfiche Accession No. 9101090454 901231).

1996 – SAND96-0957, D.I. Chanin & W.B. Murfin, *Site Restoration: Estimation of Attributable Costs from a Plutonium-Dispersal Accident*, Sandia National Laboratories, Albuquerque, NM, Unlimited Release, UC-502 (May 1996).

1997 – MACCS2 computer code, public release.

1998 – NUREG/CR-6613, SAND97-0594, D.I. Chanin & M.L. Young, *Code Manual for MACCS2: Volume 1, User's Guide*, Sandia National Laboratories, Albuquerque, NM (May 1998).

2011 March – Fukushima multi-unit accident

MAP OF THE UNIQUE 50-MILE RADIUS REGION AROUND INDIAN POINT

Region within 50 miles of Indian Point[3]

[3] Source: NYS000209 at 3 (Expert Report of Dr. Stephen C. Sheppard, Dec. 16, 2011). The red dot represents the location of Indian Point Units 1 and 2.

Pursuant to 10 C.F.R. § 2.341, the State of New York petitions the U.S. Nuclear Regulatory Commission for review of the Atomic Safety and Licensing Board's November 27, 2013 Partial Initial Decision ("Decision").[1] The State's petition focuses on the Decision insofar as it resolved admitted Consolidated Contention 12/12A/12B/12C ("NYS-12C"), which challenged the Severe Accident Mitigation Alternative ("SAMA") analysis under the National Environmental Policy Act ("NEPA"), in favor of NRC Staff and the applicant, Entergy.

I. INTRODUCTION

While the State appreciates the Board's efforts, the Decision regrettably contains several factual, legal, and procedural errors that allow NRC Staff to ignore its obligations under NEPA, NRC regulations, and Council on Environmental Quality ("CEQ") regulations to evaluate measures to mitigate severe accidents in a site-specific SAMA analysis for Indian Point—which operates in the most densely-populated and densely-developed area of any U.S. nuclear power plant. Given its location, "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 Auth. of the State of New York* (Indian Point Unit 3), CLI-85-6, 21 N.R.C. 1043, 1049-50 (1985).

The SAMA analysis and the underlying analysis performed using a computer code known as MELCOR Accident Consequence Code Systems Version 2 ("MACCS2") play a crucial role in this proceeding. The SAMA analysis identifies site-specific severe reactor accident consequences and cost beneficial measures to mitigate such consequences, and informs the Staff's evaluation of alternatives. Without even addressing much of the State's compelling

[1] *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-13-13, Partial Initial Decision (Ruling on Track 1 Contentions), 78 N.R.C. _, slip op. (Nov. 27, 2013) (ML13331B465).

evidence that site-specific inputs would yield up to a seven-fold increase in the costs of a severe accident, the Board has approved NRC Staff and Entergy's vast underestimation of severe accident costs and attendant benefits of mitigation measures by relying on data developed for a reactor site in rural Virginia, known as "Sample Problem A."

This petition raises substantial public policy issues. A severe accident at Indian Point could have a devastating impact on the State of New York, its citizens, communities, reservoirs, and natural resources. It is imperative, therefore, that the MACCS2 SAMA analysis accurately reflect the costs of such an accident and the alternatives to mitigate such devastating impacts to the New York metropolitan area. Given the potential environmental impacts, as well as concerns that NRC and the federal government might not provide funding for the restoration and remediation of contaminated areas under the Price Anderson Act or other programs,[2] NRC must squarely confront the real costs of a severe accident and the alternatives available to mitigate such harm. It has not yet done so in this licensing proceeding.

With respect to decontamination time, the Decision reads as if Fukushima never happened. *See* III.A., below. The Board ignores the State's evidence regarding decontamination experiences following actual severe accidents, such as those at Fukushima, and instead approves NRC Staff's and Entergy's estimation that it would only take an average of 90 days to decontaminate following a severe accident at Indian Point. 90 day decontamination times are simply not credible for these types of accidents. Despite NEPA's requirement that analyses contain accurate scientific data, the Decision omits any discussion of the unreasonable assumptions upon which the flawed 90-day decontamination time is based. Applied to Indian

[2] State of New York Letter to NRC Staff (Aug. 20, 2013) (included in ML13239A522).

Point, those assumptions would require 1.5 million workers to accomplish clean up in 90 days. That scenario is unrealistic and unreasonable.

With respect to decontamination cost, the Board committed factual and legal errors by accepting NRC Staff and Entergy's argument that the "pedigree" of Sample Problem A supports its continued use because its values were sourced from NUREG-1150. *See* III.B., below. The parties and the Board agree that the ultimate source of the decontamination cost inputs in Sample Problem A is not NUREG-1150, but a reference that was neither published nor peer-reviewed, and no longer exists. The Board excuses this glaring omission by assuming there was some sort of "secondary" peer review of the values when the record makes clear there was not. In fact, internal NRC documents question the "pedigree" of the Sample Problem A values. The Board has excused poor science, sloppy logic, and unsupported analysis on the part of NRC Staff and, in turn, stretched NEPA's rule of reason beyond the bounds of established law.

While the Board states that NRC Staff and Entergy used the "best available information," the Board failed to mention NUREG/CR-5148 (Tawil 1990), which included a site-specific case study of severe accident consequences at Indian Point, or the many reports cited by the State and its experts. *See* III.C., below. In defense of Sample Problem A, the Board finds that a site-specific population estimate is all that is needed for MACCS2 to generate site-specific cost estimates. However, this is not true for Indian Point. The State's experts have shown that the Sample Problem A decontamination values do not scale linearly with population, especially given the high building density surrounding the site. In addition, the Board also failed to address other flaws identified by the State in the SAMA analysis. *See* III.D., below.

Consequently, the Board erred in ruling that the SAMA and MACCS2 analysis complied with NEPA. NRC Staff should be directed to conduct a site-specific SAMA analysis using up-

to-date, accurate data explained in a further supplement to the Final Supplemental Environmental Impact Statement ("FSEIS") subject to public review and comment.

II. STATEMENT OF THE CASE

This contention and appeal concern the legitimacy of the proposed SAMA analysis and the underlying MACCS2 inputs under NEPA. Pursuant to 10 C.F.R. § 2.341(b)(2)(ii), this petition contains record citations identifying where the "matters of fact or law raised in the petition for review were previously raised before the presiding officer."

A. The Indian Point Site

The location for the Indian Point power reactors differs markedly from any other reactor site in the United States. With more than 17 million people living within 50 miles of Indian Point and almost no farmland, no other operating reactor site in the country comes close in terms of the surrounding population density or building density.[3] Indeed, NRC is well aware of the differences between the area surrounding Indian Point and all other sites in the U.S., having explained in the 1996 GEIS for license renewal:

> *Typically, nuclear power plant sites and the surrounding area are flat-to-rolling countryside in wooded or agricultural areas.* More than 50 percent of the sites have 80-km (50-mile) population densities of less than 200 persons per square mile, and over 80 percent have 80-km (50-mile) densities of less than 500 persons per square mile. *The most notable exception is the Indian Point Station, located within 80 km (50 miles) of New York City, which has a projected 1990 population density within 80 km (50 miles) of almost 2000 persons per square mile.*

[3] *See* NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Vol. 1-2* (May 1996) (NYS000131A) ("GEIS") at 2-2, Table 2.1 (based on 1990 census) NYS000131; NUREG-1437, Rev. 1 (2013) at § 3.1, Table 3.1.1 (based on 2000 census). *See, e.g.*, Transcript of Evidentiary Hearing before Atomic Safety and Licensing Board, Docket Nos. 50-247-LR & 50-286-LR, ASLBP No. 07-858-03-LR-BD01 ("Tr.") 1959:18-22 (Teagarden).

NYS000131A GEIS at 2-2 (emphasis added). Entergy projects that the surrounding population will grow to 19.2 million people by 2035—the end of the proposed relicensing period for Unit 3. Environmental Report for License Renewal of Indian Point Unit 2 and Unit 3 (2007) at 2-35.

The communities within the 50-mile radius around Indian Point contain some of the most densely-developed and most expensive real estate in the country, significant natural resources, centers of national and international commerce, critical transportation arteries and hubs, and numerous historic sites. Indian Point is 24 miles north of New York City, 35 miles from Times Square, and approximately 38 miles from Wall Street. New York City is the largest city in the nation—with more than 8 million residents. The New York City Metropolitan area differs markedly even from typical urban areas and parts of the 50-mile radius have uniquely high building density, mostly consisting of high-rise buildings. NYS000241 Lemay Initial Test. at 20. The Indian Point facilities are 6 miles west of the New Croton Reservoir in Westchester County, part of the reservoir system that provides drinking water to New York City residents, and close to other reservoirs in the New York-Connecticut-New Jersey metropolitan area. NYS00133A FSEIS[4] at Figs. 2-2, 2-11, 2-1; 2-116 – 2-118.

Entergy's witnesses confirmed that, for the area surrounding Indian Point, the wind blows predominantly from the north to the south, *i.e.*, towards and over the most densely populated and developed areas of the 50-mile radius. Tr. 2294:1-20 (J. Wardwell/Lemay/O'Kula).

When Consolidated Edison Company ("ConEd") announced its selection of the Indian

[4] AEC granted construction permits for Unit 1 in 1956, for Unit 2 in 1966, and Unit 3 in 1969. 21 Fed. Reg. 3,084 (May 9, 1956); 31 Fed. Reg. 13,616-17 (Oct. 21, 1966); 34 Fed. Reg. 13,437 (Aug. 20, 1969). NRC000004 (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). Note that NRC000004 is a one-page exhibit that "[i]ncorporates New York Exhibit NYS000133A-J."

Point site in March 1955 (21 Fed. Reg. 3,084 (May 9, 1956)), the Atomic Energy Commission ("AEC") did not have site selection regulations that addressed population, flooding, seismic, or other hazards issues.[5] To place the initial siting decision in a historical perspective, ConEd selected, and AEC approved, Indian Point as the site for a power reactor before the Three Mile Island (1979), Chernobyl (1986), and multi-unit Fukushima (2011) events. The 1955 selection of the Indian Point site also came before the enactment of NEPA (1970), the promulgation of CEQ regulations (1978), the Third Circuit's *Limerick* decision (1989), and NRC promulgation of the 10 C.F.R. § 51.53 regulation (1996) that collectively require an analysis of ways to mitigate the impacts of severe accidents at nuclear facilities. No such analysis has previously been conducted. NYS00133B FSEIS at 5-4. Thus, a site-specific SAMA analysis is required before the Commission can decide whether to grant the application to renew the operating licenses until 2033 and 2035.

B. Indian Point License Renewal

Of the three reactors at the Indian Point site, only Unit 2 and Unit 3 continue to operate. The 40-year term for the Indian Point unit 2 operating license expired in September 2013. The current 40-year operating license for Unit 3 is set to expire in December 2015. On April 23, 2007, Entergy submitted an application to the NRC to renew the operating licenses (Nos. DPR-26 and DPR-64) for an additional 20 years.

[5] After AEC approved the Indian Point site, NRC issued guidance for site selection for nuclear power plants recommending that, for sites where the population density exceeds 500 persons per square mile out to 30 miles, special attention be given to the consideration of alternative sites with lower population densities. Regulatory Guide 4.7, Rev. 1, *General Site Suitability Criteria for Nuclear Power Stations*, at 4.7-9 (Nov. 1975) (ML13038A109).

C. The National Environmental Policy Act

NEPA requires the analysis of impacts that "have catastrophic consequences, even if their probability of occurrence is low." 40 C.F.R. § 1502.22. Federal agencies must 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), including renewal of a nuclear power plant's operating license, 10 C.F.R. § 51.20(b)(2). 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 Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350-52 (1989); 40 C.F.R. § 1502.14. Under, NEPA, NRC must consider the effects on human health, safety, and natural resources.[6]

An EIS must contain "high quality" information and "accurate scientific analysis" to "ensure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements." 40 C.F.R. §§ 1500.1(b), 1502.24; *see, e.g.*, *Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 964-65 (9th Cir. 2005).

The Board's Decision is replete with references to NEPA's so-called "rule of reason," and its holding rests upon a finding of reasonableness. As discussed in detail below, however, "reasonableness" is not a meaningless or hollow standard. In fact, "[t]his 'rule of reason' standard is not materially different from arbitrary and capricious review" that is the standard for reviewing agency action under the Administrative Procedure Act. *'Ilio'ulaokalani Coalition v. Rumsfeld*, 464 F.3d 1083, 1094 (9th Cir. 2006).

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[6] 42 U.S.C. § 4321 (purpose of NEPA is "to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man."); 42 U.S.C. §4331 (NEPA charges the federal government "to use all practicable means, consistent with other essential considerations of national policy" to "assure for all Americans safe, healthful . . . surroundings."). *See also* 40 C.F.R. §§ 1508.8, 1508.27.

D. The Indian Point SAMA and MACCS2 Analysis

The requirement to perform a site-specific SAMA analysis, Entergy's SAMA analysis, and NRC Staff's review of the SAMA analysis are discussed at length in the record. *See, e.g.*, State Proposed Findings[7] ¶¶ 75-87; *see also* Decision at 281. As a general matter, here and throughout the Decision, the Board improperly focuses on Entergy, not NRC Staff. *See, e.g.*, Decision at 275 ("The details of the Staff's position will not be discussed here as it is not materially different from the Entergy's position outlined above."). The burden of complying with NEPA lies with NRC alone.[8] 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). In drafting the FSEIS, NRC Staff may draw upon the SAMA analysis submitted by the applicant in its Environmental Report; however, NRC Staff must ensure that the applicant's analysis is based on accurate severe accident cost estimates for the specific site. Thus, it is NRC Staff's actions in approving the SAMA analysis in the FSEIS, not Entergy's, which must be evaluated under NEPA's standards.

1. Requirement to Perform a Site-Specific SAMA Analysis

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

[7] State of New York's Proposed Findings of Fact and Conclusions of Law for Contention NYS-12/12A/12B/12C ("NYS-12C") (Mar. 22, 2013) (ML13081A757).

[8] *See, e.g.*, *Progress Energy Florida, Inc.*, (Levy Cty. Nuclear Power Plant, Units 1 and 2), CLI-10-02, 71 N.R.C. 27, 34 (2010) ("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) (an applicant generally has the burden of proof in a proceeding, *see* 10 C.F.R. § 2.325, but when NEPA contentions are involved, the burden shifts to NRC Staff, because the NRC, not an applicant, has the burden of complying with NEPA).

B, Table B-1. 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." NYS000131C GEIS at 5-1. 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 identified and assessed." *Duke Energy Corp.* (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-02-17, 56 N.R.C. 1, 5 (2002).

Mitigation measures, called SAMA candidates, include plant modifications or operational changes. State Proposed Findings ¶ 111. Applicants typically perform a cost-benefit analysis of SAMA candidates to "assess[] whether and to what extent the probability-weighted consequences of the analyzed severe accident sequences would decrease if a specific mitigation alternative were implemented." *Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719, 739 (3d Cir. 1989).

The SAMA requirement is rooted in *Limerick*. The *Limerick* court recognized the need for site-specific analysis of severe accident mitigation "[b]ecause the potential consequences [of a severe accident] will largely be the product of the location of the plant." *Id.* at 738. In 1996, following the 1989 mandate in *Limerick*, 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. *See* NYS00133B FSEIS at 5-4:12. The applicant must first complete a SAMA analysis as part of its Environmental Report. 10 C.F.R. § 51.53(c)(3)(ii)(L). Then, Staff reviews the applicant's SAMA analysis and presents the results of its review in its supplemental environmental impact statement. 10 C.F.R. § 51.95(c)(4); 10 C.F.R. §§ 51.53(c)(3)(ii)(L), 51.71(d). 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 alternative selected, and if not, to explain why those measures were not adopted." 10 C.F.R. § 51.103(a)(4).

2. The MACCS2 Code

Entergy and most, if not all, of license renewal applicants have used the MACCS2 computer code to calculate off-site severe accident costs as part of their SAMA analyses. Tr. 1913:7-8, 1985:20-21 (Teagarden). Released in 1997, 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. NYS000243 (NUREG/CR-6613, SAND97-0594, Vol. 1, Code Manual for MACCS2: User's Guide (May 1998) ("MACCS2 User Guide")) at 1-1 – 1-2. The MACCS2 code is an improved version of the MACCS code, which replaced the earlier CRAC2 code. *Id.* In contrast to CRAC's "hard-wired" parameters, in MACCS those parameters are user-defined, and, thus, should be derived from site-specific data. *Id.*

The MACCS2 code utilizes a polar-coordinate spatial grid for all of its calculations, with Indian Point Units 2 and 3 at the center, and the surrounding 50 mile radius divided into sections called grid elements. *See* NYS000243 MACCS2 User Guide at 2-3. For each grid element, the user inputs basic data including population and whether land is farmland or not. *Id.* at A-12 to A-13. A MACCS2 analysis 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.

Id. at 2-2.

The MACCS2 code determines the economic cost of a severe accident primarily on the basis of the CHRONC input parameters, which is a focus of NYS-12C. NYS000242 ISR Report at 4; NYS000241 Lemay Initial Test. at 13-14. The following costs are included in the economic costs 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;
- 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.

CHRONC employs a module to determine what actions to take in each contaminated grid element, depending upon contamination levels. NYS000243 MACCS2 User Guide at 7-9 to 7-10. The user can input up to three levels of decontamination, but applicants typically use two levels: one for light decontamination and one for heavy decontamination. *Id.* at 7-9; Tr. 1982:16-18 (Teagarden). These inputs are called "dose reduction factors" in the MACCS2 code.[9] Entergy used a dose reduction factor of 3 for light decontamination and 15 for heavy decontamination. ENT000450 Entergy Test. at 54, Table 4.

[9] The dose reduction factor is the ratio of the radiological dose before decontamination to the dose after decontamination. NYS000243 MACCS2 User Guide at 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.*

3. Entergy's SAMA Analysis

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 FSEIS at G-23. Sample Problem A is one of fourteen sample problems containing example sets of inputs included in the MACCS2 code package. NYS000243 MACCS2 User Guide at 4-3. The sole adjustment Entergy made to the Sample Problem A inputs was to update them from their 1986-based dollars to the 2005-based dollars of Entergy's SAMA analysis, using the Consumer Price Index. NYS00133I FSEIS at G-23.

The SAMA analysis Entergy submitted with its Environmental Report contained wind and weather data errors.[10] To correct these errors, Entergy performed a SAMA reanalysis in 2009. Using the Sample Problem A input values, Entergy's 2009 SAMA reanalysis, identified 22 mitigation measures that are cost-beneficial, *i.e.,* SAMA candidates whose cost of implementation is less than their benefit, which is the reduction in severe accident costs achieved by mitigation. NYS000133B-C FSEIS at 5-9 – 5-10.

4. NRC Staff's Acceptance of Entergy's SAMA Reanalysis in the FSEIS

In the FSEIS, NRC Staff accepted Entergy's use of Sample Problem A example inputs, stating that Entergy used "Sample Problem A values [that] were primarily developed for the Surry plant analysis in NUREG-1150 and represent best estimate information for that site and

[10] Responding to issues the State raised in NYS-16B, NRC Staff requested that Sandia National Laboratories review Entergy's SAMA analysis. Sandia "discovered a potential error in the wind rose used in the MACCS2 portion of the analysis," which, ultimately, resulted in Entergy performing a SAMA reanalysis in December 2009. NRC000041 Staff Test. at 5 (A3a) (Bixler). *See also* Tr. 2346:24-2347:17 (J. McDade, Jones, Sipos, Harris); NYS000221 (NRC Staff email) at 4 ("[T]he MACCS2 input of averaged weather used in the analysis does not appear to reflect the annual weather conditions."); NYS000217 (Excerpt, SAMA Reanalysis Using Alternate Meteorological Tower Data, NL-09-165, Dec. 2009) at 1 ("The averaging method for wind direction . . . was determined to be incorrect.").

time." NYS00133I FSEIS at G-23. The FSEIS also describes Entergy's values as including "*generic Sample Problem A economic data* [adjusted using] the consumer price index of 195.3, which accounts for inflation between 1986 and 2005." *Id.* (emphasis added). *See also* Tr. 1962:20-22, 1963:23-1964:3 (J. Wardwell/Teagarden). Despite the FSEIS admission that the Sample Problem A values incorporate site-specific data for the Surry site in rural Virginia, NRC Staff still found Entergy's decontamination cost calculations and estimates to be reasonable, acceptable, and consistent with those performed for other nuclear power plants. *Id.* at G-24.

E. New York State Contention 12C

On November 30, 2007, the State submitted Contention 12, which asserted that Entergy's Environmental Report failed to accurately model 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 states:

> 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.

Following oral argument, the Board admitted Contention 12. *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, 100-03 (Jul. 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. 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.

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 12B, and the FSEIS in Contention 12C.[11] The State submitted an expert statement and an expert report in support of Contentions 12B and 12C, respectively. Contentions 12, 12A, 12B, and 12C were admitted and consolidated as NYS-12C.[12] 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."[13]

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[11] *State of New York Contentions Concerning NRC Staff's DSEIS* (Feb. 27, 2008) (ML090690303); *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); *State of New York's Mot. for Leave to File New and Amended Contention 12C Concerning NRC Staff's December 2010 FSEIS* (Feb. 3, 2011) (ML110680212).

[12] *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Order (Ruling on New York State's New and Amended Contentions) (Jun. 16, 2009) (unpublished) (ML091670435); *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 (Jun. 30, 2010) (ML101810344); *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Memorandum and Order, 8-9 (Jul. 6, 2011) (unpublished) (ML111870344) ("July 6, 2011 Order").

[13] July 6, 2011 Order at 7-8.

Despite the State's pending contentions and NEPA comments,[14] it was only in Appendix G to the 2010 FSEIS that NRC Staff attempted to address the State's concern that the economic costs of a severe accident at Indian Point have been significantly underestimated. NYS00133I FSEIS at G-22 – G-24. Staff called on Sandia National Laboratories ("Sandia") for assistance with this portion of the analysis. In the FSEIS, 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 FSEIS at G-23 – G-24.

F. The State's Evidence

The purpose of the State's evidence was to demonstrate that there are realistic and readily-available economic cost inputs that can be used to develop a site-specific SAMA analysis as required by NEPA. The State's evidence shows that if site-specific inputs are used, the SAMA economic costs (OECR) increases by a factor of up to 7. NYS000340 at 6, Table 13.

The State's expert, Dr. François J. Lemay, is a professional engineer with a Ph.D. in Physics of Nuclear Reactors. 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.*

[14] Contentions 12 and 12A are similar to the State's NEPA scoping and DSEIS comments, respectively. *New York State Supplemental Comments Regarding Scope of NEPA Analysis*, at 2-4 (Nov. 30, 2007) (ML073600658); NYS000134 *Comments Submitted by the New York State Office of the Attorney General* (Mar. 18, 2009) at 46.

Dr. Lemay is currently the Vice President of International Safety Research, Inc. ("ISR") and has extensive experience with the MACCS and MACCS2 codes. *Id.* at 2; NYS000291 at 1; Tr. 1945:6-19 (J. Kennedy/Lemay). Dr. Lemay has also worked with the International Atomic Energy Agency as an expert on the consequences of severe accidents. NYS000291 at 4.

On December 21, 2011, the State filed its initial statement of position (NYS000240), expert report entitled ISR Report: Review of Indian Point Off Site Consequence Analysis ("ISR Report") (Dec. 21, 2011) (NYS000242), pre-filed expert testimony (NYS000241), and exhibits (NYS00132A-D, NYS00133A-J, NYS000218, NYS000243-292) for consolidated Contention NYS-12C. On June 29, 2012, the State then submitted a revised statement of position (NYS000419), pre-filed rebuttal testimony (NYS000420),[15] and additional exhibits (NYS000421-32). On October 4, 2012, the Board entered as exhibit NYS000441 for NYS-12C.[16] The State's pre-filed testimony and all 110 exhibits for NYS-12C were admitted into evidence on October 15, 2012. Tr. 1269 (J. McDade).

On October 17 and 18, 2012, the Board heard live testimony from the State's witness, Dr. Lemay, Ph.D. as well as witnesses for Staff and Entergy. Tr. 1780-2083.[17] On March 22, 2013, the State submitted its Proposed Findings of Fact and Conclusions of Law for NYS-12C. On

[15] Reflecting a labeling correction. *See* Aug. 15, 2012 Cover Letter from AAG Dean to ASLB (ML12228A657, ML12228A655).

[16] *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).

[17] The Board adopted corrections to the transcript. *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), Order (Adopting Proposed Transcript Corrections with Minor Edits) (Dec. 27, 2012) (unpublished) (ML12362A278).

May 3, 2013, the State submitted its Reply Proposed Findings of Fact and Conclusions of Law for NYS-12C.[18]

G. The Board's Decision

The Board's Decision resolved NYS-12C in favor of NRC Staff and Entergy. The Board determined "that a preponderance of the evidence submitted regarding this contention supports the conclusion that Entergy's SAMA analysis is sufficiently site specific and a reasonable method under NEPA standards given that key input parameters are per capita based and multiplied by a site-specific population distribution." Decision at 293. The Board found that NRC Staff complied with NEPA and 10 C.F.R. § 51.53(c)(3)(ii)(L) in approving Entergy's use of Sample Problem A TIMDEC and CDNFRM values. *Id.*

H. The State's Motion to Reopen the Record and for Reconsideration of NYS-12C

On December 7, 2013, the State requested that the Board reopen the hearing record on Contention NYS-12C, consider new evidence presented by the State, and reconsider its Decision ruling in light of information that NRC Staff used a decontamination time (TIMDEC) input value of 365 days in a MACCS2 analysis of a severe accident at a spent fuel pool.[19] The State explained that NRC Staff's use of this value is contrary to the position taken by Staff and Entergy—and accepted by the Board in its Decision—that Staff had consistently accepted and used TIMDEC inputs of 60 days and 120 days for the last 30 years. The motion is fully briefed and pending before the Board. Pursuant to 10 C.F.R. § 2.345(b)(6), "[a] petition for review will

[18] State of New York's Reply to NRC Staff's and Entergy's Proposed Findings of Fact and Conclusions of Law for Contention NYS-12/12A/12B/12C ("NYS-12C") (May 3, 2013) (ML13123A467).

[19] *See* State of New York Motion to Reopen the Record and For Reconsideration on Contention NYS-12C (Dec. 7, 2013) (ML13341A002 (package)).

not be granted as to issues raised before the presiding officer on a pending motion for reconsideration." Thus, until the Board rules on the motion for reconsideration, the Commission may wish to defer ruling on this petition. Additionally, because the motion has not yet been decided, this petition does not rely upon the evidence submitted with it.

III. ARGUMENT

Pursuant to 10 C.F.R. § 2.341(b)(1), the Commission may take discretionary review of the licensing board's partial initial decision. NRC regulations provide that the Commission may grant review of substantial questions with respect to the following considerations:

> (i) A finding of material fact is clearly erroneous or in conflict with a finding as to the same fact in a different proceeding;
> (ii) A necessary legal conclusion is without governing precedent or is a departure from or contrary to established law;
> (iii) A substantial and important question of law, policy, or discretion has been raised;
> (iv) The conduct of the proceeding involved a prejudicial procedural error; or
> (v) Any other consideration which the Commission may deem to be in the public interest.

10 C.F.R. § 2.341(b)(4). The State submits that the Decision contains clearly erroneous findings of material fact, erroneous legal conclusions, and prejudicial procedural errors, and involves substantial questions of law, policy and discretion as well as matters of substantial public interest. In accordance with 10 C.F.R. § 2.341(b)(2)(iii), (iv), this petition sets forth the State's position as to why the Decision was erroneous and Commission review should be exercised.

A. Decontamination Time (TIMDEC) Errors

TIMDEC is a MACCS2 input parameter used by the code to account for the time it would take to decontaminate following a severe accident. NYS000243 MACCS2 User Guide at 7-10. The MACCS2 code requires users to input two decontamination times: one for light decontamination; and one for heavy decontamination. *Id.* Entergy took its TIMDEC inputs directly from Sample Problem A. 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.

The State argued that more reasonable and realistic values would be 1 to 15 years for light decontamination and 2 to 30 years for heavy decontamination. NYS000420 Lemay Rebuttal Test. at 51; NYS000430 at 6, Table 13; Tr. 2205:20-2206:5 (Lemay). The impact of changing TIMDEC alone is striking. Simply changing decontamination time to 1 year for light decontamination and 2 years for heavy decontamination—while maintaining Entergy's values for all other inputs—more than *doubles* the economic cost used in the SAMA analysis. NYS000430 at 6, Table 13; Tr. 2181:23-25 (Lemay). This is just one of many examples of the errors the Board made when upholding NRC Staff and Entergy's analysis.

1. The Board's Finding that NRC Has Examined Decontamination Times for More than 37 Years Is Not Supported in the Record

The requirement that an EIS contain "high quality" information and "accurate scientific analysis," be "supported by credible scientific evidence," and uphold "scientific integrity," underpins NEPA. 40 C.F.R. §§ 1500.1(b), 1502.22(b)(4), 1502.24. Federal case law underscores that the scientific integrity requirement is established law. *See, e.g.*, *Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 964 (9th Cir. 2005) (discussing scientific integrity requirement that "an agency may not rely on incorrect assumptions or data in an EIS"). Additionally, NRC has committed itself to the "highest technical . . . competence," the use of "best available knowledge," and "high quality" decisionmaking. NRC, *Principles of Good Regulation* and *Organizational Values*, http://www.nrc.gov/about-nrc/values.html (last updated Jan. 31, 2014).

Instead of forcing NRC Staff to "face those stubborn, difficult-to-answer objections" as NEPA requires, the Decision allows the agency to "ignore[e] them or sweep[] them under the

rug" by accepting the unsupported conclusion that NRC has been examining decontamination times for over 37 years. *Sierra Club v. U.S. Army Corps of Eng'rs*, 772 F.2d 1043, 1049 (2d Cir. 1985) (citation omitted). While NRC did begin reviewing decontamination times 37 years ago in WASH-1400, that information was derived from nuclear weapons accidents or explosions, not power reactors. NRC000056 WASH-1400 *Reactor Safety Study*, NRC (1975) at Appendix K to Appendix VI at K-1 to K-3. NRC also reviewed decontamination time in an April 1984 contractor report, NUREG/CR-3673, *Economic Risks of Nuclear Power Reactor Accidents* (ENT000466). But that is where NRC's review ended. There is no evidence in the record that anyone has examined the MACCS2 input value of decontamination time for the past 30 years—since NUREG/CR-3673's publication. *See, e.g.*, State Reply Findings at 10-13. NRC Staff has instead repeated and recycled the TIMDEC values from report to report.

Likewise, the Board's statement that NUREG/CR-4551 "reviewed the MACCS2 input parameters used in NUREG-1150, including TIMDEC" (Decision at 287) is incorrect. While NUREG/CR-4551 mentions in its introductory abstract that "most MACCS input parameters were reviewed," there is no explanation of what this review consisted of or how it was performed for TIMDEC. NUREG/CR-4551 does discuss many other MACCS2 input parameters, but it does not discuss how the time and cost of decontamination were obtained and, therefore, does not support their reasonableness. The Board's reliance upon introductory language from NUREG/CR-4551 was a factual error.

Thus, none of NRC Staff or Entergy's witnesses point to any basis for TIMDEC other than NUREG/CR-3673, which, as discussed below in III.A.2., is unrealistic and unreasonable for the 50-mile radius around Indian Point. Their vague, unsupported conclusions about reviewing decontamination times for 37 years lack a foundation. Thus, the Board committed legal error by

relying upon testimony to which it should have afforded no weight. *See Duke Energy Corp.* (Catawba Nuclear Station, Units 1 and 2), CLI-04-21, 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."). Without any "corroborating scientific evidence," the assertion that NRC has examined TIMDEC values for 37 years is incorrect, unsupported, and unreasonable under NEPA. *W. Watersheds Project v. Kraayenbrink*, 632 F.3d 472, 493 (9th Cir. 2011); *see also New York v. NRC*, 681 F.3d 471, 480-81 (D.C. Cir. 2012) (explaining NRC's analysis "must be thorough and comprehensive.").

2. The Board Erred in Failing to Acknowledge that Sample Problem A's Decontamination Time Values Are Based Upon a Document that Contains Unrealistic Assumptions and Is Inconsistent with NUREG-1150

Although the Board found that the "decontamination times (60 and 120 days) used by the Applicant in its SAMA analyses 'are fully consistent with the NUREG-1150 values for those MACCS2 parameters'" (Decision at 273 (quoting ENT000450 at 72)), it failed to discuss admissions from both Entergy and NRC Staff that NUREG-1150 itself does not provide analysis to support the Sample Problem A decontamination time (TIMDEC) inputs. For example, as State Proposed Findings ¶ 176 points out, one of Entergy's witnesses explained that "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." Tr. 2242:10-14 (Teagarden); *see also* NRC000041 Staff Test. at 68-69 (A61) (Jones). Without more, the arbitrary selection is plainly insufficient, especially in lieu of other, actual site specific parameters for IP's urban/suburban context.

NUREG-1150 directs a "reader seeking extensive discussion of the methods used" to NUREG/CR-4551 (NRC000057). NYS00252A at 2-20. 2-28. As discussed above in III.A.1., NUREG/CR-4551 also fails to provide a detailed explanation of decontamination times.

Therefore, the only piece of evidence left from NRC Staff is the earlier 1984 document NUREG/CR-3673 (NRC000058). *See* NRC000041 Staff Test. at 89-90 (A81) (Harrison, Ghosh). The Board, however, made a factual error in finding that NUREG/CR-3673 provides the necessary support.

NUREG/CR-3673 describes a timeline and explains its assumptions for the duration of decontamination, averaging 90 days, but it is based upon unreasonable assumptions and is inconsistent with NUREG-1150. NYS000420 Lemay Rebuttal Test. at 21-23. The State's experts 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 unrealistic and unreasonable. NYS000420 Lemay Rebuttal Test. at 22; *see also* NYS000431. Even extending the cleanup to one year would require 363,000 workers, which is also unrealistic and unreasonable. NYS000420 Lemay Rebuttal Test. at 23. As Dr. Lemay explained at the hearing, by using an average of 90 days "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).[20]

Moreover, internal inconsistencies in the decontamination timelines in NUREG/CR-3673 and NUREG-1150 render them unreliable. NYS000420 Lemay Rebuttal Test. at 21-23 (explaining how in NUREG/CR-3673, decontamination begins 30 days after the severe accident while NUREG-1150's timeline starts only seven days after the accident). Even Entergy

[20] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 22.

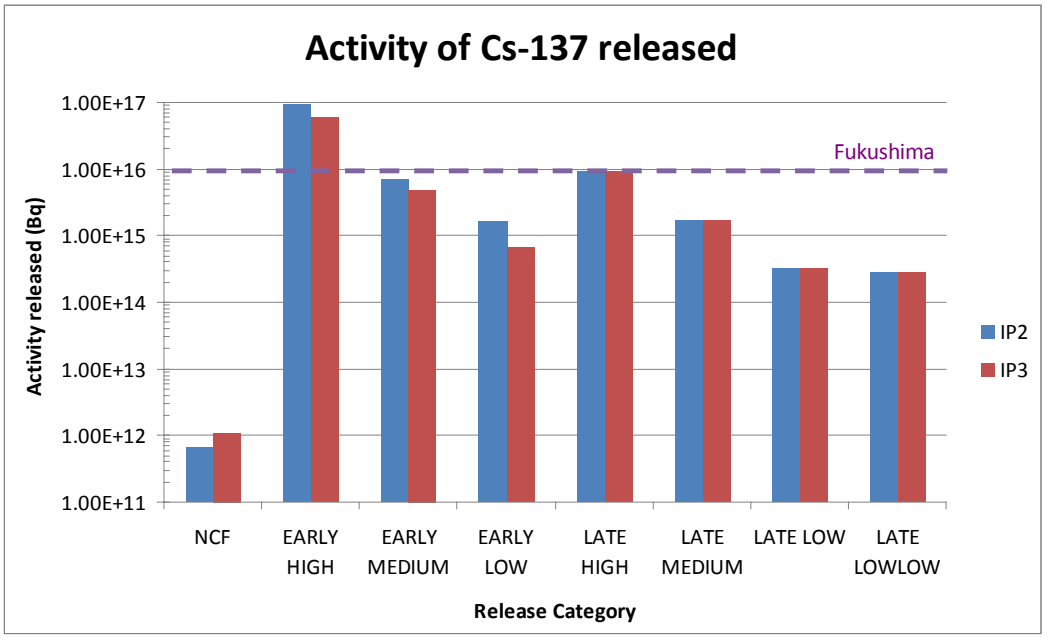
recognized these inconsistencies. *See* Tr. 2242:14-20[21] (Teagarden) (explaining that NUREG/CR-3673 "use[s] a basis of 90 days" that is "modified" in NUREG-1150).

3. Far from Being a Worst-Case Scenario, Fukushima Is Well Within the Range of Accidents Entergy Modeled and the Board Erred by Ignoring It

Data from two real-world severe accidents—Fukushima and Chernobyl—renders 60 and 120 day decontamination times for Indian Point untenable. *See* State Proposed Findings ¶¶ 264-268; State Reply Findings at 31-32. Although the Board acknowledges, in passing, that the State has submitted evidence regarding these two severe accidents, the Board then ignored the State's Fukushima evidence in upholding the FSEIS's 60 and 120 day TIMDEC values. This factual error caused a legal error under 10 C.F.R. § 2.341(b)(4)(i), (ii).

The State submitted evidence—uncontroverted by Entergy or NRC Staff—that Fukushima is well within the range of severe accidents that Entergy chose to model for the SAMA analysis. NYS000420 Lemay Rebuttal Test. at 12-15; Tr. 2183:18-20 (Lemay). The following bar chart shows the eight categories of accidents Entergy chose to model in the SAMA analysis as compared to the Fukushima release, represented by the dotted purple line. One category is six to ten times higher than Fukushima and two other categories are similar to Fukushima. It should be noted that the chart expresses the activity released using intervals corresponding to orders of magnitude, rather than a standard linear scale.

[21] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 25.



NYS000420 Lemay Rebuttal Test. at 12; *see also* Tr. 2184:6-2185:5 (Lemay). The source of the activity released is Entergy's MACCS2 input and output files. *Id.*

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. While NEPA does not require analysis of a so-called "worst-case scenario," NEPA's "hard look" requirement obligates the agency to evaluate potential environmental impacts, "includ[ing] 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). "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." *New York*, 681 F.3d at 482. Thus, NRC Staff may not dismiss consideration of a Fukushima-like

event with a multi-year decontamination timeline as "remote and speculative."

The State's expert 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 13; *see also* Tr. 2182:3-16 (Lemay). Although decontamination following the Fukushima nuclear accident has already lasted almost three years, some 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 49. Since this decontamination effort is on the outer edges of the plume deposition, it is representative of light decontamination. *Id.* Among other things, delays have been caused by the lengthy time it has taken to develop a decontamination plan, which is dependent on detailed characterization of the contaminated area via radiation surveys; to procure suitable and efficient decontamination equipment and materials; to gain government budget approval; and to secure approval from local communities for waste storage sites. *Id; see also* NYS000265. Finalizing plans and budgets for remediation efforts in the Fukushima Prefecture took one year. NYS000420 Lemay Rebuttal Test. at 41. These delays would be expected following a severe accident at Indian Point and have nothing to do with the direct damage caused by the Tsunami.[22] NYS000420 Lemay Rebuttal Test. at 49; Tr. 2205:3-14 (J. McDade/Lemay). The Board's failure to discuss or consider any of this evidence is a factual and procedural error.

[22] 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.*

With respect to Chernobyl, the Board improperly dismissed that evidence as "a single scenario of an extreme case." Decision at 285. Dr. Lemay testified that "large-scale decontamination of the area affected by the accident terminated four years after the accident," making the point that "[s]ince large-scale decontamination efforts stopped prematurely[, it] is not possible for anyone to estimate what the total duration of a clean-up for the Chernobyl accident could have been." NYS000241 Lemay Initial Test. at 52. There is no dispute that decontamination was not attempted close to the Chernobyl site, and that an exclusion area was established around Chernobyl and Pripyat.

By failing to even discuss Fukushima, and affording no weight to Chernobyl the Board contradicted case law holding that NRC acts arbitrarily and capriciously if it does 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. *See Shieldalloy Metallurgical Corp. v. NRC* ("*Shieldalloy I*"), 624 F.3d 489, 492-93 (D.C. Cir. 2010); *Shieldalloy Metallurgical Corp. v. NRC* ("*Shieldalloy II*"), 707 F.3d 371, 382 (D.C. Cir. 2013). Under NEPA, courts "do not suggest that all data relied upon by the agency be immediate, but here the data . . . was too outdated to carry the weight assigned to it. We conclude that the lack of up-to-date evidence on this relevant question prevented the [agency] from making an accurate cumulative impact assessment of the Project . . . ." *Lands Council v. Powell*, 395 F.3d 1019, 1031 (9th Cir. 2005); *see also Seattle Audubon Soc'y v. Espy*, 998 F.2d 699, 704-05 (9th Cir. 1993) (overturning an agency decision when it rested on "stale scientific evidence," "incomplete discussion of environmental effects," and "false assumptions"); s*ee 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")).

4. The Board's Decision Relies Upon an Incorrect Understanding of How "Averaging" Is Used in the MACCS2 Code and SAMA Analysis

The Board's Decision rests in large part upon a fundamental misapprehension, citing to Entergy's testimony, that the "SAMA analysis *examines the mean* annual consequences of numerous postulated accident scenarios" (Decision at 283 (citing ENT000450 at 18)) (emphasis added). This led the Board to incorrectly conclude that "we find that Entergy's selected TIMDEC values are reasonable given that the decontamination times represent the average over all the modeled severe accidents" (Decision at 286).

Conversely, the record is clear that the SAMA analysis does not rely on a simple mean or average. *See, e.g.*, NYS000241 Lemay Test. at 25; ENT000464 at 11; Tr. 1913:9-13 (Teagarden). Instead, it relies on *frequency-weighted* costs that take different accident scenarios into account. ENT000464 at 11. As explained below, in their SAMA analysis Entergy first calculated the consequences for each accident using the MACCS2 code, and then Entergy weighted those consequences by accident frequency and summed them to develop a total cost per year. *See, e.g.*, Tr. 2178:19-2180:2 (Lemay).[23]

Entergy's calculation of frequency-weighted costs began with its selection of eight different categories of severe accidents to model, ranging from lower consequence/higher frequency accidents to higher consequence/lower frequency accidents. NYS000420 Lemay Rebuttal Test. at 11; Tr. 1905:2-6 (Teagarden) ("We have eight bins, so to speak, release

[23] This testimony reflects a correction to the transcript adopted bv the Board. *See* Dec. 27, 2012 Board Order at 24.

categories postulated as part of the SAMA analysis for Indian Point of different types of releases that could occur to the environment."). The eight accidents are listed in the left column of the table below (circled in blue). The base table is reproduced from Entergy's SAMA analysis (ENT000464) and the State has highlighted various items.[24]

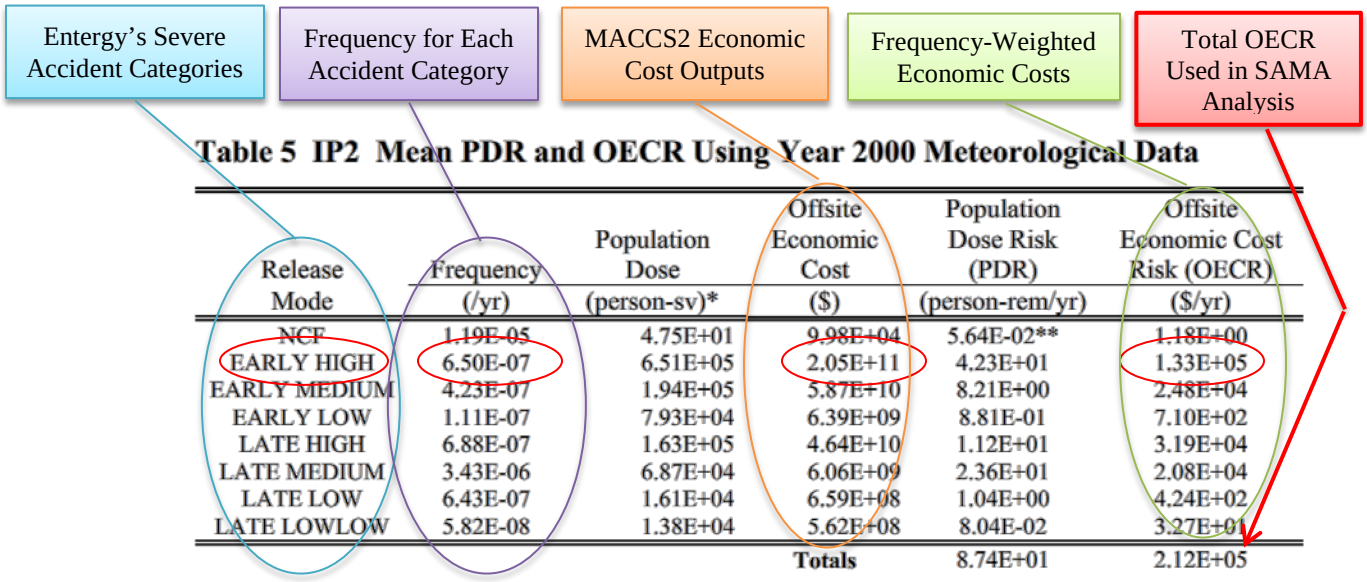


Table 5 IP2 Mean PDR and OECR Using Year 2000 Meteorological Data

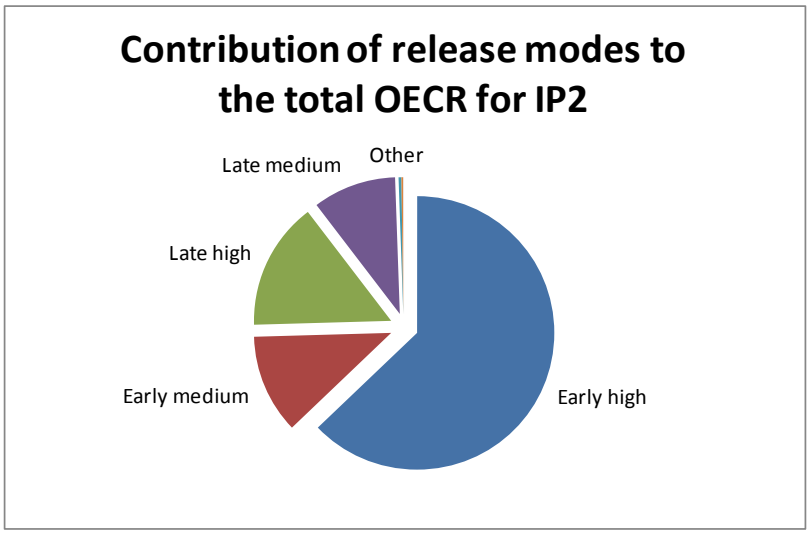
Release Mode	Frequency (/yr)	Population Dose (person-sv)*	Offsite Economic Cost ($)	Population Dose Risk (PDR) (person-rem/yr)	Offsite Economic Cost Risk (OECR) ($/yr)
NCF	1.19E-05	4.75E+01	9.98E+04	5.64E-02**	1.18E+00
EARLY HIGH	6.50E-07	6.51E+05	2.05E+11	4.23E+01	1.33E+05
EARLY MEDIUM	4.23E-07	1.94E+05	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
			Totals	8.74E+01	2.12E+05

The second column (circled in purple) shows the frequency, *i.e.*, the likelihood that the release category would occur within one year, for each release Entergy modeled. The MACCS2 code reports in the output file the offsite economic cost values for each release category, and those MACCS2 outputs are listed in the fourth column (circled in orange). *See* NYS000420 Lemay Rebuttal Test. at 11, 33. To calculate frequency-weighted costs, Entergy multiplied the cost of each release category (fourth column) by its associated frequency (second column) to obtain the offsite economic cost risk ("OECR") in the sixth column (circled in green), expressed on a cost per year basis. *See* ENT000450 Entergy Test. at 45 (A59) (O'Kula, Teagarden, Potts); Tr.

[24] Table 5 is for Indian Point Unit 2. Entergy's SAMA analysis contains a similar table for Indian Point Unit 3. ENT000464 at 16, Table 6. All numbers are expressed in scientific notation. For example, "1.19E-05" represents 1.19 times ten raised to the power of -5, which is 0.0000119 and "9.98E+04" represents 9.98 times ten raised to the power of 4, which is 99,800.

2191:20-22 (Teagarden) ("MACCS does not actually multiple the frequency, you do that yourself at the end."). Entergy summed all the frequency-weighted costs to calculate the total OECR used in the SAMA analysis (red arrow). *See* ENT000464 at 11.

"EARLY HIGH," circled in red, is one of the least frequent accidents, postulated to occur 0.00000065 times per year. With a $205 billion offsite economic cost, it has the highest consequences. Even adjusting for the frequency of "EARLY HIGH," its OECR is still the largest of all the release categories at $133,000 per year. As the following pie chart shows, based upon the Indian Point SAMA analysis calculations Entergy provided (ENT000464), the EARLY HIGH release contributes over 60% to the total OECR used in the SAMA analysis. Taken together, the most severe release categories—EARLY HIGH, EARLY MEDIUM, LATE HIGH, AND LATE MEDIUM—drives the total OECR for Indian Point, contributing over 90%.



NYS000420 Lemay Rebuttal Test. at 14-15 (using data from ENT000464). The narrow "Other" sliver combines the following four accident scenarios: NO-CONTAINMENT FAILURE (or NCF), LATE LOW, LATE LOW LOW, and EARLY LOW. These categories make an insignificant contribution to the total OECR.

As Dr. Lemay explained, in "calculat[ing] the OECR, . . . most of the cost comes from the worst accidents and that's quite logical. So we need to calculate those correctly. If I make a mistake on the [inputs relative to the] benign accidents, it has no impact on the cost. If I make a mistake on the worst accident, it completely changes the answer." Tr. 2179:21-2180:2 (Lemay).[25] As the State's Findings explain, 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. State Proposed Findings ¶ 284*; see also* NYS000420 Lemay Rebuttal Test. at 15-16; Tr. 2178:17-2179:14, 2196:14-2197:3 (Lemay).

Neither NRC Staff nor Entergy meaningfully responded to the State's argument on this point. The Board did not even address this argument, instead adopting NRC Staff and Entergy's vague discussions of "averages." This was an error of fact. Furthermore, by sanctioning such incredibly short TIMDEC values, the Board allowed NRC Staff to "consider[] only the best case scenario for environmental harm, assuming [a severe accident]" . . . [which] 'skew[s]' the data toward fewer environmental impacts, and thus impedes a 'full and fair discussion of the potential effects of the project.'" *Native Vill. of Point Hope v. Jewell*, 740 F.3d 489, 503-04 (9th Cir. 2014) (citing *Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 965 (9th Cir. 2005)). In permitting NRC Staff to violate NEPA in this way, the Board also committed legal error under 10 C.F.R. § 2.341(b)(4)(ii).

B. Decontamination Cost (CDNFRM) Errors

Nonfarm Decontamination Cost ("CDNFRM") is a MACCS2 input that defines the cost of decontaminating land that is not farmland. NYS000243 MACCS2 User Guide at 7-11.

[25] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 24.

CDNFRM has a significant impact on economic costs. *See, e.g.*, Decision at 272. MACCS2 requires the user to input a CDNFRM value in dollars per person for each dose reduction factor specified by the user for light and heavy decontamination. *Id.* In its SAMA analysis, Entergy used values of $5,184/person for a light decontamination and $13,824/person for heavy decontamination. ENT000450 Entergy Test. at 54, Table 4. Entergy obtained these values by adjusting Sample Problem A values (sourced from NUREG-1150) of $3,000/person and $8,000/person from 1986 to 2005 dollars using the Consumer Price Index. *Id.* at 53. CDNFRM is a critical MACCS2 input parameter with a large effect on cost. Tr. at 2054: 23-2055:4 (Lemay); *see also* NYS000430 at 5-6, Tables 11 & 13.

As will be discussed in more detail below, NUREG-1150 contains a gaping hole—the source and basis of the decontamination cost parameters in NUREG-1150 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" to for documenting the Sample Problem A decontamination costs Entergy relied upon);[26] 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."). As discussed below, even internal NRC documents, which NRC Staff failed to disclose during this proceeding, question the "pedigree" of NUREG-1150's decontamination cost inputs.

The missing source document, combined with the fact that neither Entergy nor NRC Staff supplied a rationale for reliance on Sample Problem A for CDNFRM, led the State's experts to attempt to determine whether those costs were reasonable using several sources of available alternative data. NYS000242 ISR Report at 12-13; NYS000241 Lemay Initial Test. at 30. The

[26] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 20.

State's experts relied upon different sources of readily-available data. For every methodology the State's experts used, the range of decontamination costs calculated are much higher than the decontamination costs calculated by Entergy using Sample Problem A. NYS000430 at 6, Table 13. The Board ignored this evidence. Thus, as set forth in more detail below, in finding NRC Staff and Entergy's CDNFRM value "reasonable," the Board made many errors of law and fact.

1. The Board Erred in Deferring to NRC Staff's Acceptance of Decontamination Cost Values that Are Based on a Reference that Was Not Published or Peer Reviewed, No Longer Exists, and Cannot Be Evaluated

The State's Proposed Findings explain in detail the lack of a documented basis for Sample Problem A's decontamination cost and time values, including the gaping hole in NUREG-1150[27]—the source of the economic cost parameters in NUREG 1150/Sample Problem A simply does not exist. Both NRC Staff and Entergy admit that the source reference cannot be located. State Proposed Findings ¶ 160. The Board

- "agree[s] with New York with regard to the absence of source documentation of the NUREG-1150 values[,]"
- "agree[s] with New York that sound science demands that if analysis results are determined to be sensitive to a particular input parameter, then that parameter should be closely scrutinized[,]" and
- "agrees with New York that it is difficult to scrutinize a value whose source does not exist."

Decision at 288-98. Nonetheless, the Board reaches an untenable conclusion: "Despite being in agreement with New York on these points, we conclude that Entergy's reliance on the input values obtained from NUREG-1150 is justified by the peer reviews conducted on documents using the same CDNFRM value, and that the Applicant's use of this value was reasonable." *Id.*

[27] NUREG-1150, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (Dec. 1990) (NYS00252A-NYS00252D).

at 289. This is an error of fact and law because there is neither a primary source of the values nor "secondary peer review." *Id.* Not only does CDNFRM lack an articulated rational basis, but also Entergy's values are much lower than values calculated using available realistic data. *See* III.B.4., below. The CDNFRM values accepted by NRC Staff do not meet NEPA's scientific integrity requirement, which the Board did not even discuss, and is unreasonable.

a. Lack of Primary Source

All parties agree that the ultimate source of Sample Problem A's decontamination cost values (CDNFRM) does not exist and, thus, cannot be verified. That source, "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 8-8 (emphasis added). NRC Staff has not produced Os84 and in fact has admitted that this document does not exist, at least in any available form.[28]

Thus, Os84 appears to have never been published or peer-reviewed. As Dr. Lemay points out, even if Os84 did exist, 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 "[t]hey 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:

[28] *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).

> Little data exist which are directly applicable to the small particle sizes (0.1-10 μm) 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 4-15.

No one knows the origin of the NUREG-1150 decontamination cost values; all that exists is a brief and cryptic description of Os84 contained in NUREG/CR-3673 stating that they were based upon "national average statistics." NRC000058 (NUREG/CR-3673) at 4-17. But because Os84 does not exist, there is no way to verify what national average statistics were used and whether they are applicable to Indian Point—the site surrounded by the highest population and building density of any U.S. site. Relying on vague descriptions of Os84 in NUREG/CR-3673 is simply not reasonable under NEPA.

Moreover, it is also important to place NUREG/CR-3673 in an historical context: released in 1984, it was prepared in the wake of the 1979 Three Mile Island Unit 2 accident—a non-containment failure ("NCF") accident that had little or no offsite consequences or decontamination costs. This 1984 document could not possibly have accounted for real world experience and decontamination information from the 2011 Fukushima or 1986 Chernobyl accidents.

After admitting that no copy of Os84 is available, the Board unconvincingly finds that Entergy's use of the decontamination values purportedly explained in Os84's "detailed review," but nowhere else, is still reasonable. Decision at 290. Providing an explanation of why Os84 is not available, Dr. Ghosh told the Board that

> [i]t'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). But neither Dr. Ghosh, nor any other witness in this proceeding, has personal knowledge of what Os84 contained.

No one knows what Os84, and thus Sample Problem A, are based on. This fundamental flaw is underscored by the conflicting, speculative testimony NRC Staff and Entergy provided on the source of Sample Problem A values. NRC witnesses initially told the Board that they thought Sample Problem A/NUREG-1150 values were derived from 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). However, later in the evidentiary hearing they changed their testimony and admitted that the information may have come from nuclear weapons releases and test sites.[29] Dr. Bixler initially contended that NUREG-1150 is "based on a typical source term that you would have from a nuclear reactor." and, thus would be "of interest for this problem that we're dealing with here." Tr. 2000:19-2001:1 (Bixler). Dr. Bixler maintained that "NUREG-1150 doesn't deal with [a] plutonium dispersal accident." Tr. 2001:16-21 (Bixler). Likewise, Mr. Jones initially expressed the position that NUREG-1150 was based on nuclear reactor accident data when discussing Os84. *See* Tr. 2011:3-17 (J. McDade/ Jones). 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

[29] 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 in the ISR Report and Pre-filed Testimony. *See* NYS000242, NYS000241, NYS000420.

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).

However, after Dr. Lemay pointed out the 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" (NYS00252D at D-32 (emphasis added); Tr. 2025:3-6 (Lemay)), 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) (emphasis added). *See also* Tr. 2037:1-2038:1 (O'Kula/Harrison). Mr. Jones further clarified his earlier testimony and admitted, "I am not aware of any specific cesium-related characterization or cost data." Tr. 2100:16-18 (Jones).

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). The Board's Decision fails to discuss any of this evidence.

b. "Secondary Peer Review"

Turning to the purported "secondary peer review" of the CDNFRM value, there is no record evidence to show that such a review ever took place. NUREG-1150 does not explain how the Sample Problem A costs were obtained. Tr. 2004:17-2005:24 (J. Wardwell/Lemay). In fact, NRC's response to comments on NUREG-1150 state that NRC expected that site-specific estimates of decontamination costs would be developed in the future:

> 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 actions.*
>
> 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). These NUREG-1150 reviewer comments support the State's point: cost/benefit calculations should be developed in the context of this specific regulatory activity, *i.e.*, Entergy's license renewal application.

Dr. Ghosh attempted to discredit these comments by labeling them as "public comments" as opposed to "expert comments." Tr. 2028:10-23 (J. Wardwell/Ghosh). While it is not clear who authored these comments, at the hearing, but not in the Decision, the Board correctly noted that Dr. Lemay's point in citing the comment was the substance of the NRC response. *Id.*

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).[30] The fact that the final version of NUREG-1150 removed the calculation of economic costs actually supports the State's argument—that economic costs should be calculated on a site-specific basis.

NUREG-1150's companion, NUREG/CR-4551 (NRC000057), also does not contain a review of the Sample Problem A values. Even the Board's quote from NUREG/CR-4551 states that "*most* MACCS input parameters were reviewed." Decision at 289 (quoting NUREG/CR-4551 at iii/iv) (emphasis added). While some inputs are explained in NUREG/CR-4551, there is no further explanation in NUREG/CR-4551 of decontamination costs or a peer review of those costs. NUREG/CR-4551 does cite NUREG/CR-3673 (NRC00058), as a reference for the Sample Problem A decontamination cost values. NUREG/CR-3673, however, does not contain a description of a peer review of the Sample Problem A CDNFRM values. It simply states:

[30] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 20.

> 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 4-15.

The Board's conclusion that the Sample Problem A values were subject to some sort of "secondary peer review" is based on unsupported assumptions and speculation suggested by NRC Staff and Entergy. It was error for the Board to afford weight to this testimony without any documentary evidence of peer review, and evidence showing that it is unclear what Os84 was relied upon or what further review of those values, if any, took place. *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. § 2.337(a) ("Only relevant, material, and reliable evidence which is not unduly repetitious will be admitted."); NRC Staff's and Entergy's testimony 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*, LBP-05-04, 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.). *See Phila. Elec. Co.* (Limerick Generating Station, Units 1 and 2), ALAB-819, 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."). Unsupported assumptions and unfounded conclusions cannot refute the State's criticism of the cost estimates in used in the SAMA analysis. *See Monroe Co. 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).

c. Scientific Integrity

The Board erred in failing to take up the State's objection to the CDNFRM values based on the absence of scientific integrity and reliability. State Proposed Findings ¶¶ 317, 318 ; State Reply Findings at 3-5. As discussed above in III.A.1., NEPA requires that an EIS contain "high quality" information and "accurate scientific analysis," be "supported by credible scientific evidence," and uphold "scientific integrity." 40 C.F.R. §§ 1500.1(b), 1502.22(b)(4), 1502.24. Federal case law confirms the scientific integrity requirement as established law. *See, e.g., Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 964 (9th Cir. 2005) (discussing scientific integrity requirement that "an agency may not rely on incorrect assumptions or data in an EIS"). Additionally, NRC has committed itself to the "highest technical . . . competence," the use of "best available knowledge," and "high quality" decision-making. NRC, *Principles of Good Regulation* and *Organizational Values*. Both the lack of a primary source for and the lack of any "peer review" of the CDNFRM values run afoul of the scientific integrity requirement.

An agency's use of a model is arbitrary if that model "bears *no* rational relationship to the reality it purports to represent." *American Iron & Steel Inst. v. EPA*, 115 F.3d 979, 1005 (D.C. Cir. 1997) (quotation marks and citations omitted) (emphasis in original). Models need not fit every application perfectly, nor need an agency "justify the model on an ad hoc basis for every chemical to which the model is applied." *Chemical Mfrs. Ass'n v. EPA*, 28 F.3d 1259, 1265 (D.C. Cir. 1994). If, however, "the model is challenged, the agency must provide a full analytical defense." *Eagle-Picher Indus., Inc. v. EPA*, 759 F.2d 905, 921 (D.C. Cir. 1985); *see also Natural Resources Defense Council, Inc. v. Herrington*, 768 F.2d 1355, 1385 (D.C. Cir. 1985).

Furthermore, an agency "retains a duty to examine key assumptions as part of its affirmative burden of promulgating and explaining a non-arbitrary, non-capricious rule." *Small*

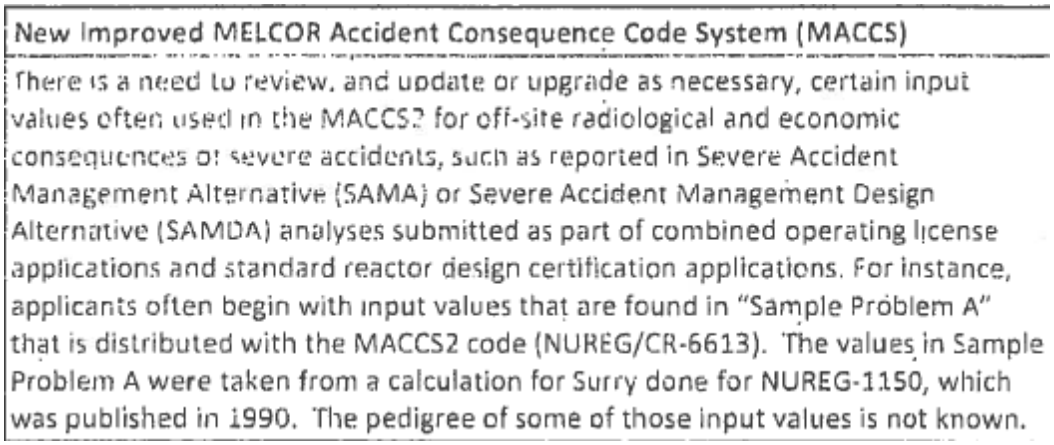
Refiner Lead Phase-Down Task Force v. EPA, 705 F.2d 506, 534 (D.C. Cir. 1983) (internal quotations omitted). Here, the NRC knows that "key assumptions" underlying Sample Problem A/NUREG-1150 MACCS2 code inputs are unfounded and inapposite, yet has offered no defense of its continued reliance on those inputs. *Cf. Columbia Falls Aluminum Co. v. EPA*, 139 F.3d 914, 923 (D.C. Cir. 1998); *Lands Council*, 395 F.3d at 1032 (holding that NEPA requires "up-front disclosures of relevant shortcomings in the data or models" and that withholding such information violates the statute).

The acceptance of the plainly identified and critically relevant shortcomings in Sample Problem A and CDNFRM values by NRC Staff and the Board is contrary to CEQ regulations and applicable NEPA case law. 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. *See Shieldalloy I*, 624 F.3d 489, 492-93 (D.C. Cir. 2010); *Shieldalloy II*, 707 F.3d 371, 382 (D.C. Cir. 2013); *see also Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 964-65 (9th Cir. 2005) (NEPA requires scientific integrity); *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")).

2. The Board Erred by Failing to Address Internal NRC Documents Questioning the "Pedigree" of the Sample Problem A Values from NUREG-1150

Remarkably, the Board's Decision does not even mention an internal NRC email chain and what appeared to be an attachment to that email chain that 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.[31] This document, entitled FY13 Long-Term Research Plan, is "a staff proposal for long-term research." Tr. 2287:3-4 (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 that "[*t*]*he pedigree of some of those input values is not known.*" NYS000441 at 5 (emphasis added). The text, in context, is reproduced below.



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. Because this document was plainly applicable to, directly contradicted, and undermined the arguments NRC Staff and Entergy raised in defense of Sample Problem A, the Board's failure to acknowledge and discuss the document constitutes a procedural, factual, and legal error. The document calls into question the pedigree of the Sample Problem A values taken from NUREG-1150, supporting the State's argument that they are unreasonable .

[31] 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").

Nor did the Board discuss NRC Staff's troubling failure to disclose the "pedigree" document.[32] NRC regulations obligate Staff to disclose documents in Staff's possession which are relevant to admitted contentions, regardless of whether they support or contradict the Staff's litigation position. 10 C.F.R. § 2.336. Coupled with Staff's failure to disclose the Tawil 1990 report that included a site-specific methodology for analyzing a severe accident at Indian Point (NYS000424A-BB, discussed below in III.C.3.), Staff's failure to disclose the "pedigree" document raises troubling questions about Staff's approach to its NEPA obligations to take a hard look at environmental consequences and alternatives to mitigate such consequences—as well as Staff's compliance with the 2004 Subparts C and L disclosure rules.

3. There Is No Rational Basis Articulated to Justify the Use of Sample Problem A for the Indian Point SAMA Analysis

Although the Board stated that the manager of Entergy's SAMA submission "considered the appropriateness of the NUREG-1150 numbers" to the Indian Point SAMA /MACCS2 analysis (Decision at 291), the record does not support this conclusion. In actuality, neither Entergy nor NRC Staff provided a documented, rational basis for the use of Sample Problem A.

To begin with, the MACCS2 reanalysis was performed for Entergy in 2009 by three Enercon employees—K. Hong, M. Golshani, and C. Yeh. ENT000464.[33] No contemporaneous written evidence exists documenting their justification of the input values, nor did Entergy produce these three individuals as witnesses for the evidentiary hearing. *See* Tr. 2528:19-2529:9

[32] 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).

[33] These individuals were also involved in the preparation of the original MACCS2 and SAMA analysis in 2006 and 2007. Entergy did not introduce any contemporaneous documentation identifying a basis for selecting the Sample Problem A CDNFRM values as part of the initial 2006/2007 MACCS2 and SAMA analysis.

(Sipos/Potts). Thus there is no direct competent evidence as to what, if anything, these individuals considered when they performed the MACCS2 analysis.

Likewise, at the time it performed its MACCS2 analyses, Entergy did not prepare a contemporaneous writing documenting its "consider[ation of] the appropriateness of the NUREG-1150 numbers" for the unique 50 mile area surrounding Indian Point. When discussing the Sample Problem A / NUREG-1150 values, Ms. Potts, Entergy's manager, testified, "I'm confident that the analysts that did it looked at the reasonableness of them," but 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).[34] 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 household of four, or a house apartment of 200." Tr. 2068:19-24 (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." Tr. 2068:25-2069:3 (Potts).

After Ms. Potts testified that no written review or documentation existed, counsel for Entergy unilaterally 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'Neill). However, that Entergy exhibit is dated February 5, 2008—after the initial MACCS2 analysis. Moreover, 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 later 2008 document contains nothing more than conclusory, circular sentences about the pedigree of

[34] This testimony reflects a correction adopted by the Board. *See* Dec. 27, 2012 Order at 21.

NUREG-1150, repeats baseless statements regarding Sample Problem A, and refers to the Sample Problem A values as "default values."[35] *See* ENT000460 at 37-38. The RAI response's observation that the values "have been used by other license renewal applicants" is not sufficient to provide a rational basis for their use under NEPA in a site- specific analysis in the New York metropolitan context. *See* III.C.4., below. Similarly, the response's statement that "default values" were converted to 2005 dollars by (simply) multiplying the Consumer Price Index does not make those values specific to the 50 mile area surrounding the Indian Point site—it merely converts an inadequately sourced number contained in a 1990 report to a 2005 value. Finally, as discussed previously, NEPA places the obligation to analyze the validity of the input values squarely upon the federal action agency, not with the applicant. *See* III.B.1.a., above.

Standing in stark contrast to the lack of documented, rational basis for relying upon Sample Problem A's decontamination cost (CDNFRM) and time (TIMDEC) values, the State's expert report (NYS000242), and Dr. Lemay's testimony (NYS000241) transparently disclosed how the State's experts calculated site-specific decontamination cost and time values without relying upon Sample Problem A. *Compare* Tr. 2357:18-21 (Lemay) (Entergy's critique "illustrate[s] the value of having documented basis for the cost of decontamination, because we can get a peer review and identify mistakes, and then correct them."), *with* Tr. 2134:8-10 (Lemay) ("And I wish I could scrutinize and examine the way they came up with the cost that we have in the Entergy sample Problem A."). Rendering its ultimate conclusion all the more untenable, "[t]he Board agree[d] with Dr. Lemay – having a documented source to be scrutinized

[35] 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).

and reviewed would have been useful in reviewing Entergy's reliance on the contested CDNFRM values." Decision at 292.

Without a documented rational basis for the SAMA cost estimates, NRC Staff has failed to "provid[e] a springboard for public comment," frustrating one of NEPA's two purposes: public information. *Balt. Gas & Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 97 (1983). The environmental analysis is not just a bureaucratic burden—it should 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."); *see also Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 768-69 (2004). For these reasons, NRC Staff has violated NEPA.

4. The Board Erred by Failing to Address the State's Evidence that CDNFRM Values Based on Available Data Are Always Higher than Sample Problem A CDNFRM Values

Given the missing source of Sample Problem A, the State's experts used several available sources of relevant data to calculate site-specific decontamination costs (CDNFRM) for the area surrounding Indian Point. This was a benchmarking exercise undertaken by the State to compare Entergy's CDNFRM values (approved by NRC Staff) to values calculated from available, realistic data sources. *See* 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.* Each available data source resulted in CDNFRM values higher than Entergy's values showing that they are not only unsourced, but also unrealistic for Indian Point. *See* NYS000430 at 5, Table 11. The Board failed to even mention this evidence.

Neither Entergy nor NRC Staff explain why they did not perform a benchmarking analysis for the Level 3 probabilistic risk assessment ("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 earlier levels of the SAMA analysis, *i.e.*, Level 1 PRA (analysis of core damage frequency) and Level 2 PRA (analysis of release frequencies). NYS000420 Lemay Rebuttal Test. at 9-10 (citing ENT000460 (Attachment I to NL-08-028)).

Replicating the Sample Problem A values from Surry, without even attempting to verify their reasonableness for Indian Point's uniquely high population and building density using benchmarking, further violates NEPA's scientific integrity requirement. State Proposed Findings ¶¶ 135-40. Entergy contends that the Sample Problem A values are "default values" (Entergy Proposed Findings ¶¶ 133, 140), but the MACCS2 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 on his or her computer. Tr. 2059:20-2060:7 (J. Kennedy/Teagarden); *see also* NYS000243 MACCS2 User Guide at 7-1. David Chanin, a developer of the MACCS2 code, explained that

> We went so far as to scrupulously avoid 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.[36] *See also* State Proposed Findings ¶¶ 143-44, 122.

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); *see also* Tr. 2021:5-19 (Jones) (providing examples of relevant data that would be available today to develop decontamination input parameters). Despite acknowledging 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).

In contrast to the NRC Staff's inadequate showing, the State's Findings explain in detail their experts' methodology and approaches for determining CDNFRM using four relevant and available data sources. This approach presents a "factual [and] expert basis for why the proposed changes in the analysis are warranted," is consistent with *NextEra Energy Seabrook, LLC* (Seabrook Station, Unit 1), CLI-12-05, 75 N.R.C. 301, 323 (2012).[37] The State challenged specific input parameters used by Entergy, and disclosed in an expert report various methods and calculations for developing site-specific values that would comply with NEPA:

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[36] NYS000247 (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)).

[37] Nor is the State's challenge at all similar to the rejected contention in *Davis-Besse* (Staff Proposed Findings ¶ 5.17), which "neither directly challenged relevant cost estimates set forth in the Davis-Besse SAMA analysis, nor explained why or how the estimates or framework of other studies were appropriate for use in the Davis-Besse site-specific reactor accident SAMA analysis, or would lead to more accurate estimates than those reached in the Davis-Besse analysis." *FirstEnergy Nuclear Operating Co.* (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-08, 75 NRC __, (slip op. at 34) (Mar. 27, 2012).

- Approach A is based on data from Sandia *Site Restoration*[38] as modified by Luna's *Survey of Costs*[39] 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.;[40]

- Approach C uses CONDO,[41] a decontamination cost estimation tool from the United Kingdom ("UK") National Radiological Protection Board, and its database;

- Approach D relies upon data from RISO[42] presenting results from decontamination analyses completed by RISO National Laboratory in Denmark.

NYS000242 ISR Report at 13-15, Figure 3 (methodology flowchart); NYS000241 Lemay Initial Test. at 31-32. The result of the State's analysis are ranges of "site-specific value[s] that [are] 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).

ISR updated its CDNFRM calculations to incorporate comments received in NRC Staff and Entergy's pre-filed submissions. *See* NYS000430 at 5, Table 11. Even after incorporating

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[38] NYS000249 (D. Chanin & W. Murfin, SAND96-0957, *Site Restoration: Estimation of Attributable Costs From Plutonium-Dispersal Accidents* (May 1996)) ("Sandia *Site Restoration*").

[39] 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*").

[40] NYS000256 (B. Reichmuth, S. Short, T. Wood, *Economic Consequences of a Rad/Nuc Attack: Cleanup Standards Significantly Affect Cost*, Pacific Northwest Laboratory, Working Together Conference, Apr. 28, 2005, Boston, MA.) ("Reichmuth").

[41] 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").

[42] 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").

NRC Staff and Entergy's comments, the calculated CDNFRM values were always much higher than Entergy's values (based on Sample Problem A). NYS000430 at 6, Table 13.

Failing to consider this important and relevant evidence was error on the part of the Board. *See Native Vill. of Point Hope*, 740 F.3d at 503-04 (agency violated NEPA because it relied on an estimation of economically recoverable oil that was lower than the entire range of calculated values of economically recoverable oil); *Earth Island Inst. v. U.S. Forest Serv.*, 351 F.3d 1291, 1302 (9th Cir. 2003) ("if Plaintiffs are able to convince the district court that the agency unreasonably relied upon inaccurate data, they may be able to succeed on the merits of this [NEPA] claim."); *Idaho Sporting Congress v. Rittenhouse*, 305 F.3d 957, 972 (9th Cir. 2002) (invalidating agency methodology that produced obviously inaccurate habitat numbers).

In addition to the fact that NRC Staff and Entergy's CDNFRM values fall well outside the range of calculated values, data from real world experience raises substantial questions regarding the dose reduction factors used by Entergy and unquestioningly accepted by NRC Staff. *See* II.D.2, n.9, above (explaining dose reduction factor). Entergy used a dose reduction factor of 15, which represents a 93% decrease in radiation. However, real world experience demonstrates that decontamination of an entire building to a level greater than 10, *i.e.*, 90%, may not be possible or realistic. NYS000242 ISR Report at 12 (citing NYS000249, NYS000250, NYS000251). For the purposes of comparison, the State's experts calculations used the same decontamination factors as Entergy, but Entergy's values are likely unrealistic. NYS000420 Lemay Rebuttal Test. at 30-31; Tr. (J. Wardwell/Teagarden). The Board also erred in failing to discuss this point.

5. The Board's Decision Does Not Recognize that NRC Staff and Entergy's Use of the MACCS2 Code Fails to Account for All of the Costs Associated with a Severe Accident

As all parties and the Board recognized, there are many categories of costs associated with a severe accident that are not included in the MACCS2 code calculations. Having chosen to use the MACCS2 code to estimate severe accident costs, NRC Staff and Entergy should explain how they account for these costs or why it is not necessary to account for these costs. Staff Proposed Findings ¶ 5.35 discusses this major drawback of the MACCS2 code by explaining "[i]t is important to note that MACCS2 only calculates a portion of the costs associated with an accident." For example, the MACCS2 code does not calculate the loss of natural resources. Tr. 2285:5-8 (Ghosh). Additionally, NRC Staff's experts admitted, in response to a question from Judge McDade, that the MACCS2 code "does not account any economic value to the loss of the water" including drinking water. Tr. 2284:6-10 (Bixler). These significant omissions further contribute to an underestimation of SAMA costs at Indian Point, undermining and impeding the NEPA alternatives and mitigation analysis that must be performed in this proceeding pursuant to *Limerick.*

Additionally, as stated in State Proposed Findings ¶ 303, given that there are many categories of known and relevant costs which the MACCS2 code fails to adequately account for, it is even more important that NRC Staff and Entergy provide a documented cost basis for a "best estimate" of the costs the code does consider. Although the State does not challenge Entergy's use of the MACCS2 code, the State contends that NRC Staff and Entergy's use of the MACCS2 code underestimates the costs of a severe accident at the Indian Point reactors. There is no requirement, regulatory or otherwise, that the MACCS2 code be used in a SAMA analysis. *See* Tr. 2339:4-2340:10 (J. McDade/Liberatore/Harrison/Ghosh) (NRC has not promulgated a regulation pursuant to the Administrative Procedure Act rulemaking procedures that mandates

the use of the MACCS2 code). Nor is there an NRC regulation that states that the Sample Problem A inputs for MACCS2 encompass the entirety of the environmental impacts that could realistically be associated with a severe reactor accident or that a NEPA site specific environmental impact statement must be limited only to such Sample Problem A inputs.

C. Errors in Holding that the SAMA Analysis Is Site-Specific

To put the Board's errors in context, when Indian Point Units 2 and 3 were designed, licensed, and constructed many decades ago, NRC thought severe accidents were so unlikely that they did not even have to be considered. *Limerick*, 869 F.2d at 726. *Limerick* directed NRC to comply with NEPA and perform a site-specific analysis of severe accident mitigation alternatives. *Id.* at 738-41. Nevertheless, NRC Staff continues to repackage the arguments it made in *Limerick* some 25 years ago to avoid a realistic site-specific analysis at Indian Point.

1. The Board Committed Factual and Legal Errors in Finding that the Use of One Site-Specific Input—Population—Renders the SAMA Analysis Site-Specific

In finding that the FSEIS's SAMA analysis complied with NEPA, "[t]he Board notes the important distinction between our conclusion that the ultimate decontamination cost estimate (or the SAMA analysis) is site specific and New York's argument that the decontamination cost input parameters are not site specific." Decision at 283. The Board explained that although "*there is no evidence that the challenged NUREG-1150 values are site specific*, the Board concludes that, given that the decontamination cost input parameter is a per capita number, the ultimate decontamination cost estimate (that results from multiplying the per capita input values by the site-specific IPEC region population) results in a site-specific decontamination cost estimate." *Id.* (emphasis added).

Although the Board acknowledges that "NEPA requires that a SAMA analysis must be site specific," it ultimately found that "given the fact that MACCS2 applies the CDNFRM values

on a per person basis we conclude that costs in Entergy's SAMA analysis are sufficiently site specific." Decision at 281 (internal quotation omitted). The Board agreed with the testimony of Entergy and Staff that decontamination costs scale linearly with population such that the same CDNFRM values can be used for different sites if the correct population is input—even though neither party offered more than conclusory statements and unsupported allegations in the way of proof. The Board erred in considering these unsupported statements. *See S. Carolina Elec. & Gas Co.* (Summer Nuclear Station, Unit 1), ALAB-663, 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.").

The Board also fundamentally erred by accepting wholesale Entergy's mischaracterization of a quote from the State's expert, Dr. Lemay, and ignoring the balance of Dr. Lemay's testimony and report.[43] Decision at 283, n.1543; *compare* Entergy Proposed Findings ¶ 147; *with* State Reply Findings at 9. The Board had a duty to review the actual transcript, not Entergy's misleading excerpt, including the entire quote from Dr. Lemay. While Dr. Lemay did testify that the idea of correlating decontamination costs with population could be "a brilliant insight," he was clear that the correlation falls apart for densely populated areas such as New York City. Dr. Lemay explained that the correlation may work for "a site with individual dwellings[,] . . . [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,

[43] The State's Reply Findings at 9 warned the Board that Entergy's partial quote was misleading.

'Hm. You can't just keep extrapolating.'" Tr. 2136:2-15 (Lemay). Accordingly, Dr. Lemay pointedly disagreed that the application of decontamination costs on a per person basis using the Sample Problem A value for CDNFRM is a valid approach for Indian Point.

At the hearing, Judge Kennedy understood this as well in explaining, "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 in this." Tr. 2128:2-6 (J. Kennedy). NRC witness Dr. Bixler admitted 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 [CDNFRM].").

Indeed, Dr. Lemay explained that the way ISR calculated CDNFRM values took "the kind of mix of building and building density that we observe in New York" by first calculating decontamination costs on an area basis and then dividing those costs by population to get the correct units of cost per population that the CDNFRM input requires. Tr. 2137:15-25 – 2138:1-3 (Lemay). Because all of the ISR-calculated CDNFRM values were based on available data—as opposed to "some value that nobody knows where it comes from"—and were substantially larger than Sample Problem A's CDNFRM values, the State's expert report shows that if any linear correlation between population and decontamination costs exists, it falls apart in the 50-mile radius surrounding Indian Point. Tr. 2136:2-15 (Lemay); *see* III.B. 4., above. In this way, ISR has proven that population is not the only criteria or proxy that differs from plant to plant and could affect decontamination costs and that building density, types of buildings, real estate development, and other land improvements also impact decontamination costs. Thus, it was

error for the Board to disregard Dr. Lemay's pre-filed testimony, expert report, and hearing testimony and accept Entergy's incomplete and misleading Proposed Findings of Fact.

2. The Board Failed to Recognize that Sample Problem A Is Not Consistent with Guidance Endorsed by the NRC

Contrary to the Board's decision, industry guidance does not direct applicants to adjust Sample Problem A values for inflation and then simply "cut and paste" them into a site-specific SAMA analysis.[44] The Board erred in downplaying the importance of user-defined inputs, only noting in passing that "[t]he MACCS2 code purports to offer users flexibility by facilitating the performance of site-specific calculations and evaluations of sensitivities and uncertainties." Decision at 271 (citing NYS000243); *see also id.* at 281. As Dr. Lemay testified, user-defined inputs are the bedrock of a realistic SAMA analysis:

> 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.

Entergy incorrectly reads NEI 05-01 guidance (NYS000287) as only requiring the "escalation" of Sample Problem A values to current year dollars using the Consumer Price Index. Entergy Proposed Findings ¶¶ 138, 156. While NEI 05-01 does suggest that "[e]conomic data from a past census can be converted to today's dollars," it emphasizes that the MACCS2 user should define site-specific inputs for many of the MACCS2 parameters, including

[44] In another license renewal context, the NRC Office of Inspector General documented instances where Staff and applicants copied text from one document and added it to another regulatory document and states that such practices raise questions about whether the underlying regulatory decisions were adequately reviewed. *Audit of NRC's License Renewal Program*, OIG-07-A-15, NRC Office of Inspector General (Sept. 6, 2007).

decontamination cost and time. State Proposed Findings ¶¶ 121, 122, 144, 301, 302. NEI 05-01 instructs the applicant to describe the various input parameters and associated assumptions. NYS000287 at 13. NEI 05-01 provides only "[s]ample MACCS2 economic data," and nowhere does NEI 05-01 instruct the applicant to use Sample Problem A values. NYS000287 at 14. Likewise, the MACCS2 User Guide warns "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." Consequently, Entergy did not follow NEI-01-05 or the MACCS2 User Guide.

3. The Board Erred in Failing to Even Discuss NUREG/CR-5148 (Tawil 1990), a Site-Specific Case Study Commissioned by NRC to Estimate the Costs Associated with a Severe Accident at Indian Point

The Board failed to discuss the fact that 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) (NYS000424H at Chapter 5). Not only did the agency commission the Indian Point site-specific study, but NRC also failed to disclose it in the FSEIS or this proceeding. The State only became aware of it in researching NRC Staff's "pedigree" arguments presented in their initial pre-filed testimony. *See* NYS000426 (Dr. Tawil email explaining that NRC Staff was concerned about the results of Tawil 1990); NYS000420 Lemay Rebuttal Test. at 26-27. Notably, Donald 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 4.

Tawil 1990 shows 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* NYS000420 Lemay Rebuttal Test. at 28; *see also* State Proposed Findings ¶ 202-205. Tawil 1990 provides an extremely detailed analysis of the area surrounding Indian Point. NYS00424G at 4.23 – 4.35.

For example, Figure 4.4 lists numerous surface types for a single grid element in Westchester County (exterior brick walls, exterior wood walls, asphalt streets, other paved asphalt, carpeted floors, linoleum floors, wood floors, etc.), the decontamination cost for each surface type, and the portion of the grid element's area containing each surface type. *Id; see also* NYS000425A-G NUREG/CR-3413, *Off-Site Consequences of Radiological Accidents: Methods, Costs and Schedules for Decontamination*, J.J. Tawil, *et al.* (Aug. 1985) (explaining the DECON code used in Tawil 1990).

What is important about Tawil 1990 is its methodology of developing site-specific decontamination costs using site-specific data for each grid element, instead of Sample Problem A values, which rely upon a single decontamination cost for every grid element no matter what surfaces it contains. *See* NYS000420 Lemay Rebuttal Test. at 26. In short, Tawil 1990 represents an actual case study of the economic impacts of severe accident costs at Indian Point, using data to develop site-specific values that both NRC Staff and Entergy failed to disclose, and the Board failed to discuss. Tawil 1990 supports the State's position that site-specific values can be developed and therefore, should have been developed for Indian Point. The Board erred in not considering this evidence.

4. <u>The Use of Sample Problem A Values in Other Relicensing Proceedings or NRC Studies Is Not Relevant to Whether Their Use in the Indian Point SAMA Analysis Is Reasonable</u>

The Board cites Entergy's witness for the proposition "that the use of the challenged NUREG-1150 values is standard for SAMA analyses" and "that, to their knowledge, all prior NRC license renewal applicants have used these same values (as appropriately escalated) in their SAMA analyses." Decision at 289 (citing Tr. at 1951 (Teagarden)). By admitting that the Sample Problem A values have been used and accepted routinely NRC Staff and Entergy acknowledge that they are not site-specific. It defies logic to understand how using Sample

Problem A input values can be site-specific and at the same time applicable to all power plants, no matter their location or context. *See* State Reply Findings at 6-8. The State's evidence, discussed above, shows that site-specific characteristics such as building density affect decontamination costs.

D. The Board's Focus Only on Decontamination Time and Decontamination Cost Was Based upon Erroneous Factual Findings, and Constitutes a Prejudicial Procedural Error

The Board incorrectly "limit[ed] its consideration" to decontamination time and cost because "[i]t was uncontested that the TIMDEC and CDNFRM input values have the most significant impact among the MACCS2 parameters at issue here, with the others being essentially irrelevant to the MACCS2 model's economic cost results." Decision at 272-73 (citing Tr. 2054 (Lemay)). While the hearing focused on those two parameters, the State evaluated other sensitive MACCS2 input parameters including the value of nonfarm wealth (VALWNF) and the per capita costs of relocation (POPCST) that had a significant effect on economic cost results.[45] *See* State Proposed Findings ¶¶ 273-75; State Reply Findings at 35-37. The State presented expert evidence that correcting errors in VALWNF would lead to an 18% increase in OECR and errors in POPCST would lead to a 5% to 105% increase in OECR.[46] The

[45] *See* NYS000242 ISR Report at 25-26, 28-29; 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)). Entergy's Proposed Findings ¶ 235 and the ISR report (NYS000242 at 28-30) discuss two additional parameters, societal discount rate for property (DSRATE) and fraction of nonfarm property due to improvements (FRNFIM). Although Entergy unreasonably relied upon Sample Problem A values for these values, the State's experts' evaluation of more appropriate, site-specific values resulted in a 8-12% decrease in OECR due to DSRATE and a 3% increase in OECR due to FRNFIM. *See* NYS000242 at 28, 30. The ISR report discusses a third sensitive parameter, the property depreciation rate (DPRATE). NYS000242 at 27. Entergy's value appeared to be reasonable. *Id.* at 27, 32.

[46] Although neither Entergy nor NRC Staff undertook an analysis to determine the effects that the State's experts calculated ranges of reasonable, site-specific input values would have on the

Board committed a prejudicial procedural error in failing to address these other parameters, which are summarized on the chart below. *See* Tr. 2103:11-2104:25 (Lemay) (explaining the chart).

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

Parameter	Description	Entergy's value	ISR's proposed input value		ISR's calculated OECR ($/yr) and ratio[a]	
			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 y	15 y	4.43E+05	1.20E+06
TIMDEC (DF=15)	Time required for heavy decontamination	120 d	2 y	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: [a] The ratio shown in brackets is the ratio of the ISR-calculated OECR to the Entergy-calculated OECR ($2.12E+05/yr).						

NYS000430 at 6, Table 13.

E. The Board Erred in Failing to Require NRC Staff to Supplement the FSEIS

Under NEPA, the appropriate remedy for a deficient environmental impact statement is for the 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 that is circulated for public comment. The Board did not reach the issue of remedy in the context

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SAMA analysis, Entergy did, however, purport to analyze the effect that population flaws discussed in NYS-16B would have on the required SAMA analysis. *See* State Proposed Findings ¶¶ 285-89. In that analysis for NYS-16B, the State concluded that an 11% increase in costs would render IP2 SAMA 025 cost-beneficial and, therefore, meet Entergy's "materiality" test. *Id.*

of NYS-12C because it did not find a NEPA violation. However, as explained above, the Board's Decision contains numerous errors, warranting review under 10 C.F.R. § 2.341(b)(4). Thus, for the reasons set forth in the State's filings, the Commission should also review the question of proper NEPA remedy and require that NRC Staff remedy the NEPA deficiencies in a supplement to the FSEIS that is circulated for public comment. *See* NYS000419 State of New York Revised Statement of Position on NYS-12C at 31 (Jun. 29, 2012) (NYS000419); State Proposed Findings ¶¶ 353-71.

IV. CONCLUSION

For the foregoing reasons, the Commission should grant review of LBP-13-13 insofar as it resolved NYS-12C in favor of NRC Staff and Entergy. In its discretion under 10 C.F.R. 2.341(c)(2), the Commission should, as it deems appropriate, either require additional briefing or decide the matter on the basis of the petition for review, reversing LBP-13-13, resolving NYS-12C in favor of the State, and holding that 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 unless and until NRC Staff cures the deficiencies in the FSEIS in a supplement that is circulated for public comment.

Respectfully submitted,

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