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NL-17-002

February 1, 2017

U.S. Nuclear Regulatory Commission
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SUBJECT: Response to Request for Additional Information for the Review of the Indian Point Nuclear Generating Unit Nos. 2 and 3 License Renewal Application Environmental Review – Severe Accident Mitigation Alternatives
Indian Point Nuclear Generating Unit Nos. 2 and 3
Docket Nos. 50-247 and 50-286 (License Nos. DPR-26 and DPR-64)

REFERENCES:
1) Entergy Letter NL-07-039, "Indian Point Energy Center License Renewal Application" (Apr. 23, 2007) (ML071210507)
2) Entergy Letter NL-09-165, "License Renewal Application – SAMA Reanalysis Using Alternate Meteorological Tower Data" (Dec. 11, 2009) (ML093580089)
3) NUREG-1437, Supp. 38, Vols. 1-3, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3 - Final Report" (Dec. 2010)
4) Entergy Letter NL-13-075, "License Renewal Application – Completed Engineering Project Cost Estimates for SAMAs Previously Identified as Potentially Cost-Beneficial" (May 6, 2013) (ML13142A013)
5) NUREG-1437, Supp. 38, Vol. 5, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3 – Draft Report for Comment" (Dec. 2015)
6) USNRC Letter, "Request for Additional Information Related to the Indian Point Nuclear Generating Unit Nos. 2 and 3 License Renewal Application Environmental Review – Severe Accident Mitigation Alternatives (CAC Nos. MD5411 and MD5412 (Sept. 12, 2016) (ML16232A119)

Dear Sir or Madam:

By letter dated April 23, 2007 (Reference 1), Entergy Nuclear Operations, Inc. (Entergy) submitted an application pursuant to 10 CFR Part 54 and 10 CFR Part 51, to renew the operating licenses for Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3), for review by the U.S. Nuclear Regulatory Commission (NRC). As required by 10 CFR 51.53(c)(3)(ii)(L), Entergy performed and submitted the results of a severe accident mitigation alternatives (SAMA) analysis for IP2 and IP3. The original SAMA analysis was documented in

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Section 4.21 and Attachment E of the Environmental Report (ER) to the Indian Point Energy Center (IPEC) license renewal application (LRA).

Since 2007, the IPEC SAMA analysis has been revised and augmented by Entergy and fully reviewed by the NRC Staff. Namely, on December 11, 2009, Entergy submitted a revised SAMA analysis using corrected meteorological data (Reference 2). The revised SAMA analysis applied the same methods described in the April 2007 ER to estimate the implementation cost of each candidate SAMA. Except for a limited number of SAMAs, Entergy used the same implementation cost estimates reported in the ER. Entergy identified three additional potentially cost-beneficial SAMAs for IP2 and three additional potentially cost-beneficial SAMAs for IP3 raising the total number of SAMAs identified as potentially cost-beneficial to 22 SAMAs.

In December 2010, the NRC Staff issued its Final Supplemental Environmental Impact Statement (FSEIS) for IP2 and IP3 license renewal (Reference 3). Section G.2.3 of the FSEIS documents the Staff's detailed evaluation and acceptance of the IPEC SAMA analysis, as revised in December 2009. It concludes that "the SAMA evaluations performed by Entergy are reasonable and sufficient for the license renewal submittal" (Reference 3, App. G, at G-49).

On May 6, 2013, Entergy submitted refined engineering project cost estimates for the 22 potentially cost-beneficial SAMAs to address, in part, certain concerns raised by the NRC's Atomic Safety and Licensing Board (ASLB) during its adjudication of a contention related to the SAMA analysis (Reference 4). Based on the refined cost estimates, Entergy determined that 6 of the 22 SAMAs previously determined to be potentially cost-beneficial were not cost-beneficial. It also provided justification for deferring further consideration of certain cost-beneficial SAMAs pending implementation of action items required by the NRC's post-Fukushima comprehensive safety assessment and related Commission Orders. Entergy further noted its now-completed implementation of four SAMAs previously identified as potentially cost-beneficial.

In December 2015, the Staff issued Draft Supplement 2 to the FSEIS, in which it documented its review of Entergy's May 2013 refined engineering project cost estimates (Reference 5). As documented in the FSEIS and Draft Supplement 2, the Staff has concluded that Entergy's SAMA analysis for IP2 and IP3 is reasonable and acceptable under the National Environmental Policy Act (NEPA) and NRC regulations at 10 CFR Part 51.

On May 4, 2016, the Commission issued a decision (CLI-16-07) in the IP2 and IP3 license renewal adjudicatory proceeding, in which it directed the NRC staff to supplement its review of the IP2 and IP3 SAMA analysis with sensitivity analyses involving, at a minimum, the use of alternative decontamination time (TIMDEC) and non-farmland decontamination cost (CDNFRM) parameter input values to the SAMA analysis. Accordingly, by letter dated September 12, 2016 (Reference 6), the Staff requested that Entergy provide additional information consistent with the Commission's Order for consideration in the Staff's review.

Attachment 1 contains Entergy's response to the Staff's request for additional information (RAI). To facilitate the Staff's review (and potentially the Staff's documentation of that review in its forthcoming Final FSEIS Supplement 2),[1] Entergy is including two supporting Engineering

[1] As noted in Attachment 1 to this letter, the NRC Staff issued similar RAIs to other license renewal applicants as a result of the Commission's decision in CLI-16-07 (*i.e.*, RAIs directing the applicants to develop new MACCS2 code sensitivity cases applying the maximum code-allowed TIMDEC and CDNFRM values). In the LaSalle Units

Reports, IP-RPT-16-00077 and IP-RPT-16-00078, as Enclosures 1 and 2, respectively. Entergy notes that the MACCS2 code input and output files, as requested in RAI 3, are being separately provided to the NRC Project Manager for IP2/IP3 license renewal via electronic mail.

There are no new commitments being made in this submittal.

On January 5, 2017, Entergy requested an additional 30 days to provide the subject RAI response. The NRC granted Entergy's extension request.

Subsequently, on January 9, 2017, Entergy, the Attorney General of the State of New York, and River keeper, Inc. (among other related corporate and governmental entities) entered into a settlement agreement regarding the continued operation, and early shutdown, of IP2 and IP3. Under the agreement, IP2 will shut down by April 30, 2020, and IP3 will shut down by April 30, 2021, subject to operating extensions through, but not beyond, 2024 and 2025, respectively, under circumstances specified in the agreement. Entergy has further agreed to file, by February 8, 2017, an amendment to the IPEC LRA, whereby it will modify the proposed terms of the renewed licenses from 20 years for each unit to the periods ending April 30, 2024 for Unit 2 and April 30, 2025 for Unit 3. In view of these developments, Entergy intends to review the sensitivity analysis results discussed in Attachment 1 to this letter and to update them as necessary to reflect the effects of the reduced operating lives for IP2 and IP3, insofar as a 20-year license renewal period was used in calculating the net present value for each SAMA, consistent with NRC cost-benefit analysis guidance. See Reference 3, App. G at G-40 to G-42. If any revisions are necessary or appropriate, Entergy will submit the updated sensitivity analysis results to the NRC by March 31, 2017.

If you have any questions, or require additional information, please contact Mr. Robert Walpole at 914-254-6710.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 2/1, 2017.

Sincerely,

AJV/rl

Attachments: 1. Response to Request for Additional Information on Severe Accident Mitigation Alternatives Analysis for Indian Point Nuclear Generating Units 2 and 3 License Renewal Environmental Report

1 and 2 license renewal proceeding, the Staff did not issue a draft report or supplement to document its review of the applicant's new combined TIMDEC-CDNFRM sensitivity case. Instead, the Staff documented its review of the new sensitivity case in its Final Supplemental Environmental Impact Statement, which the Staff issued on August 26, 2016, approximately six weeks after the applicant submitted its RAI response on July 11, 2016. *See* NUREG-1437, Supp. 57, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding LaSalle County Station, Units 1 and 2 – Final Report," App. F at F-23 (Aug. 2016) (ML16238A029).

Enclosures:
1. Entergy Engineering Report IP-RPT-16-00077, "Indian Point RAI CLI-16-07 MACCS2 Sensitivities," Rev. 0 (Jan. 4, 2017)
2. Entergy Engineering Report IP-RPT-16-00078, "Indian Point RAI CLI-16-07 SAMA Cost-Benefit Sensitivities," Rev. 0 (Jan. 4, 2017)

cc: Mr. Daniel H. Dorman, Regional Administrator, NRC Region I
Mr. Sherwin E. Turk, NRC Office of General Counsel, Special Counsel
Mr. William Burton, NRC Senior Project Manager, Division of License Renewal
Mr. Douglas Pickett, NRR Senior Project Manager
Ms. Bridget Frymire, New York State Department of Public Service
Mr. John B. Rhodes, President and CEO NYSERDA
NRC Resident Inspector's Office

ATTACHMENT 1 TO NL-17-002

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION ON SEVERE ACCIDENT MITIGATION ALTERNATIVES ANALYSIS FOR INDIAN POINT NUCLEAR GENERATING UNITS 2 AND 3 LICENSE RENEWAL ENVIRONMENTAL REPORT

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3
DOCKET NOS. 50-247 AND 50-286

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION ON SEVERE ACCIDENT MITIGATION ALTERNATIVES ANALYSIS FOR INDIAN POINT NUCLEAR GENERATING UNITS 2 AND 3 LICENSE RENEWAL ENVIRONMENTAL REPORT

Section 1.0 below provides a brief historical overview of the Indian Point Energy Center (IPEC) severe accident mitigation alternatives (SAMA) analysis as well as a summary of the related adjudication that led to the NRC Staff's September 12, 2016 request for additional information (RAI) (Reference 1-1). That section is intended to provide background and context for the discussion in subsequent sections. Section 2.0 presents the text of the RAI. Section 3.0 includes a description of the MACCS2 code sensitivity case and cost-benefit analysis methodologies and assumptions used by Entergy to respond to the RAI (Sections 3.1 and 3.2) and Entergy's specific responses to the RAI's various subparts (Section 3.3). Section 4.0 presents Entergy's overall conclusions regarding the results of the new sensitivity analyses.

1.0 HISTORICAL AND PROCEDURAL BACKGROUND

1.1 Overview of IPEC SAMA Analyses

1.1.1 Entergy's April 2007 SAMA Analysis

Entergy submitted its SAMA analysis for Indian Point Units 2 and 3 (IP2 and IP3) in April 2007 as part of the Environmental Report (ER) for the license renewal application (LRA) (Reference 1-2). Entergy followed the NRC-approved guidance contained in NEI 05-01 (Rev. A) in preparing its SAMA analysis (Reference 1-3). Consistent with that guidance, the IPEC SAMA analysis included four principal steps.

Entergy first quantified the level of risk associated with postulated severe accidents using the plant-specific probabilistic safety analysis (PSA) and insights acquired from other risk assessments previously performed for each unit. Entergy used the MELCOR Accident Consequence Code System Version 2 (MACCS2) code to perform Level 3 PSA models for IP2 and IP3 and calculate the public dose and offsite economic cost consequences using site-specific meteorological, population, and economic data. *See* Reference 1-2.

Next, Entergy identified possible SAMAs for reducing the risk associated with the major risk contributors for each unit. In evaluating potential SAMAs, Entergy considered SAMAs that addressed the major contributors to core damage frequency (CDF) and large early release frequency (LERF) at IP2 and IP3, as well as SAMA candidates for other operating plants that had submitted LRAs. From these initial lists of "Phase 1" candidate SAMAs, Entergy identified 68 "Phase 2" SAMAs for IP2 and 62 SAMAs for IP3 for more detailed evaluation. *See* Reference 1-1.

Entergy then prepared monetized estimates of how much each SAMA could reduce risk in accordance with NRC guidance (NUREG/BR-0184, NUREG/BR-0058) for performing regulatory analyses (References 1-4, 1-5). It also developed initial cost estimates for implementing each candidate. This process included reviewing cost estimates prepared by other licensees for similar improvements considered in prior NRC-approved SAMA analyses. Entergy prepared its cost estimates in accordance with NEI 05-01 guidance, which recommends that the cost of each SAMA candidate be conceptually estimated to the point where economic viability of the proposed modification can be adequately gauged. *See* References 1-2, 1-3. NEI 05-01 notes that "the SAMA analysis is not a complete engineering project cost-benefit analysis" (Reference 1-3, p. 33).

Finally, Entergy compared the costs and benefits of each of the remaining SAMAs to determine whether the SAMA was potentially cost-beneficial. To account for uncertainties, Entergy also compared the cost of SAMA implementation with a benefit value estimated by applying an uncertainty multiplier to the internal and external events estimated benefit.[2] This value is defined as the "baseline benefit with uncertainty." The cost-benefit analyses in the April 2007 ER showed that five IP2 and five IP3 SAMA candidates were potentially cost beneficial in either the "baseline" analysis or "sensitivity" analysis using a 3 percent discount rate.[3] Based on consideration of analysis uncertainties, Entergy identified two additional potentially cost-beneficial SAMAs for IP2 in the ER (IP2-044 and IP2-056). *See* Reference 1-2.

1.1.2 Entergy's February 2008 and May 2008 RAI Responses

Entergy responded to Staff RAIs concerning its SAMA analysis in 2008. In a February 2008 RAI response, Entergy provided an additional analysis case in which the impact of lost tourism and business was analyzed as the baseline analysis and multiplied to account for uncertainties (Reference 1-6). This new baseline with uncertainty case resulted in the identification of two additional potentially cost-beneficial SAMAs for IP2 (IP2-009, IP2-053) and one additional potentially cost-beneficial SAMA for IP3 (IP3-53).[4]

In a May 2008 RAI response (Reference 1-7), Entergy provided the results of a sensitivity study in which it increased the conditional thermally-induced steam generator tube rupture (TI-SGTR) probability to values comparable to those reported in NUREG-1570, "Risk Assessment of Severe Accident-Induced Steam Generator Tube Rupture" (Mar. 1998). Entergy identified the candidate SAMAs potentially affected by the TI-SGTR assumption and reassessed the benefits for these SAMAs. No additional cost-beneficial SAMAs were identified.

In its May 2008 response to another Staff RAI, Entergy identified one additional potentially cost-beneficial SAMA that is applicable to SGTR events in both units. Specifically, Entergy identified a dedicated "gagging device" (used to close a stuck open steam generator safety valve on an SGTR before core damage occurred) as potentially cost-beneficial (Reference 1-7).

In summary, Entergy identified a total of 16 potentially cost-beneficial SAMAs, including nine out of 68 Phase II SAMAs for IP2 (9, 28, 44, 53, 54, 56, 60, 61, and 65) and five out of 62 Phase II

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[2] In the ER, Entergy presented the results of an uncertainty analysis of the internal-event CDF for IP2 and IP3, which indicated that the 95th percentile value for CDF (CDF_{95}) is a factor of 2.1 times the mean CDF for IP2 and 1.4 times the mean CDF for IP3. (The CDF_{95} is that value for which there is a 0.95 probability that the value of CDF is less than CDF_{95}.) Entergy assessed the impact on the SAMA screening if the estimated benefits for each SAMA were further increased by these uncertainty factors. For purposes of this assessment, Entergy applied a multiplier of 8 to the internal-event benefits for each unit to account for both internal and external events, with analysis uncertainty.

[3] In accordance with NEI 05-01 recommendations, the original SAMA analyses described in the ER included multiple cases, including a baseline case with uncertainty (using a 7-percent discount rate) and three sensitivity cases: (1) use of a 3 percent discount rate, (2) use of a longer period for remaining plant operating life (*i.e.*, eight years on the original plant license plus the 20-year license renewal period), and (3) consideration of economic losses by tourism and business. The sensitivity cases in the ER did not identify additional potentially cost beneficial SAMAs beyond those already identified by the baseline with uncertainty case.

[4] In its February 2008 response to Staff RAI 5g, Entergy corrected the benefit analysis for one of the IP3 SAMAs (30), finding it no longer potentially cost-beneficial (Reference 1-6).

SAMAs for IP3 (52, 53, 55, 61, and 62), and an additional (unnumbered) SAMA for both IP2 and IP3 involving a dedicated gagging device for SGTR events.

1.1.3 Entergy's December 2009 Revised SAMA Analysis

During its review of the IPEC SAMA analysis, the Staff sought clarification from Entergy regarding certain wind direction data as an input to the MACCS2 code. In response, Entergy submitted a revised SAMA analysis in December 2009 that used a single, representative year (2000) of meteorological data (Reference 1-8). Entergy performed the revised analysis only for the most conservative case; *i.e.*, the case in which the impact of lost tourism and business was analyzed as the baseline analysis and multiplied to account for uncertainties. The revised SAMA analysis used the same non-meteorological input data as the original analysis case. Entergy also provided updated responses to the Staff RAIs concerning the TI-SGTR sensitivity analysis and main steam safety valve gagging SAMA to reflect its use of the year-2000 meteorological data.

The revised SAMA analysis applied the same methods described in the April 2007 ER to estimate the implementation cost of each candidate SAMA (Reference 1-8). Except for a limited number of SAMAs, Entergy used the same implementation cost estimates reported in Tables E.2-2 and E.4-2 of the ER. In some cases, Entergy presented more detailed cost estimates to meaningfully compare the cost of implementing a particular SAMA relative to its benefit.[5] Entergy identified three additional potentially cost-beneficial SAMAs for IP2 (SAMAs 21, 22, 62) and three additional potentially cost-beneficial SAMAs for IP3 (SAMAs 7, 18, 19), raising the total number of SAMAs identified as potentially cost-beneficial to 22 SAMAs.

1.1.4 The NRC Staff's December 2010 Final Supplemental Environmental Impact Statement (FSEIS)

In December 2010, the NRC Staff issued its FSEIS (Reference 1-10). Section G.2.3 of the FSEIS documents the NRC Staff's detailed evaluation of the Indian Point SAMA analysis, including the methods used in those analyses and the results. As stated in that section, the Staff utilized the relevant technical expertise of Sandia MACCS2 and decontamination specialists in performing its review. The Staff concluded that Entergy's methodology "provides an acceptable basis from which to proceed with an assessment of candidate SAMAs." It further concluded that Entergy's decontamination cost estimates are "reasonable and acceptable," and consistent with those used in SAMA analyses performed for other nuclear power plants and previously accepted by the NRC.

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[5] Specifically, Entergy subjected a subset of the candidate SAMAs to more rigorous cost-estimating techniques; *i.e.*, those SAMAs that appeared to be cost-beneficial based on the new benefit estimate and the original implementation cost estimate. For two IP2 SAMAs (IP2 SAMAs 17 and 40) and four IP3 SAMAs (IP3 SAMAs 17, 20, 40, and 50), the revised cost estimate resulted in the SAMA becoming non-cost-beneficial. For each of these SAMAs, the Staff requested that Entergy provide the basis for the revised cost estimate, including a breakdown of the major cost factors. Entergy provided this information by letter dated January 14, 2010, in which Entergy explained that it developed the revised cost estimates using its standard process for preparing conceptual-level project cost estimates (Reference 1-9).

1.1.5 Entergy's May 2013 Revised Cost Estimate Submittal and the NRC Staff's December 2015 Draft Second FSEIS Supplement

On May 6, 2013, Entergy submitted detailed engineering project cost estimates for the 22 SAMAs previously identified as potentially cost beneficial (Reference 1-11).[6] Based on the refined cost estimates, Entergy determined that six of the 22 SAMAs previously determined to be potentially cost beneficial would no longer be cost beneficial: SAMAs IP2-021, IP2-022, IP2-053, IP2-056, IP3-018, and IP3-019. In addition to providing the refined cost estimates, Entergy provided justification for deferring further consideration of certain cost-beneficial SAMAs pending implementation of numerous safety and accident mitigation enhancements required by the NRC's post-Fukushima comprehensive safety assessment and related Orders. On November 20, 2014, in response to a Staff RAI, Entergy provided additional information concerning certain elements of its refined engineering project cost estimates (Reference 1-12). The Staff's review of Entergy's refined engineering project cost estimates is documented in its Draft FSEIS Supplement 2, issued on December 22, 2015, in which the Staff concluded that Entergy's cost-estimating methodologies and refined cost estimates are reasonable (Reference 1-13).

1.2 Summary of Contested Adjudication on Contention NYS-12C

As part of the adjudicatory proceeding associated with the IPEC LRA, New York State filed several contentions challenging various aspects of Entergy's SAMA analysis and the NRC Staff's review thereof. Most relevant here, contention NYS-12C, alleged that the SAMA analysis does not accurately address decontamination costs associated with a severe accident in the region surrounding Indian Point, including New York City. New York principally challenged the reasonableness of the decontamination cost (CDNFRM) and decontamination time (TIMDEC) values used by Entergy as inputs to the MACCS2 code.

The ASLB issued its decision (LBP-13-13) in November 2013, in which it resolved NYS-12C on the merits in favor of the Staff and Entergy, and found the IPEC SAMA analysis to be sufficient under NEPA (Reference 1-14). The Board found that the TIMDEC and CDNFRM values used in the SAMA analysis were "reasonable and appropriate for Indian Point." New York appealed that ASLB decision, and in February 2015, the Commission sought additional briefing from the parties on specific technical issues discussed in the hearing record.

On May 4, 2016, the Commission issued its decision (CLI-16-07) on New York's appeal, in which it reversed, in part, the Board's ruling on NYS-12C.[7] The Commission found that there were "potentially significant uncertainties" in the TIMDEC and CDNFRM values used by Entergy, notwithstanding the Staff's acceptance of those values in long-standing NRC guidance documents (*e.g.*, NUREG-1150 (Reference 1-16)).[8] Noting that the NEPA record in this case is not yet closed, the Commission directed the Staff to supplement its review of the SAMA analysis with sensitivity analyses for the CDNFRM and TIMDEC values, which it noted would "help demonstrate whether and to what extent variations in an uncertain input value might affect the overall cost-benefit conclusions."[9] Specifically, it directed the Staff to conduct sensitivity runs for the maximum

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[6] Entergy submitted this information to support resolution of issues identified in an Atomic Safety and Licensing Board (ASLB) decision granting NYS's motion for summary disposition of NYS-35/36.

[7] *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), CLI-16-07 (May 4, 2016) (slip opinion) (Reference 1-15).

[8] CLI-16-07, slip opinion at 35.

[9] *Id.* at 36.

MACCS2 code-allowed TIMDEC value (365 days) and CDNFRM value ($100,000) for the four most severe accident categories modeled in the SAMA analysis.[10] The Commission also stated that the Staff should consider examining the sensitivity of the per capita value of non-farm wealth (VALWNF) input to MACCS2 by scaling up the VALWNF dollar values to 2005 dollar values.[11]

2.0. THE NRC'S SEPTEMBER 2016 REQUEST FOR ADDITIONAL INFORMATION (RAI)

On September 12, 2016, in response to the Commission's directive in CLI-16-07 that the NRC Staff perform additional sensitivity analyses to supplement its NEPA review of the IPEC SAMA analysis, the Staff issued the following RAI to Entergy (Reference 1-1).

Request

1. Entergy Nuclear Operations, Inc. (Entergy) is requested to scale up the value of nonfarm wealth (VALWNF) input to the SAMA analysis' base-year dollars (see pp. 41-42 of CLI-16-07), and to re-run its base analyses using this corrected VALWNF input. Entergy is requested to evaluate how the change in VALWNF may affect its identification of potentially cost-beneficial SAMAs.

2. Using the revised baseline from Request 1, Entergy is requested to run supplemental sensitivity analyses using the input values specified in CLI-16-07. Specifically:

    a. Apply the maximum values specified by the Commission and allowed by the MACCS[2] code for TIMDEC and CDNFRM values (one year (365 days) and $100,000, respectively) for "heavy decontamination" (i.e., the decontamination/dose reduction factor of 15).

    b. Exercise the additional option to explain, with sufficient justification, its rationale for choosing any additional values for the TIMDEC and CDNFRM inputs for its sensitivity analyses.

Entergy at a minimum should run its sensitivity analyses for the four worst release categories, as specified in CLI-16-07. Entergy is requested to evaluate how these sensitivity analyses may affect its identification of potentially cost-beneficial SAMAs.

3. Upon completing these additional analyses, Entergy is requested to submit the input and output files for the IP2 and IP3 MACCS[2] code. Additionally, Entergy is requested to submit the spreadsheet (or equivalent table if another method is used) that conveys the population dose and off-site economic cost for each release category and integrates the results into a Population Dose Risk and an Offsite Economic Cost Risk for IP2 and IP3.

3.0 ENTERGY RESPONSE TO THE NRC STAFF'S RAI

3.1 Overview of MACCS2 Sensitivity Case Methodologies/Assumptions

To address the Staff's RAI, Entergy performed a series of MACCS2 sensitivity cases in which it made adjustments to specific MACCS2 parameter input values, including the values used for

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[10] *Id.* at 36-37.

[11] *Id.* at 42.

CDNFRM, TIMDEC, and VALWNF. For purposes of consistency and completeness, Entergy applied the MACCS2 parameter value changes to all eight release categories, not just to the four "worst" release categories as specified in the RAI. All assumptions used in IP-CALC-09-00265, "Re-analysis of MACCS2 Models for IPEC," Rev. 0 (Dec. 2009) (Reference 1-17), the MACCS2 model analysis calculation underlying the 2009 revised SAMA analysis, were carried forward to the new MACCS2 sensitivity case runs and calculations. For each sensitivity case, the MACCS2 results for total 50-mile offsite costs and 50-mile population dose for each release category were multiplied by the applicable release category frequency to calculate the SAMA analysis risk metrics of offsite economic cost risk (OECR) and population dose risk (PDR). Entergy then compared the OECR and PDR values for the various sensitivity cases to the applicable reference cases to determine the impact of the revised MACCS2 parameter values on those risk metrics. These additional MACCS2 sensitivity cases are documented in Entergy Engineering Report IP-RPT-16-00077, "Indian Point RAI CLI-16-07 MACCS2 Sensitivities," Rev. 0 (Jan. 4, 2017) (Enclosure 1).

Additionally, as noted above, Entergy performed TI-SGTR sensitivity analyses that also required the use of different source terms for certain SAMA candidates. As documented in Appendix A to IP-RPT-16-00077 (Enclosure 1), Entergy re-performed these SAMA candidate-specific MACCS2 cases using the re-analyzed meteorological data in IP-CALC-09-00265 (Reference 1-17) and the new sensitivity cases discussed herein.

Entergy performed a total of eight MACCS2 sensitivity cases (Enclosure 1). Some of these cases were not specifically required to address the RAI, but were performed to gain further insights into the sensitivity of the OECR and PDR results to selected MACCS2 input values. Two of these cases involved the use of an alternative dry deposition velocity (VDEPOS) that reflects insights gained from a recent NRC technical study (Reference 1-19), and which parallels sensitivity cases recently performed by other license renewal applicants (References 1-24, 1-25). The eight MACCS2 sensitivity cases are summarized below.

- Case 0
  - SAMA Base Case Check
  - This case confirms that the results of IP-CALC-09-00265 can be reproduced with the applicable MACCS2 files upon which the sensitivity cases are built.
- Case 1
  - TIMDEC is escalated to one year (365 days) for a decontamination factor (DF) =15 ("heavy" decontamination) in the MACCS2 CHRONC input file.
  - This TIMDEC value represents the maximum value allowed by MACCS2.
  - This case examines only the effects of using the maximum TIMDEC value and thus is not used to support the RAI response, which must consider the combined effects of using the maximum TIMDEC and CDNFRM input values allowed by the MACCS2 code as well as the escalated VALWNF value.
- Case 2
  - CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file.
  - This CDNFRM value represents the maximum value allowed by MACCS2.
- This case examines only the effects of using the maximum CDNFRM value and thus is not used to support the RAI response, which must consider the combined effects of using the

maximum TIMDEC and CDNFRM input values allowed by the MACCS2 code as well as the escalated VALWNF value.

- Case 3
  - TIMDEC is escalated to one year (365 days) and CDNFRM was escalated to $100,000/person for DF=15 in the CHRONC input file.
  - This TIMDEC and CDNFRM values represent the maximum values allowed by MACCS2.
  - This case considers the combined effects of using the maximum TIMDEC and CDNFRM values but is not used to support the RAI response because it does not include the escalated VALWNF value.
- Case 4
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values. VALWNF is used in the CHRONC input file and represents an average value for the 50 mile region. VNFRM is used in the SITE input file and is calculated on a county-specific basis. Calculation of these values is documented in Entergy Engineering Report IP-RPT-16-00077 (Enclosure 1).
  - This case addresses Part 1 of the RAI (*i.e.*, corrected VALWNF), and represents the "revised baseline" as specified in the RAI.
- Case 5
  - TIMDEC is escalated to one year (365 days) and CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file.
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - This case addresses Part 2(a) of the RAI.
- Case 6
  - TIMDEC is escalated to one year (365 days) and CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file.
  - VALWNF & VNFRM without including lost tourism and business.
  - This case examines the effect of excluding the lost business and tourism component from Entergy's baseline VALWNF value and thus is not used to support the RAI response.
- Case 7
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - The dry deposition velocity, VDEPOS, is set to 0.003 m/sec in the ATMOS input file rather than the value of 0.010 m/sec used in the 2009 revised SAMA analysis. The value of 0.003 m/sec is documented by the recent NRC's State-of-the-Art Reactor Consequence Analyses (SOARCA) project (Reference 1-19) to be the dominant or average value for use in SOARCA and is viewed as more

representative of severe accident source terms than the value of 0.010 m/sec used in the NUREG-1150 study (References 1-16). As noted below, other recent NRC license renewal applicants have performed sensitivity analyses using smaller dry deposition velocity values, including the SOARCA-based value of VDEPOS (0.003 m/sec).

- Similar to Case 4, Case 7 addresses Part 1 of the RAI (*i.e.*, corrected VALWNF), and represents the "revised baseline" as specified in the RAI, except with an updated dry deposition velocity.

- Case 8
  - TIMDEC is escalated to one year (365 days) and CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file.
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - The dry deposition velocity, VDEPOS, is set to 0.003 m/sec in the ATMOS input file rather than the Reference 1-14 value of 0.010 m/sec.
  - Similar to Case 5, Case 8 addresses Part 2(a) of the RAI (*i.e.*, corrected VALWNF, increased TIMDEC & CDNFRM), as specified in the RAI, except with an updated dry deposition velocity.

3.2 Overview of Revised Cost-Benefit Analysis Methodologies/Assumptions

Entergy performed revised SAMA cost-benefit analyses for IP2 and IP3 using the new MACCS2 results for the sensitivity cases listed below. Entergy used the same NRC-approved cost-benefit analysis methods used to perform the December 2009 revised SAMA analysis, as described therein and in the NRC Staff's December 2010 FSEIS. The new cost-benefit analyses are documented in Entergy Engineering Report No. IP-RPT-16-00078, "Indian Point RAI CLI-16-07 SAMA Cost-Benefit Sensitivities," Rev. 0 (Jan. 4, 2017) (Enclosure 2) and the various electronic files (spreadsheets) referenced therein.

As noted above, more MACCS2 cases are documented in IP-RPT-16-00077 (Enclosure 1) than are strictly required to address the RAI response. Therefore, all of these additional cases were not carried through the new SAMA cost-benefit analyses. The evaluation of potentially cost-beneficial SAMAs was performed only for the MACCS2 cases listed below.

- Case 0
  - SAMA Base Case Check
  - This case confirms that the results of the 2009 revised SAMA cost-benefit analysis documented in IP-RPT-09-00044 (Reference 1-20) can be reproduced with the applicable MACCS2 files upon which the sensitivity cases are built.

- Case 4
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values. VALWNF is used in the CHRONC input file and represents an average value for the 50 mile region. VNFRM is used in the SITE input file and is calculated on a county basis. Calculation of these values is presented below.

- This case addresses Part 1 of the RAI (*i.e.*, corrected VALWNF), and represents the "revised baseline" as specified in the RAI.

- Case 5
  - TIMDEC is escalated to one year (365 days) and CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file.
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - This case addresses Part 2(a) of the RAI.

- Case 7
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - The dry deposition velocity, VDEPOS, is set to 0.003 m/sec in the ATMOS input file rather than the value of 0.010 m/sec. As discussed further below, the value of 0.003 m/sec is documented by the NRC's recent SOARCA study (Reference 1-19) project to be the dominant or average value for use in SOARCA and is viewed as more representative than the value of 0.010m/sec used in the NUREG-1150 study (Reference 1-16).
  - Similar to Case 4, Case 7 addresses Part 1 of the RAI (*i.e.*, corrected VALWNF), and represents the "revised baseline" as specified in the RAI, except with an updated dry deposition velocity.

- Case 8
  - TIMDEC is escalated to one year (365 days) and CDNFRM is escalated to $100,000/person for DF=15 in the CHRONC input file. These are the maximum values allowed by the MACCS2 source code.
  - VALWNF & VNFRM (including lost tourism and business) are escalated to 2005 values in the CHRONC and SITE input files, respectively.
  - The dry deposition velocity, VDEPOS, is set to 0.003 m/sec in the ATMOS input file rather than the value of 0.010 m/sec.
  - Similar to Case 5, Case 8 addresses Part 2(a) of the RAI (*i.e.*, corrected VALWNF, increased TIMDEC & CDNFRM), as specified in the RAI, except with an updated dry deposition velocity.

3.3 Response to the NRC Staff's RAI

3.3.1 Response to RAI 1

RAI 1 concerns the MACCS2 parameter, VALWNF, which is used in the CHRONC input file and represents an average value for the 50-mile region. VALWNF defines the value of the per capita nonfarm wealth in the region. Nonfarm wealth includes all public and private property not associated with farming that would be unusable if the region was rendered either temporarily or permanently uninhabitable (*e.g.*, the cost of land, buildings, infrastructure, and non-recoverable equipment or machinery). The RAI requests that Entergy (1) scale up the value of the nonfarm

wealth (VALWNF) input to the SAMA analysis base-year dollars, (2) re-run its base case analyses using this corrected VALWNF input value, and (3) evaluate how the change in VALWNF affects its identification of potentially cost-beneficial SAMAs (Reference 1-1).

By way of background, Entergy developed estimates of the nonfarm wealth value for each county in the SAMA analysis region based upon fixed reproducible tangible wealth, a measure of the durable goods that are owned in an area. It obtained county-specific values for nonfarm wealth data using the SECPOP2000 computer software and its economic database from the 1997 Census of Agriculture. It then computed an average regional value of nonfarm wealth for the 50-mile radius area for use in the MACCS2 analysis. This value was calculated as VNFRM weighted by the area that each of the 28 counties has in the IPEC 50-mile radius area. Entergy's original calculated baseline VALWNF value was $163,631/person in 1997 dollars. Entergy did not scale up this value to the SAMA analysis base-year dollars. *See* Reference 1-21.

Entergy later modified its original baseline VALWNF value. Specifically, Entergy estimated the impact of lost tourism and business as a sensitivity case in response to a 2008 NRC Staff RAI. To assess lost business, Entergy obtained measures of total economic activity by examining a suite of products related to the national Gross Domestic Product (GDP), which is a measure of the total value of goods and services produced in an area. The GDP per person values for 2004 were developed to estimate the total value of goods and services produced in the 50-mile radius area. This essentially is all the items that were manufactured or produced in the area in 2004, plus "services" that produce economic activity in that year. The modified VALWNF values, therefore, were a measure of people's nonfarm wealth as well as a measure of their economic output. The revised estimate of average nonfarm wealth value for the full 50-mile radius region was quantified as $208,838/person (with a lost tourism/business component of $45,207/person) based on 2004 data. The revised VALWNF value represents a factor of 1.28 increase from the original value of $163,631. *See* References 1-6, 1-7, 1-8, and 1-10.

For purposes of this RAI response, Entergy scaled up the VALWNF input to the SAMA analysis base-year (2005) dollars. The Consumer Price Index (CPI) values (Series CUUR0000SA0, All Urban Consumers) shown below were used to obtain the applicable escalation factors:

- Annual 1997 CPI = 160.5
- Annual 2004 CPI = 188.9
- Annual 2005 CPI = 195.3
- Escalation Factor 1997-2005 = 1.22
- Escalation Factor 2004-2005 = 1.03

Using these escalation factors, the 2005 VALWNF was calculated as follows:

- VALWNF without lost tourism/business = $163,631/person * 1.22 = $199,630/person
- Lost tourism/business component = $45,207/person * 1.03 = $46,563/person
- Total with lost tourism/business (2005 dollars) = $246,193/person, rounded up to $247,000/person.

Entergy also scaled up the individual county average VNFRM values of nonfarm wealth used in the SITE input file. The same approach and CPI escalation values developed for the VALWNF

calculation were applied to the county-level data. The original and escalated values for each county are shown in Table 1 below.

Table 1 – Original and Escalated VNFRM County-Level Values

	Basis Year for Dollar Values:	1997	1997, 2004	2004	2005
Region	County	Original No Tourism VNFRM ($)	Original With Tourism VNFRM ($)	Tourism Portion ($)	With Tourism VNFRM ($)
1	FAIRFIELD	232659	287881	55222	340723
2	BERGEN	205863	262186	56323	309166
3	LITCHFIELD	148522	186016	37494	219816
4	NEWHAVEN	144105	192427	48322	225580
5	ESSEX	147351	197400	50049	231319
6	DUTCHESS	129000	169417	40417	199010
7	MORRIS	213389	277661	64272	326535
8	PASSAIC	121880	161864	39984	189877
9	SUSSEX	136197	165741	29544	196591
10	UNION	160860	209708	48848	246563
11	KINGS	104714	123701	18987	147308
12	NASSAU	192755	239932	47177	283753
13	ORANGE	113976	148873	34897	174995
14	PUTNAM	154926	180274	25348	215118
15	QUEENS[1]	169126	226728	57602	265664
16	ROCKLAND	163105	203359	40254	240450
17	SUFFOLK	149615	192471	42856	226672
18	SULLIVAN	104859	139374	34515	163478
19	ULSTER	104090	138739	34649	162678
20	WESTCHESTER	217278	263389	46111	312573

Note 1: To ensure that economic information pertaining to New York City was included in the analysis, Entergy combined the nonfarm property values for four counties within the metropolitan New York City region as a weighted average (weighted by population) and assigned it to the Queens economic region (Reference 1-21).

Entergy re-ran the baseline analyses using the VALWNF and VNFRM values escalated to 2005 dollar values. Table 2 and Table 3 show the resulting PDR and OECR for the revised baseline. Comparison of these results to the baseline results in the 2009 revised SAMA analysis

(References 1-8, 1-20) shows a modest OECR increase of approximately 9-10% and no appreciable change in the PDR.

Table 2 - IP2 Escalated VALWNF and VNFRM MACCS2 Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	6.50E-07	6.51E+07	4.23E+01	48.44%	2.27E+11	1.48E+05	63.33%
H/L	6.88E-07	1.63E+07	1.12E+01	12.84%	5.04E+10	3.47E+04	14.88%
M/E	4.23E-07	1.94E+07	8.21E+00	9.39%	6.36E+10	2.69E+04	11.55%
M/L	3.43E-06	6.87E+06	2.36E+01	26.98%	6.59E+09	2.26E+04	9.70%
L/E	1.11E-07	7.94E+06	8.81E-01	1.01%	6.93E+09	7.69E+02	0.33%
L/L	6.43E-07	1.61E+06	1.04E+00	1.19%	7.15E+08	4.60E+02	0.20%
LL/L	5.82E-08	1.38E+06	8.03E-02	0.09%	6.10E+08	3.55E+01	0.02%
NCF	1.19E-05	4.75E+03	5.65E-02	0.06%	1.07E+05	1.27E+00	0.00%
Total	1.79E-05	--	8.74E+01	100%	--	2.33E+05	100%

Note 1: Table 2E in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Table 3 – IP3 Escalated VALWNF and VNFRM MACCS2 Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	9.43E-07	5.09E+07	4.80E+01	50.55%	1.86E+11	1.75E+05	61.50%
H/L	4.23E-07	1.63E+07	6.89E+00	7.26%	5.00E+10	2.12E+04	7.42%
M/E	1.24E-06	2.00E+07	2.48E+01	26.12%	6.01E+10	7.45E+04	26.13%
M/L	2.01E-06	6.85E+06	1.38E+01	14.50%	6.59E+09	1.32E+04	4.64%
L/E	1.46E-07	5.21E+06	7.61E-01	0.80%	3.87E+09	5.65E+02	0.20%
L/L	3.75E-07	1.61E+06	6.04E-01	0.64%	7.14E+08	2.68E+02	0.09%
LL/L	5.66E-08	1.38E+06	7.81E-02	0.08%	6.10E+08	3.45E+01	0.01%
NCF	6.30E-06	8.04E+03	5.07E-02	0.05%	3.17E+05	2.00E+00	0.00%
Total	1.15E-05	--	9.50E+01	100%	--	2.85E+05	100%

Note 1: Table 3E in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

As requested by the Staff in RAI 1, Entergy evaluated how the change in the value of VALWNF/ VNFRM affects the identification of potentially cost-beneficial SAMAs. The revised baseline with escalation of VALWNF and VNFRM resulted in one additional potentially cost-beneficial SAMA

(IP2-021) when the Revised Baseline with Uncertainty (which reflects application of the 95th percentile CDF uncertainty multiplier) is compared to the most recent implementation cost estimate available for IP2-021 (an engineering project cost estimate submitted in 2013 via NL-13-075 (Reference 1-11), and adjusted in 2014 via NL-14-143 (Reference 1-12).[12]

Phase II SAMA	Description	Revised Baseline Benefit ($)	Revised Baseline Benefit With Uncertainty ($)	Estimated Cost ($) (NL-14-143)
IP2-021	021 - Install additional pressure or leak monitoring instrumentation for ISLOCAs.	2,216,549	**4,666,419**	**4,632,227**

The identification of IP2-021 as potentially cost-beneficial in this case is not unexpected insofar as the estimated benefit with uncertainty was $4,408,109 prior to the escalation of VALWNF input to the SAMA analysis base-year dollars. In fact, IP2-021 was one of two SAMAs (the other being IP2-053) that the Staff recommended in its Draft FSEIS Supplement 2 that Entergy retain further consideration because "the incremental difference by which the SAMAs are not cost beneficial, when viewed in the context of uncertainties in the cost estimates, is too small to exclude them from further consideration" (Reference 1-13).

Two points bear emphasis with respect to the identification of SAMA IP2-021 as potentially cost-beneficial in the new VALWNF sensitivity case. First, the escalated VALWNF value still includes a lost business and tourism component. As the Staff noted in the FSEIS, the inclusion of tourism and business losses within the baseline analysis is conservative. *See* FSEIS, Vol. 3, App. G at G-46 (Reference 1-10) ("[T]he NRC staff has conservatively adopted the case incorporating lost tourism and business as its base case and has reflected the results of that case in Table G-6.").

Second, even in the new sensitivity case, SAMA IP2-021 is only marginally cost-beneficial; *i.e.*, the difference between the estimated benefit with uncertainty and current cost estimate is about $34,000, less than a 1% difference. Although Entergy used a more detailed 2014 engineering project cost estimate for the cost-benefit comparison, it is conceivable, if not likely, that the actual implementation cost would be more than 1% larger than the currently-estimated $4.6 million value for the reasons stated in Entergy's March 2016 comments on the Draft FSEIS Supplement 2. Specifically, SAMA IP2-021 involves the installation of pressure transmitters at nine inter-system ISLOCA paths to measure pressure changes within an isolation boundary and to transmit the information to a location outside containment for remote display and monitoring. The current cost estimate includes typical vendor transmitter and recorder product specification sheets as well as

[12] RAI 1 requests that Entergy escalate the VALWNF value used in its SAMA analysis from 1997 to 2005 dollars and "rerun its base analyses using this corrected VALWNF input . . . to evaluate how the change in VALWNF may affect its identification of potentially cost-beneficial SAMAs." In its 2009 revised SAMA analysis, Entergy included any additional SAMAs identified as cost-beneficial in the uncertainty analysis using the 95th percentile CDF multiplier within the set of potentially cost-beneficial SAMAs, even if they were not cost-beneficial in the baseline analysis. Given that RAI 1 seeks to gauge the impact of a fairly minor adjustment to a single MACCS2 input parameter (VALWNF), Entergy adheres to the same approach here. In contrast, RAI 2 requests that Entergy perform entirely new sensitivity analyses involving substantial increases to two MACCS2 input values (TIMDEC and CDNFRM). For reasons explained further below, Entergy did not combine the 95th percentile CDF multiplier and maximum TIMDEC-CDNFRM value cases, as each is a sensitivity case in its own right.

piping single line diagrams and system block diagrams. However, other project considerations might be included if the cost estimate were to be further refined for implementation purposes. For example, the current estimate assumes that the recorder will be located in the control building on the 33' elevation. For the operators to more expeditiously determine that there is an Inter-System LOCA, the recorder also could be located in the control room. To locate the recorder in the control room, there would be many design considerations that must be met, such as penetration and resealing of the fire barrier for cables, Human Factor evaluation to ensure proper location of the recorder(s), panel mounting of the recorder, cable separation requirements, etc. *See* NL-16-021, Att. 1 at 10 (Reference 1-22).

In short, the preparation of an even more refined cost estimate for SAMA IP2-021 conceivably could render that SAMA not cost-beneficial, even under the escalated VALWNF sensitivity case.

3.3.2 Response to RAI 2.a

Using the revised baseline from RAI 1, Entergy ran supplemental sensitivity analyses using the input values specified in CLI-16-07 and RAI 2.a. Specifically, the maximum values specified by the Commission and allowed by the MACCS2 code for TIMDEC and CDNFRM values (365 days and $100,000, respectively) for "heavy decontamination" (*i.e.*, the decontamination/dose reduction factor of 15) were applied. The parameter value changes were applied to all release categories for consistency, not just to the four worst release categories as specified in the RAI.

Table 4 and Table 5 show the PDR and OECR results when the TIMDEC and CDNFRM values are increased to the maximum MACCS2 allowed values as stipulated in the RAI, with the revised baseline. Comparison of these results to the baseline results in the 2009 revised SAMA analysis (References 1-8, 1-20) shows that the OECR increases approximately 126-133%. The PDR increase, approximately 11-12%, is much smaller (an order of magnitude less).

Table 4 - IP2 Increased TIMDEC and CDNFRM (with Escalated VALWNF and VNFRM) MACCS2 Sensitivity Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	6.50E-07	7.90E+07	5.14E+01	52.57%	5.03E+11	3.27E+05	68.35%
H/L	6.88E-07	1.69E+07	1.16E+01	11.90%	8.56E+10	5.89E+04	12.31%
M/E	4.23E-07	2.06E+07	8.71E+00	8.92%	1.25E+11	5.29E+04	11.05%
M/L	3.43E-06	6.97E+06	2.39E+01	24.48%	1.09E+10	3.74E+04	7.82%
L/E	1.11E-07	8.03E+06	8.91E-01	0.91%	1.12E+10	1.24E+03	0.26%
L/L	6.43E-07	1.63E+06	1.05E+00	1.07%	1.45E+09	9.32E+02	0.19%
LL/L	5.82E-08	1.39E+06	8.09E-02	0.08%	1.24E+09	7.22E+01	0.02%
NCF	1.19E-05	4.75E+03	5.65E-02	0.06%	1.07E+05	1.27E+00	0.00%
Total	1.79E-05	--	9.77E+01	100%	--	4.78E+05	100%

Note 1: Table 2F in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Table 5 - IP3 Increased TIMDEC and CDNFRM (with Escalated VALWNF and VNFRM) MACCS2 Sensitivity Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	9.43E-07	5.95E+07	5.61E+01	53.42%	4.51E+11	4.25E+05	69.93%
H/L	4.23E-07	1.69E+07	7.15E+00	6.81%	8.52E+10	3.60E+04	5.93%
M/E	1.24E-06	2.12E+07	2.63E+01	25.03%	9.95E+10	1.23E+05	20.29%
M/L	2.01E-06	6.95E+06	1.40E+01	13.30%	1.09E+10	2.19E+04	3.60%
L/E	1.46E-07	5.30E+06	7.74E-01	0.74%	6.15E+09	8.98E+02	0.15%
L/L	3.75E-07	1.63E+06	6.11E-01	0.58%	1.45E+09	5.44E+02	0.09%
LL/L	5.66E-08	1.39E+06	7.87E-02	0.07%	1.24E+09	7.02E+01	0.01%
NCF	6.30E-06	8.04E+03	5.07E-02	0.05%	3.17E+05	2.00E+00	0.00%
Total	1.15E-05	--	1.05E+02	100%	--	6.08E+05	100%

Note 1: Table 3F in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

With respect to the impact on the cost-benefit analysis results, increasing the TIMDEC and CDNFRM values to the maximum MACCS2 code-allowed values as stipulated in the RAI, with the revised VALWNF baseline (but excluding the 95th percentile CDF uncertainty multiplier), resulted in one additional potentially cost-beneficial SAMA, IP3-057, as shown below. As Entergy explained in a February 2008 RAI response (Reference 1-6), for this IP3 SAMA, the alternate cooling water could be supplied by backup service water pumps, three of which are available to provide cooling water from the discharge canal to essential service water in the unlikely event that the service water intake structure is lost.

Phase II SAMA	Description	Sensitivity Benefit ($)	Estimated Cost ($) (from IP-RPT-09-00044)
IP3-057	057 - Provide backup cooling water source for the component cooling water (CCW) heat exchangers.	118,434	109,000

Entergy did not use the 95th percentile CDF uncertainty multiplier in the SAMA candidate cost-benefit evaluation in this case because the application of that multiplier is itself a sensitivity case intended to capture analytical uncertainties.[13] As CLI-16-07 makes clear, the purpose of the additional sensitivity analyses directed by the Commission is to better understand how material

[13] *See, e.g.*, NUREG-1437, Supp. 57, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding LaSalle County Station, Units 1 and 2 – Final Report," App. F at F-1 (Aug. 2016) (Reference 1-23) (noting that the applicant "performed sensitivity analyses on the real discount rate, *CDF uncertainty at the 95th percentile*, as well as the offsite consequence parameters") (emphasis added).

uncertainties in the values of two specific MACCS2 parameter inputs – CDNFRM and TIMDEC – are to the SAMA analysis conclusions (Reference 1-15). Moreover, this approach allows Entergy to compare the results of the CDF uncertainty multiplier and maximum CDNFRM-TIMDEC sensitivity cases – an approach used by other applicants in their responses to similar RAIs (References 1-26 to 1-30) and accepted by the Staff in the FSEIS for LaSalle Units 1 and 2 license renewal (Reference 1-23).[14]

With respect to the IPEC SAMA analysis, this comparison shows that the increases to the base case seen in the OECR and the PDR for the new combined CDNFRM-TIMDEC value sensitive case are bounded by the baseline with uncertainty (95th percentile CDF multiplier) case for IP2, and nearly bounded for IP3. As a practical matter, Entergy concludes that the baseline with uncertainty case also might bound the new CDNFRM-TIMDEC value sensitivity case for IP3 if an updated cost estimate for SAMA IP3-057 were developed. The calculated sensitivity benefit for SAMA IP3-057 ($118,434) exceeds the currently-available implementation cost estimate ($109,000) by less than $10,000. That implementation cost estimate was provided in the original 2007 SAMA analysis, and thus does not represent one of the refined engineering project cost estimates submitted by Entergy in 2013-2014 for certain other SAMAs. It is very possible that a refined engineering project cost estimate prepared for SAMA IP3-057, which was evaluated as a means to provide alternate cooling water to the CCW heat exchangers, would exceed $109,000.

3.3.3 Response to RAI 2.b

RAI 2.b states that Entergy may exercise the additional option to explain, with sufficient justification, its rationale for choosing any additional values for the TIMDEC and CDNFRM inputs for its sensitivity analyses (Reference 1-1). Given the minimal impact of the maximum TIMDEC-CDNFRM sensitivity case discussed in the response to RAI 2.a above, Entergy does not propose additional values for the TIMDEC and CDNFRM inputs. As noted above, however, Entergy does propose use of an alternative value for the dry deposition velocity (VDEPOS) parameter input to MACCS2 in light of insights gained from the NRC's recent SOARCA project and VDEPOS sensitivity analyses performed for other plants seeking renewed licenses, as documented in the Staff's FSEISs for those plants.[15]

In Entergy's original and revised SAMA analyses, a VDEPOS value of 0.010 m/sec (1.0 cm/sec) was used in the ATMOS input file to MACCS2 (Reference 1-17). The NRC's recent SOARCA project found a value of 0.003 m/sec (0.3 cm/sec) to be the dominant or average value for use in SOARCA. As explained in the main SOARCA study report (NUREG/CR-7110):

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[14] *See id.* at F-23 ("In response to an RAI relating to [CLI-16-07], Exelon developed a new MACCS2 TIMDEC and CDNFRM combined sensitivity case (TIMDEC CDNFRM) and applied the maximum values specified by the Commission . . . to all of the LaSalle release categories. New [OECR and PDR] values were calculated. The increase to the base case seen in the OECR was approximately 54 percent and in the PDR was approximately 2 percent for this TIMDEC CDNFRM sensitivity case. These increases are well within the bounds of the 214 percent increase determined by the baseline with uncertainty (95th percentile) which was included as part of the SAMA candidate cost-benefit evaluation documented in Section F.7 of the Environmental Report.").

[15] *See, e.g.*, NUREG-1437, Supp. 54, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Byron Station, Units 1 and 2 — Final Report," App. F at F-18 (July 2015) (Reference 1-24); NUREG-1437, Supp. 55, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Braidwood Station, Units 1 and 2 – Final Report," App. F at F-17 (Nov. 2015) (Reference 1-25).

> Dry deposition of aerosol particles is represented through a set of aerosol size bins. Each size bin represents a range of aerosol sizes, usually characterized by a mass median diameter. Each aerosol bin is assigned a dry deposition velocity. The set of dry deposition velocities are used by MACCS2, along with airborne aerosol concentrations that are calculated using the Gaussian plume approximation, to determine the ground concentrations. Common practice from the time of the 1982 Siting Study [Reference 1-18] through NUREG-1150 [Reference 1-16] was to treat a single aerosol bin using a representative deposition velocity of 1 cm/s. This single-bin practice is still common today. The practice used in SOARCA is to use all of the aerosol data from MELCOR. These data are for 10 aerosol bins, each representing a range of aerosol sizes. The representative deposition velocities for the 10 bins range from 0.05 cm/s for the smaller particles to 1.7 cm/s for the larger ones. *The dominant or average deposition velocity in SOARCA is about 0.3 cm/s, a factor of 3 lower than the single value used in the 1982 Siting Study.*

Reference 1-19 (emphasis added). Thus, 0.003 m/sec (0.3 cm/sec) is viewed as more representative than the value of 0.010 m/sec used in the NUREG-1150 studies.

Entergy ran an alternative revised baseline using the VALWNF and VNFRM values escalated to 2005 dollar values, as described in the response to RAI 1, but with a VDEPOS value of 0.003 m/sec (0.3 cm/sec). Table 6 and Table 7 show the resulting PDR and OECR values for the alternative revised baseline. Comparison of these results to those in Table 2 and Table 3 shows that use of the lower dry deposition velocity more than offsets the increase associated with escalating the value of non-farm wealth to 2005 values. Comparison of these results to the baseline results in the 2009 revised SAMA analysis (References 1-8, 1-20) shows that the OECR decreases between 10-17% compared to the SAMA base case. The PDR value changes a small amount (2.5% decrease for IP-2; 1.8% increase for IP-3).

Table 6 - IP2 Escalated VALWNF and VNFRM and Revised VDEPOS MACCS2 Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	6.50E-07	6.85E+07	4.45E+01	52.30%	1.94E+11	1.26E+05	66.34%
H/L	6.88E-07	1.60E+07	1.10E+01	12.93%	3.71E+10	2.55E+04	13.43%
M/E	4.23E-07	1.90E+07	8.04E+00	9.44%	4.28E+10	1.81E+04	9.52%
M/L	3.43E-06	5.80E+06	1.99E+01	23.37%	5.71E+09	1.96E+04	10.30%
L/E	1.11E-07	6.40E+06	7.10E-01	0.83%	4.67E+09	5.18E+02	0.27%
L/L	6.43E-07	1.33E+06	8.55E-01	1.00%	3.72E+08	2.39E+02	0.13%
LL/L	5.82E-08	1.12E+06	6.52E-02	0.08%	3.19E+08	1.86E+01	0.01%
NCF	1.19E-05	3.25E+03	3.87E-02	0.05%	4.00E+03	4.76E-02	0.00%
Total	1.79E-05	--	8.51E+01	100%	--	1.90E+05	100%

Note 1: Table 2H in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Table 7 - IP3 Escalated VALWNF and VNFRM and Revised VDEPOS MACCS2 Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	9.43E-07	5.49E+07	5.18E+01	53.59%	1.45E+11	1.37E+05	62.57%
H/L	4.23E-07	1.60E+07	6.77E+00	7.01%	3.71E+10	1.57E+04	7.18%
M/E	1.24E-06	2.03E+07	2.52E+01	26.06%	4.36E+10	5.41E+04	24.74%
M/L	2.01E-06	5.79E+06	1.16E+01	12.05%	5.71E+09	1.15E+04	5.25%
L/E	1.46E-07	4.48E+06	6.54E-01	0.68%	2.85E+09	4.16E+02	0.19%
L/L	3.75E-07	1.33E+06	4.99E-01	0.52%	3.72E+08	1.40E+02	0.06%
LL/L	5.66E-08	1.12E+06	6.34E-02	0.07%	3.19E+08	1.81E+01	0.01%
NCF	6.30E-06	5.54E+03	3.49E-02	0.04%	1.17E+04	7.37E-02	0.00%
Total	1.15E-05	--	9.66E+01	100%	--	2.19E+05	100%

Note 1: Table 3H in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Using the alternative revised baseline (with escalated VALWNF and VNFRM and revised VDEPOS), Entergy ran supplemental sensitivity analyses using the input values specified in CLI-16-07 and RAI 2.a. Specifically, the maximum values specified by the Commission and allowed by the MACCS2 code for TIMDEC and CDNFRM values (365 days and $100,000, respectively) for DF

= 15) were applied. The parameter value changes were applied to all release categories for consistency (not just to the four most severe release categories as specified in the RAI). Table 8 and Table 9 show the PDR and OECR results, when the TIMDEC and CDNFRM values are increased to the maximum MACCS2 code-allowed values, with the alternative revised baseline. Comparison of these results to the baseline results in the 2009 revised SAMA analysis shows that the OECR increases approximately 82-91%, and that the PDR increases by approximately 7-10%.

Table 8 - IP2 Increased TIMDEC and CDNFRM (with Escalated VALWNF and VNFRM and Revised VDEPOS) MACCS2 Sensitivity Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	6.50E-07	7.90E+07	5.14E+01	55.22%	4.49E+11	2.92E+05	72.05%
H/L	6.88E-07	1.66E+07	1.14E+01	12.28%	7.10E+10	4.88E+04	12.06%
M/E	4.23E-07	1.99E+07	8.42E+00	9.05%	7.96E+10	3.37E+04	8.31%
M/L	3.43E-06	5.87E+06	2.01E+01	21.65%	8.57E+09	2.94E+04	7.26%
L/E	1.11E-07	6.45E+06	7.16E-01	0.77%	7.02E+09	7.79E+02	0.19%
L/L	6.43E-07	1.33E+06	8.55E-01	0.92%	7.21E+08	4.64E+02	0.11%
LL/L	5.82E-08	1.12E+06	6.52E-02	0.07%	6.09E+08	3.54E+01	0.01%
NCF	1.19E-05	3.25E+03	3.87E-02	0.04%	4.00E+03	4.76E-02	0.00%
Total	1.79E-05	--	9.30E+01	100%	--	4.05E+05	100%

Note 1: Table 2I in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Table 9 - IP3 Increased TIMDEC and CDNFRM (with Escalated VALWNF and VNFRM and Revised VDEPOS) MACCS2 Sensitivity Results[1]

Release Category	Frequency (per yr)	Population Dose (p-rem)	Population Dose Risk (p-rem/yr)	PDR % of Total	Offsite Economic Cost ($)	Offsite Economic Cost Risk ($/yr)	OECR % of Total
H/E	9.43E-07	6.16E+07	5.81E+01	55.72%	3.59E+11	3.39E+05	71.22%
H/L	4.23E-07	1.65E+07	6.98E+00	6.70%	7.10E+10	3.00E+04	6.32%
M/E	1.24E-06	2.11E+07	2.62E+01	25.10%	7.15E+10	8.87E+04	18.65%
M/L	2.01E-06	5.85E+06	1.18E+01	11.28%	8.56E+09	1.72E+04	3.62%
L/E	1.46E-07	4.52E+06	6.60E-01	0.63%	4.10E+09	5.99E+02	0.13%
L/L	3.75E-07	1.33E+06	4.99E-01	0.48%	7.21E+08	2.70E+02	0.06%
LL/L	5.66E-08	1.12E+06	6.34E-02	0.06%	6.09E+08	3.45E+01	0.01%
NCF	6.30E-06	5.54E+03	3.49E-02	0.03%	1.17E+04	7.37E-02	0.00%
Total	1.15E-05	--	1.04E+02	100%	--	4.75E+05	100%

Note 1: Table 3I in IP-RPT-16-00077 (Enclosure 1 to this Attachment)

Increasing the TIMDEC and CDNFRM values to the maximum MACCS2 code-allowed values as stipulated in the RAI, with the alternative revised baseline (*i.e.*, with the escalated VALWNF and VNFRM and revised VDEPOS values), but excluding the 95th percentile CDF uncertainty multiplier, did not result in any additional potentially cost-beneficial SAMAs.

3.3.4 Response to RAI 3

The input and output files for the IP2 and IP3 MACCS2 code sensitivity cases discussed herein and in Engineering Report IP-RPT-16-00077 (Enclosure 1) are being provided to the NRC Staff. The tables in the preceding RAI responses and Enclosures 1 and 2 convey the population dose and off-site economic cost for each release category and integrate the results into a PDR and an OECR for IP2 and IP3.

4.0 SUMMARY AND CONCLUSIONS

As stated in the response to RAI 1, the revised baseline with VALWNF and VNFRM escalated to 2005 dollars (and still retaining the 95th percentile CDF analysis uncertainty multiplier) resulted in one additional potentially cost-beneficial SAMA (IP2-021, "Install additional pressure or leak monitoring instrumentation for ISLOCAs"). Notably, SAMA IP2-021 is only marginally cost-beneficial; *i.e.*, the difference between the estimated benefit with uncertainty and the current cost estimate is about $34,000, which represents less than a 1% difference. Although Entergy used a more detailed 2014 engineering project cost estimate for the cost-benefit comparison, it is very possible, if not likely, that the actual implementation cost would be more than 1% larger than the currently-estimated $4.6 million value for the reasons stated above.

With respect to the RAI 2a response, which involved running sensitivity cases using the maximum TIMDEC and CDNFRM input values allowed by the MACCS2 code, Entergy found that the 95th percentile CDF uncertainty multiplier case is bounding for IP2, even without the preparation of further refined engineering project cost estimates for any SAMA.[16] For IP3, Entergy identified one additional SAMA (IP3-057, "Provide backup cooling water source for the CCW heat exchangers") as potentially cost-beneficial. However, Entergy concludes that the baseline with uncertainty (95th percentile CDF multiplier) case also might bound the new CDNFRM-TIMDEC value sensitivity case for IP3 if an updated cost estimate for SAMA IP3-057 was developed. The calculated sensitivity benefit for SAMA IP3-057 ($118,434) exceeds the currently-available implementation cost estimate ($109,000) by less than $10,000. That implementation cost estimate dates back to the original 2007 SAMA analysis, and thus does not represent one of the refined engineering project cost estimates developed by Entergy in 2013-2014 for certain other SAMAs. Any refined engineering project cost estimate prepared for SAMA IP3-057, which was evaluated as a means to provide alternate cooling water to the CCW heat exchangers, likely would exceed $109,000. Additionally, if the same MACCS2 sensitivity cases are performed using a more representative dry deposition velocity value (as determined in the SOARCA study), no additional potentially cost-beneficial SAMAs are identified, even when the maximum TIMDEC and CDNFRM values are used.

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[16] This result is consistent with the results of comparable sensitivity analyses performed by other plants (*e.g.*, LaSalle Units 1 & 2, Fermi Unit 2, South Texas Project Units 1 and 2, Seabrook Unit 1, Grand Gulf Unit 1) seeking license renewal to which the NRC issued similar RAIs as a result of the Commission's decision in CLI-16-07. That is, for each of those plants, the applicant found that the 95th percentile CDF uncertainty multiplier case bounded the maximum TIMDEC-CDNFRM sensitivity case. *See* References 1-26 to 1-30.

The results of the additional MACCS2 sensitivity cases performed in response to the Staff's RAI underscore the conservative nature of the assumptions and methodologies used in the 2009 revised SAMA analysis, as previously summarized by Entergy during the litigation of NYS-12C (Reference 1-31, pp. 33-37). As an initial matter, the existing margin in the SAMA analysis accommodates uncertainties of various types, including those associated with the Level 3 PRA. Consequently, the theoretical benefit of implementing all of the 22 IP2 and IP3 SAMAs previously identified by Entergy as potentially cost-beneficial would exceed the maximum attainable benefit (*i.e.*, eliminate the baseline risks of plant operation) for IP2 and IP3, and, in the case of IP2, eliminate the baseline risks twice over. This reflects the fact that SAMA analysis is done on an individual SAMA candidate basis, and that many of the SAMA candidates act on the same accident sequences. Thus, as the lower-cost alternatives for mitigating the dominant accident sequences (*e.g.*, SGTR) are implemented, the baseline risk, as recalculated, is reduced, thereby reducing the likelihood that other SAMA candidates acting on the same accident sequences will remain, or become, potentially cost-beneficial.

Importantly, the existing margin in the IPEC SAMA analysis reflects a number of conservatisms that are embedded in the SAMA analysis. Those conservatisms include, for example, Entergy's use of: (1) the projected population in the year 2035, which is the last year of the IP3 period of extended operation and two years after the end of the IP2 period of extended operation; (2) a "no-evacuation" assumption, which overestimates doses incurred in the early phase of potential accidents; (3) the results of a sensitivity case for lost tourism and business in the base case analysis (as discussed above); (4) mean consequence values (because, as explained by an NRC Staff member during the hearing process, the mean results were generally between the 66th and 72nd percentiles, causing the SAMA analysis results to be skewed in the direction of greater offsite dose and economic consequences); and (5) a larger dry deposition velocity that resulted in more modeled radionuclide deposition than MACCS2 would have predicted had Entergy used a more representative deposition velocity based information contained in the NRC's recent SOARCA study (as confirmed by the VDEPOS sensitivity case discussed in Section 3.3.3 above). *See* Reference 1-31 (pp. 33-37) (summarizing NYS-12 hearing testimony and evidence on conservatisms and margin in the IPEC SAMA analysis).

In addition, since Entergy submitted the revised SAMA analysis in December 2009, it has voluntarily implemented four of the 22 SAMAs previously identified as potentially cost-beneficial (References 1-8, 1-10).[17] It also has implemented numerous safety and accident mitigation improvements required by the NRC's post-Fukushima Order EA-12-049 (References 1-32, 1-33). This fact is important because as the Commission explained in Order CLI-16-10 (Reference 1-34), the SAMA analysis evaluates each mitigation measure independently of the others. However, if one or more measures actually are implemented, then the plant's configuration changes, affecting its baseline risk profile (*e.g.*, CDF), in turn potentially rendering other mitigation measures less cost-beneficial or even no longer cost-beneficial.[18] Similarly, when two or more potentially cost-beneficial SAMAs act on the same risk contributor (*e.g.*, internal flooding, station blackout, or loss

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[17] The four implemented SAMAs include IP3-052 (open the city water supply valve for alternative auxiliary feedwater pump suction, IP3-053 (install an excess flow valve to reduce the risk associated with hydrogen explosions), and IP2-GAG and IP3-GAG (install steam generator safety valve gagging devices).

[18] *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), CLI-16-10 (June 2, 2016) (slip opinion at 19) (quoting *NRDC v. NRC*, No. 14-1225, slip op. at 17 (D.C. Cir. Apr. 26, 2016) ("As SAMAs are implemented, the 'relative benefits of adopting additional mitigation alternatives diminish.'") (Reference 1-34).

of offsite power), the implementation of one measure could reduce residual risk to a point that renders another measure less marginally beneficial in preventing or mitigating the specific accident concern. Therefore, depending on the types of SAMAs identified and their interrelationships, the implementation of a subset of SAMAs may achieve much of the potential risk reduction and might do so in an overall more cost-effective way than implementing all identified SAMAs. Draft FSEIS Supplement 2 also recognizes this fact in stating that "certain NRC-mandated actions, as well as the nuclear power industry's initiatives to address the challenges faced at Fukushima Dai-ichi, are likely to have an impact on certain SAMA candidates previously found to be potentially cost beneficial" (Reference 1-13, p. 20). Accordingly, the fact that the IPEC SAMA analysis does not take into account already-implemented safety and accident mitigation-related enhancements is itself another significant conservatism in the analysis.

Finally, Entergy reiterates that none of the SAMAs identified in the 2009 revised SAMA analysis or the instant RAI response as potentially cost-beneficial are related to adequately managing the effects of aging during the period of extended operation. Therefore, consistent with the Commission's decision in CLI-16-10 (Reference 1-34), none of those SAMAs must be implemented as part of license renewal pursuant to 10 CFR Part 54.[19] Any further consideration of any of the SAMAs identified as potentially cost-beneficial by Entergy and the Staff to date is instead to be accomplished through established Part 50 processes (References 1-10, 1-13, 1-34).

[19] *See* CLI-16-10, slip opinion at 20 ("But no statute or regulation requires the NRC to impose the implementation of a specific SAMA *in this license renewal proceeding*. Nor must the Staff in its NEPA review reach a final determination regarding SAMA implementation.") (emphasis in original).

Attachment 1 References

1-1 USNRC letter, "Request for Additional Information Related to the Indian Point Nuclear Generating Unit Nos. 2 and 3 License Renewal Application Environmental Review – Severe Accident Mitigation Alternatives (CAC Nos. MD5411 and MD5412 (Sept. 12, 2016) (ML16232A119)

1-2 Entergy Letter NL-07-039, "Indian Point Energy Center License Renewal Application" (Apr. 23, 2007) (ML071210507)

1-3 NEI 05-01, Rev. A, Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document (Nov. 2005) (ML060530203)

1-4 NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook" (Jan. 1997) (ML050190193)

1-5 NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Rev. 4 (Sept. 2004) (ML042820192)

1-6 Entergy Letter NL-08-028, "Reply to Request for Additional Information Regarding License Renewal Application – Severe Accident Mitigation Alternatives Analysis" (Feb. 5, 2008) (ML080420264)

1-7 Entergy Letter NL-08-086, "Supplemental Reply to Request for Additional Information Regarding License Renewal Application — Severe Accident Mitigation Alternatives Analysis" (May 22, 2008) (ML081490336)

1-8 Entergy Letter NL-09-165, "License Renewal Application – SAMA Reanalysis Using Alternate Meteorological Tower Data" (Dec. 11, 2009) (ML093580089)

1-9 NL-10-013, Letter from Fred Dacimo, Entergy, to NRC, License Renewal Application – Supplement to SAMA Reanalysis Using Alternate Meteorological Tower Data (Jan. 14, 2010) (ML100260750)

1-10 NUREG-1437, Supp. 38, Vols. 1-3, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3 - Final Report" (Dec. 2010) (https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/supplement38/)

1-11 Entergy Letter NL-13-075, "License Renewal Application – Completed Engineering Project Cost Estimates for SAMAs Previously Identified as Potentially Cost-Beneficial" (May 6, 2013) (ML13142A013)

1-12 Entergy Letter NL-14-143, "Reply to Request for Additional Information Regarding the License Renewal Application" (Nov. 20, 2014) (ML14337A042)

1-13 NUREG-1437, Supp. 38, Vol. 5, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3 – Draft Report for Comment" (Dec. 2015) (ML15351A422)

1-14 *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), LBP-13-13, 78 NRC 246 (2013)

1-15 *Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), CLI-16-07 (May 4, 2016) (slip opinion.) (ML16125A150)

1-16 NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (Dec. 1990) (https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1150/)

1-17 Entergy Engineering Calculation No. IP-CALC-09-00265, "Re-analysis of MACCS2 Models for IPEC," Rev. 0 (Dec. 2009) (ML12339A570)

1-18 NUREG/CR-2239, "Technical Guidance for Siting Criteria Development" (1982) (ML072320420)

1-19 NUREG/CR-7110, Vol. 1, "State-of-the-Art Reactor Consequence Analyses Project Volume 1: Peach Bottom Integrated Analysis" (May 2013) (ML13150A053)

1-20 Entergy Engineering Report No. IP-RPT-09-00044, "Re-analysis of IP2 and IP3 Severe Accident Mitigation Alternatives (SAMAs)," Rev. 0 (Dec. 2009) (ML12339A573)

1-21 Enercon Services, Inc., "Site-Specific MACCS2 Input Data for Indian Point Energy Center," Rev. 1 (Dec. 2009) (ML13073A553 and ML13073A557)

1-22 Entergy Letter NL-16-021, "Comments on Second Draft Supplement to Final Supplemental Environmental Impact Statement for Indian Point License Renewal" (Mar. 4, 2016) (ML16070A053)

1-23 NUREG-1437, Supp. 57, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding LaSalle County Station, Units 1 and 2 – Final Report," App. F (Aug. 2016) (ML16238A029)

1-24 NUREG-1437, Supp. 54, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Byron Station, Units 1 and 2 — Final Report," App. F (July 2015) (ML15196A263)

1-25 NUREG-1437, Supp. 55, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Braidwood Station, Units 1 and 2 – Final Report," App. F (Nov. 2015) (ML15314A814)

1-26 Exelon Generation Letter RS-16-144, "Response to NRC Request for Additional Information on Severe Accident Mitigation Alternatives for LaSalle County Station Units 1 and 2 License Renewal Environmental Review dated July 6, 2016" (July 11, 1016) (ML16193A389)

1-27 DTE Energy Letter NRC-16-0042, "Response to NRC Request for Additional Information for the Environmental Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives Sensitivity Analysis" (July 19, 2017) (ML16201A293)

1-28 STP Nuclear Operating Company Letter NOC-AE-16003404, "Request for Additional Information for the Review of the South Texas Project, Units 1 and 2, License Renewal Severe Accident Mitigation Alternatives (SAMA) (TAC Nos. ME4936 and ME4937)" (Sept. 27, 2016) (ML16278A661)

1-29 NextEra Energy Seabrook, LLC Letter SBK-L-16134, "Response to RAI Related to Severe Accident Mitigation Alternatives NextEra Energy Seabrook License Renewal Application" (Sept. 6, 2016) (ML16252A222)

1-30 Entergy Letter GNRO-2016/00040, "Response to Request for Additional Information (RAI) on Severe Accident Mitigation Alternatives (SAMA) for Grand Gulf Nuclear Station License Renewal Environmental Review" (Sept. 7, 2016) (ML16251A567)

1-31 Entergy Nuclear Operations, Inc., Initial Brief in Response to Commission Questions in CLI-15-2 Concerning Contention NYS-12C (Mar. 30, 2015) (ML15089A544).

1-32 Entergy Letter NL-16-089, "Notification of Full Compliance with Order EA-12-049 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events' and Order EA-12-051 'Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation' (TAC Nos. MF0744 and MF0737)," Indian Point Unit Number 2, Docket No. 50-247, License No. DPR-26 (Aug. 12, 2016) (ML16235A292)

1-33 Entergy Letter NL-15-059, "Notification of Full Compliance with Order EA-12-049 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events' and Order EA-12-051 'Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation' (TAC Nos. MF0745 and MF0738)," Indian Point Unit Number 3, Docket No. 50-286, License No. DPR-64 (May 20, 2015) (ML15149A140)

1-34 *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), CLI-16-10, 83 NRC __ (June 2, 2016) (slip op.) (ML16154A056)