Entergy

Entergy Nuclear Northeast
Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, NY 10511-0249
Tel (914) 254-2055

Anthony J Vitale
Site Vice President

NL-17-039

March 31, 2017

U.S. Nuclear Regulatory Commission
Document Control Desk
11545 Rockville Pike, TWFN-2 F1
Rockville, MD 20852-2738

SUBJECT: Updated 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 Based on a Reduced Renewal Period
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) 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)
2) Entergy Letter NL-17-002, "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" (February 1, 2017) (ML17040A433)
3) Entergy Letter NL-17-019, "Amendment to License Renewal Application—Reflecting Shortened License Renewal Terms for Units 2 and 3" (February 8, 2017) (ML17044A005)
4) 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)

Dear Sir or Madam:

On May 4, 2016, the Commission issued a decision (CLI-16-07) in the Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3) license renewal adjudicatory proceeding, in which it directed the Nuclear Regulatory Commission (NRC) staff to supplement its review of the IP2 and IP3 severe accident mitigation alternatives (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 1), the Staff requested that Entergy

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Nuclear Operations, Inc. (Entergy) provide additional information consistent with the Commission's Order for consideration in the Staff's review.

By letter dated February 1, 2017 (Reference 2), Entergy provided its response to the Staff's request for additional information (RAI). To facilitate the Staff's review, Entergy included with that submission two supporting Engineering Reports, IP-RPT-16-00077, Rev. 0, and IP-RPT-16-00078, Rev. 0, as Enclosures 1 and 2, respectively. Entergy also separately provided the MACCS2 code input and output files to the NRC Project Manager for IP2/IP3 license renewal via electronic mail.

As noted in Entergy's February 1, 2017 response, 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 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. Pursuant to that agreement, Entergy filed, on February 8, 2017, an amendment to the IPEC License Renewal Application (LRA) modifying 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 (Reference 3).

In view of that agreement, Entergy stated its intent to review the sensitivity analysis results included with that submission 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. Entergy stated it would submit the updated sensitivity analysis results to the NRC by March 31, 2017. This letter provides the NRC staff with revised sensitivity analysis results reflecting the reduced operating term. As part of this submission, Entergy is including a copy of IP-RPT-16-00077, Rev. 0, and IP-RPT-16-00078, Rev. 1, as Enclosures 1 and 2, respectively. (Enclosure 1 is unaffected by the reanalysis of a reduced renewal period; Enclosure 2 has been revised accordingly.) The MACCS2 code files Entergy provided with its February 1, 2017 response are unchanged, so no additional files are being provided with this submission.

As described further in the Attachment to this letter and Enclosure 2, based on a shortened renewal period (11 years for IP2 and 10 years for IP3), none of the sensitivity cases prepared in response to the Staff's RAIs resulted in any new potentially cost-beneficial SAMAs as compared to the SAMA analysis documented in the Staff's December 2015 Draft Supplement 2 to the Final Supplemental Environmental Impact Statement (FSEIS) (Reference 4).

There are no new commitments being made in this submittal.

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 March 31, 2017.

Sincerely,

AJV/rl

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

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. 1 (March 23, 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-17-039

UPDATED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION ON SEVERE ACCIDENT MITIGATION ALTERNATIVES ANALYSIS BASED ON A REDUCED RENEWAL PERIOD 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

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

Section 1.0 in Attachment 1 to Entergy's February 1, 2017 RAI response included 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). For efficiency, that information is not repeated here, but is incorporated by reference. Section 2.0 of this Attachment 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

Section 1.0 in Attachment 1 to Entergy's February 1, 2017 RAI response (Reference 2) is incorporated herein by reference.

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

On September 12, 2016, 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 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 1-2), the MACCS2 model analysis calculation underlying Entergy's 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). IP-RPT-16-00077 is unaffected by the updated SAMA analyses to reflect the reduced renewal period.

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 1-2) 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 1-3), and which parallels sensitivity cases recently performed by other license renewal applicants (References 1-4, 1-5). 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 1-3) 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 1-7). 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 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. 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. 1 (March 23, 2017) (Enclosure 2) and the various electronic files (spreadsheets) referenced therein. Section 6.0 was added in IP-RPT-16-00078, Rev. 1, to describe the changes necessary for the SAMA cost-benefit sensitivities to reflect the revised license renewal period (11 years for IP2 and 10 years for IP3). A summary of results of the revised analysis are provided in Section 7.0, including updated SAMA Sensitivity Case Results presented in revised Tables 10-14.

As described in revised Section 6.0, the license renewal period impacts the SAMA analysis in two ways. First, it defines the year to which the population projections for the 50-mile region around the plant are extrapolated. Second, it is used in the calculations of onsite and offsite exposure costs and economic costs following a severe accident to take into account the time value of money. For the Indian Point SAMA analyses, the population in the 50-mile region was projected to the year 2035 to encompass the license renewal period for both units. With a shorter license renewal period (ending in 2024 for IP2 and 2025 for IP3), the population in the region would generally be expected to be lower. However, the many MACCS2 cost input values are based on present dollars not future dollars, so they are not impacted by the duration of the license renewal period. Since the only change to the MACCS2 analyses would be the population, and re-projecting the population is a time consuming task, Entergy has conservatively retained the 2035 population in Revision 1 of IP-RPT-16-00078 (Enclosure 2). Therefore, the results of the MACCS2 sensitivity cases described in Section 5.1 of Enclosure 2 and presented in Tables 2 through 9 remain unchanged from Revision 0. Also, the escalated VALWNF described in Section 2.0 of Enclosure 2 and the VNFRM values in Table 1 remain unchanged from Revision 0.

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 1-6) 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.
  - 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 1-3) 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 1-7).
    - 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. Entergy 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 1-8.

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 1-9, 1-10, 1-11, and 1-12.

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 of IP-RPT-16-00078, Rev. 1 (Enclosure 2).

Entergy re-ran the baseline analyses using the VALWNF and VNFRM values escalated to 2005 dollar values. Table 2 and Table 3 of IP-RPT-16-00078, Rev. 1 (Enclosure 2) 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 1-11, 1-6) shows a modest OECR increase of approximately 9-10% and no appreciable change in the PDR.

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.[1] As noted above, Section 6.0 was added in Revision 1 of IP-RPT-16-00078 to describe the changes necessary for the SAMA cost-benefit sensitivities to reflect the revised license renewal period (11 years for IP2 and 10 years for IP3). Results of the revised analysis are provided in Section 7.0 of IP-RPT-16-00078 and show the following:

- With an 11 year license renewal period for IP2 and a 10 year license renewal period for IP3, revised Sensitivity Case 0, Shortened License Renewal Period Baseline, has two less potentially cost-beneficial SAMAs (IP2-028, *"Provide a portable diesel-driven battery charger,"* and IP2-062, *"Provide a hard-wired connection to an SI pump from ASSS power supply,"* are not potentially cost-beneficial). *See* Enclosure 2,Table 10.

- Revised Sensitivity Case 7, Shortened License Renewal Period and Revised TIMDEC and CDNFRM (Escalated VALWNF and VNFRM and Revised VDEPOS), shows that one SAMA, IP2-044, *"Use fire water system as backup for steam generator inventory,"* that was potentially cost-beneficial in revised Sensitivity Case 0 is not potentially cost beneficial. *See* Enclosure 2, Table 13.

- None of the remaining sensitivity cases (Cases 4, 5 and 8) adds any potentially cost-beneficial SAMAs. *See* Enclosure 2, Tables 11, 12, and 14.

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 of IP-RPT-16-00078, Rev. 1 (Enclosure 2) show the PDR and OECR results when the TIMDEC and CDNFRM values are increased to the maximum MACCS2

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[1] 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.

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 shows that the OECR increases approximately 126-133%. The PDR increase, approximately 11-12%, is much smaller.

As requested by the staff in RAI 2.a, Entergy evaluated the impact on the cost-benefit analysis results from 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). As noted above, Section 6.0 was added in Revision 1 of IP-RPT-16-00078 to describe the changes necessary for the SAMA cost-benefit sensitivities to reflect the revised license renewal period (11 years for IP2 and 10 years for IP3). Results of the revised analysis are provided in Section 7.0 of IP-RPT-16-00078 and show the following:

- With an 11 year license renewal period for IP2 and a 10 year license renewal period for IP3, revised Sensitivity Case 0, Shortened License Renewal Period Baseline, has two less potentially cost-beneficial SAMAs (IP2-028, *"Provide a portable diesel-driven battery charger,"* and IP2-062, *"Provide a hard-wired connection to an SI pump from ASSS power supply,"* are not potentially cost-beneficial). *See* Enclosure 2, Table 10.

- Revised Sensitivity Case 7, Shortened License Renewal Period and Revised TIMDEC and CDNFRM (Escalated VALWNF and VNFRM and Revised VDEPOS), shows that one SAMA, IP2-044, *"Use fire water system as backup for steam generator inventory,"* that was potentially cost-beneficial in revised Sensitivity Case 0 is not potentially cost beneficial. *See* Enclosure 2, Table 13.

- None of the remaining sensitivity cases (Cases 4, 5 and 8) adds any potentially cost-beneficial SAMAs. *See* Enclosure 2, Tables 11, 12, and 14.

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.[2] As CLI-16-07 makes clear, the purpose of the additional sensitivity analyses directed by the Commission is to better understand how material uncertainties in the values of two specific MACCS2 parameter inputs – CDNFRM and TIMDEC – are to the SAMA analysis conclusions (Reference 1-13). 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 1-14 to 1-18) and accepted by the Staff in the FSEIS for LaSalle Units 1 and 2 license renewal (Reference 1-19).[3]

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[2] *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 1-19) (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).

[3] *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

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. 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 State-of-the-Art Reactor Consequence Analyses (SOARCA) project and VDEPOS sensitivity analyses performed for other plants seeking renewed licenses, as documented in the Staff's FSEISs for those plants.[4]

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 1-2). 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):

> 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 through NUREG-1150 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 1-3 (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 of IP-RPT-16-00078, Rev. 1 (Enclosure 2) show the

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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.").

4 *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 1-4); 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 1-5).

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 1-11, 1-6) 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).

As noted above, Section 6.0 was added in Revision 1 of IP-RPT-16-00078 to describe the changes necessary for the SAMA cost-benefit sensitivities to reflect the revised license renewal period (11 years for IP2 and 10 years for IP3). Results of the revised analysis are provided in Section 7.0 of IP-RPT-16-00078 and show the following:

- With an 11 year license renewal period for IP2 and a 10 year license renewal period for IP3, revised Sensitivity Case 0, Shortened License Renewal Period Baseline, has two less potentially cost-beneficial SAMAs (IP2-028, *"Provide a portable diesel-driven battery charger,"* and IP2-062, *"Provide a hard-wired connection to an SI pump from ASSS power supply,"* are not potentially cost-beneficial). *See* Enclosure 2, Table 10.

- Revised Sensitivity Case 7, Shortened License Renewal Period and Revised TIMDEC and CDNFRM (Escalated VALWNF and VNFRM and Revised VDEPOS), shows that one SAMA, IP2-044, *"Use fire water system as backup for steam generator inventory,"* that was potentially cost-beneficial in revised Sensitivity Case 0 is not potentially cost beneficial. *See* Enclosure 2, Table 13.

- None of the remaining sensitivity cases (Cases 4, 5 and 8) adds any potentially cost-beneficial SAMAs. *See* Enclosure 2, Tables 11, 12, and 14.

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 of IP-RPT-16-00078, Rev. 1 (Enclosure 2) 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%.

As noted above, Section 6.0 was added in Revision 1 of IP-RPT-16-00078 to describe the changes necessary for the SAMA cost-benefit sensitivities to reflect the revised license renewal period (11 years for IP2 and 10 years for IP3). Results of the revised analysis are provided in Section 7.0 and show the following:

- With an 11 year license renewal period for IP2 and a 10 year license renewal period for IP3, revised Sensitivity Case 0, Shortened License Renewal Period Baseline, has two less potentially cost-beneficial SAMAs (IP2-028, *"Provide a portable diesel-driven battery*

charger," and IP2-062, *"Provide a hard-wired connection to an SI pump from ASSS power supply,"* are not potentially cost-beneficial). *See* Enclosure 2, Table 10.

- Revised Sensitivity Case 7, Shortened License Renewal Period and Revised TIMDEC and CDNFRM (Escalated VALWNF and VNFRM and Revised VDEPOS), shows that one SAMA, IP2-044, *"Use fire water system as backup for steam generator inventory,"* that was potentially cost-beneficial in revised Sensitivity Case 0 is not potentially cost beneficial. *See* Enclosure 2, Table 13.

- None of the remaining sensitivity cases (Cases 4, 5 and 8) adds any potentially cost-beneficial SAMAs. *See* Enclosure 2, Tables 11, 12, and 14.

3.3.4 Response to RAI 3

The input and output files for the IP2 and IP3 MACCS2 code sensitivity cases previously provided to the Staff and discussed herein are unchanged. The tables referenced 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 summarized above, based on a shortened renewal period (11 years for IP2 and 10 years for IP3), none of the sensitivity cases prepared in response to the Staff's RAIs resulted in any new potentially cost-beneficial SAMAs as compared to the SAMA analysis documented in the Staff's December 2015 Draft Supplement 2 to the Final Supplemental Environmental Impact Statement (FSEIS) (Reference 1-20). In fact, Sensitivity Case 0, Shortened License Renewal Period Baseline, identified that two SAMAs (IP2-028 and IP2-062) that were potentially cost-beneficial with a 20 year license renewal period are no longer cost beneficial with the shortened renewal term. In addition, Sensitivity Case 7, Shortened License Renewal Period Alternate Revised Baseline (Escalated VALWNF and VNFRM and revised VDEPOS) identified one SAMA (IP2-044) that is no longer cost beneficial with the shortened renewal term.

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 1-21, pp. 33-37). 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 1-11, 1-12).[5] It also has implemented numerous safety and accident mitigation improvements required by the NRC's post-Fukushima Order EA-12-049 (References 1-22, 1-23). This fact is important because as the Commission explained in Order CLI-16-10 (Reference 1-24), 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 will change, affecting its baseline risk profile (*e.g.*, CDF), in turn

[5] 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).

potentially rendering other mitigation measures less cost-beneficial or even no longer cost-beneficial.[6] Similarly, when two or more potentially cost-beneficial SAMAs act on the same risk contributor (*e.g.*, internal flooding, station blackout, or loss 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 1-20, 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 in this 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 1-24), none of those SAMAs must be implemented as part of license renewal pursuant to 10 CFR Part 54.[7] 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 1-12, 1-20, 1-24).

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6 *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 1-24).

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

1-3 NUREG/CR-7110, Vol. 1, "State-of-the-Art Reactor Consequence Analyses Project Volume 1: Peach Bottom Integrated Analysis" (May 2013) (ML13150A053)

1-4 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)

1-5 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)

1-6 Entergy Engineering Report No. IP-RPT-09-00044, "Re-analysis of IP2 and IP3 Severe Accident Mitigation Alternatives (SAMAs)," Rev. 0 (Dec. 2009) (ML12339A573)

1-7 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/)

1-8 Enercon Services, Inc., "Site-Specific MACCS2 Input Data for Indian Point Energy Center," Rev. 1 (Dec. 2009) (ML13073A553 and ML13073A557)

1-9 Entergy Letter NL-08-028, "Reply to Request for Additional Information Regarding License Renewal Application — Severe Accident Mitigation Alternatives Analysis" (February 5, 2008) (ML080420264)

1-10 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)

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

1-12 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/)

1-13 Entergy Nuclear Operations, Inc. (Indian Point, Units 2 and 3), CLI-16-07, 83 NRC (May 4, 2016) (slip op.) (ML16125A150)

1-14 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, 2016) (ML16193A389)

1-15 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)

1-16 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)

1-17 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)

1-18 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)

1-19 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)

1-20 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)

1-21 Entergy Nuclear Operations, Inc. (Indian Point, Units 2 and 3), Initial Brief in Response to Commission Questions in CLI-15-2 Concerning Contention NYS-12C (Mar. 30, 2015) (ML15089A544).

1-22 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)

1-23 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)

1-24 *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), CLI-16-10, 83 NRC __ (June 2, 2016) (slip op.) (ML16154A056)