UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 6, 2014

Mr. Michael Gallagher
Vice President, License Renewal Projects
Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348

SUBJECT: REQUESTS FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE BYRON AND BRAIDWOOD NUCLEAR STATIONS LICENSE RENEWAL APPLICATION – SEVERE ACCIDENT MITIGATION ALTERNATIVES REVIEW (TAC NOS. MF1790, MF1791, MF1792, AND MF1793)

Dear Mr. Gallagher:

By letter, dated May 29, 2013, Exelon Generation Company, LLC (Exelon), submitted an application pursuant to Title 10 of the *Code of Federal Regulations* (CFR) Part 54, to renew the operating licenses for Byron Nuclear Station (Byron) and Braidwood Nuclear Station (Braidwood), for review by the U.S. Nuclear Regulatory Commission staff. The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review.

These requests for additional information were discussed with Mr. Christopher Wilson of your staff and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact either myself, the Environmental Project Manager for Byron, by telephone at 301-415-3306 or by e-mail at Lois.James@nrc.gov; or Tam Tran, the Environmental Project Manager for Braidwood, by telephone at 301-415-3617 or by e-mail at Tam.Tran@nrc.gov.

Sincerely,

Lois James, Environmental Project Manager
Projects Branch 2
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-454, 50-455; 50-456, and 50-457

Enclosure:
Requests for Additional Information

cc w/encl: Listserv

January 6, 2014

Mr. Michael Gallagher
Vice President, License Renewal Projects
Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348

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Sincerely,
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Lois James, Environmental Project Manager
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NAME	IKing	TTran	LJames	BWittick	LJames
DATE	12/18/13	12/23/13	12/24/13	12/26/13	1/6/14

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Letter to M. Gallagher from L. James dated January 6, 2014

SUBJECT: REQUESTS FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE BYRON AND BRAIDWOOD NUCLEAR STATIONS LICENSE RENEWAL APPLICATION – SEVERE ACCIDENT MITIGATION ALTERNATIVES REVIEW (TAC NOS. MF1790, MF1791, MF1792, AND MF1793)

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lois.james@nrc.gov
john.daily@nrc.gov
lindsay.robinson@nrc.gov
tam.tran@nrc.gov
david.wrona@nrc.gov
brian.wittick@nrc.gov
mitzi.young@nrc.gov
anita.ghosh@nrc.gov
christina.england@nrc.gov
eric.duncan@nrc.gov
scott.burnell@nrc.gov
david.mcintyre@nrc.gov
ivonne.couret@nrc.gov
viktoria.mitlyng@nrc.gov
prema.chandrathil@nrc.gov
allan.barker@nrc.gov
harral.logaras@nrc.gov
john.robbins@nrc.gov
james.mcghee@nrc.gov
raymond.ng@nrc.gov
brent.boston@nrc.gov
joel.wiebe@nrc.gov
michael.mahoney@nrc.gov
Nancy.ranek@exeloncorp.com
Robert.tarr@exeloncorp.com
Christopher.Wilson2@exeloncorp.com
ogle@gouker.net
dwestin@rmu.net
charlesmedrano@gmail.com
prairiestatestrategies@gmail.com
Jarid.Funderburg@mail.house.gov
edstirling@jvlnet.com
rcolson@oglecounty.org
allenchristianson13@gmail.com
todd@byronforestpreserve.com
mharn@oglecounty.org
sara.faller@exeloncorp.com
twolf@ilchamber.org
byrontownship@yahoo.com
cmillard@es-il.org

BYRON NUCLEAR STATION, UNITS 1 AND 2
BRAIDWOOD NUCLEAR STATION, UNITS 1 AND 2
LICENSE RENEWAL APPLICATION
SEVERAL ACCIDENT MITIGATION ALTERNATIVES
REQUESTS FOR ADDITIONAL INFORMATION

Requests for Additional Information (RAI):

All questions apply to both Byron Nuclear Station (Byron/BY) and Braidwood Nuclear Station (Braidwood/BW) unless otherwise indicated.

1. Provide the following information regarding the probabilistic risk assessment (PRA) used for the severe accidents mitigation alternatives (SAMA) analysis. The basis for this request is as follows: Applicants for license renewal are required by Title 10 of the *Code of Federal Regulations* (10 CFR) 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff evaluates the applicant's treatment of internal events and calculation of core damage frequency (CDF) in the Level 1 PRA model. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's Level 1 PRA model for supporting the SAMA evaluations.

    a. In Table F.2-1, the comment for PRA Revision 5A states "Revised the model and data to address the PRA quality issues raised by CR#00142080 (1/30/03) against Rev. 5 model." Describe these quality and related process issues and associated corrective actions.

    b. As indicated in Table F.2-1, the CDF goes from 2.2E-5 ***{2.3E-05}*** to 1.7E-5 ***{1.6E-5}*** in going from Revision 6D to Revision 6E. The associated model changes are the inclusion of credit for the auxiliary feedwater (AFW) unit crosstie and the implementation of human error probability (HEP) changes. This corresponds to a 23 to 30 percent reduction in CDF due to the two changes in the model. The AFW unit crosstie is SAMA 15, which is indicated in Section F.6.12 to only reduce CDF by 2 to 2.5%. Discuss the relative impact of the two model changes made in Revision 6D and, unless the HEP changes are the significantly larger contributor, why the apparent benefit of the AFW unit crosstie is greater than that shown by the evaluation of SAMA 15. ***{BW values}***

    c. Section F.2.4 states that the 27 Level A and B facts and observations (F&Os) identified during the 1999 Westinghouse Owner's Group (WOG) peer review have been "closed out." Describe what is meant by "closed out," how this was verified, and if these F&Os were considered in the 2012 self-assessment and the corrections incorporated in the PRA that was used for the SAMA analysis.

    d. Section F.2.4 identifies a 2012 self-assessment. Clarify if this self-assessment was performed following the self-assessment process guidance in Regulatory Guide (RG) 1.200, Rev. 2, and Nuclear Energy Institute (NEI) 00-02, Rev. 1. If not, discuss the purpose, objectives, and procedures of the 2012 self-assessment.

e. Describe any actual or planned potentially significant changes to hardware or operation (including changes in fuel cycle or fuel management), that have not been incorporated in the SAMA PRA.

f. Identify the systems that are shared or that can be cross-tied between units and describe the modeling, including the treatment of unavailability, during outages of the other unit.

g. The anticipated transient without scram (ATWS) CDF is given in Figures F.2-1 and F.2-2 as less than a value that is equal to 1% of the unit total CDF. Confirm that the Byron and Braidwood PRAs model ATWS, that actual values are available and that the identification of SAMA includes consideration of the ATWS. If not, please justify the approach taken. Provide the actual ATWS CDF.

h. From the description of important initiators on page F-5, it is apparent that loss of essential service water (SX) can be mitigated by recovery of main feedwater. Discuss these scenarios.

i. Describe the loss of auxiliary electric power initiating event, how it is modeled, and how it is related to a loss of offsite power (LOOP). Please provide the CDF contribution due to a LOOP as well as the LOOP initiating event frequencies.

j. The Unit 2 CDF and percent contribution values given in Byron Figure F.2-2 are internally inconsistent. Provide a correct Figure F.2-2. ***{BY only}***

k. There is a significant difference between some of the PRA results between the Byron and Braidwood sites. For example, the contributions to total CDF due to loss of SX, loss of component cooling water and small loss of coolant accident as provided in Figures F.2-1 and F.2-2 of the respective environmental reports (ERs). See also the differences in accident sequence frequencies SLOC-02 (Braidwood higher than Byron) and SLOC-06 (Byron higher than Braidwood) as shown in Table F.2-2 of the respective ERs. Explain and provide more information on the reasons for these differences. In addition, assess if the reasons for these differences suggest design or operating changes that might be cost beneficial SAMAs for one site or the other.

2. Provide the following information regarding the Level 2 analysis used for the SAMA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff evaluates the applicant's treatment of accident progression and radionuclide release analysis in the Level 2 PRA model. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's Level 2 PRA model for supporting the SAMA evaluations.

   a. Provide a brief description of any reviews (e.g., in-house review, self-assessment, peer review, etc.) of the updated Level 2 model included in

Rev. BB011b1 of the PRA model and/or any reviews of WCAP-16341-P, "Simplified Level 2 Modeling Guidelines." Discuss the major reasons for the factor of 2-3 decrease in large early release frequency (LERF) shown in Table F.2-1 from implementing this updated methodology.

b. It is stated that, "The Level 2 model is generally consistent with the 'Simplified Level 2 Modeling Guidelines,' WCAP-16341-P." Describe any major areas where it is not consistent with these guidelines and the rationale and/or basis for these deviations.

c. From the containment event tree (CET) in Figure F.2-4, the containment isolation failures lead to Sequence LERF09 which is release category LERF-CI. Table F.3-8 indicates that this has a cesium iodide (CsI) release fraction of 0.0142. This analysis must assume that isolation failure is large enough so that early containment failures due to such things as hydrogen explosion and direct containment heating are prevented. If not, it would appear that the CsI release fraction for release category LERF-CFE of 0.3 is more appropriate for the fraction of isolation failures that might have an early containment failure. Discuss the impact of this on the SAMA analysis.

d. Table F.2-8 indicates about a 20% difference between Units 1 and 2 for release category LATE-CHR-NOAFW frequency. Describe the reason for this difference. ***{BY only}***

e. Section F.2.3.2 indicates that containment failure due to direct containment heating is "0.000". Clarify if this is a zero failure probability, and how this and other early containment failure probabilities are included in the Level 2 models.

f. Table F.2-7provides the modular accident analysis program (MAAP) results for several cases for 200, 800 and 1600 hour runs. Section F.3.5 and Table F.3-8 identify that the "MAAP cases were run to achieve a plateau of the release fractions, with primary attention paid to CsI and [cesium hydroxide] CsOH release fractions." Provide additional discussions concerning the CsI and CsOH release fraction contribution occurring for Cases 4a, 5a, 6a, 9a, 10a and 12b (e.g. what were the relative increase in fractions for extending the MAAP cases to such long time frames; what was the fundamental cause of the continuing release, etc.)

3. Provide the following information regarding the treatment and inclusion of external events in the SAMA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff evaluates the applicant's treatment of external events in the PRA model and the SAMA analysis. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's PRA model for supporting the SAMA evaluations.

a. Provide more information on the 2009 Byron ***{2008 Braidwood}*** fire PRA including: scope, status of development, major conservatisms and non-conservatisms, quality assurance activities, and reviews. Discuss qualitatively the impact on the SAMA results of the conservatisms and non-conservatisms.

b. It is noted that the sum of the fire zone CDFs given in Section F.5.1.6.1 for Unit 2, is considerably higher than that for Unit 1 (7.03E-05 versus 4.38E-05). Provide justification to support the use of the Unit 1 fire CDF value in the external event multiplier. ***{BY only}***

c. The results from the 2008 Braidwood fire PRA were reduced by a factor of 1.262 to account for using the lower ignition frequencies from EPRI 1016735. A comparison of the important fire zones between Braidwood and Byron indicates that there are considerable differences between the results for the two sites and, therefore, it does not support the validity of using the Byron reduction factor for Braidwood. Provide further justification for the use of the Byron factor or assess the impact on the SAMA results if this factor is not used ***{BW only}***.

d. A seismic CDF (SCDF) of 1E-06 per year was used for determining the external events multiplier. Assess the impact on the SAMA analysis if the Generic Issue 199 weakest link SCDF values based on the 2008 United States Geology Survey (USGS) seismic hazard curves of 5.8E-06 per year for Byron and 7.3E-06 for Braidwood are used or provide technical support for use of other assessments of the Byron/Braidwood SCDFs.

4. Please provide the following information regarding the Level 3 PRA used in the SAMA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff evaluates the applicant's analysis of accident consequences in the Level 3 PRA. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's Level 3 PRA model for supporting the SAMA evaluations.

   a. Section F.3.7 discusses the meteorological data used in the SAMA analysis. Clarify whether all of the data is from onsite meteorological stations, or whether a local weather station was also used. If data from a local weather station was used, identify the local station and its location.

   b. Section F.3.2 identifies that transient and special facility population data were included within the 10-mile radius. Provide the year 2000 transient and special facility population used in the SAMA analysis.

   c. Tables F.3-2 and 3-3 provide the year 2046 population distribution used in the MELCOR Accident Consequence Code System, Version 2 (MACCS2) analysis. Since the SECPOP2000 code was utilized to develop initial residential population estimates for each spatial element within the 50 mile region based on year 2000 census data, provide the SECPOP year 2000 population distribution.

d. For Byron, Section F.3.2 identifies the year 2046 population as 1,734,765, and Section 2.6.1 identifies a population base of 1,247,087. For Braidwood, Section F.3.2 identifies the year 2047 population as 7,554,998, and Section 2.6.1 identifies a population base of 4,968,734. Clarify if Section 2.6.1 is the year 2010 or 2000 population base.

e. Section F.3.2 identifies that the year 2010 population data was not incorporated. Briefly address how the 2010 population (from Section 2.6.1) compares to an estimated year 2010 population assuming the growth rates from Table F.3-1 for both Byron and Braidwood.

f. Section F.3.3 identifies that SECPOP economic data was not utilized due to known errors. Clarify if this included the formatting error associated with population data. If not, provide an assessment of the impact on the SAMA analysis of using corrected population data.

g. Section F.3.6 of the ERs note the longest evacuation times presented in the study. Clarify if these were for a specific event evacuation or used for all event evacuations.

h. Provide the values and associated assumptions made regarding the following MACCS2 input parameters: rainfall, mixing heights, building wake effects, plume release energy, land fraction, region index, watershed index, growing season, fraction of farmland, and shielding and protection factors.

i. Section F.3.4 discusses ingestion dose. Identify the critical input parameters used to produce these results.

j. MAAP Users Group News Bulletin, "MAAP-FLASH #68" (August 5, 2008), recommended that users of MAAP versions 4.0.5 through 4.0.7 (MAAP software version 4.0.6 was used in the SAMA analysis) include plant-specific values for the mass of the relevant fission product elements instead of the isotopic activity of those elements. Clarify whether plant specific fission product mass or isotopic activity were used in the MAAP 4.0.6 analyses. If the isotopic inventory was used, assess the impact on the SAMA analysis if the mass inventory is used.

k. For Braidwood Section F.7.4, the base maximum averted cost-risk (MACR) and decrease in MACR for including SAMA 15 in the base case do not match Section F.6.14 ($64.7M and $63.0M versus $46.4M and $45.2M). Please clarify. ***{BW only}***

l. For both Byron and Braidwood, provide a discussion of the major contributors/factors that contribute to the magnitude of the Byron and Braidwood MACR and provide a qualitative assessment of the relative effect and the realism or conservatism of these factors.

5. Provide the following information regarding the identification and screening of Phase I SAMA candidates. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood

SAMA analyses, NRC staff evaluates the applicant's identification and screening of Phase I candidate SAMAs. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's identification and screening of Phase I SAMAs in the overall SAMA evaluations.

a. Section F.5.1.1 indicates that the external events multiplier was not used in determining the risk reduction worth (RRW) corresponding to the least cost SAMAs used in identifying potential SAMAs from the Units PRA importance. The reasons given are that 1) the fire results were reviewed separately for the purposes of SAMA identification, and 2) the fire model is in an interim state. Provide further justification for not extending the review down to a RRW value which would encompass failures whose mitigation would have a benefit of $100,000 as determined in the Braidwood Phase II cost-benefit analysis. ***{BW only}***

b. Section F.5.1 indicates that Phase I SAMAs were based on Byron/Braidwood PRA results and PRA Group Insights. Explain what is meant by PRA group insights. Discuss if this was a separate task or if PRA group insights were used to develop SAMAs for the importance of other reviews.

c. Describe the steps taken to identify SAMAs involving improvements in procedures, training or available cues for the important human errors.

d. In Table F.5-1 (p. F-208) for basic event 0VA1SUPP----PNMM "UNIT 1 VA SUPPLY PLENUM MAINTENANCE," the only SAMA identified is SAMA 4, Installation of the "no-leak" [reactor coolant pump] RCP seals. Consider other potentially lower cost alternatives such as providing portable ventilation during maintenance activities. ***{BY only}***

e. In Table F.5-1 (p. F-222) basic events 1AP-142-1---TRMM and 1AP-142-2---TRMM appear to result in the unavailability of the same equipment, the startup feedwater pump and the same 2 of 4 condensate pumps. This implies that both system auxiliary transformers (SATs) are needed. Provide additional information to explain this situation. In addition, since these are maintenance unavailabilities, explain if it is possible to use a temporary alignment while this maintenance is underway. ***{BY only}***

f. Discuss the effectiveness of SAMA 15 (inter unit AFW cross-tie) if both units are tripped.

g. Seven potentially cost-beneficial SAMAs in the Indian Point Generating Station (Indian Point) Unit 2 SAMA analysis were discussed in ER Section F.5.1.3.6. The NUREG-1437, Supplement 38, identifies a total of 13 potentially cost-beneficial SAMAs. Address the applicability of these additional SAMAs to Byron/Braidwood.

h. According to the NRC safety evaluation report (SER) on the Byron and Braidwood individual plant examination (IPE) reports, the transmittal of the

modified IPE reports indicated that a potential vulnerability involving a dual loss of SX due to internal flooding had been identified and that a modification was being considered. Confirm the implementation of this modification.

i. From the discussion in Braidwood Section F.5.1.6.1, it is not clear how the fire zone CDF results from the 2008 Braidwood fire PRA were modified to account for using the lower ignition frequencies from EPRI 1016735. Discuss how this was done. Provide further justification for this use of the Byron results or assess the impact on the identification and evaluation of fire specific SAMAs if the 2008 Braidwood fire PRA results are not modified or if a different approach to the modification is taken ***{BW only}***.

j. Important fire zones at Braidwood were reviewed for potential SAMAs down to a zone CDF of 1E-06 per year. This corresponds to a benefit of $474K. Provide assurance that use of this lower end cutoff does not result in missing some potentially cost effective SAMAs. ***{BW only}***

k. In Section F.5.1.6.1 the "major" scenarios contributing to the fire zone risk are identified. Discuss what is meant by major.

l. The Unit 2 fire zone results given in Section F.5.1.6.1 include a fire in Unit 1 Containment. It is stated that the fire induced failures are Unit 1 equipment and the fire is modeled as requiring a Unit 2 shutdown without the availability of untraced equipment, such as the main feedwater system. Discuss whether or not the same modeling logic is applicable to Unit 1 for a fire in Unit 2 containment. In addition, please discuss if this modeling logic is applicable to fires in other areas. ***{BW only}***

m. Fire zone U2: 11.6-2 is the largest contributor to Unit 2 fire CDF and is analyzed using a bounding scenario. Discuss whether or not insights from the analysis of the same or similar fire zone in Unit 1 can be used to identify potential fire specific SAMAs. ***{BY only}***

n. The discussions of fire zones U2: 5.2-2 and U2: 5.1-2 (and others) in Section F.5.1.6.1 state:

   "One of the larger contributors to the conditional core damage probability for the scenario is the operator failure to refill the [diesel generator] DG B fuel oil tank. Automating the refill capability would help reduce the risk from these fires (SAMA 18)."

   SAMA 18 is described as automating the refill of the diesel driven AFW pump fuel oil day tank, not the DG B fuel oil tank. Clarify.

o. Describe the extent to which new or improved Byron/Braidwood fire procedures to mitigate the important fires have been considered in the SAMA analysis.

p. Fire zone U1: 11.6c-0 is the auxiliary building laundry room with the fire source described as totally being composed of transient initiators. If these are due to the laundry room operation, consider a SAMA involving moving the laundry to another facility.

q. For the discussion of seismic outliers in Section F.5.1.6.2, provide further information on the disposition of the following: ***{BY only}***

   i. For the Equipment Identification (ID) group 1AP10E, 2AP06E, etc., discuss how the seismic interaction issues were addressed.

   ii. For the Equipment ID group 1(2)DC03E, 1(2)DC05E, etc., discuss whether or not the proceduralized operator actions were implemented. Also, for these and for Equipment ID 1RD05E and 2RD05E, please discuss if relay chatter is the only adverse consequence of cabinet interactions.

   iii. Equipment ID 1DC04E and 1DC06E of IPEEE Table 3.3 do not appear to be thoroughly addressed in Section F.5.1.6.2. Unit 2 items are addressed, however Unit 1 items are not. Please include a similar discussion for Unit 1 items.

r. Section F.5.1.3.1 identifies two additional Vogtle Electric Generating Plant (Vogtle) SAMAs (6,16) that were found not cost beneficial (to Vogtle). However, the costs of implementation were moderate to low (816K and 25K, respectively), as documented in the Vogtle ER, 2007 and RAI responses dated December 20, 2007, Agencywide Documents Access and Management System (ADAMS) Accession No. ML073580627. The base case cost-risk for Byron is approximately five times greater than Vogtle, and the dose risk more than ten times greater. Clarify whether these SAMAs would be applicable or potentially cost beneficial to Byron or Braidwood.

s. SAMA 24 provides a reactor vessel cooling system to prevent vessel melt through. Based on the Byron IPE (ComEd 1994), plant procedures were implemented to direct reactor cavity flooding in core damage scenarios to provide a means of exterior vessel cooling (Section F.5.1.4). Clarify why vessel cooling requires an additional cooling system to perform this function.

6. Provide the following information regarding the Phase II cost-benefit evaluations. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff evaluates the applicant's cost-benefit analysis of the Phase II SAMAs. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's cost estimates for individual SAMAs and the cost-benefit evaluations.

a. Section F.6 provides only a brief description of the cost estimating process for determining the implementation cost for the various SAMAs. Provide a more detailed description of the cost estimating process including: whom or what organization performed the estimate, what is included or not included in the costs (for example: lifetime training and/or maintenance costs, inflation) and the treatment of cost savings due to the sharing of certain costs between units at the same site (or potentially between sites). If such cost sharing is not considered provide justification for this or describe the impact such cost sharing would have on the results of the SAMA analysis.

b. Provide further support for the $100,000 per unit value used for the cost of a procedure change and its applicability to Byron/Braidwood.

c. The cost estimate of $46M for SAMA 1(to install a diesel driven SX pump in a new dedicated building) is based on the inflation adjusted cost of a new suppression pool cooling system evaluated in the Limerick Generating Station (Limerick) severe accident mitigation design alternative assessment. While the reference to Limerick's cost estimate is justified as being similar in scope, the NRC staff notes that a suppression pool cooling system will include a large heat exchanger that is expected to significantly contribute to the cost. Also, it is not clear if the Limerick addition for a dedicated suppression pool cooling system was for a safety related system. Provide further support for the SAMA cost estimate and the impact of using non-safety grade equipment.

d. The SAMA 12 cost estimate is based on an estimate that moving the SAT maintenance from on-line to an outage would require an additional one week added to each outage. Provide additional details why an outage must be extended versus being able to perform the maintenance in parallel with other outage work. Provide a similar discussion for the SAMA 20 cost estimate.

e. The CDF uncertainty multiplier is based on the BB011a CDF. However, the point estimate CDF and summary table CDFs in Section F.7.2 do not match the CDF in Table F.2-1. Please explain this apparent discrepancy. ***{BY only}***

f. Section F.7.2 gives for the BY BB011a model a mean CDF of 3.95E-05 and a point estimate of 4.26E-05 (which should be 4.17E-05) and for the Braidwood BB011a model a mean CDF of 4.12E-05 and a point estimate of 4.26E-05. Usually the mean is greater than the point estimate due to the correlation of uncertainties. Please explain these results and assess the impact on the SAMA analysis.

g. SAMA 14, Section F.6.11 for Byron and F.6.13 for Braidwood, identifies that for steam generator tube rupture (SGTR) scenarios, installing an automated refueling water storage tank makeup system could provide 'indefinite' cooling, but for non-SGTR scenarios this action "would extend the time available for transition to recirculation mode." However, it is also stated that "it is assumed that the actions to control injection and perform a cooldown will eventually have to be

taken to reach a successful endstate." Clarify whether this applies to both SGTR and non-SGTR scenarios.

h. In Section F.7.3, the MACCS2 sensitivity case for economic rate of return shows a change in dose consequence. This variable is effectively an interest rate. Clarify why there is an impact on dose consequence in the table of sensitivity results presented in Section F.7.3.

7. For certain SAMAs considered in the Byron/Braidwood ER, there may be lower-cost or more effective alternatives that could achieve much of the risk reduction. In this regard, provide an evaluation of the following SAMAs. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the Byron/Braidwood SAMA analyses, NRC staff considers additional SAMAs that may be more effective or have lower implementation costs than the other SAMAs evaluated by the applicant. The requested information is needed in order for the NRC staff to reach a conclusion on the adequacy of the applicant's determination of cost-beneficial SAMAs.

   a. A cost beneficial SAMA identified in the Diablo Canyon submittal might represent an unevaluated SAMA candidate for Byron (i.e., Diablo Canyon Power Plant (Diablo Canyon) SAMA 24 – Prevent clearing of [reactor coolant system] RCS cold leg water seals). Please provide additional information evaluating the applicability of this SAMA to Byron/Braidwood.

   b. Design and fabrication of a steam generator (SG) power operated relief valve (PORV) gagging device to be used following a SGTR with a stuck open SG PORV is a potential alternate SAMA to SAMA 14. Note that this is disposed of in the Byron/Braidwood SAMA assessments by citing information from a Diablo Canyon RAI response. This response was specific to the Diablo Canyon safety valve design. It is not clear if it is applicable to the Byron/Braidwood design. Please provide additional information evaluating the applicability of this SAMA to Byron/Braidwood.

   c. SAMA 4 replaces the RCP seal with "no leak" seals at an estimated cost of $12.3M. Vogtle SAMA 7 identified the potential for installing enhanced seals that 'reduce' RCP seal leakage at a lower cost ($1.05M). Clarify whether this is a similar RCP seal modification, and, if yes, provide addition justification for the cost difference. If not, please clarify whether this RCP seal modification is applicable to Byron/Braidwood.

   d. In the Phase I SAMA development, the installation of a flood alarm was found not to be needed as the particular event was not applicable to Byron/Braidwood (e.g., Indian Point SAMA 054). Discuss the more generic position of whether additional flood alarms would be potentially beneficial if applied to Byron/Braidwood flooding events.