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PSEG
Nuclear LLC

10 CFR 50.90

LR-N18-0109
LAR H18-02
OCT 17 2018

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Hope Creek Generating Station
Renewed Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Response to Request for Additional Information, Re: License Amendment Request: Inverter Allowed Outage Time (AOT) Extension

References:
1. PSEG letter to NRC, "License Amendment Request: Inverter Allowed Outage Time (AOT) Extension" dated April 13, 2018 (ADAMS Accession No. ML18103A218)
2. NRC email to PSEG, "Hope Creek AOT Final RAI-from PRA Branch," (EPID L-2018-LLA-0101) dated September 12, 2018 (ADAMS Accession No. ML18263A144)

In the Reference 1 letter, PSEG Nuclear LLC (PSEG) submitted a license amendment request for Hope Creek Generating Station. The proposed amendment would revise Technical Specifications to increase the Alternating Current (AC) Inverters allowed outage time (AOT) from 24 hours to 7 days. In Reference 2, the Nuclear Regulatory Commission (NRC) requested PSEG to provide additional information in order to evaluate the proposed License Amendment Request to revise Technical Specifications. The response due date was subsequently extended to October 19, 2018 at PSEG's request.

Attachment 1 to this letter provides a restatement of the RAI questions followed by our responses. PSEG has determined that the information provided in this submittal does not alter the conclusions reached in the 10 CFR 50.92 no significant hazards determination previously submitted. In addition, the information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

There are no regulatory commitments contained in this letter.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), PSEG is providing a copy of this response, with attachments, to the designated State of New Jersey Official.

Should you have any questions regarding this submittal, please contact Mr. Lee Marabella at 856-339-1208.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 10/17/18
(Date)

Sincerely,

Eric Carr
Site Vice President
Hope Creek Generating Station

Attachments:
1. Response to Request for Additional Information - License Amendment Request to Revise Technical Specification 3.8.3.1 Regarding Alternating Current Inverters

cc: Administrator, Region I, NRC
Mr. J. Kim, Project Manager, NRC
NRC Senior Resident Inspector, Hope Creek
Mr. P. Mulligan, Chief, NJBNE
Hope Creek Commitment Tracking Coordinator
Corporate Commitment Tracking Coordinator

Attachment 1

Response to Request for Additional Information - License Amendment Request to Revise Technical Specification 3.8.3.1 Regarding Alternating Current Inverters

By letter dated April 13, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML18103A218), PSEG Nuclear LLC (PSEG) submitted a license amendment request (LAR) [1] regarding the Hope Creek Generating Station. The proposed amendment would revise Technical Specification (TS) 3.8.3.1, "Distribution - Operating," to increase the allowed outage time (AOT) for one or both inverters inoperable in one channel from 24 hours to 7 days.

By email dated September 12, 2018, the NRC staff requested additional information to complete the review of the LAR.

Below is a restatement of the questions followed by our responses.

Question 1 (APLA RAI-1)

Section 3.2.1 and Attachment 2 of the LAR provides a very detailed discussion about the licensee's evaluation of the technical adequacy of the full-power internal events (FPIE) PRA to support the proposed amendment. The discussion includes some details that appear unnecessary, e.g. an extensive discussion of a 1999 peer review and results that were superseded by a 2008 full scope peer review. Other details are difficult to interpret, e.g., that the 2008 peer review was performed using the 2007 American Society of Mechanical Engineers (ASME) ASME PRA Standard endorsed in Regulatory Guide (RG) 1.200 Rev. 1 whereas Rev. 1 of RG 1.200 endorses, with qualifications, the ASME RA-Sb-2005 PRA Standard.

A previous staff review described in "Hope Creek Generating Station - Issuance of Amendment RE: Technical Specification Change for Permanent Extension to Type A and Type C Containment Leak Rate Test Frequencies" (ADAMS Accession No. ML17291A209) indicated that,

> "…an independent full-scope peer review of the internal events and internal flooding PRA model was performed in 2008 against the requirements set forth in the 2005 version of the ASME PRA standard and the qualifications provided in the staff's endorsement of that standard in RG 1.200, Revision 1. The peer review was performed against the CC II Supporting Requirements. Following PRA model revisions arising from the peer review, the licensee performed a self-assessment of the Hope Creek [full-power internal events] FPIE PRA model in 2011 to determine if there were any gaps present between the Hope Creek FPIE PRA model and the CC II Supporting Requirements in the 2009 version of the ASME/American Nuclear Society."

Section 3.2.1 of the LAR further added that more recently "[t]he Full Power Internal Events and Flooding PRA was the subject of a Facts and Observations (F&Os) closure review completed by the BWR Owners Group in August 2017 [15]. At this time, there are no F&Os that are considered open."

Please confirm that the above summary of the internal events PRA reviews is current and correct or provide correction and clarification.

Response:

The above summary of PRA reviews is accurate, with one minor correction.

Upon review of the FPIE model's documented history, it was determined that the evaluation supporting "Hope Creek Generating Station – Issuance of Amendment RE: Technical Specification Change for Permanent Extension to Type A and Type C Containment Leak Rate Test Frequencies" was incorrect in stating that the 2008 peer review was performed against the RA-Sb-2005 [2] standard. The peer review report [3] identifies RA-Sc-2007 [4] as the standard used in the review team's evaluation.

However, it is noted that RA-Sc-2007 is a very minor revision to the ASME Standard, comprising the addition of a non-mandatory appendix clarifying the distinction between PRA "maintenance" and "upgrades" as well as some front matter errata. No changes to the Supporting Requirements or any other technical items are identified, rendering it functionally equivalent to RA-Sb-2005. Therefore, the conclusions of the 2008 peer review would have been the same under RA-Sb-2005 as RA-Sc-2007.

While preparing this RAI response, the PSEG team noted that the gap assessment of differences between the 2008 peer reviewed model and the current model has not been explicitly reviewed by an independent team. Therefore, PSEG concluded that this should be performed and reported to the NRC as part of the discussion of PRA technical adequacy. Since there are no SR differences between RA-Sb-2005 and RA-Sc-2007, the gap assessment provided below directly follows guidance in NEI 05-04 [5].

1. Overview of High Level Requirement and Supporting Requirement Changes (NEI 05-04 Section 3.3)

   In general, the changes to the ASME/ANS PRA standard high level requirements (HLRs) and SRs in the transition from Addendum B (ASME RA-Sb-2005) through Revision 1, Addendum A (ASME/ANS-RA-Sa-2009) were minor and include the following:

   - Incorporation into the ASME/ANS PRA Standard issues that were identified by the NRC in RG 1.200, Revision 1 [6],
   - Renumbering of the ASME/ANS PRA Standard HLRs and SRs to remove deleted SRs and SRs ending with a letter (for example, SR QU-A2a); as listed in Appendix F of NEI 05-04, Revision 3,
   - Changes in the cross-references updated to the new tables, and
   - Corrections of typographical and grammar errors, and changes in wording.

   However, there were a few examples of changes to either the ASME/ANS PRA standard or the RG 1.200, Revision 2 that would require re-evaluation of the PRA against the ASME/ANS PRA Standard requirements. These are discussed in the following sections.

2. Supporting Requirements Requiring Re-evaluation (NEI 05-04 Section 3.3.1)

   SRs that require re-evaluation are those SRs that have changed significantly, including those with new issues identified in RG 1.200, Revision 2; these SRs are provided in Table 1.

Table 1
SUPPORTING REQUIREMENTS REQUIRING GAP ASSESSMENT RE-EVALUATION

ASME/ANS RA-Sa-2009 Supporting Requirement	NEI 05-04, Revision 3, Table 3-2 Comments	RG 1.200, Rev. 1 to Rev. 2 Gap Assessment Re-evaluation and Capability Category (CC)
HR-D6	RG 1.200, Revision, 2 provides clarification that should be evaluated.	Meets: The HCGS HRA models characterize the uncertainty in the estimates of the human error probabilities (HEPs) consistent with the quantification approach and use mean values in the quantification of the PRA results. Uncertainty cases are also provided using the 50th and 95th percentiles of the HEPs.
HR-G3	RG 1.200, Revision 2, provided clarification to items (d) and (g) of the SR. Some of the RG 1.200, Revision 1 wording remains, while some additional clarification is provided.	CC I, II, III: The HCGS HRA models use the EPRI HRA calculator, which includes a discussion of the specific scenario to evaluate; the (d) degree of clarity of the cues/indications in supporting the detection, diagnosis, and decision-making give the plant clarification and scenario-specific context of the event, and (g) complexity of detection, diagnosis, and decision-making and executing the required response.
New DA SR	RG 1.200, Rev. 1, included a new SR – DA-08. The recommended new SR is included in RG 1.200, Rev. 2, as DA-D9 (with the renumbering).	Meets: The HCGS PRA models only take credit for repairing the emergency diesel generators (EDGs) in the electric power recovery (EPR) model. This EPR model uses a convolution methodology to calculate the probability of recovering offsite power or repairing an EDG in time to prevent core damage as a function of the accident sequence in which the SSE failure appears.
QU-A2	Need to ensure QU-A2 evaluates LERF results.	Meets: The HCGS PRA models provide estimates of the individual sequences in a manner consistent with the estimation of CDF and LERF to identify significant accident sequences and confirm that the logic is appropriately reflected. These estimates are accomplished by quantifying the individual accident sequences.

Table 1
SUPPORTING REQUIREMENTS REQUIRING GAP ASSESSMENT RE-EVALUATION

ASME/ANS RA-Sa-2009 Supporting Requirement	NEI 05-04, Revision 3, Table 3-2 Comments	RG 1.200, Rev. 1 to Rev. 2 Gap Assessment Re-evaluation and Capability Category (CC)
QU-A3	Need to ensure QU-A3 evaluates LERF results.	CCII: The HCGS PRA models are quantified using PRAQuant. UNCERT is used to determine the mean CDF and LERF to be estimated by correlating event probabilities. When propagating uncertainty distributions, the CDF and LERF are estimated.
QU-B5	RG 1.200, Rev. 2, provides clarification that should be evaluated. Need to verify breaking logic loops does not result in undue conservatism.	Meets: Both RG 1.200, Rev. 1, Table A-1. "Staff Position on ASME RA-S-2002, ASME RA-Sa-2003, and ASME RA-Sb-2005," and RG 1.200, Rev. 2, Table A-2. "Staff Position on ASME/ANS RA-Sa-2009 Part 2, Technical and Peer Review Requirements for At-Power Internal Events" have "No objection" to SR QU85. Furthermore, the HCGS PRA model logical loops are broken in a manner that still permits each dependency to be accounted for when quantified using event trees with conditional split fractions.
QU-B6	Need to ensure QU-B6 evaluates LERF results.	Meets: The CAFTA event tree linking quantification process that is used by the HCGS PRA models account for system successes in addition to system failures in the evaluation of accident sequences to the extent needed for realistic estimation of CDF and LERF. This accounting is accomplished by using numerical quantification of success probability. Since the event trees are linked, all "successes" are transferred between event trees.
QU-E3	Need to ensure QU-E3 evaluates LERF results.	CCII: The HCGS PRA models take into account the "state of knowledge" correlation between selected parameter distributions, propagate these uncertainties through a Monte Carlo quantification using UNCERT, and calculate the estimated CDF and LERF distributions.

Table 1
SUPPORTING REQUIREMENTS REQUIRING GAP ASSESSMENT RE-EVALUATION

ASME/ANS RA-Sa-2009 Supporting Requirement	NEI 05-04, Revision 3, Table 3-2 Comments	RG 1.200, Rev. 1 to Rev. 2 Gap Assessment Re-evaluation and Capability Category (CC)
QU-E4	Revision 1, Addendum A of the ASME/ANS Standard rewords this SR. Additionally, RG 1.200, Rev. 2, provides clarification to remove Note 1.	Meets: The HCGS PRA models identify sources of model uncertainty and their related assumptions, as well as how the PRA model is affected by these.
Flooding SRs: IFPP-B1, B2, B3, IFSO-B1, B2, B3, IFSN-B1, B2, B3, IFEV-B1, B2, B3, IFQU-B1, B2, B3.	These are new requirements for flooding that expand on the original SRs in the ASME/ANS PRA Standard.	Meets: The HCGS Internal Flooding PRA model documentation is consistent with the SRs. All technical determinations of the internal flooding analysis, as well as the methodologies and sources of uncertainty involved, are documented. Additionally, the uncertainty in CDF and LERF is addressed by using UNCERT.
IFSN-A6	RG 1.200, Rev. 2, provides clarification that should be evaluated.	CCIII: The HCGS Internal Flooding PRA model included investigation into component failure due to flooding, induced jet impingement, humidity, condensation, temperature, etc.

3. Supporting Requirements that May Require Re-evaluation (NEI 05-04 Section 3.3.2)

   A number of the SRs changed in the ASME/ANS PRA standard as a result of the NRC comments to remove the word "key" with respect to assumptions and sources of (modeling) uncertainty.

   The NEI guidance suggests that if the original peer review or self-assessment did evaluate the PRA against these NRC-recommended wording changes, but the SR was assessed as "Not Met", then it may be useful for the gap assessment to include a re-evaluation of these eleven impacted SRs once the methods are modified per the disposition of the applicable F&O. The assessment of these affected SRs is provided in Table 2.

Table 2
SUPPORTING REQUIREMENTS AFFECTED BY "KEY" ASSUMPTIONS AND UNCERTAINTY REQUIRING GAP ASSESSMENT RE-EVALUATION

ASME/ANS RA-Sa-2009 Supporting Requirement	2009 HCGS Peer Review SR Capability Category	Associated F&O	RG 1.200, Rev. 1 to Rev. 2 Gap Re-evaluation
IE-D3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
AS-C3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
SC-C3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
SY-C3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
HR-I3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
DA-E3	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
QU-E1	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
QU-E2	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
QU-F4	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.
LE-D6 (LE-D5 in ASME RA-Sb-2005)	N/A	None	Not applicable to BWRs
LE-G4	Meets	None	Meets: Previously assessed as "Meets." No re-evaluation required.

4. SRs Not Requiring Re-evaluation (NEI 05-04 Section 3.3.3)

   A number of the SRs changed between Addendum B (ASME RA-Sb-2005) and Revision 1, Addendum A of the ASME/ANS PRA standard (ASME/ANS RA-Sa-2009) do not require re-evaluation during a gap assessment. These include the numbering changes to the SRs and minor editorial changes. NEI 05-04 Rev. 3, Appendix F provides a cross-reference table of the SR numbering changes.

5. Conclusions

   There were some editorial revisions and clarifications to the internal events PRA standard from the 2005 version to Part 2 (Internal Events) of the 2009 combined standard. The NRC, in RG 1.200, Rev. 2, endorsed this combined standard and did not identify any exceptions. The internal events supporting requirements are essentially the same in the two standards since there are no substantive technical changes to the internal events PRA standard. This, along with the NEI 05-04 Section 3.3 gap assessment provided above for the HCGS internal events PRA model, qualifies the

HCGS internal events and internal flooding PRA models as fully compliant with RG 1.200, Rev. 2, at Capability Category II or better. Therefore, the HCGS internal events PRAs based on RG 1.200, Rev. 1 also conform to RG 1.200, Rev. 2, and use of the current HCGS PRA models to perform the inverter allowed outage time risk assessment is justified.

The LAR's statement in Section 3.2.1 regarding the results of the August 2017 F&O Closure Review is unclear in its reference to "open F&Os". This passage should more appropriately read:

The Full Power Internal Events and Flooding PRA was the subject of a Facts and Observations (F&Os) closure review completed by the BWR Owners Group in August 2017 [ref]. At this time, ~~there are no F&Os that are considered open~~ all FPIE Supporting Requirements are met at Capability Category (CC) II.

This wording more precisely communicates the relevancy of the Peer Review results.

Question 2 (APLA RAI-2)

In Section 3.2.1 of the LAR, the licensee states that in November 2010 it completed a full-scope peer review of its then current base Fire PRA. However, the licensee does not provide any details as to which standard the peer review was conducted against or what peer review method was used.

Please provide a discussion summarizing the standard to which the peer review was conducted against and the peer review method that was used.

Response:

The peer review was conducted against the ASME/ANS RA-Sa-2009 PRA Standard [7] using the process defined in NEI 07-12 [8] and the clarifications provided by the NRC in Regulatory Guide 1.200, Rev. 2 [9]. It was a full-scope evaluation of all technical elements and Supporting Requirements of the Standard and involved extensive, iterative review of all PRA documentation over the course of several weeks. This process included a week-long onsite meeting to facilitate direct question- and-answer sessions between the PRA development and review teams, as well as a plant walkdown to confirm the treatment of spatial dependencies.

Question 3 (APLA RAI-3)

In the resolution to F&O 5-40, the licensee states that joint human error probabilities (JHEPs) are not risk-significant for the inverters or the reported risk evaluation.

Please characterize the process used to determination that JHEPs are not significant for the risk from inverters and provide any quantitative results.

Response:

While there are several JHEPs with a contribution to the change in FPIE CDF and / or LERF, the conclusion of the risk evaluation is not particularly sensitive to these inputs. During the initial analysis supporting the LAR, this conclusion was based on the analysts' review of the cutsets contributing to the risk increase. In this response, PSEG develops a quantitative sensitivity analysis. Even assuming a large change in the values of these JHEPs, the calculated values of ΔCDF_{AVE} / ICCDP and $\Delta LERF_{AVE}$ / ICLERP are still far below the acceptance limits.

To begin, Table 3-3 through Table 3-5 from the LAR submittal, which summarize these risk metrics, are reproduced as Table 3 through Table 5 below for reference.

Table 3

SUMMARY OF QUANTIFIED CDF

Case	Internal Events CDF (/yr)	Fire CDF(/yr)	Total CDF (/yr)
Base Case MOR	5.91E-06	1.80E-05	2.39E-05
Channel A Inverters OOS	1.02E-05	1.92E-05	2.94E-05
Channel B Inverters OOS	1.13E-05	1.99E-05	3.13E-05
Channel C Inverters OOS	9.95E-06	1.88E-05	2.87E-05
Channel D Inverters OOS	1.02E-05	1.82E-05	2.85E-05

This table is a reproduction of Table 3-3 in Reference [1]

Table 4

SUMMARY OF QUANTIFIED LERF

Case	Internal Events LERF (/yr)	Fire LERF (/yr)	Total LERF (/yr)
Base Case MOR	1.84E-07	2.25E-06	2.44E-06
Channel A Inverters OOS	4.43E-07	2.48E-06	2.92E-06
Channel B Inverters OOS	6.02E-07	2.28E-06	2.88E-06
Channel C Inverters OOS	4.54E-07	2.45E-06	2.90E-06
Channel D Inverters OOS	4.85E-07	2.28E-06	2.77E-06

This table is a reproduction of Table 3-4 in Reference [1]

Table 5
COMPARISON OF QUANTITATIVE RESULTS WITH ACCEPTANCE GUIDELINES
(TOTAL OF INTERNAL AND EXTERNAL EVENTS)

	ΔCDF_{AVE}	ICCDP	$\Delta LERF_{AVE}$	ICLERP
Acceptance Criteria	1.00E-6		1.00E-7	
Channel A Inverters OOS	1.06E-07		9.30E-09	
Channel B Inverters OOS	1.41E-07		8.54E-09	
Channel C Inverters OOS	9.19E-08		8.93E-09	
Channel D Inverters OOS	8.65E-08		6.31E-09	

This table is a reproduction of Table 3-5 in Reference [1]

Next, in order to gauge these metrics' sensitivity to the JHEP values, the tables below develop a recalculation assuming a doubled contribution from the potentially risk-significant JHEPs for each channel. These are identified as those JHEPs with a Fussell-Vesely importance measure greater than 0.02 in the delterm cutsets (i.e., the change in cutsets between the base case Models of Record and the inverters taken out-of-service, as described in the LAR). Table 6 and Table 7 below list the relevant JHEPs and F-V values and recalculate the resulting CDFs and LERFs assuming these values were doubled.

Doubling the JHEP values is judged to be a significantly conservative sensitivity because of the breadth and depth associated with the model used to quantify them. Regarding breadth, each JHEP consists of several HEPs from both closely- and loosely-related activities. Some JHEPs are derived from HEPs related to high-pressure injection (closely-related, not very diverse), while other JHEPs are derived from HEPs related to depressurization and suppression pool cooling (not closely-related, but more diverse). The JHEPs span the entirety of the set of HEPs, so applying this conservatism will touch on every aspect of the fault tree model. Regarding depth, while the doubling considered by this sensitivity case is applied to each JHEP's individual value, JHEPs are in actuality the end result of a highly analytical process. Each one incorporates information from multiple underlying independent HEPs, themselves systematically calculated in detail based on a number of performance shaping factors (such as timing, stress, procedure quality, and operator cues), composing them together in a holistic manner via the dependency analysis. Therefore, an imposed increase in a JHEP's final value really represents a host of increases in those underlying parameters. The resulting overall conservatism is the convolution of these many smaller conservatisms.

JHEPs do not appear in the Fire delterm cutsets at all, and therefore the Fire ΔCDFs and Fire ΔLERFs will not change in this sensitivity analysis.

Table 6
EFFECT OF DOUBLED RISK-SIGNIFICANT JHEPS (FPIE CDF)

		Channel A	Channel B	Channel C	Channel D	
LAR CDF	Base Case MOR	5.91E-06	5.91E-06	5.91E-06	5.91E-06	
	With Inverters OOS	1.02E-05	1.13E-05	9.95E-06	1.02E-05	
JHEPs	FDEPGROUP-XHD246		0.035			Delterm F-V Importance
	FDEPGROUP-XHD455			0.161	0.152	
	FDEPGROUP-XHD244			0.152	0.143	
	FDEPGROUP-XHD456			0.139	0.131	
	FDEPGROUP-XHD421			0.081	0.076	
Sensitivity CDF	(Assume the contribution of these JHEPs is doubled)	1.02E-05	1.15E-05	1.21E-05	1.24E-05	

(There are no risk-significant JHEPs for Channel A)

Table 7
EFFECT OF DOUBLED RISK-SIGNIFICANT JHEPS (FPIE LERF)

		Channel A	Channel B	Channel C	Channel D	
LAR LERF	Base Case MOR	1.84E-07	1.84E-07	1.84E-07	1.84E-07	
	With Inverters OOS	4.43E-07	6.02E-07	4.54E-07	4.85E-07	
JHEPs	FDEPGROUP2-XHD154	0.027				Delterm F-V Importance
	FDEPGROUP2-XHD169		0.056			
	FDEPGROUP2-XHD182			0.250	0.226	
	FDEPGROUP2-XHD175			0.083	0.075	
	FDEPGROUP2-XHD145			0.071	0.064	
Sensitivity LERF	(Assume the contribution of these JHEPs is doubled)	4.50E-07	6.26E-07	5.63E-07	5.95E-07	

Finally, these new FPIE CDFs and LERFs may now be substituted back into Table 3 through Table 5 to recalculate the new ΔCDF_{AVE} / ICCDPs and $\Delta LERF_{AVE}$ / ICLERPs for this sensitivity case. Tables 8 through Table 10 develop these updated values.

Table 8
SUMMARY OF QUANTIFIED CDF –
DOUBLED JHEP SENSITIVITY

Case	Internal Events CDF (/yr)	Fire CDF(/yr)	Total CDF (/yr)
Base Case MOR	5.91E-06	1.80E-05	2.39E-05
Channel A Inverters OOS	1.02E-05	1.92E-05	2.94E-05
Channel B Inverters OOS	1.15E-05	1.99E-05	3.14E-05
Channel C Inverters OOS	1.21E-05	1.88E-05	3.09E-05
Channel D Inverters OOS	1.24E-05	1.82E-05	3.06E-05

Table 9
SUMMARY OF QUANTIFIED LERF –
DOUBLED JHEP SENSITIVITY

Case	Internal Events LERF (/yr)	Fire LERF (/yr)	Total LERF (/yr)
Base Case MOR	1.84E-07	2.25E-06	2.44E-06
Channel A Inverters OOS	4.50E-07	2.48E-06	2.93E-06
Channel B Inverters OOS	6.26E-07	2.28E-06	2.91E-06
Channel C Inverters OOS	5.63E-07	2.45E-06	3.01E-06
Channel D Inverters OOS	5.95E-07	2.28E-06	2.87E-06

Table 10
COMPARISON OF QUANTITATIVE RESULTS WITH ACCEPTANCE GUIDELINES
(TOTAL OF INTERNAL AND EXTERNAL EVENTS) –
DOUBLED JHEP SENSITIVITY

	ΔCDF_{AVE}	ICCDP	$\Delta LERF_{AVE}$	ICLERP
Acceptance Criteria	1.00E-6		1.00E-7	
Channel A Inverters OOS	1.06E-07 (+0%)		9.51E-09 (+2%)	
Channel B Inverters OOS	1.44E-07 (+2%)		9.04E-09 (+6%)	
Channel C Inverters OOS	1.34E-07 (+46%)		1.11E-08 (+24%)	
Channel D Inverters OOS	1.28E-07 (+48%)		8.45E-09 (+34%)	

Even though doubling the JHEPs greatly exaggerates their contribution to the risk metrics, Channels A and B are barely affected, showing at most a 6% change. Channels C and D share several high-importance JHEPs and display an accordingly large increase, ranging from 24 – 48%. However, even this only brings them into rough parity with the other two channels. All metrics remain about an order of magnitude below the RG 1.174 [10] and 1.177 [11] acceptance limits. Therefore, the results are not sensitive to the values of JHEPs and using bounding estimates does not alter the conclusions of the risk evaluation or the acceptability of the inverter allowed outage time extension proposed by the LAR.

References:

[1] PSEG, "LR-N18-0032, License Amendment Request: Inverter Allowed Outage Time (AOT) Extension," 13 April 2018.

[2] ASME/ANS, "RA-Sb-2005: Addenda to ASME RA-S-2002: Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications".

[3] PSEG, "Hope Creek Generating Station PRA Peer Review Report Using ASME PRA Standard Requirements," March 2009.

[4] ASME/American Nuclear Society, "ASME RA-Sc-2007, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," August 2007.

[5] NEI, "NEI 05-04, Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard, Rev. 3".

[6] USNRC, "Regulatory Guide 1.200, An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities, Revision 1," January 2007.

[7] ASME/American Nuclear Society, "ASME/ANS RA-Sa-2009, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," March 2009.

[8] NEI, "NEI 07-12, Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines, Revision 1," June 2010.

[9] USNRC, "Regulatory Guide 1.200, An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities, Revision 2," March 2009.

[10] USNRC, "Regulatory Guide 1.174: An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis, Revision 3," January 2017.

[11] USNRC, "Regulatory Guide 1.177: An Approach for Plant-Specific, Risk-Informed Decision-Making: Technical Specifications, Rev. 1," May 2011.