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PROPRIETARY INFORMATION – WITHOLD UNDER 10 CFR 2.390

10 CFR 50.90
10 CFR 2.390

April 28, 2015

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

Peach Bottom Atomic Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: MELLLA+ License Amendment Request – Supplement 3
Response to Request for Additional Information

Reference: Exelon letter to the NRC, "License Amendment Request – Maximum Extended Load Line Limit Analysis Plus," dated September 4, 2014 (ADAMS Accession No. ML14247A503)

In accordance with 10 CFR 50.90, Exelon Generation Company, LLC (EGC) requested amendments to Facility Operating License Nos. DPR-44 and DPR-56 for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3, respectively (see referenced letter). Specifically, the proposed changes would revise the Renewed Operating Licenses to allow operation in the expanded Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain and the use of the Detect and Suppress – Confirmation Density (DSS-CD) stability solution.

The attachments to this letter provide responses to Requests for Additional Information (RAIs) from the PRA and Human Performance Branch (APHB) and the Reactor Systems Branch (SRXB) review of the referenced LAR. Portions of the information provided in Attachment 1 are considered to be proprietary and, therefore, exempt from public disclosure pursuant to 10 CFR 2.390. Attachment 2 provides a non-proprietary version. Attachment 4 contains an affidavit for withholding information executed by GE Hitachi Nuclear Energy Americas LLC (GEH). On behalf of GEH, EGC requests Attachment 1 be withheld from public disclosure in accordance with 10 CFR 2.390(b)(1).

EGC has reviewed the information supporting a finding of no significant hazards consideration and the environmental consideration provided to the U.S. Nuclear Regulatory Commission in the referenced LAR. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration. Further, the additional information provided in this submittal does not affect the bases for concluding that neither

Attachment 1 contains Proprietary Information.
When separated from Attachment 1, this document is decontrolled.

an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the Commonwealth of Pennsylvania and the State of Maryland of this application by transmitting a copy of this letter along with the attachments to the designated State Officials.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter, please contact Mr. David Neff at (610) 765-5631.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of April 2015.

Respectfully,

Kevin F. Borton
Manager, Licensing – Power Uprate
Exelon Generation Company, LLC

Attachments:

1. Response to Reactor Systems Branch Request for Additional Information - Proprietary
2. Response to Reactor Systems Branch Request for Additional Information – Non-Proprietary
3. Responses to PRA and Human Performance Branch Request for Additional Information
4. Affidavit in Support of Request to Withhold Information

cc:	USNRC Region I, Regional Administrator	w/attachments
	USNRC Senior Resident Inspector, PBAPS	w/attachments
	USNRC Project Manager, PBAPS	w/attachments
	R. R. Janati, Commonwealth of Pennsylvania	w/o proprietary attachment
	S. T. Gray, State of Maryland	w/o proprietary attachment

Attachment 2

MELLLA+ LAR Supplement 3
Peach Bottom Atomic Power Station Units 2 and 3
NRC Docket Nos. 50-277 and 50-278

Responses to Reactor Systems Branch Request for Additional Information – Non-proprietary

Responses to Reactor Systems Branch (SRXB) Request for Additional Information

By letter dated September 4, 2014, Exelon Generation Company, LLC (EGC) submitted a license amendment request for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. The proposed amendment would allow operation in the Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain and the use of the Detect and Suppress – Confirmation Density stability solution.

In an email dated April 7, 2015, from the NRC (Rick Ennis) to Exelon (David Neff), the NRC provided updated requests for additional information seeking clarification of certain issues related to the LAR. This attachment provides responses to those RAIs.

SRXB-RAI-1

Appendix A to the M+SAR lists the limitations and conditions listed in Section 9.0 of the NRC staff safety evaluation (SE) for GE-Hitachi Nuclear Energy Americas LLC (GEH) licensing topical report (LTR) NEDC-33173P-A (ADAMS Accession No. ML121150469), referred to as the Methods LTR. Limitation and Condition 9.3 reads as follows:

> Plant-specific EPU and expanded operating domain applications will confirm that the core thermal power to core flow ratio will not exceed 50 MWt/Mlbm/hr at any statepoint in the allowed operating domain. For plants that exceed the power-to-flow value of 50 MWt/Mlbm/hr, the application will provide power distribution assessment to establish that neutronic methods axial and nodal power distribution uncertainties have not increased.

The power distribution root mean square (RMS) data provided to support the Methods SE (Method LTR Figure 3-4) ranged from [[ ]] and an extrapolation to 50 MWt/Mlbm/hr was allowed based on the safety limit minimum critical power ratio (SLMCPR) adders.

As discussed in Section 1.2.1 and 2.2.5 of the M+SAR, and shown in Table 2-3 of the M+SAR, the power-to-flow ratio at the low flow/high power statepoint "K" (55% of core flow, 78.8% of current licensed thermal power) is 55.23 MWt/Mlbm/hr, which exceeds the 50 MWt/Mlbm/hr value in Limitation and Condition 9.3. As such, a power distribution assessment is required. Provide a copy of a recent traversing incore probe (TIP) report and an evaluation of the power distribution uncertainties in PBAPS, showing historical power distribution uncertainties as function of burnup, to demonstrate that PBAPS is not an outlier plant (compared to other plants in the fleet).

RESPONSE

The PBAPS Unit 2 and Unit 3 TIP statistical comparison report for pre-EPU conditions is provided as part of this response.

The TIP statistical comparisons are based on the radial, axial, and nodal root mean square (RMS) power distributions and are compared with respect to the power-to-flow (P/F) ratio metric. Because PBAPS has not yet operated at extended power uprate (EPU) or MELLLA+

conditions, there is insufficient information to demonstrate neutron methods uncertainties have not increased with EPU and MELLLA+ conditions.

Based on the available data, there is no specific TIP RMS statistics trending observed as a function of P/F ratio metric. The TIP RMS statistics are reasonably consistent between both pre EPU PBAPS units and other boiling water reactor plants with pre-EPU and EPU conditions as shown in the TIP statistical comparison report for pre-EPU conditions provided as part of this response.

Enclosure to Response to SRXB-RAI-1

PBAPS Units 2 and 3 TIP Report

Request for Additional Information

The Nuclear Regulatory Commission (NRC) requested that Peach Bottom Atomic Power Station (PBAPS) Units 2 and 3 provide an update of the traversing in-core probe (TIP) comparisons for current operating conditions in response to SRXB-RAI-1.

General

The request pertains to Methods LTR SER Limitation and Condition 9.3 (Reference 1) which states the following:

> "Plant-specific EPU and expanded operating domain applications will confirm that the core thermal power to total core flow ratio will not exceed 50 MWt/Mlbm/hr at any statepoint in the allowed operating domain. For plants that exceed the power-to-flow value of 50 MWt/Mlbm/hr, the application will provide power distribution assessment to establish that neutronic methods axial and nodal power distribution uncertainties have not increased."

The current operating conditions for PBAPS Units 2 and 3 plants are pre-EPU and do not include extended power uprate (EPU) or maximum extended load line limit analysis plus (MELLLA+) conditions. However, EPU conditions are included for comparison with Plants A and B. In responding to this request, it was necessary to gather specific off-line information in order to perform a proper comparison. The off-line core tracking is done using non-adapted thermal margins, as compared to the plant usage of 3DMonicore with shape adaption for the thermal margins. For this response, comparisons of the thermal margins are not provided. Only the TIP root mean square (RMS) statistical comparisons are provided, as the purpose is to provide additional information for an assessment that the neutronic methods radial, axial, and nodal power distribution uncertainties have not increased with EPU and MELLLA+ conditions. Because the PBAPS EPU license amendment request (LAR) has been approved by the NRC, operating data at EPU conditions will be obtained in the near future as the EPU domain is implemented. PBAPS operating data at MELLLA+ conditions will be obtained further in the future after the PBAPS MELLLA+ LAR is approved and the MELLLA+ domain is implemented.

The PBAPS plants use gamma TIP detectors. These detectors have a smaller variability in the agreement with off-line calculations than neutron TIP detectors. A full discussion comparing these two detector types is provided in Reference 2. This enclosure shows that for the same actual power distribution, the TIP radial RMS for a neutron TIP detector system will be larger by a significant amount as compared to a gamma TIP detector system.

The larger values observed in neutron TIP plants are not a safety concern, but rather an operational concern to the utility, as the observed thermal margins will show a larger variability with a neutron TIP system as compared to a gamma TIP system. It is noted that Plants A and B have neutron TIP systems. Therefore, the larger observed TIP RMS values are a consequence of the neutron TIP system rather than the EPU conditions, power density or any other difference from the PBAPS plants.

Approach

While SRXB-RAI-1 is specific to PBAPS Units 2 and 3, it is also informative to look at the PBAPS Units 2 and 3 TIP data collectively with data from some other plants. After the PBAPS Units 2 and 3 data is presented, additional data is provided for comparison with Plants A and B. The general plant characteristics for Plant A, Plant B, PBAPS Unit 2, and PBAPS Unit 3 are presented in Table 1. Data for Plants A and B is available for years 2010 to 2014. Data for PBAPS Unit 2 is available for years 2004 to 2014. Data for PBAPS Unit 3 is available for years 2005 to 2014. Figure 1 characterizes the available TIP comparison data, showing the range of the power-to-flow (P/F) ratio parameter (MWt/Mlbm/hr) vs. time, while Figure 2 characterizes the TIP data points showing reactor power vs. time. PBAPS Units 2 and 3 use gamma TIPs. Plants A and B use neutron TIPs.

Table 1 - Plant Characteristics

Plant	TIP System	Current Licensed Thermal Power (CLTP) (MWt)	% Original Licensed Thermal Power (OLTP)	Power Density (kW/l)	Rated Core Flow (Mlbm/hr)	OLTP Rated P/F Ratio (MWt/Mlbm/hr)	CLTP Rated P/F Ratio (MWt/Mlbm/hr)
A	Neutron	[[					
B	Neutron						]]
PBAPS Unit 2	Gamma	3951	120.0%	58.44	102.5	32.13	38.55
PBAPS Unit 3	Gamma	3951	120.0%	58.44	102.5	32.13	38.55

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Figure 1 - Power-to-Flow Ratio vs. Date for PBAPS Units 2 and 3 and Plants A and B

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Figure 2 - Core Power vs. Date for PBAPS Units 2 and 3 and Plants A and B

Available Peach Bottom TIP Data

The available PBAPS Units 2 and 3 TIP measurements are summarized in Table 2 and Table 3. These data points are also shown in the power flow map in Figure 3.

Table 2 - PBAPS Unit 2 TIP Measurements

Cycle	Date	Cycle Exposure	Core Power	Core Flow	Power-to-Flow Ratio	Power Density
#	M/D/Y	MWd/ST	MWt	Mlbm/hr	MWt/Mlbm/hr	kW/l
16	10/15/2004	140.2	[[			51.82
16	11/24/2004	1034.2				51.92
16	1/10/2005	2006.1				51.95
16	2/18/2005	2822.0				51.93
16	3/17/2005	3451.3				51.89
16	4/22/2005	4289.1				52.02
16	5/26/2005	5063.1				51.89
16	6/29/2005	5855.7				51.85
16	8/12/2005	6825.4				52.04
16	9/8/2005	7450.7				51.92
16	10/16/2005	8226.7				51.97
16	11/30/2005	9276.2				51.94
16	12/19/2005	9719.1				51.86
16	1/25/2006	10581.4				51.96
16	2/27/2006	11331.8				51.96
16	4/6/2006	12216.3				51.98
16	5/10/2006	13007.5				51.91
16	5/12/2006	13054.0				51.89
16	6/15/2006	13834.3				51.89
16	7/20/2006	14648.2				52.00
16	8/24/2006	15449.2				49.41
17	10/11/2006	18.9				30.76
17	10/23/2006	288.9				51.94
17	10/27/2006	382.2				51.89
17	12/11/2006	1432.4				51.95
17	1/8/2007	2085.1				51.93
17	2/12/2007	2900.9				51.89
17	3/20/2007	3733.7				51.87
17	5/3/2007	4753.8				51.73
17	5/31/2007	5406.6				51.95
17	7/5/2007	6222.8				51.98
17	8/10/2007	7062.1				51.97
17	9/14/2007	7837.4				51.91

Cycle	Date	Cycle Exposure	Core Power	Core Flow	Power-to-Flow Ratio	Power Density
#	M/D/Y	MWd/ST	MWt	Mlbm/hr	MWt/Mlbm/hr	kW/l
17	10/18/2007	8630.1				51.97
17	11/20/2007	9400.7				52.00
17	12/26/2007	10240.2				52.01
17	2/1/2008	11093.0				51.94
17	3/5/2008	11862.4				51.96
17	3/11/2008	12001.3				51.94
17	4/11/2008	12722.5				51.99
17	5/8/2008	13342.5				51.92
17	5/14/2008	13480.0				51.84
17	6/25/2008	14456.1				51.97
17	8/25/2008	15827.9				47.11
18	10/29/2008	172.5				51.84
18	1/29/2009	2340.1				51.96
18	4/14/2009	4075.1				51.98
18	6/17/2009	5554.4				51.92
18	8/11/2009	6835.7				51.93
18	10/21/2009	8480.6				51.91
18	12/18/2009	9832.9				51.96
18	3/8/2010	11647.5				51.93
18	5/18/2010	13297.3				51.93
18	7/29/2010	14936.2				51.71
18	9/9/2010	15879.9				46.27
18	9/10/2010	15890.8				46.21
19	10/10/2010	24.9				30.36
19	10/16/2010	159.7				51.90
19	12/16/2010	1562.2				51.90
19	2/25/2011	3185.6				51.96
19	5/12/2011	4928.2				51.93
19	7/22/2011	6551.0				51.97
19	10/18/2011	8566.9				51.86
19	12/5/2011	9669.4				51.95
19	2/14/2012	11292.6				51.93
19	4/23/2012	12876.5				51.85
19	7/13/2012	14711.7				51.88
20	10/21/2012	28.7				34.60
20	10/26/2012	140.7				51.88
20	2/1/2013	2361.0				51.95
20	4/8/2013	3849.8				51.94

Cycle	Date	Cycle Exposure	Core Power	Core Flow	Power-to-Flow Ratio	Power Density
#	M/D/Y	MWd/ST	MWt	Mlbm/hr	MWt/Mlbm/hr	kW/l
20	6/18/2013	5447.8				51.92
20	8/28/2013	7055.9				51.92
20	11/8/2013	8658.5				51.96
20	1/13/2014	10149.3				51.99
20	3/24/2014	11719.4			]]	51.94

Table 3 - PBAPS Unit 3 TIP Measurements

Cycle	Date	Cycle Exposure	Core Power	Core Flow	Power-to-Flow Ratio	Power Density
#	M/D/Y	MWd/ST	MW(t)	Mlbm/hr	MWt/Mlbm/hr	kW/L
16	10/18/2005	22.6	[[			30.19
16	11/4/2005	401.2				52.09
16	12/7/2005	1169.9				51.91
16	1/11/2006	1984.9				52.01
16	2/15/2006	2791.8				51.80
16	3/31/2006	3814.0				51.92
16	4/25/2006	4397.2				51.94
16	5/31/2006	5217.3				51.83
16	7/6/2006	6055.3				52.00
16	8/11/2006	6893.6				52.03
16	10/17/2006	8449.5				51.72
16	11/21/2006	9264.4				51.97
16	12/27/2006	10101.8				51.99
16	1/29/2007	10864.3				51.77
16	3/9/2007	11759.1				51.77
16	4/11/2007	12525.6				51.74
16	5/17/2007	13352.7				51.97
16	6/22/2007	14189.3				51.92
16	7/27/2007	15002.3				51.43
16	8/22/2007	15599.4				50.02
17	10/23/2007	154.3				51.74
17	3/27/2008	3691.0				51.92
17	8/15/2008	6966.6				51.92
17	12/30/2008	10154.2				51.90
17	6/24/2009	14014.8				51.84
18	10/14/2009	16.4				34.55
18	2/23/2010	3075.7				51.93
18	9/1/2010	7476.1				51.95

Cycle	Date	Cycle Exposure	Core Power	Core Flow	Power-to-Flow Ratio	Power Density
#	M/D/Y	MWd/ST	MW(t)	Mlbm/hr	MWt/Mlbm/hr	kW/L
18	2/16/2011	11242.7				51.93
18	7/8/2011	14527.9				51.87
19	10/17/2011	37.8				31.26
19	4/13/2012	4135.0				51.96
19	8/29/2012	7279.3				51.90
19	3/27/2013	12090.1				51.94
19	8/29/2013	15475.0				47.65
20	10/26/2013	49.6				25.58
20	11/11/2013	413.6				51.96
20	12/30/2013	1525.5				51.93
20	3/14/2014	3162.6			]]	51.84

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Figure 3 - PBAPS Power Flow Map Showing TIP Measurement Cases

Results of PBAPS TIP RMS Comparisons

To provide a basis for trending of the PBAPS Units 2 and 3 TIP statistics, Tables 4 and 5 provide a comparison of the ratio of the case specific TIP RMS to the average TIP RMS for all PBAPS Units 2 and 3 cases, with values for the radial (bundle), axial, and nodal TIP RMS. This data is displayed as a function of P/F ratio in Figures 4, 5, and 6 for the radial, axial, and nodal RMS statistics, respectively. The ratio to the average TIP RMS value is used so as to focus on the trending; however, no specific trending can be established as a function of power-to-flow ratio.

Table 4 - PBAPS Unit 2 TIP RMS Statistics

Core Quantities				Ratio to Average		
Date	Cycle Exposure	Core Power	Core Flow	Radial	Axial	Nodal
M/D/Y	MWd/ST	MWt	Mlbm/hr	RMS	RMS	RMS
10/15/2004	140.2	[[				
11/24/2004	1034.2					
1/10/2005	2006.1					
2/18/2005	2822.0					
3/17/2005	3451.3					
4/22/2005	4289.1					
5/26/2005	5063.1					
6/29/2005	5855.7					
8/12/2005	6825.4					
9/8/2005	7450.7					
10/16/2005	8226.7					
11/30/2005	9276.2					
12/19/2005	9719.1					
1/25/2006	10581.4					
2/27/2006	11331.8					
4/6/2006	12216.3					
5/10/2006	13007.5					
5/12/2006	13054.0					
6/15/2006	13834.3					
7/20/2006	14648.2					
8/24/2006	15449.2					
10/11/2006	18.9					
10/23/2006	288.9					
10/27/2006	382.2					
12/11/2006	1432.4					
1/8/2007	2085.1					
2/12/2007	2900.9					
3/20/2007	3733.7					

Core Quantities				Ratio to Average		
Date	Cycle Exposure	Core Power	Core Flow	Radial	Axial	Nodal
M/D/Y	MWd/ST	MWt	Mlbm/hr	RMS	RMS	RMS
5/3/2007	4753.8					
5/31/2007	5406.6					
7/5/2007	6222.8					
8/10/2007	7062.1					
9/14/2007	7837.4					
10/18/2007	8630.1					
11/20/2007	9400.7					
12/26/2007	10240.2					
2/1/2008	11093.0					
3/5/2008	11862.4					
3/11/2008	12001.3					
4/11/2008	12722.5					
5/8/2008	13342.5					
5/14/2008	13480.0					
6/25/2008	14456.1					
8/25/2008	15827.9					
10/29/2008	172.5					
1/29/2009	2340.1					
4/14/2009	4075.1					
6/17/2009	5554.4					
8/11/2009	6835.7					
10/21/2009	8480.6					
12/18/2009	9832.9					
3/8/2010	11647.5					
5/18/2010	13297.3					
7/29/2010	14936.2					
9/9/2010	15879.9					
9/10/2010	15890.8					
10/10/2010	24.9					
10/16/2010	159.7					
12/16/2010	1562.2					
2/25/2011	3185.6					
5/12/2011	4928.2					
7/22/2011	6551.0					
10/18/2011	8566.9					
12/5/2011	9669.4					
2/14/2012	11292.6					

Core Quantities				Ratio to Average		
Date	Cycle Exposure	Core Power	Core Flow	Radial	Axial	Nodal
M/D/Y	MWd/ST	MWt	Mlbm/hr	RMS	RMS	RMS
4/23/2012	12876.5					
7/13/2012	14711.7					
10/21/2012	28.7					
10/26/2012	140.7					
2/1/2013	2361.0					
4/8/2013	3849.8					
6/18/2013	5447.8					
8/28/2013	7055.9					
11/8/2013	8658.5					
1/13/2014	10149.3					
3/24/2014	11719.4					]]

Table 5 - PBAPS Unit 3 TIP RMS Statistics

Core Quantities				Ratio to Average		
Date	Cycle Exposure	Core Power	Core Flow	Radial	Axial	Nodal
M/D/Y	MWd/ST	MWt	Mlbm/hr	RMS	RMS	RMS
10/18/2005	22.6	[[				
11/4/2005	401.2					
12/7/2005	1169.9					
1/11/2006	1984.9					
2/15/2006	2791.8					
3/31/2006	3814.0					
4/25/2006	4397.2					
5/31/2006	5217.3					
7/6/2006	6055.3					
8/11/2006	6893.6					
10/17/2006	8449.5					
11/21/2006	9264.4					
12/27/2006	10101.8					
1/29/2007	10864.3					
3/9/2007	11759.1					
4/11/2007	12525.6					
5/17/2007	13352.7					
6/22/2007	14189.3					
7/27/2007	15002.3					
8/22/2007	15599.4					

Core Quantities				Ratio to Average		
Date	Cycle Exposure	Core Power	Core Flow	Radial	Axial	Nodal
M/D/Y	MWd/ST	MWt	Mlbm/hr	RMS	RMS	RMS
10/23/2007	154.3					
3/27/2008	3691.0					
8/15/2008	6966.6					
12/30/2008	10154.2					
6/24/2009	14014.8					
10/14/2009	16.4					
2/23/2010	3075.7					
9/1/2010	7476.1					
2/16/2011	11242.7					
7/8/2011	14527.9					
10/17/2011	37.8					
4/13/2012	4135.0					
8/29/2012	7279.3					
3/27/2013	12090.1					
8/29/2013	15475.0					
10/26/2013	49.6					
11/11/2013	413.6					
12/30/2013	1525.5					
3/14/2014	3162.6					]]

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Figure 4 - Trending of Radial TIP RMS vs. Power-to-Flow Ratio

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Figure 5 - Trending of Axial TIP RMS vs. Power-to-Flow Ratio

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Figure 6 - Trending of Nodal TIP RMS vs. Power-to-Flow Ratio

Peach Bottom TIP RMS Comparison Assessment

As can be seen from Figures 4, 5, and 6, there is no significant trending with respect to the P/F ratio parameter. The observed TIP variations depend on a variety of factors including plant heat balance and flow calibration uncertainties, uncertainties in the basic cross sections that feed the lattice physics calculations, and statistical variations in fuel dimensions and as-built isotopics.

The scatter for the recent pre-EPU operating cycles of PBAPS Units 2 and 3 is similar to that observed in Figure 25-19 of MFN 05-029 (Reference 3). The TIP RMS differences vs. P/F ratio is plotted in MFN 05-029 Figure 25-19 for gamma TIP cycles and is plotted in MFN 05-029 Figure 25-20 for neutron TIP cycles. As can be seen in MFN 05-029 Figure 25-19, the radial (bundle) TIP RMS is comparable to the PBAPS Units 2 and 3 results. The PBAPS Units 2 and 3 axial and nodal TIP RMS results are slightly higher than that illustrated in MFN 05-029 Figure 25-19. However, all PBAPS Units 2 and 3 TIP RMS metrics are better than those depicted in MFN 05-029 Figure 25-20 due to gamma TIP usage at PBAPS Units 2 and 3.

The TIP RMS statistical comparisons for recent pre-EPU cycles of PBAPS Units 2 and 3 are consistent with the information provided to the NRC in MFN 05-029.

TIP RMS Comparisons Including Plants A and B

To further augment the PBAPS Units 2 and 3 discussions, TIP comparisons for two additional plants are also included. Table 6 summarizes the TIP RMS statistics for the four plants, in terms of absolute RMS. The plots will continue to use the P/F ratio metric to the ratio values for the comparative ease of evaluating a potential trend. As expected, the TIP radial RMS statistics for neutron TIP plants are larger than for the gamma TIP plants.

Table 6 - TIP RMS Statistics for Plants A, B, and PBAPS 2 and 3 (Averaged Over All Cycles)

	TIP Type	Radial TIP RMS	Axial TIP RMS	Nodal TIP RMS
Plant A	Neutron	[[		
Plant B	Neutron			
PBAPS 2	Gamma			
PBAPS 3	Gamma			]]

Figures 7, 8, and 9 provide the respective TIP RMS trending for radial, axial, and nodal components as a function of P/F ratio metric.

Based on the available data, there is no specific TIP RMS statistics trending observed as a function of P/F ratio metric. The TIP RMS statistics are reasonably consistent between both pre-EPU PBAPS units and other boiling water reactor (BWR) plants with pre-EPU and EPU conditions.

[[

]]

Figure 7 - Radial TIP RMS Trending as a Function of Power-to-Flow Ratio

[[

]]

Figure 8 - Axial TIP RMS Trending as a Function of Power-to-Flow Ratio

[[

]]

Figure 9 - Nodal TIP RMS Trending as a Function of Power-to-Flow Ratio

Conclusion

As shown in the previous sections, there is no apparent trending in the TIP RMS comparisons between measured and calculated results as a function of the P/F ratio metric. The ranges of values are within the ranges of values previously communicated to the NRC (Reference 3).

The radial TIP RMS comparisons are useful as one of the components of the safety limit minimum critical power ratio (SLMCPR) uncertainties. The nodal TIP RMS comparisons provide some indications regarding linear heat generation rate (LHGR) modeling uncertainties. The axial TIP RMS comparisons, however, are not used in any evaluation of uncertainty components in any safety evaluations, but rather provide indication regarding the agreement of the off-line calculated core average axial power distribution with the measured core average axial power distribution. Any disagreements of the off-line axial core power distributions are removed in the on-line 3DMonicore shape adaption process. If a comparison such as Figure 8 were to be provided for the on-line monitoring system, the axial TIP RMS values would be seen to be near zero, and only a flat line would be seen as a function of P/F ratio metric.

References

1. GE Hitachi Nuclear Energy, "Applicability of GE Methods to Expanded Operating Domains," NEDC-33173P-A, Revision 4, November 2012.

2. "BWR TIP Detector Operational Impacts for Thermal vs. Gamma TIP Detectors" by John P. Rea and John C. Hannah, ANS 2013 LWR Fuel Performance / TOP Fuel September 15-19, 2013.

3. Letter from Louis M. Quintana (GE Nuclear Energy) to Herbert Berkow (NRC), "Responses to RAIs - Methods Interim Process (TAC No. MC5780)," MFN 05-029, April 8, 2005.

SRXB-RAI-2

M+SAR Section 2.2.1, "Safety Limit Minimum Critical Power Ratio," states that "[t]he cycle-specific SLMCPR analysis will incorporate a +0.02 SLMCPR adder for MELLLA+ operation." Section 2.2.2 "Operating Limit Minimum Critical Power Ratio [OLMCPR]," states that "[w]ith the usage of TRACG-AOO instead of ODYN the +0.01 adder to the resulting OLMCPR as required by Methods LTR SER Limitation and Condition 9.19 is no longer applicable and will not be applied to the OLMCPR."

Provide a list of SLMCPR and OLMCPR adders in MELLLA+ with respect to pre-EPU conditions. Specify which adders are part of the EPU upgrade, and which are MELLLA+ specific.

RESPONSE

The PBAPS SLMCPR and OLMCPR had no adders applied at pre-EPU conditions. At EPU without MELLLA+, the PBAPS SLMCPR and OLMCPR had no adders applied.

As the PBAPS MELLLA+ P/F map (See Figure SRXB-RAI-2-1) includes statepoints with a P/F ratio of greater than 42 MWt/Mlbm/hr, the SLMCPR will have a +0.02 adder applied. The PBAPS MELLLA+ analyses were performed using TRACG04 methods; thus, there are no OLMCPR adders required for EPU/MELLLA+ operation. The SLMCPR adder is MELLLA+-specific and is the same for PBAPS Unit 2 and PBAPS Unit 3.

The SLMCPR adder is defined by the Methods LTR SER (see NEDC-33173P-A, Revision 4, November 2012) Limitation and Condition 9.5. The OLMCPR adder is defined by Methods LTR SER Limitation and Condition 9.19 and is not applicable to PBAPS since TRACG04 methods are used.

The PBAPS Unit 2 Cycle 21 Supplemental Reload Licensing Report (SRLR) (see EGC letter to NRC, "MELLLA+ License Amendment Request – Supplement 1 Supplemental Reload Licensing Report," dated January 29, 2015 (ADAMS Accession No. ML15029A640) details the adders applied to the SLMCPR to support EPU/MELLLA+ conditions. SRLR Section 11 gives the proposed Technical Specification SLMCPR values, which includes the +0.02 adder noted in Footnote 10. Section 11 also provides a summary of calculated OLMCPR results for various events. SRLR Appendix G notes the MELLLA+ LTR SER Limitation and Condition 12.6 requirements and provides a table of calculated SLMCPR results without any adders applied based on the limiting result for each statepoint evaluated at beginning/middle/end of cycle conditions.

Figure SRXB-RAI-2-1 shows a graphical depiction of the SLMCPR evaluation statepoints and Methods LTR SER SLMCPR adders based on the P/F ratio. The 100P/100F and 100P/110F cases are evaluated with two loop operation (TLO) uncertainties. The 100P/83F and 78.8P/55F cases are evaluated with single loop operation (SLO) uncertainties. Since SLO uncertainties cases (P/F ratio > 42 MWt/Mlbm/hr) will always be more limiting than TLO uncertainties cases (P/F ratio < 42 MWt/Mlbm/hr), the +0.02 adder has been conservatively applied to all calculated MELLLA+ SLMCPR results before establishing the most limiting SLMCPR required for the Technical Specification.

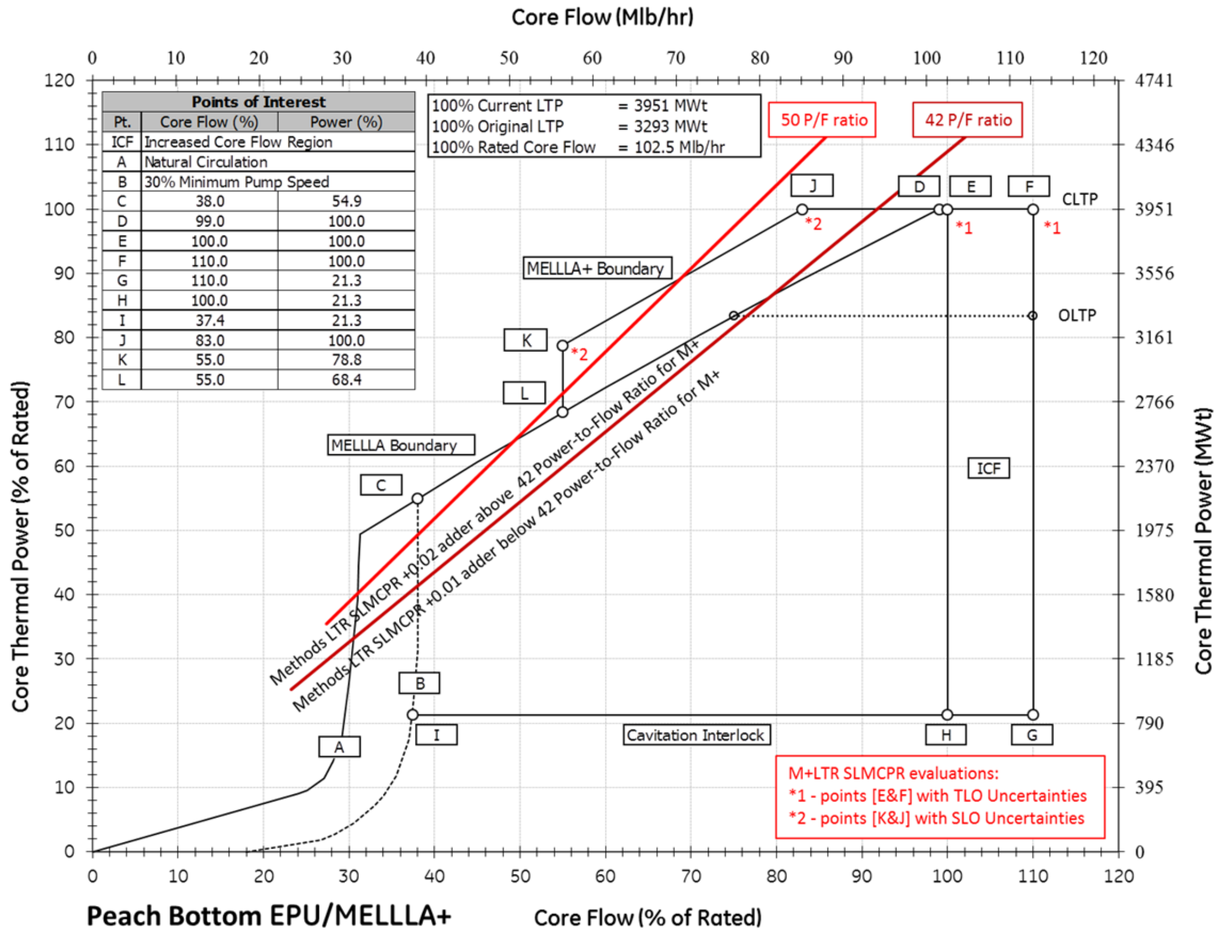

Figure SRXB-RAI-2-1 - PBAPS Power Flow Map Showing SLMCPR Statepoints

SRXB-RAI-3

M+SAR Section 2.4.4 "M+LTR SER Limitation and Condition 12.5.b," states that feedwater (FW) temperature will be limited to be greater than 371.5 °F.

Further, M+ SAR Section 2.4.1 states:

[[

]]

a) Provide the variability in FW temperature for a typical 24-month cycle at full power conditions (i.e., min/max for the cycle).

b) Provide a justification for how [[
]].

c) Expand on the reasoning why indefinite operation at reduced FW temperature is acceptable in the M+ domain, including what analysis was done to support this conclusion.

d) Provide plots of CPR versus time, and the time of DSS-CD scram for the TRACG calculations described in M+ SAR Section 2.4.1 [[
]].

RESPONSE

a) Review of data for Cycle 20 (pre-EPU) of Unit 2 shows that the maximum feedwater temperature is 374.63 °F and the minimum temperature is 372.64 °F. This is for the reactor operating at 99% power and above with normal feedwater heating.

b) [[

]]

c) [[

]]

d) The critical power ratio (CPR) versus time plot for the TRACG [[
]] is provided in the response to SRXB-RAI-15.

The CPR versus time plot for the TRACG [[
]] is provided below as Figure SRXB-RAI-3-1.

[[

]]

Figure SRXB-RAI-3-1 - PBAPS MELLLA+ Equilibrium Cycle [[ ]]

<u>SRXB-RAI-4</u>

The power-flow map (M+SAR Figure 1-1) shows Point F with 110% flow in the increased core flow (ICF) region. What is the maximum core flow that PBAPS can achieve? Is this a function of exposure (e.g., bottom-peaked shapes may result in reduced max achievable flow)? Is PBAPS susceptible to bi-stable flow in the recirculation loops? If so, what is the maximum (or range of) achievable recirculation flow used in normal operation to minimize bi-stable flow concerns?

RESPONSE

PBAPS can achieve 110% rated core flow near end of cycle (EOC) when it is beneficial for extending power generation during coast-down.

Maximum core flow is a function of "core" exposure. Maximum achievable core flow rises once core exposure is beyond the point that power shape has shifted up. This is why maximum core flow is achievable towards the end of cycle and not early in the cycle when there is a strong bottom peak. A top-peaked core has much less core flow resistance due to the shorter boiling

length and two phase flow. As exposure increases to the point that axial power shape shifts up, the core resistance becomes less and core flow rises for the same recirculation drive flow. The coastdown in power also reduces core resistance, but even at full power, a top-peaked core will allow higher core flows for a given drive flow.

PBAPS is susceptible to bi-stable flow. Power operation procedures provide guidance that small fluctuations can be experienced due to bi-stable flow. However, the effect is not significant and, as such, recirculation system operation at PBAPS is not restricted by considerations of bi-stable flow.

SRXB-RAI-5

In reference to M+SAR Tables 2-4 and 2-5, provide the calculated MCPR margin for the equilibrium M+ cycle. Provide the OLMCPR and SLMCPR values (both two-loop operation (TLO) and single loop operation (SLO)) for the current operating cycle at PBAPS even if not designed for MELLLA+ operation.

RESPONSE

MSAR Tables 2-4 and 2-5 are established based on the DSS-CD plant-specific application methodology documented in the Detect and Suppress Solution – Confirmation Density (DSS-CD) Licensing Topical Report, NEDC-33075P-A, Section 6. The Minimum Critical Power Ratio (MCPR) margin for PBAPS Unit 2 Cycle 21 is presented in Table 15-1 of the SRLR (see EGC letter dated January 29, 2015 (ADAMS Accession No. ML15029A640.))

A summary of the SLMCPR and OLMCPR values is provided in Section 11 of the SRLR. Note that the reported SLMCPR value of 1.15 includes the 0.02 adder discussed in the response to SRXB-RAI-2.

SRXB-RAI-6

On M+SAR Figures 2-2 through 2-6, explain the difference between the lines labeled "PBAPS M+SAR" and "PBAPS M+SAR 100F." Do these refer to points D and J in Figure 1.1? What is the equivalent operating point for the other plants (A, B, C, D, E, and F) shown in Figures 2-2 through 2-6?

The text in SAR M+ Section 2.1.2 "Core Design and Fuel Thermal Monitoring Threshold." states:

> Figures 2-3 through 2-5 shows [sic] that exit voiding at PBAPS is higher than other plants. This is because of operating a high power density plant at lower CFs [core flows] through the entire cycle."

Are the other plants in these figures operated with the planned flow as a function of exposure, or at 100% flow?

RESPONSE

M+SAR Figures 2-2 through 2-6 show the Methods LTR (NEDC-33173P-A, Revision 4) reference plant plot series (Plant A through Plant F) as originally provided, along with the PBAPS plot series for EPU/MELLLA (PUSAR) and EPU/MELLLA+ (M+SAR).

The PBAPS M+SAR and PBAPS M+SAR 100F plot series do not refer to cycle operation at specific Statepoints D and J in M+SAR Figure 1-1.

The PBAPS M+SAR plot series assumes operation at 120% original licensed thermal power (OLTP) in the MELLLA+ domain with planned flow varying between Statepoint J (83% flow) and Statepoint E (100% flow) for most of the cycle, reaching Statepoint F (110% flow) at end of cycle (EOC). The cycle average core flow is about 90% for the PBAPS M+SAR plot series.

The PBAPS M+SAR 100F plot series, based on the same M+SAR equilibrium core loading, assumes operation at 120% OLTP with a planned 100% core flow (100F) for comparison purposes only. This is the only plot series fixed for the entire cycle at a specific statepoint (M+SAR Figure 1-1 Statepoint E). The cycle average core flow is 100% for the PBAPS M+SAR 100F plot series.

The differences observed between the PBAPS M+SAR and PBAPS M+SAR 100F plot series is the effect of reduced core flow capability with MELLLA+ at 120% OLTP.

The PBAPS PUSAR plot series assumes operation at 120% OLTP in the MELLLA domain with planned flow varying between Statepoint D (99% flow) and Statepoint E (100% flow) for most of the cycle, reaching Statepoint F (110% flow) at EOC. The cycle average core flow is ~100% for the PBAPS PUSAR plot series.

Because the reference plants operate with different power and flow conditions compared to PBAPS, the equivalent operating point can only be compared based on similar cycle average power and flow conditions. All the reference plants use either planned flow or actual flow as a function of cycle exposure. None of the reference plants operate at only 100% flow.

The cycle average characteristics of core flow and core power are compared between the reference plants and PBAPS as shown in Table SRXB-RAI-6-1. Only reference Plant C and Plant F have 120% OLTP core power and about 100% core flow conditions similar to PBAPS. None of the reference plants have 120% OLTP core power and MELLLA+ less than 99% core flow conditions.

Table SRXB-RAI-6-1 - PBAPS and Reference Plant Cycle Average Core Power and Core Flow Characteristics

Plant	Cycle Average Core Power (%-OLTP)	Cycle Average Core Flow (% of rated)
A	112	~90
B	105	~95
C	120	~100
D	105	~90
E	105	~90
F	120	~100
PBAPS PUSAR	120	~100
PBAPS MSAR	120	~90
PBAPS MSAR 100F	120	~100

SRXB-RAI-7

M+SAR Section 2.4.3 "Backup Stability Protection," describes that the detect and suppress solution - confirmation density (DSS-CD) LTR provides two options: (1) backup stability protection (BSP) manual regions and (2) BSP implemented with average power range monitor (APRM) flow-biased scram. This section of the PBAPS M+SAR appears to be a summary of the DSS-CD LTR, but it is not clear which of the two options will be implemented by PBAPS. Which option will PBAPS use for the first MELLLA+ cycle?

Have the BSP regions been evaluated for the PBAPS equilibrium cycle? Provide them if available. If not, where will they be documented?

RESPONSE

Both BSP options are used for operation with the DSS-CD Long Term Solution. The implementation of BSP is outlined in the proposed change to PBAPS Technical Specification 3.3.1.1 Conditions I and J, included in Attachment 2 of the M+ License Amendment Request submitted September 4, 2014 (ADAMS Accession No. ML14247A503.) As noted in the proposed Action for Condition I, if the DSS-CD solution (i.e., OPRM Upscale function) is inoperable, the required actions are to immediately initiate implementation of the Manual BSP regions and to implement the Automated BSP (ABSP) Scram region within 12 hours. If the ABSP option cannot be implemented within that time, Condition J requires the operator to implement the Manual BSP Regions and BSP Boundary.

The BSP Regions and the BSP Boundary have been established for PBAPS Unit 2 Cycle 21 and are shown on Figures 16 and 17 in the SRLR (see EGC letter submitted on January 29, 2015 (ADAMS Accession No. ML15029A640.)) Similar information will be developed and included in the SRLR for Unit 3.

SRXB-RAI-8

Provide additional plant design parameters relevant to the ATWS calculations in Section 9 of the M+SAR. Specifically: turbine bypass capacity, sources of high pressure injection and their operability issues (e.g., steam is lost after isolation), sources of low pressure injection and their operability issues (e.g., condensate storage tank (CST) pumps). Are FW pumps steam driven, or motor driven? Provide vessel component elevations in units comparable to the ones used for water level in the Section 9 figures (e.g., separators, FW spargers, nominal level, level setpoints for actuations, and top of active fuel (TAF)).

RESPONSE

The turbine bypass capacity used in the analysis is 17.4% of rated steam flow.

The sources of high pressure injection credited in the analyses include the FW system, when available, and high pressure coolant injection (HPCI) / reactor core isolation cooling (RCIC). HPCI / RCIC are credited when FW is unavailable such as in the main steam isolation valve closure (MSIVC) and pressure regulator failure open (PRFO) analyses. There are no low pressure injection systems credited in the anticipated transient without scram (ATWS) analysis.

The HPCI and RCIC systems contain a steam turbine driven pump which is supplied by a separate steam line connected to a main steam line inside containment. Each system's steam supply line has a separate containment penetration and therefore is not affected by closure of the MSIVs. The suction source for the HPCI and RCIC pumps used in the analysis is the condensate storage tank.

The main FW pumps are steam turbine-driven; steam is supplied from the main steam lines or the high pressure turbine exhaust and as such, the pumps are not available following closure of the MSIVs. One of the limitations of the FW system following a turbine trip is the loss of FW heating. This loss of FW heating is included in the ATWS instability analysis. The suction source for the main FW pumps is the condensate system.

In the ODYN MSIVC and PRFO analyses, additional flow is included to control reactor water level to TAF + 5 feet as required per the ODYN analysis.

All level readings in the figures are in units of inches in relation to the separator skirt elevation. This is 514.01 inches above vessel zero (AVZ). For comparison, the following are other elevations in the same units in descending order:

Upper Tap -	598.58 in AVZ
High Water Level (L8) -	589.00 in AVZ
Nominal Level -	562.00 in AVZ
Low Water Level (L3) -	536.00 in AVZ
Narrow Range Level (NRL)	516.50 in AVZ
Separator Skirt Elevation	514.01 in AVZ
Feedwater -	501.38 in AVZ
Top of Active Fuel (TAF)	366.30 in AVZ
Wide Range Level (WRL)	365.55 in AVZ

SRXB-RAI-9

Provide tables of the assumed sequence of events for the ODYN licensing calculation and the ATWS/instability calculation. Describe the sources of water used to control the reactor level. For the equipment used, describe automated actions and other assumptions about operability after the main steam isolation valve (MSIV) isolation occurs.

RESPONSE

For PBAPS ATWS overpressure, the TRACG methods described in Supplement 1-A of NEDE-32906P have been used in lieu of the ODYN licensing calculation.

For the PBAPS ATWS long-term pool and containment heatup, the ODYN licensing method was used.

See Tables SRXB-RAI-9-1 through 9-6 for the sequence of events for the TRACG ATWS overpressure, ODYN long-term heatup, and the TRACG ATWS instability transients.

Table SRXB-RAI-9-1 - PRFO ATWS Overpressure Sequence of Events – TRACG

Item	Event Response	MELLLA+ Beginning of Cycle (BOC) Event Time (sec)
1	[[	
2		
3		
4		
5		
6		]]

Table SRXB-RAI-9-2 - MSIVC ATWS Overpressure Sequence of Events – TRACG

Item	Event Response	MELLLA+ BOC Event Time (sec)
1	[[	
2		
3		
4		
5		]]

Table SRXB-9-3 - PRFO ATWS Long Term Heatup Sequence of Events - ODYN

Item	Event Response	MELLLA+ BOC Event Time (sec)	MELLLA+ EOC Event Time (sec)
1	[[		
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			]]

Table SRXB-RAI-9-4 - MSIVC ATWS Long Term Heatup Sequence of Events - ODYN

Item	Event Response	MELLLA+ BOC Event Time (sec)	MELLLA+ EOC Event Time (sec)
1	[[		
2			
3			
4			
5			
6			
7			
8			
9			
10			

Item	Event Response	MELLLA+ BOC Event Time (sec)	MELLLA+ EOC Event Time (sec)
11			
12			
13			
14			]]

Table SRXB-RAI-9-5 - Turbine Trip With Bypass (TTWBP) ATWS Instability Sequence of Events - TRACG

Item	Event Response	Time (sec)
1	[[	
2		
3		
4		
5		
6		
7		
8		]]

Table SRXB-RAI-9-6 - Recirculation Pump Trip (RPT) ATWS Instability Sequence of Events - TRACG

Item	Event Response	Time (sec)
1	[[	
2		
3		
4		]]

See the response to SRXB-RAI-8 for a description of the sources of water used to control the reactor level.

In the TRACG ATWS overpressure calculations (Tables SRXB-RAI-9-1 and 9-2) the peak vessel pressure occurs at less than 25 seconds. Thus, main FW is all that is important in this transient, and the effects of automated actions and other assumptions about operability are unimportant for the peak pressure assessment.

In the ODYN ATWS long-term heatup calculations (Tables SRXB-RAI-9-3 and 9-4) additional flow is included to control reactor water level to TAF + 5 feet. This flow comes from a

combination of main FW flow and HPCI / RCIC. HPCI / RCIC are available when FW is unavailable.

In the TRACG ATWS instability calculations (Tables SRXB-RAI-9-5 and 9-6) [[ ]] In the limiting TTWBP ATWS instability calculation the reactor water level is decreased via operator action starting at 120 seconds. Loss of FW heating is included in the ATWS instability analysis due to the loss of steam flow to the FW heaters.

SRXB-RAI-10

Typically, critical operator actions for ATWS include: place the reactor switch in shutdown mode, initiate reduction of water level, initiate standby liquid control system (SLCS) injection, and terminate and prevent injection into the core. Provide a table with the critical operator actions in PBAPS, including two columns: (a) required timing by TS/procedure/training, and (b) assumed timing in the ATWS calculations. Note: report "NA" on the calculation column if the operator critical action has no impact on the calculation (e.g. place switch in shutdown mode). In addition, provide a discussion of the treatment of uncertainties for operator action timing.

RESPONSE

Table SRXB-RAI-10-1 below provides the key operator actions in response to the following ATWS events:

- Main Steam Isolation Valve Closure (MSIVC)
- Pressure Regulator Failure Open- Maximum Steam Demand (PRFO)
- Turbine Trip with Bypass (TTWB)
- Reactor Recirculation Pump Trip (RPT)

Table SRXB-RAI-10-1 - ATWS Event Sequence

	OPERATOR ACTIONS	MSIVC Analysis Timing (EOC) (sec)	PRFO Analysis Timing (EOC) (sec)	TTWB Analysis Timing (BOC) (sec)	RPT Analysis Timing (BOC) (sec)	Procedure timing per EGC Operator Response Time Program (sec)
1.	Place mode switch in Shutdown	NA	NA	NA	NA	NA
2.	Initiate Standby Liquid Control System (SLCS) injection	123.8	143.3	120	220	120
3.	Terminate and prevent RPV injection to lower Reactor water level	NA	NA	120	180	120
4.	Initiate RHR containment cooling	660	660	NA	NA	660

The procedural times specified are time critical operator actions per the EGC Operator Response Time Program. Completion of these actions within the time requirements assures the plant complies with the assumptions made during the analysis of design basis events, regulatory

committed design events, and events with high PRA significance. Operator response procedures are symptom-based and do not include time requirements.

The response to APHB-RAI-5 provides a discussion of how margin is assured for operators to accomplish actions within the required times.

SRXB-RAI-11

The neutron flux provided for the ATWS-instability turbine trip with full bypass (TTWBP) calculation is core-average, and the power oscillations [[

]] Is the oscillation out-of-phase (OOP)? Provide additional plots with hot channel powers at symmetric core locations showing the amplitude of the regional oscillations for the ATWS-instability calculation.

RESPONSE

Additional ATWS-instability (ATWSI)-TTWBP plots showing two sets of hot channel powers in opposite regions are provided in Figures SRXB-RAI-11-1 and 11-2. Figure SRXB-RAI-11-1 shows hot channels 113 and 114, and Figure SRXB-RAI-11-2 shows hot channels 115 and 116. Figure SRXB-RAI-11-3 shows the liquid mass flow in the lower part section heated length of Channel 116 (about one quarter of the heated length, where the PCT is high). The PCT plotted in M+SAR Figure 9-8 is a composite of the PCT for all channels. The plots provided in this response represent the four hot channels with the highest individual PCT values. These plots show that the oscillations begin in phase but transition to out of phase, regional oscillations as the power oscillations grow.

Note that the channel power oscillations are greater than the core-average power oscillations. Channel power oscillations of this magnitude are large enough to cause flow oscillations with very low minimum flows in the lower part of the heated length (Figure SRXB-RAI-11-3 illustrates this for Channel 116). The low flows result in the lower part of the channel entering into boiling transition. Once in boiling transition, the PCT heat-up is primarily driven by the average power (not the power peaks) because the power oscillation period is relatively small compared to the thermal time constant of the fuel rod. The PCT oscillations observed are consistent with the predicted channel power and flow behavior.

[[

]]

Figure SRXB-RAI-11-1 - TRACG ATWS Analysis – TTWBP – [[
]]

[[

]]

Figure SRXB-RAI-11-2 - TRACG ATWS Analysis – TTWBP – [[
]]

[[

]]

Figure SRXB-RAI-11-3 - TRACG ATWS Analysis – TTWBP – [[
]]

SRXB-RAI-12

a) Section 9.3.3 of the M+SAR specifies that [[
]] Is the TRACG quench model turned on for these calculations? Is it activated for the ATWS/instability transient?

b) The ATWS/instability calculation (M+SAR Figure 9-8) shows [[
]] What mechanism allows for rewet if the quench model is turned off?

c) Provide plots similar to M+SAR Figure 9-8 that shows PCT superimposed with the calculated Tmin value.

RESPONSE

a) The quench model is turned on for the ATWSI cases.

b) [[

]] It is noted that M+SAR PCT in Figure 9-8 is in units of Fahrenheit; whereas, Figure SRXB-RAI-12-1 shows temperature in units of Kelvin. [[

]]

c) The "Peak Clad Temperature" in M+SAR Figure 9-8 shows the highest clad temperature in the core at each time step. The location of the highest PCT can vary from different channels and/or levels. To address this RAI, the PCT and Tmin at a single location is provided. The chosen location is the location that resulted in the highest overall PCT. This location occurs in Channel 114, heated level 16. It is noted that M+SAR PCT in Figure 9-8 is in units of Fahrenheit; whereas, Figure SRXB-RAI-12-2 shows temperature in units of Kelvin.

[[

]]

Figure SRXB-RAI-12-1 - [[

]]

[[

]]

Figure SRXB-RAI-12-2 - [[

]]

SRXB-RAI-13

What methods are used for PBAPS fluence calculations for the Pressure and Temperature Limits Report (PTLR) results? How is the uncertainty in the fluence calculation impacted by MELLLA+? Does the uncertainty stay below 20%?

RESPONSE

The fast neutron (>1 MeV) fluence is calculated using the GEH methodology described in Licensing Topical Report NEDC-32983P-A, Revision 2; a mix of fluence methods is not used. The uncertainty [[ ]] is less than 20%.

The PBAPS Pressure-Temperature Limit Reports (PTLRs) for Units 2 and 3 are based on fast neutron fluence that accounts for operational history and the EPU thermal power level of 3,951 MW starting in Cycle 21. The effect of MELLLA+ operation on reactor vessel fast neutron fluence is specifically evaluated in Section 3.2.1 of the PBAPS M+SAR and [[ ]] The current pressure and temperature curves remain bounding. Since the methodology used for MELLLA+ is consistent with EPU, [[ ]]

SRXB-RAI-14

Question Deleted.

SRXB-RAI-15

M+SAR Section 2.4.1, "DSS-CD Setpoints," page 2-13, states:

> [[ ]]

Provide the TRACG transient results to demonstrate that [[ ]] In the results, mark the time that DSS-CD detects the oscillations and would have scrammed if active for this calculation.

RESPONSE

Figure SRXB-RAI-15-1 shows the TRACG transient [[ ]]

[[

]]

Figure SRXB-RAI-15-1 - PBAPS MELLLA+ Equilibrium Cycle [[
]]

SRXB-RAI-16

With regard to M+SAR Section 3.1.2, "Overpressure Relief Capacity," what is the peak calculated pressure for the overpressure analyses? Specify the most limiting overpressure event.

RESPONSE

As stated in Section 3.1.2 of the PBAPS M+SAR, the limiting overpressure event is the main steam isolation valve closure with scram on high flux (MSIVF). The resulting peak dome pressure is 1324 psig and the peak RPV pressure is 1352 psig. Both are less than the ASME Service Level B limit of 1375 psig.

SRXB-RAI-17

There are three outliers that are visually apparent in M+SAR Figure 2-17 at Integrated Bundle Power (PB) vs Bundle Average In-Channel Void Fraction (VFC) of about 0.5 and 0.41, respectively. Provide a discussion on these and any other outliers in Figure 2-17.

RESPONSE

The purpose of M+SAR Figure 2-17 is to address Methods LTR SER Limitation and Condition 9.6 (NEDC-33173P-A, Revision 4) by showing the VFC corresponding to the bundles with the lowest critical power ratio (CPR) or highest bundle power (PB). The region of importance is above 50% VFC for EPU cores. The bundles with the lowest critical power margin and highest bundle power (i.e., hot channel) correspond to the data points highlighted in yellow in Figure SRXB-RAI-17-1. The yellow highlighted data points should be around 60% VFC (as noted by the red line indication) to confirm the appropriate hot channel axial average void condition is used in the R-factor calculation.

M+SAR Figure 2-17 is typically plotted for data points from 40% to 70% VFC to capture bundles with CPR less than 2 and PB greater than 1. Data points below 40% VFC are typically bundles near or on the core periphery and have CPR greater than 2 and PB less than 1. The perceived outliers described in the RAI (see green highlighted data points in Figure SRXB-RAI-17-1) are not outliers based on correlation fitting, but are representative of lower powered bundles on or near the core periphery. Lower powered bundles will have lower axial average void conditions and thus greater critical power margin. These perceived outlier data points are not in the region of interest for confirming the appropriate hot channel axial average void condition are used in the R-factor calculation.

The data points in M+SAR Figure 2-17 are generated for every bundle in the core (764) at every statepoint (51) evaluated in the equilibrium cycle, for a total of 38,964 data points for both CPR vs VFC and PB vs VFC series values. The complete data range is shown below in Figure SRXB-RAI-17-2, with the area extracted to complete M+SAR Figure 2-17 highlighted with the light blue outline.

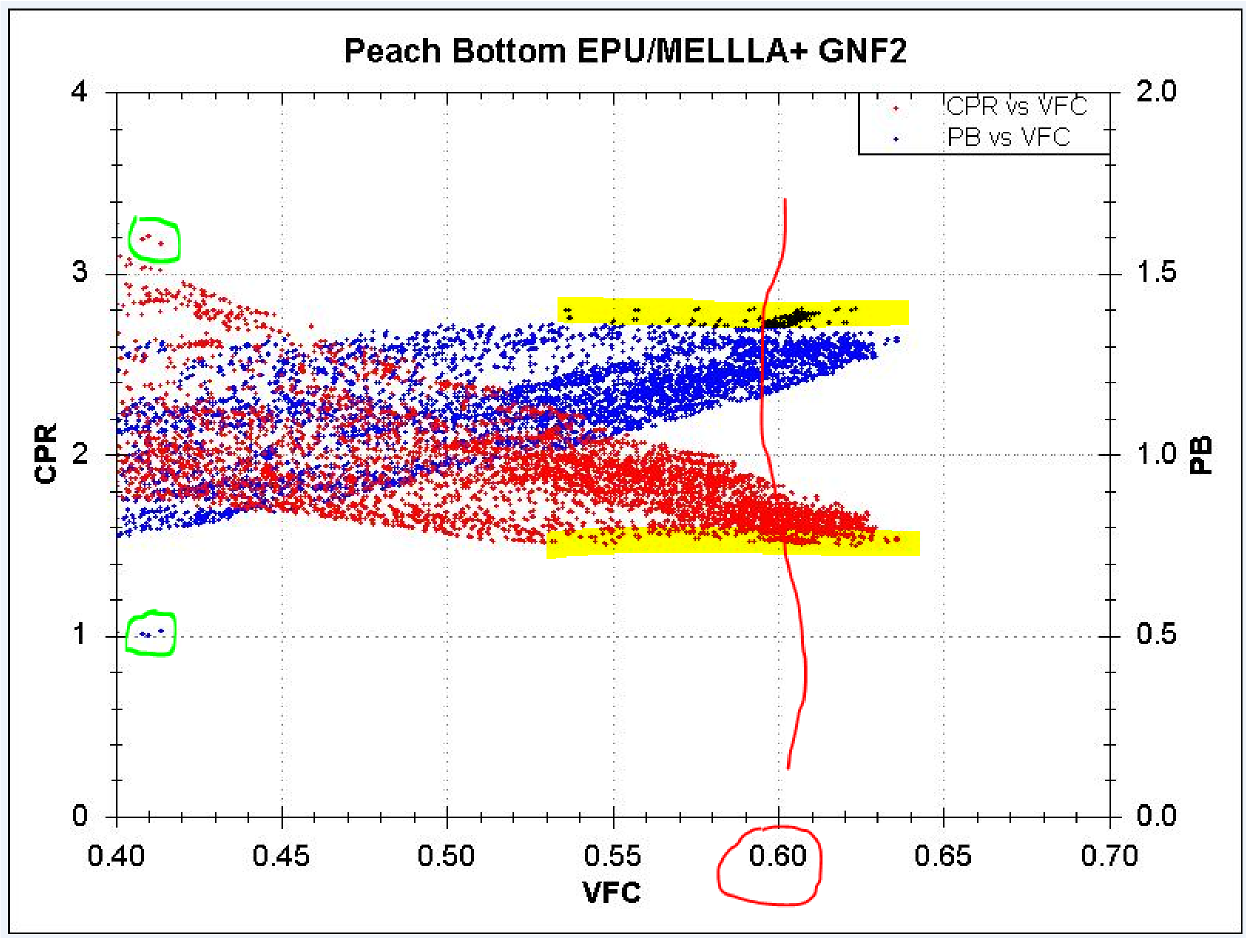

Figure SRXB-RAI-17-1 - Highlighted Content of M+SAR Figure 2-17

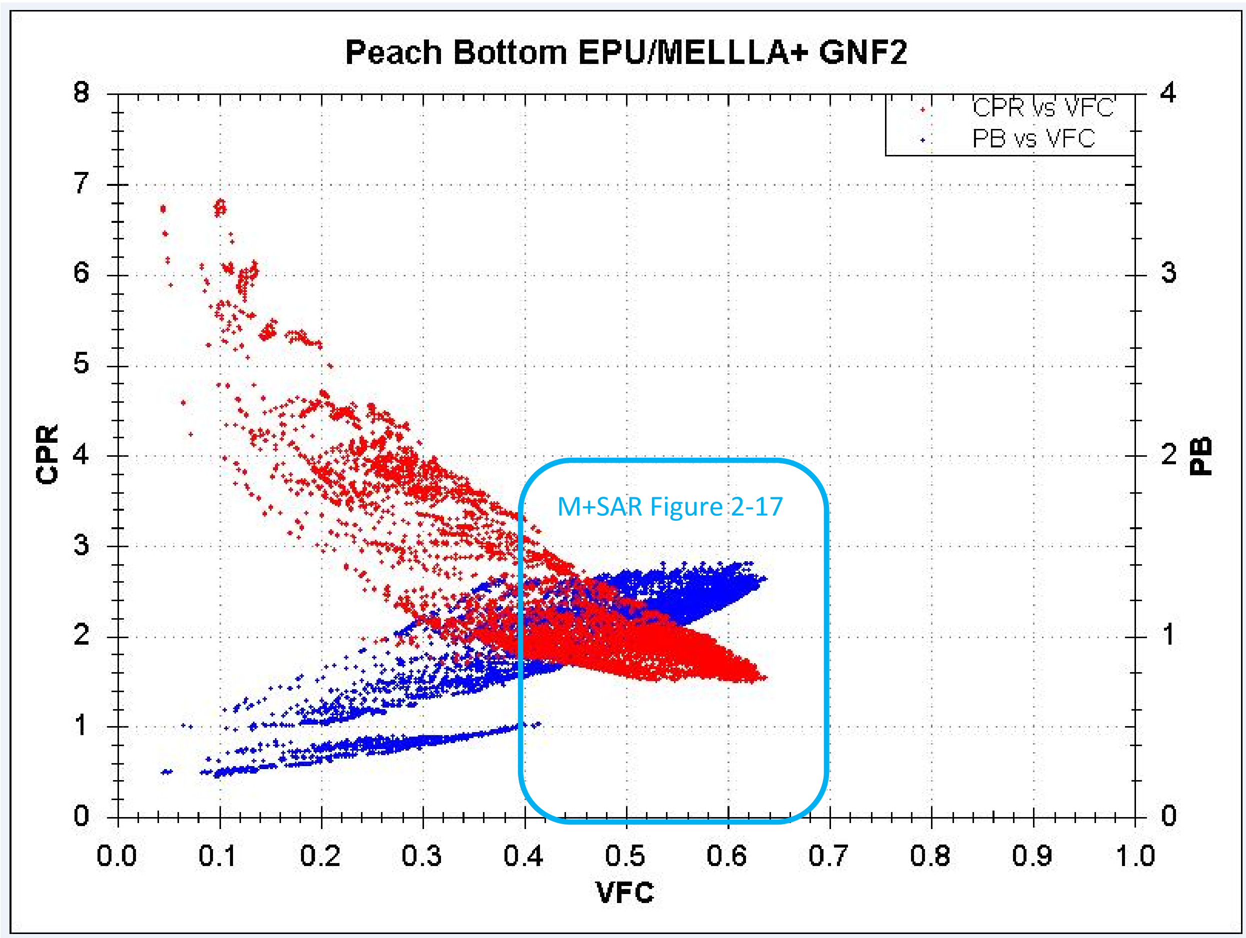

Figure SRXB-RAI-17-2 - Data Extraction for M+SAR Figure 2-17

Attachment 3

MELLLA+ LAR Supplement 3
Peach Bottom Atomic Power Station Units 2 and 3
NRC Docket Nos. 50-277 and 50-278

Response to PRA and Human Performance Branch (APHB)
Request for Additional Information

Response to PRA and Human Performance Branch (APHB)
Request for Additional Information

By letter dated September 4, 2014, Exelon Generation Company, LLC (EGC) submitted a license amendment request for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. The proposed amendment would allow operation in the Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain and the use of the Detect and Suppress – Confirmation Density stability solution.

In an email dated April 7, 2015, from the NRC (Rick Ennis) to Exelon (David Neff), the NRC provided updated requests for additional information seeking clarification of certain issues related to the LAR. This attachment provides responses to those RAIs.

APHB-RAI-13

Attachment 1 to the licensee's submittal dated February 6, 2015, described future actions Exelon plans to take with respect to time-critical operator actions associated with the MELLLA+ analysis. Since the licensee has not yet validated that these time-critical operator actions can be completed consistent with the MELLLA+ analysis, the NRC staff proposes that the licensee add a license condition to control these validation activities. Please confirm the acceptability of the following proposed license condition, or propose an alternative:

(17) Maximum Extended Load Line Limit Analysis Plus (MELLLA+) Operator Training

Prior to operation in the MELLLA+ operating domain, the licensee shall:

(a) Complete operator training on time-critical actions supporting the MELLLA+ analysis.

(b) Validate the ability to complete the time-critical actions consistent with the assumptions in the MELLLA+ analysis.

(c) Provide the results of the validation activities to the NRC as a report in accordance with 10 CFR 50.4. As a minimum, the report shall contain the following:

1) a listing of the time-critical response times assumed in the MELLLA+ analysis;

2) the average times recorded for completion of the associated actions for all operating crews during operator training; and

3) any problems/discrepancies identified during the validation activities and how the problems/discrepancies were resolved. The report shall be submitted to the NRC within 90 days following completion of the validation activities.

RESPONSE

EGC accepts the above license condition with minor modifications as noted below. Consistent with the MELLLA+ ATWS analysis, the proposed license condition applies to the time-critical actions of initiating reactor water level reduction and initiating boron injection:

(17) Maximum Extended Load Line Limit Analysis Plus (MELLLA+) Operator Training
Prior to operation in the MELLLA+ operating domain, the Exelon Generation Company shall:

(a) Complete operator training on time-critical actions supporting the MELLLA+ analysis.

(b) Validate the ability to complete the time-critical actions consistent with the assumptions in the MELLLA+ analysis.

(c) Provide the results of the validation activities to the NRC as a report in accordance with 10 CFR 50.4. As a minimum, the report shall contain the following:

1) a listing of the time-critical response times assumed in the MELLLA+ analysis;

2) the average times recorded for completion of the associated actions for all operating crews during operator training; and

3) a description of the resolution of any problems/discrepancies identified during the validation activities. The report shall be submitted to the NRC within 90 days following completion of the validation activities.

Attachment 4

MELLLA+ LAR Supplement 3
Peach Bottom Atomic Power Station Units 2 and 3
NRC Docket Nos. 50-277 and 50-278

Affidavit in Support of Request to Withhold Information

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Lisa K. Schichlein, state as follows:

(1) I am a Senior Project Manager, NPP/Services Licensing, Regulatory Affairs, GE-Hitachi Nuclear Energy Americas LLC (GEH), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosures 1 and 3 of GEH letter, GEH-PBAPS-MP-132, "GEH Responses to PBAPS MELLLA+ RAIs SRXB-RAI-1 through 3, 6, 8, 9, 11 through 13, 15, and 17," dated April 24, 2015. The GEH proprietary information in Enclosure 1, which is entitled "Responses to SRXB RAIs in Support of PBAPS MELLLA+ LAR," and Enclosure 3, which is entitled "TIP Report," is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] Figures and large objects are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the *Freedom of Information Act* ("FOIA"), 5 U.S.C. Sec. 552(b)(4), and the *Trade Secrets Act*, 18 U.S.C. Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for trade secrets (Exemption 4). The material for which exemption from disclosure is here sought also qualifies under the narrower definition of trade secret, within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975 F.2d 871 (D.C. Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F.2d 1280 (D.C. Cir. 1983).

(4) The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. Some examples of categories of information that fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information that, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information that reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information that discloses trade secret or potentially patentable subject matter for which it may be desirable to obtain patent protection.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, not been disclosed publicly, and not been made available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary or confidentiality agreements that provide for maintaining the information in confidence. The initial designation of this information as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in the following paragraphs (6) and (7).

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, who is the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or who is the person most likely to be subject to the terms under which it was licensed to GEH.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary or confidentiality agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed results and conclusions regarding supporting evaluations of the safety-significant changes necessary to demonstrate the regulatory acceptability of the Maximum Extended Load Line Limit Analysis Plus analysis for a GEH Boiling Water Reactor ("BWR"). The analysis utilized analytical models and methods, including computer codes, which GEH has developed, obtained NRC approval of, and applied to perform evaluations of Maximum Extended Load Line Limit Analysis Plus for a GEH BWR.

The development of the evaluation processes along with the interpretation and application of the analytical results is derived from the extensive experience and information databases that constitute a major GEH asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH. The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial. GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

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

Executed on this 23rd day of April 2015.

Lisa K. Schichlein
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Regulatory Affairs
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