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Your Ref: Docket No. 52-006  
Our Ref: DCP\_NRC\_003287

March 15, 2016

**Subject: 10 CFR 50.46 Annual Report for the AP1000<sup>®1</sup> Standard Plant Design**

Pursuant to 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors", Westinghouse Electric Company, LLC is submitting this report to document emergency core cooling system (ECCS) evaluation model changes or errors for the 2015 – 2016 model year that affect the peak cladding temperature (PCT) calculations for the AP1000 standard plant design. On December 30<sup>th</sup>, 2011, the U.S. Nuclear Regulatory Commission amended its regulations to certify an amendment to the Design Certification rule for the AP1000 standard plant. As such, AP1000 Design Control Document (DCD) Revision 19 documented the analyses of record (AOR).

The limiting Transient for the AP1000 Certified Design as documented in the AP1000 DCD Revision 19 is the Best Estimate Large Break Loss-of-Coolant Accident (LBLOCA). Westinghouse last provided an annual reporting letter to the NRC in March, 2015 (DCP\_NRC\_003285) which presented an estimated PCT of 2010°F for the LBLOCA evaluation. There are no new ECCS model changes that impact PCT for the 2015 – 2016 model year. The estimated PCT for LBLOCA remains at 2010°F and does not exceed the 10 CFR 50.46 (b)(1) acceptance criterion of 2200°F. The summary of the PCT margin allocations and their bases are provided in the Attachment 1.

It is noted that since the last annual report, the NRC has approved the AP1000 Core Reference Report (WCAP-17524-P-A), a generic topical which includes an ECCS "reanalysis" in the context of 10 CFR 50.46. Although the results of the reanalysis have been generically approved for the AP1000 standard plant design, the AOR contained in the Core Reference Report (CRR) has not yet formally been incorporated into COLs or COLAs referencing the standard design. For current COL holders, the CRR AOR will be adopted into the plant-specific AOR pending approval of their license amendment requests. COL applicants may incorporate the CRR AOR as a post-COL license amendment. Despite that the CRR AOR is not yet incorporated into any plant-specific AP1000 design, it is included in this report as Attachment 2 for completeness and as a relevant reference point for the AP1000 design basis.

The information included in this letter is generic and is expected to apply to all COL Holders and COL Applicants referencing the amended Design Certification Rule for the AP1000 nuclear power plant. By copy of this letter, COL Holders and COL Applicants are hereby notified of any changes or errors in the AP1000 standard plant design PCT calculations as required by 10 CFR 50.46(a)(3)(iii).

<sup>1</sup> AP1000<sup>®</sup> is a registered trademark of Westinghouse Electric Company LLC, its subsidiaries and/or affiliates in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

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NRD

Questions or requests for additional information related to content and preparation of this information should be directed to Westinghouse. Please send copies of such questions or requests to the respective COL Holders and COL Applicants referencing the Design amended Certification Rule for the **AP1000** standard plant. A representative for each COL Holder and COL Applicant is included on the cc: list of this letter.

Very truly yours,



Paul A. Russ  
Director, U.S. Licensing and Regulatory Support  
Nuclear Power Plants

/Attachments

1. 10 CFR 50.46 Annual Report for the **AP1000** Standard Plant Design, 2015 – 2016 Model Year
2. 10 CFR 50.46 Annual Report for the **AP1000** Future AOR (CRR), 2015 – 2016 Model Year

Cc: J. McKirgan - U.S. NRC  
L. Burkhart - U.S. NRC  
B. Baval - U.S. NRC  
W. Gleaves - U.S. NRC  
A. Rice - SCANA  
B. Whitley - Southern Company  
R. Kitchen - Duke/Progress Energy  
D. Stout - TVA  
S. Franzone - Florida Power & Light  
R. Easterling - Westinghouse  
D. Weaver - Westinghouse  
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Z. Harper - Westinghouse  
K. Hosack - Westinghouse  
L. Guo - Westinghouse  
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A. Pfister - Westinghouse  
S. Ray - Westinghouse  
D. Olinsky - Westinghouse  
A. Colussy - Westinghouse  
M. Cerrone - Westinghouse

Internal Reference: LTR-LIS-16-21

ATTACHMENT 1

10 CFR 50.46 Annual Report for the **AP1000** Standard Plant Design

2015 – 2016 Model Year

## **ERROR IN NOTRUMP-AP600 EM CORE REFLUX LOGIC**

### **Background**

An error was identified in which the core reflux flow link logic was not properly capturing all flow links that could potentially be contributing to liquid refluxing. The core reflux logic only becomes active when the core/upper plenum mixture level drops into the active fuel region (i.e., core uncover).

This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451 [1].

### **Affected Evaluation Model(s)**

1985 Westinghouse Advanced Plant Small Break LOCA Evaluation Model with NOTRUMP.

### **Estimated Effect**

An estimated peak cladding temperature effect of 0°F is assessed for the existing AP1000® plant small break LOCA analysis results based upon examination of existing calculation results, which indicate that there is no refluxing from the neglected flow path for transients that undergo core uncover.

### **References**

1. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.

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**Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break**

**Plant Name:** AP1000  
**Utility Name:** Westinghouse Nuclear Power Plants  
**Revision Date:** 2/1/2016

**Analysis Information**

**EM:** ASTRUM (2004)      **Analysis Date:** 5/9/2008      **Limiting Break Size:** Split  
**FQ:** 2.6      **FdH:** 1.75  
**Fuel:** RFA      **SGTP (%):** 10

**Notes:**

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1837	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1 . Evaluation of Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	139	2	
2 . Revised Heat Transfer Multiplier Distributions	11	3	
3 . Error in Burst Strain Application	23	4	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1 . None	0		
<b>C. 2015 ECCS MODEL ASSESSMENTS</b>			
1 . None	0		
<b>D. OTHER*</b>			
1 . None	0		

**LICENSING BASIS PCT + PCT ASSESSMENTS**      **PCT =** 2010

\* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.

**References**

- 1 . APP-GW-GL-700, Revision 19, "AP1000 Design Control Document," Tier 2, Chapter 15, June 2011.
- 2 . LTR-LIS-12-288, "Information Regarding the Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown Including Analysis Input Changes for AP1000 Large Break LOCA Analysis," June 2012.
- 3 . LTR-LIS-13-357, "AP1000 Plant 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
- 4 . LTR-LIS-14-41, "AP1000 Plant 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

**Notes:**

None

**Westinghouse LOCA Peak Clad Temperature Summary for Appendix K Small Break**

**Plant Name:** AP1000  
**Utility Name:** Westinghouse Nuclear Power Plants  
**Revision Date:** 2/1/2016

**Analysis Information**

**EM:** NOTRUMP-AP      **Analysis Date:** 8/23/2002      **Limiting Break Size:** 10 Inch  
**FQ:** 2.6      **FdH:** 1.65  
**Fuel:** RFA      **SGTP (%):** 10  
**Notes:**

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1370	1	(a)
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1 . Adiabatic Heat-up Calculation	264	2	(a)
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1 . None	0		
<b>C. 2015 ECCS MODEL ASSESSMENTS</b>			
1 . None	0		
<b>D. OTHER*</b>			
1 . None	0		
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1634</b>		
* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.			

**References**

- 1 . APP-GW-GL-700, Revision 19, "AP1000 Design Control Document," Tier 2, Chapter 15, June 2011.
- 2 . LTR-LIS-10-373, "10 CFR 50.46 Report for the Evaluation of AP1000 SBLOCA 10-inch Transient Adiabatic Heat-up Calculation," June 2010.

**Notes:**

- (a) This is an adiabatic heat-up calculated PCT.

ATTACHMENT 2

10 CFR 50.46 Annual Report for the **AP1000** Future AOR (CRR)  
2015 – 2016 Model Year

## **ERROR IN NOTRUMP-AP600 EM CORE REFLUX LOGIC**

### **Background**

An error was identified in which the core reflux flow link logic was not properly capturing all flow links that could potentially be contributing to liquid refluxing. The core reflux logic only becomes active when the core/upper plenum mixture level drops into the active fuel region (i.e., core uncover).

This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451 [1].

### **Affected Evaluation Model(s)**

1985 Westinghouse Advanced Plant Small Break LOCA Evaluation Model with NOTRUMP.

### **Estimated Effect**

An estimated peak cladding temperature effect of 0°F is assessed for the existing AP1000® plant small break LOCA analysis results based upon examination of existing calculation results, which indicate that there is no refluxing from the neglected flow path for transients that undergo core uncover.

### **References**

1. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.

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**Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break****Future - CRR**

**Plant Name:** AP1000  
**Utility Name:** Westinghouse Nuclear Power Plants  
**Revision Date:** 2/1/2016

**Analysis Information**

**EM:** ASTRUM (2004)      **Analysis Date:** 12/11/2012      **Limiting Break Size:** DEG  
**FQ:** 2.6      **FdH:** 1.72  
**Fuel:** 17x17 AP1000      **SGTP (%):** 10  
**Notes:** Plant specific adaptation of the ASTRUM EM which explicitly accounts for effects of thermal conductivity degradation and peaking factor burndown.

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1936	1	(a)
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1 . Revised Heat Transfer Multiplier Distributions	11	2	
2 . Error in Burst Strain Application	23	3	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1 . None	0		
<b>C. 2015 ECCS MODEL ASSESSMENTS</b>			
1 . None	0		
<b>D. OTHER*</b>			
1 . None	0		

**LICENSING BASIS PCT + PCT ASSESSMENTS**      **PCT =** 1970

\* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.

**References**

- 1 . WCAP-17524-P-A, Revision 1, "AP1000 Core Reference Report," May 2015.
- 2 . LTR-LIS-13-357, "AP1000 Plant 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
- 3 . LTR-LIS-14-41, "AP1000 Plant 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

**Notes:**

- (a) Value contains 2°F bias for PCT sensitivity to PRHR isolation, per Reference 1 response to CRR-008, Table 2 and Table 15.6.5-8.

**Westinghouse LOCA Peak Clad Temperature Summary for Appendix K Small Break****Future - CRR**

**Plant Name:** AP1000  
**Utility Name:** Westinghouse Nuclear Power Plants  
**Revision Date:** 2/1/2016

**Analysis Information**

**EM:** NOTRUMP-AP      **Analysis Date:** 8/26/2013      **Limiting Break Size:** 2 Inch  
**FQ:** 2.6      **FdH:** 1.75  
**Fuel:** RFA      **SGTP (%):** 10  
**Notes:**

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	663.5	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1 . NOTRUMP Bubble Rise/Drift Flux Model Inconsistencies	32	2	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1 . None	0		
<b>C. 2015 ECCS MODEL ASSESSMENTS</b>			
1 . None	0		
<b>D. OTHER*</b>			
1 . None	0		

**LICENSING BASIS PCT + PCT ASSESSMENTS**      **PCT =** 695.5

\* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.

**References**

- 1 . WCAP-17524-P-A, Revision 1, "AP1000 Core Reference Report," May 2015.
- 2 . LTR-LIS-15-5, "Updates to the AP1000 Plant SBLOCA 10 CFR 50.46 PCT Rackups," January 2015.

**Notes:**

- (a) None