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Our Ref: DCP_NRC_003311

March 28, 2017

Subject: 10 CFR 50.46 Annual Report for the AP1000® 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 2016 – 2017 Model Year (i.e., 01/01/2016 – 12/31/2016) that affect the peak cladding temperature (PCT) calculations for the AP1000 plant design.

As described below, three AP1000 analyses of record (AORs) are reported:

AP1000 Design Certification AOR:

On December 30th, 2011, the U.S. Nuclear Regulatory Commission certified an amendment to the Design Certification Rule for the AP1000 plant. As such, AP1000 Design Control Document (DCD) Revision 19 documents the AOR for the AP1000 Design Certification. The limiting transient for the AP1000 Design Certification is the Best Estimate Large Break Loss-of-Coolant Accident (LBLOCA). Westinghouse last provided an annual reporting letter to the NRC in March, 2016 (DCP_NRC_003287) which presented an estimated PCT of 2010°F for the LBLOCA evaluation. There are no new ECCS model changes that impact PCT for the 2016 – 2017 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 for the AP1000 Design Certification AOR are provided in the Attachment 1.

AP1000 V.C. Summer Units 2 & 3 AOR:

In addition to the AOR for the AP1000 Design Certification, 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. The AOR contained in the Core Reference Report (CRR) has also been approved for incorporation into the V.C. Summer Units 2 & 3 licenses via license amendment request (LAR). There are no new ECCS model changes that impact PCT for the 2016 – 2017 model year. The estimated PCT for LBLOCA remains at 1970°F and does not exceed the 10 CFR 50.46 (b)(1) acceptance criterion of 2200°F.

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D063
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The summary of the PCT margin allocations and their bases for the AP1000 V.C. Summer Units 2 & 3 AOR are provided in the Attachment 2.

AP1000 Vogtle Units 3 & 4 AOR:

In addition to the AOR for the AP1000 Design Certification, 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. The AOR contained in the Core Reference Report (CRR) has also been approved for incorporation into the Vogtle Units 3 & 4 licenses via LAR. There are no new ECCS model changes that impact PCT for the 2016 – 2017 model year. The estimated PCT for LBLOCA remains at 1970°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 for the AP1000 Vogtle Units 3 & 4 AOR are provided in the Attachment 3.

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). This letter contains site-specific evaluations for V.C. Summer Units 2 & 3 and Vogtle Units 3 & 4.

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 amended AP1000 Design Certification Rule for the AP1000 nuclear power 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

/Attachments

1. 10 CFR 50.46 Annual Report for the AP1000 Design Certification AOR, 2016 – 2017 Model Year
2. 10 CFR 50.46 Annual Report for the AP1000 V.C. Summer Units 2 & 3 AOR, 2016 – 2017 Model Year
3. 10 CFR 50.46 Annual Report for the AP1000 Vogtle Units 3 & 4 AOR, 2016 – 2017 Model Year

Cc:

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ATTACHMENT 1

10 CFR 50.46 Annual Report for the AP1000 Design Certification AOR

2016 – 2017 Model Year (i.e., 01/01/2016 – 12/31/2016)

GENERAL CODE MAINTENANCE

Background

Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. These changes represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

References

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

ERROR IN OXIDATION CALCULATIONS

Background

A closely-related group of errors were discovered in the WCOBRA/TRAC software program. The errors are related to the calculation of high temperature oxidation within a realistic large break loss-of-coolant accident (LOCA) calculation. This issue has been evaluated to estimate the impact on the Automated Statistical Treatment of Uncertainty Method (ASTRUM) and the Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) licensing-basis analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that correcting the high temperature oxidation calculation in WCOBRA/TRAC is estimated to have a negligible impact on the BE LBLOCA peak cladding temperature (PCT) analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

ERROR IN USE OF ASME STEAM TABLES

Background

The American Society of Mechanical Engineers (ASME) steam tables are used to calculate the steady-state upper head liquid temperature as a function of the pressure and specific enthalpy in the ASTRUM software program. The steam table applicable to steam/gas is used to determine the upper head fluid temperature. However, the water in the upper head is in the subcooled liquid state during normal operation (and the steady-state calculation). Therefore, the steam table applicable to liquid should be used to determine the upper head fluid temperature. This issue has been evaluated to estimate the impact on Automated Statistical Treatment of Uncertainty Method (ASTRUM) Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that the temperatures calculated by the ASME steam tables applicable to the steam/gas side and the liquid side are very similar within the typical upper head pressure and liquid specific enthalpy ranges. Therefore, this error was evaluated to have a negligible impact on the ASTRUM BE LBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

ERRORS IN ADS STAGE 1-3 LINE RESISTANCE CALCULATIONS

Background

During a review of the AP1000[®] plant small break loss-of-coolant accident (SBLOCA) analysis automatic depressurization system (ADS) Stages 1, 2, and 3 line resistances, inconsistencies were identified in the calculation methodology. Several segments of piping were double accounted and other segments were not included. The overall impact of these corrections is a reduction in ADS Stage 1 -3 piping resistance. This change represents a Non-Discretionary Change to the Evaluation Model 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

The impact of these changes are negligible while the ADS Stage 1-3 flow path is experiencing choked flow, and a small increase in flow from ADS Stage 1-3 may be experienced when the flow becomes noncritical. The impact of this difference on the PCT and cladding oxidation results will be minimal since by the time the ADS Stage 1-3 flow path un-chokes, the ADS-4 valves have actuated or the break is large enough to provide an additional significant depressurization path. Therefore, it is concluded that these changes would have a negligible impact on the SBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

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

Plant Name: AP1000
Utility Name: Westinghouse Nuclear Power Plants
Revision Date: 2/21/2017

DCD**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
LICENSING BASIS			
Analysis-Of-Record PCT	1837	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
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. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
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:

- (a) None

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

Plant Name: AP1000
Utility Name: Westinghouse Nuclear Power Plants
Revision Date: 3/17/2017

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
LICENSING BASIS			
Analysis-Of-Record PCT	1370	1	(a)
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . Adiabatic Heat-up Calculation	264	2	(a)
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
1 . None	0		

LICENSING BASIS PCT + PCT ASSESSMENTS **PCT = 1634**

* 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 V.C. Summer Units 2 & 3 AOR

2016 – 2017 Model Year (i.e., 01/01/2016 – 12/31/2016)

GENERAL CODE MAINTENANCE

Background

Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. These changes represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

References

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

ERROR IN OXIDATION CALCULATIONS

Background

A closely-related group of errors were discovered in the WCOBRA/TRAC software program. The errors are related to the calculation of high temperature oxidation within a realistic large break loss-of-coolant accident (LOCA) calculation. This issue has been evaluated to estimate the impact on the Automated Statistical Treatment of Uncertainty Method (ASTRUM) and the Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) licensing-basis analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that correcting the high temperature oxidation calculation in WCOBRA/TRAC is estimated to have a negligible impact on the BE LBLOCA peak cladding temperature (PCT) analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

ERROR IN USE OF ASME STEAM TABLES

Background

The American Society of Mechanical Engineers (ASME) steam tables are used to calculate the steady-state upper head liquid temperature as a function of the pressure and specific enthalpy in the ASTRUM software program. The steam table applicable to steam/gas is used to determine the upper head fluid temperature. However, the water in the upper head is in the subcooled liquid state during normal operation (and the steady-state calculation). Therefore, the steam table applicable to liquid should be used to determine the upper head fluid temperature. This issue has been evaluated to estimate the impact on Automated Statistical Treatment of Uncertainty Method (ASTRUM) Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that the temperatures calculated by the ASME steam tables applicable to the steam/gas side and the liquid side are very similar within the typical upper head pressure and liquid specific enthalpy ranges. Therefore, this error was evaluated to have a negligible impact on the ASTRUM BE LBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

ERRORS IN ADS STAGE 1-3 LINE RESISTANCE CALCULATIONS

Background

During a review of the AP1000[®] plant small break loss-of-coolant accident (SBLOCA) analysis automatic depressurization system (ADS) Stages 1, 2, and 3 line resistances, inconsistencies were identified in the calculation methodology. Several segments of piping were double accounted and other segments were not included. The overall impact of these corrections is a reduction in ADS Stage 1 -3 piping resistance. This change represents a Non-Discretionary Change to the Evaluation Model 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

The impact of these changes are negligible while the ADS Stage 1-3 flow path is experiencing choked flow, and a small increase in flow from ADS Stage 1-3 may be experienced when the flow becomes noncritical. The impact of this difference on the PCT and cladding oxidation results will be minimal since by the time the ADS Stage 1-3 flow path un-chokes, the ADS-4 valves have actuated or the break is large enough to provide an additional significant depressurization path. Therefore, it is concluded that these changes would have a negligible impact on the SBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

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

Plant Name: AP1000 - V. C. Summer Units 2 & 3
Utility Name: South Carolina Electric & Gas
Revision Date: 3/17/2017

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
LICENSING BASIS			
Analysis-Of-Record PCT	1936	1	(a)
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . Revised Heat Transfer Multiplier Distributions	11	2	
2 . Error in Burst Strain Application	23	3	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
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

Plant Name: AP1000 - V. C. Summer Units 2 & 3
Utility Name: South Carolina Electric & Gas
Revision Date: 3/17/2017

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
LICENSING BASIS			
Analysis-Of-Record PCT	663.5	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . NOTRUMP Bubble Rise/Drift Flux Model Inconsistencies	32	2	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
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

ATTACHMENT 3

10 CFR 50.46 Annual Report for the AP1000 Vogtle Units 3 & 4 AOR

2016 – 2017 Model Year (i.e., 01/01/2016 – 12/31/2016)

GENERAL CODE MAINTENANCE

Background

Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. These changes represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

References

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

ERROR IN OXIDATION CALCULATIONS

Background

A closely-related group of errors were discovered in the WCOBRA/TRAC software program. The errors are related to the calculation of high temperature oxidation within a realistic large break loss-of-coolant accident (LOCA) calculation. This issue has been evaluated to estimate the impact on the Automated Statistical Treatment of Uncertainty Method (ASTRUM) and the Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) licensing-basis analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that correcting the high temperature oxidation calculation in WCOBRA/TRAC is estimated to have a negligible impact on the BE LBLOCA peak cladding temperature (PCT) analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

ERROR IN USE OF ASME STEAM TABLES

Background

The American Society of Mechanical Engineers (ASME) steam tables are used to calculate the steady-state upper head liquid temperature as a function of the pressure and specific enthalpy in the ASTRUM software program. The steam table applicable to steam/gas is used to determine the upper head fluid temperature. However, the water in the upper head is in the subcooled liquid state during normal operation (and the steady-state calculation). Therefore, the steam table applicable to liquid should be used to determine the upper head fluid temperature. This issue has been evaluated to estimate the impact on Automated Statistical Treatment of Uncertainty Method (ASTRUM) Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

It was determined that the temperatures calculated by the ASME steam tables applicable to the steam/gas side and the liquid side are very similar within the typical upper head pressure and liquid specific enthalpy ranges. Therefore, this error was evaluated to have a negligible impact on the ASTRUM BE LBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

AP1000 PLANT LAR-114 EVALUATION

Background

The design changes associated with License Amendment Request (LAR) 114 have been evaluated against the AP1000[®] Core Reference Report large break loss-of-coolant accident (LBLOCA) analysis performed in [1]. The evaluated design changes included changes to the ADS stage 2, 3, and 4 local flow areas. The LBLOCA ASTRUM model does not model the opening of ADS stages 1, 2, and 3, and the LBLOCA transients are terminated far before the actuation of ADS stage 4.

These items represent changes in plant configuration, distinguished from an evaluation model change in Section 4 of WCAP-13451 [2].

Affected Evaluation Model(s)

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

A qualitative LBLOCA evaluation was performed to assess the impacts of the design changes included in LAR-114 to the ADS stage 2, 3, and 4 local flow areas. It was concluded that the design changes have no impact on the AP1000 plant Core Reference Report analysis [1]. Therefore, the estimated Peak Cladding Temperature (PCT) impact is 0°F for the AP1000 plant.

References

1. WCAP-17524-P-A, Revision 1, "AP1000 Core Reference Report," May 2015.
2. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.

ERRORS IN ADS STAGE 1-3 LINE RESISTANCE CALCULATIONS

Background

During a review of the AP1000[®] plant small break loss-of-coolant accident (SBLOCA) analysis automatic depressurization system (ADS) Stages 1, 2, and 3 line resistances, inconsistencies were identified in the calculation methodology. Several segments of piping were double accounted and other segments were not included. The overall impact of these corrections is a reduction in ADS Stage 1 -3 piping resistance. This change represents a Non-Discretionary Change to the Evaluation Model 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

The impact of these changes are negligible while the ADS Stage 1-3 flow path is experiencing choked flow, and a small increase in flow from ADS Stage 1-3 may be experienced when the flow becomes noncritical. The impact of this difference on the PCT and cladding oxidation results will be minimal since by the time the ADS Stage 1-3 flow path un-chokes, the ADS-4 valves have actuated or the break is large enough to provide an additional significant depressurization path. Therefore, it is concluded that these changes would have a negligible impact on the SBLOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

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

AP1000 PLANT LAR-114 EVALUATION

Background

The design changes associated with License Amendment Request (LAR) 114 are reductions to the automatic depressurization system (ADS) Stage 2, 3, and 4 flow areas. These changes impact the AP1000® small break loss-of-coolant accident (SBLOCA) analysis. These items represent changes in plant configuration or associated set points, distinguished from an evaluation model change in Section 4 of WCAP-13451 [1].

Affected Evaluation Model(s)

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

Estimated Effect

The updated ADS Stage 2, 3, and 4 flow areas were included in a simulation of the latest limiting SBLOCA transient to assess the combined impact of the design changes and concluded that the reduction in ADS Stage 2, 3, and 4 flow areas resulted in a 13°F PCT impact. As a result, a 13°F PCT penalty is assessed against the AP1000 Core Reference Report analysis [2].

References

1. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.
2. WCAP-17524-P-A, Revision 1, "AP1000 Core Reference Report," May 2015.

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

Plant Name: AP1000 - Vogtle Units 3 & 4
Utility Name: Southern Nuclear Operating Company
Revision Date: 3/17/2017

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
LICENSING BASIS			
Analysis-Of-Record PCT	1936	1	(a)
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . Revised Heat Transfer Multiplier Distributions	11	2	
2 . Error in Burst Strain Application	23	3	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
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

Plant Name: AP1000 - Vogtle Units 3 & 4
Utility Name: Southern Nuclear Operating Company
Revision Date: 3/17/2017

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
LICENSING BASIS			
Analysis-Of-Record PCT	663.5	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . NOTRUMP Bubble Rise/Drift Flux Model Inconsistencies	32	2	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . LAR-114 Evaluation	13	3, 4, 5	(a)
C. 2016 ECCS MODEL ASSESSMENTS			
1 . None	0		
D. OTHER*			
1 . None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 708.5		

* 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.
- 3 . LTR-LIS-16-144, "Update to the AP1000 Plant SBLOCA 10 CFR 50.46 PCT Rackups for LAR-114," January 2017.
- 4 . LTR-LIS-17-59, "AP1000 Plant 10 CFR 50.46 Annual Notification and Reporting for 2016," March 2017.
- 5 . ND-16-0984 (ML16207A340), "Automatic Depressurization System (ADS) Stage 2, 3 & 4 Valve Flow Area Changes and Clarifications (LAR-16-012)," July 2016. Approved by NRC December 29, 2016 as Amendment 62 (ML16357A640).

Notes:

- (a) The LAR-114 evaluation assesses the impact of reduced automatic depressurization system (ADS) Stage 2, 3, and 4 flow areas described in design change proposals (DCPs) 5051 and 5054.