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L-06-168

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

Subject: **Beaver Valley Power Station, Unit No. 1 and No. 2**
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
10 CFR 50.46 Report of Changes or Errors in ECCS Evaluation Models

This report is provided as an annual notification of changes or errors in emergency core cooling system (ECCS) evaluation models for BVPS Unit Nos. 1 and 2. Current information for both large and small break transients has been provided herein to satisfy reporting requirements. The following attachments provide information as requested by 10 CFR 50.46:

Attachment 1 Provides a listing of each change or error in an acceptable evaluation model that affects the peak fuel cladding temperature (PCT) calculation for particular transients. It quantifies the effects of changes that have occurred since the previous report (December 28, 2005) for the specified transients and provides an "index" into Attachment 2 (Descriptions).

Attachment 2 Provides a description for each model change or error.

Attachment 3 Provides a list of references, including those identified in the various descriptions. These documents have already been provided to the NRC by Westinghouse.

The PCT effects, listed in Attachment 1, result in PCTs for the large and small break LOCA transients as follows:

BVPS-1 Large Break LOCA - 2025°F
BVPS-1 Small Break LOCA - 1895°F
BVPS-2 Large Break LOCA - 1977°F
BVPS-2 Small Break LOCA - 1917°F

Changes to the PCT values for all of the above analyses reflect the changes previously reviewed and approved by the NRC via license amendments associated with Extended

A001

Power Uprate, Containment Conversion and BELOCA methodologies for BVPS Unit Nos. 1 and 2.

FENOC previously committed to performing and submitting a re-analysis of the Large Break LOCA for BVPS Unit No. 1 based on analysis input changes which resulted in PCT impacts of greater than 50 degrees Fahrenheit. This commitment was identified in FENOC letter L-05-050 dated April 13, 2005 and the proposed schedule has not changed.

No new commitments are contained in this submittal. If you have questions or require additional information, please contact Mr. Henry L. Hegrat, Supervisor, Fleet Licensing at 330-315-6944.

Sincerely,

James H. Lash

Attachments:
1) Summary of PCT Effects for BVPS LOCA Transients
2) Descriptions of Model Changes or Errors
3) References

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator

ATTACHMENT 1

SUMMARY OF PCT EFFECTS FOR BVPS LOCA TRANSIENTS

SUMMARY OF PCT EFFECTS FOR BVPS LOCA TRANSIENTS

DESCRIPTION	PCT EFFECT (°F)	ATTACHMENT 2 PAGE
BVPS-1 LARGE BREAK LOCA		
REVISED BLOWDOWN HEATUP UNCERTAINTY DISTRIBUTION	5	1
REVISED ITERATION ALOGORITHM FOR CALCULATING THE AVERAGE FUEL TEMPERATURE	0	2
PELLET RADIAL PROFILE OPTION	0	3
IMPROVED AUTOMATION OF END OF BLOWDOWN TIME	0	4
THERMODYNAMIC PROPERTIES FROM THERMO	0	5
PRESSURIZER FLUID VOLUMES	0	6
VESSEL UNHEATED CONDUCTOR NODING	0	7
CONTAINMENT RELATIVE HUMIDITY ASSUMPTION	0	8
GENERAL CODE MAINTENANCE	0	9
BVPS-1 SMALL BREAK LOCA		
PRESSURIZER FLUID VOLUMES	0	10
LOWER GUIDE TUBE ASSEMBLY WEIGHT	0	11
DISCREPANCY IN NOTRUMP RWST DRAINDOWN CALCULATION	0	12
GENERAL CODE MAINTENANCE	0	13

SUMMARY OF PCT EFFECTS FOR BVPS LOCA TRANSIENTS

DESCRIPTION	PCT EFFECT (°F)	ATTACHMENT 2 PAGE
BVPS-2 LARGE BREAK LOCA		
REVISED BLOWDOWN HEATUP UNCERTAINTY DISTRIBUTION	5	1
REVISED ITERATION ALOGORITHM FOR CALCULATING THE AVERAGE FUEL TEMPERATURE	0	2
PELLET RADIAL PROFILE OPTION	0	3
IMPROVED AUTOMATION OF END OF BLOWDOWN TIME	0	4
THERMODYNAMIC PROPERTIES FROM THERMO	0	5
PRESSURIZER FLUID VOLUMES	0	6
VESSEL UNHEATED CONDUCTOR NODING	0	7
CONTAINMENT RELATIVE HUMIDITY ASSUMPTION	0	8
GENERAL CODE MAINTENANCE	0	9
BVPS-2 SMALL BREAK LOCA		
PRESSURIZER FLUID VOLUMES	0	10
DISCREPANCY IN NOTRUMP RWST DRAINDOWN CALCULATION	0	12
GENERAL CODE MAINTENANCE	0	13

ATTACHMENT 2

DESCRIPTIONS OF MODEL CHANGES OR ERRORS

REVISED BLOWDOWN HEATUP UNCERTAINTY DISTRIBUTION

Background

Correction of modeling inconsistencies and input errors in the LOFT input decks have resulted in a change in the predicted peak cladding temperature transients. Revised analyses of the LOFT and ORNL tests were performed using the current version of WCOBRA/TRAC. As a result of this re-analysis, revised blowdown heatup heat transfer coefficients were developed and the revised cumulative distribution function (CDF) was programmed into a new version of HOTSPOT. The revised CDF was previously reported to the NRC in LTR-NRC-04-11. The overall code uncertainty for blowdown was also recalculated and programmed into a new version of MONTECF. The overall code uncertainty for reflood was not affected. These corrections were determined to be Non-Discretionary changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

An estimate of the PCT effect of the revised blowdown heatup CDF was performed for the 1996 and 1999 Evaluation Models by calculating the impact on the reference transient for representative 2-, 3- and 4-loop plants. The estimates bound all of the 95^{th} percentile HOTSPOT results. Estimates of the effect of the revised overall code uncertainty for blowdown were made on a plant-specific basis by repeating the MONTECF analysis, for those plants that track the blowdown period. Therefore, the estimated effect is approximately 5 degrees PCT impact.

REVISED ITERATION ALGORITHM FOR CALCULATING THE AVERAGE FUEL TEMPERATURE
(Enhancements/Forward-Fit Discretionary Change)

Background
Under certain conditions, the iteration scheme to calculate an average fuel temperature in HOTSPOT converged slowly, exceeding the maximum iteration count. This led to an average fuel temperature calculation that was inconsistent with the WCOBRA/TRAC temperature for calculating the stored energy in the fuel. A revised iteration scheme, based on a combination of a secant method and a parabolic interpolation with a bracketing scheme, was implemented to resolve the non-convergence issue. This change is considered to be a Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
The prior inconsistencies between the WCOBRA/TRAC temperature and the HOTSPOT average fuel temperature always resulted in a higher HOTSPOT average fuel temperature. Therefore, a 0°F impact is conservatively assigned for 10 CFR 50.46 reporting purposes.

PELLET RADIAL PROFILE OPTION
(Enhancements/Forward-Fit Discretionary Change)

Background
The radial power profile of fuel pellets was previously assumed to be uniform when setting up the conduction network over the fuel pellet in HOTSPOT. However, the accuracy of this approximation decreases for highly burned fuel since the radial power profile tends to increase from the center towards the outside of the fuel pellet at higher burnups. As such, an option was added in HOTSPOT to use a non-uniform radial power profile consistent with the WCOBRA/TRAC code. These changes were considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
This change is for forward-fit purposes only, and has no effect on existing analyses.

IMPROVED AUTOMATION OF END OF BLOWDOWN TIME
(Enhancements/Forward-Fit Discretionary Change)

Background
Heat transfer multipliers are considered in the uncertainty methodology as a function of the time period in the transient. The blowdown cooling heat transfer multipliers are applied during the time period following turnaround of the blowdown heatup through the end of blowdown. For simplicity, the end of blowdown was originally defined as the time when the system pressure dropped below 40 psia. This definition was then later improved by defining end of blowdown based on the time at which the system pressure stops decreasing. This definition has been further revised in order to improve the automated selection of the end of blowdown time. The revised definition for the end of blowdown was improved by replacing system pressure stops decreasing criterion with a selection based on the time when the collapsed liquid level in the lower plenum reaches a minimum and begins to increase again. These changes were considered to be discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application toPWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
The correct end of blowdown time was selected in all prior analyses. Therefore, the estimated effect is zero degrees.

THERMODYNAMIC PROPERTIES FROM THERMO
(Enhancements/Forward-Fit Discretionary Change)

Background
Subroutine THERMO supplies the thermodynamic properties for the WCOBRA/TRAC one-dimensional components. It is stated in Section 10 of WCAP-12945-P-A and WCAP-16009-P-A that THERMO supplies the thermodynamic properties valid for temperatures within the following range: $280\ K \le T_l \le 697\ K$ However, the thermodynamic properties supplied by THERMO are actually valid for temperatures within the following range: $277\ K \le T_l \le 647\ K$ This is not a change in the methodology, but rather, a correction of the documentation. This change is considered to be Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
This change does not affect the results of design basis analyses. Therefore, the estimated effect is zero degrees.

PRESSURIZER FLUID VOLUMES
(Non-Discretionary Change)

Background
The Westinghouse Systems and Equipment Engineering group has recommended that the previously transmitted pressurizer fluid volumes be replaced with nominal cold values. This change resolves a discrepancy in the prior calculations while providing a close approximation of the actual as-built values. The revised values have been evaluated for impact on current licensing basis analyses and will be incorporated into the plant-specific input databases on a forward-fit basis. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
The differences between the previously transmitted and revised volumes are very small and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated zero degree PCT impact.

VESSEL UNHEATED CONDUCTOR NODING
(Non-Discretionary Change)

Background
A discrepancy was identified in a 1996 Westinghouse Best Estimate Large Break LOCA (BE LBLOCA) Evaluation Model analysis whereby some unheated conductors used node sizes that are inconsistent with the analysis input guidelines. Inspection of selected other analyses using this Evaluation Model identified similar occurrences, and evaluations were completed to estimate the effect of these differences on typical large break LOCA analysis results. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect
Representative plant calculations using the 1996 Westinghouse BE LBLOCA Evaluation Model indicated that correcting the unheated conductor node sizes resulted in a small reduction in peak cladding temperature (PCT) that will conservatively be assigned a 0°F effect for 10 CFR 50.46 reporting purposes. Similar effects would be expected for the 1999 Westinghouse BE LBLOCA Evaluation Model for plants with Upper Plenum Injection, and analyses using this Evaluation Model will also be assigned a 0°F PCT effect. The 2004 Westinghouse BE LBLOCA Evaluation Model with ASTRUM is unaffected, since the discrepancy was identified prior to completion of the initial plant application.

CONTAINMENT RELATIVE HUMIDITY ASSUMPTION
(Non-Discretionary Change)

Background
Large Break LOCA analyses have historically used maximum initial relative humidity to specify the initial containment air and steam partial pressures. This assumption is conservative for a given total initial containment pressure, but is non-conservative for a given initial containment air partial pressure. The historical assumption has been revised accordingly. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

Estimated Effect
An evaluation for the plants within Westinghouse Pittsburgh large break LOCA analysis cognizance concluded that no PCT assessments are required, leading to an estimated PCT effect of 0°F.

GENERAL CODE MAINTENANCE
(Enhancements/Forward-Fit Discretionary Change)

Background
A number of coding changes were made as part of normal code maintenance. Examples include more descriptive file naming, improved automation in the ASTRUM codes, and improved input diagnostics in the WCOBRA/TRAC code. All of these changes are considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
None of these changes affect the results of design basis analyses. Therefore, the estimated effect is zero degrees.

PRESSURIZER FLUID VOLUMES
(Non-Discretionary Change)

Background
The Westinghouse Systems and Equipment Engineering group has recommended that the previously-transmitted pressurizer fluid volumes be replaced with nominal cold values. This change resolves a discrepancy in the prior calculations while providing a close approximation of the actual as-built values. The revised values have been evaluated for impact on current licensing-basis analyses and will be incorporated into the plant-specific input databases on a forward-fit basis. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect
The differences between the previously transmitted and revised volumes are very small and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

LOWER GUIDE TUBE ASSEMBLY WEIGHT
(Non-Discretionary Change – applicable to BVPS-1 only)

Background
An error was discovered in the lower guide tube assembly weight for three units that resulted in a small over-estimation of the upper plenum metal mass. The corrected values have been evaluated for impact on current licensing-basis analyses and will be incorporated into the plant-specific input databases on a forward-fit basis. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP- 13451.

Affected Evaluation Models
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect
The differences in upper plenum metal mass are very small and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

DISCREPANCY IN NOTRUMP RWST DRAINDOWN CALCULATION
(Non-Discretionary Change)

Background
For small break LOCA calculations where the break size is greater than the safety injection (SI) line diameter, and where the SI line is connected directly to the reactor coolant system (RCS), it is assumed that the broken loop safety injection flows do not inject to the RCS, but rather spill to containment. Typically, this is modeled in NOTRUMP-EM analyses by setting the flows injected to the broken loop equal to zero, which neglects the continued depletion of the refueling water storage tank (RWST) inventory. As a result, the RWST draindown time is incorrectly calculated, potentially resulting in an inaccurate modeling of enthalpy changes and/or SI interruptions that can occur at switchover to sump recirculation. Therefore, the SI spilling flows need to be explicitly modeled in order to correctly calculate the RWST draindown time.

Affected Evaluation Models
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect
For Westinghouse plants using the NOTRUMP-EM, the larger small breaks are typically non-limiting and the transients are of short duration. Therefore, correct modeling of the spilling flows in the RWST draindown calculation for these breaks would be expected to produce a negligible effect on SBLOCA results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

GENERAL CODE MAINTENANCE
(Enhancements/Forward-Fit Discretionary Change)

Background
Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculated results. In addition, various updates were made to eliminate inactive coding, improve active coding, and enhance commenting, both for enhanced usability and to facilitate code debugging when necessary. 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 Models
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect
The nature of these changes leads to an estimated PCT impact of 0°F.

ATTACHMENT 3

REFERENCES

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REFERENCES

1. NS-NRC-89-3464 "Correction of Errors and Modifications to the NOTRUMP Code in the Westinghouse Small Break LOCA ECCS Evaluation Model Which Are Potentially Significant," Letter from W. J. Johnson (Westinghouse) to T. E. Murley (NRC), Dated October 5, 1989.

2. WCAP-9220-P-A, Revision 1 (Proprietary), WCAP-9221-A, Revision 1 (Non-Proprietary), "Westinghouse ECCS Evaluation Model - 1981 Version," 1981, Eicheldinger, C.

3. WCAP-10266-P-A, Revision 2 (Proprietary), WCAP-10267-A, Revision 2 (Non-Proprietary), Besspiata, J.J., et. al., "1981 Version of the Westinghouse ECCS Evaluation Model Using the BASH Code," March 1987.

4. WCAP-10054-P-A (Proprietary), WCAP-10081-A (Non-Proprietary), "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," Lee, N., et. al., August 1985.

5. "LOCTA-IV Program: Loss-of-Coolant Transient Analysis," WCAP-8305, (Non-Proprietary), June 1974.

6. "BART-A1 A Computer Code for the Best Estimate Analysis of Reflood Transients," WCAP-9695-A (Non-Proprietary), March 1984.

7. "10CFR50.46 Annual Notification for 1989 of Modifications in Westinghouse ECCS Evaluation Models," NS-NRC-89-3463, Letter from W. J. Johnson (Westinghouse) to T. E. Murley (NRC), Dated October 5, 1989.

8. WCAP-12909-P (Proprietary), "Westinghouse ECCS Evaluation Model Revised LBLOCA Power Distribution Methodology," Dated May 22, 1991.

9. NS-NRC-91-3578, "Westinghouse ECCS Evaluation Model Revised LBLOCA Power Distribution Methodology," Dated May 22, 1991.

10. WCAP-13451, "Westinghouse Methodology For Implementation of 10 CFR 50.46 Reporting."

11. WCAP-10484, Addendum 1, "Spacer Grid Heat Transfer Effects During Reflood," Shimeck, December 1992.

12. ET-NRC-91-3633, "Methodology Clarifications to WCAP-12909-P," Letter from S.R. TRITCH (Westinghouse) to R.C. Jones (NRC), Dated November 21, 1991.

13. ET-NRC-93-3971, "Notification of a Significant Change To Westinghouse Small Break LOCA ECCS Evaluation Model, Pursuant To 10 CFR 50.46(a)(3)(ii): Safety Injection (SI) in the Broken Loop," Letter from N. J. Liparulo (Westinghouse) to R. C. Jones (NRC), Dated September 21, 1993.

14. WCAP-10924-P-A, Revision 1, Volume 1, Addendum 4, "Westinghouse Large Break LOCA Best Estimate Methodology," 1991.

15. NTD-NRC-94-4343, "Interim Report of an Evaluation of a Failure to Comply Pursuant to 10 CFR 21.21(a)(2)-Closeout 94-002," letter from N. J. Liparulo (Westinghouse) to NRC, Dated November 15, 1994.

16. NTD-NRC-94-4143, "Change in Methodology for Execution of Bash Evaluation Model," letter from N. J. Liparulo (Westinghouse) to W. T. Russell (NRC), Dated May 23, 1994.

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REFERENCES (Continued)

17. NTD-NRC-95-4518, "Withdrawal of WCAP 12909-P on Power Shape Sensitivity Model (PSSM)," letter from N. J. Liparulo (Westinghouse) to NRC, Dated August 7, 1995.

18. NTD-NRC-95-4477, "Transmittal of Topical Reports WCAP-14404-P and WCAP-14405-P, "Methodology for Incorporating Hot Leg Nozzle Gaps into BASH,"" letter from N. J. Liparulo (Westinghouse) to R. C. Jones (NRC), Dated July 25, 1995.

19. WCAP-10484-P-A, "Spacer Grid Heat Transfer Effects During Reflood," M. Y. Young et. al., March 1991.

20. NSD-NRC-99-5845, "Closure of Westinghouse Interim report No. 98-029," letter from H. A. Sepp (Westinghouse) to NRC, Dated August 27, 1999.

21. WCAP-9561-P-A, "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients," M. Y. Young et. al., March 1984.

22. WCAP-7437-L, "LOCTA-R2 Program: Loss of Coolant Transient Analysis," W. A. Bezella, et al., January 1970.

23. WCAP-12945-P-A Volume I (Revision 2) and Volumes II-V (Revision 1), "Westinghouse Code Qualification for Best Estimate Loss of Coolant Accident Analysis," S. M. Bajorek, et al., March 1998.