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L-18-037

10 CFR 50.46

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
2017 Annual 10 CFR 50.46 Report of Changes to or Errors in Emergency Core Cooling System Evaluation Models

In accordance with Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.46(a)(3)(ii), FirstEnergy Nuclear Operating Company (FENOC) hereby submits the 2017 annual report of changes to or errors in emergency core cooling system evaluation models, or in the application of the models, for the Beaver Valley Power Station, Unit Nos. 1 (BVPS-1) and 2 (BVPS-2).

The attachments provide a summary list and description of each change to or error in the acceptable evaluation models that affects the peak fuel cladding temperature (PCT) calculation for various loss-of-coolant accidents, as well as the estimated PCT effects of the change or error.

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager - Nuclear Licensing & Regulatory Affairs, at (330) 315-6810.

Sincerely,

Richard D. Bologna

Attachments:

1. Summary of 2017 Peak Fuel Cladding Temperature (PCT) Effects for Beaver Valley Power Station (BVPS) Loss-of-Coolant Accident (LOCA) Transients
2. Descriptions of 2017 Emergency Core Cooling System (ECCS) Evaluation Model Changes or Errors

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Attachment 1
L-18-037

Summary of 2017 Peak Fuel Cladding Temperature (PCT) Effects for Beaver Valley Power Station (BVPS) Loss-of-Coolant Accident (LOCA) Transients

Beaver Valley Power Station, Unit 1		Large Break LOCA	Small Break LOCA
		PCT or PCT Change	PCT or PCT Change
Licensing Basis PCT at BEGINNING of 2017		1840°F	1895°F
2017 Activity			
EM Changes	General Computer Code Maintenance (refer to page 1 of Attachment 2)	0°F	0°F
EM Errors	Vessel Average Temperature Uncertainty (refer to page 2 of Attachment 2)	0°F	0°F
	Error in Upper Plenum Fluid Volume Calculation (refer to page 3 of Attachment 2)	N/A	0°F
	Inconsistent Application of Numerical Ramp (refer to page 4 of Attachment 2)	0°F	N/A
	Inappropriate Resetting of Transverse Liquid Mass Flow (refer to page 5 of Attachment 2)	0°F	N/A
	Steady-State Fuel Temperature Calibration Method (refer to page 6 of Attachment 2)	0°F	N/A
Licensing Basis PCT at END of 2017		1840°F	1895°F

Beaver Valley Power Station, Unit 2		Large Break LOCA	Small Break LOCA
		PCT or PCT Change	PCT or PCT Change
Licensing Basis PCT at BEGINNING of 2017		1839°F	1917°F
2017 Activity			
EM Changes	General Computer Code Maintenance (refer to page 1 of Attachment 2)	0°F	0°F
EM Errors	Vessel Average Temperature Uncertainty (refer to page 2 of Attachment 2)	0°F	0°F
	Error in Upper Plenum Fluid Volume Calculation (refer to page 3 of Attachment 2)	N/A	0°F
	Inconsistent Application of Numerical Ramp (refer to page 4 of Attachment 2)	0°F	N/A
	Inappropriate Resetting of Transverse Liquid Mass Flow (refer to page 5 of Attachment 2)	0°F	N/A
Licensing Basis PCT at END of 2017		1839°F	1917°F

GENERAL COMPUTER CODE MAINTENANCE

Background

Various changes have been made to enhance the usability of computer 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 computer 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, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.

Affected Evaluation Model(s)

1. 1996 Westinghouse Best-Estimate Large Break Loss of Coolant Accident (LOCA) Evaluation Model
   (Applicable to BVPS-2)

2. 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)
   (Applicable to BVPS-1)

3. 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP
   (Applicable to BVPS-1 and BVPS-2)

Estimated Effect

The nature of these changes leads to an estimated peak cladding temperature (PCT) impact of 0°F for both BVPS-1 and BVPS-2.

VESSEL AVERAGE TEMPERATURE UNCERTAINTY

Background

A hysteresis issue was identified for plants with Weed Resistance Temperature Detectors (RTDs) supplied to Westinghouse, which resulted in an additional uncertainty of +0.1°F bias (indicated higher than actual) that applies to the reactor coolant system (RCS) average temperature accident analysis initial condition uncertainty. This discrepancy has been evaluated for impact on existing large and small break LOCA analysis results, and its resolution represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1. 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP (Applicable to BVPS-1 and BVPS-2)

2. 1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model (Applicable to BVPS-2)

3. 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM (Applicable to BVPS-1)

Estimated Effect

This issue was evaluated as having a negligible impact on existing large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for both BVPS-1 and BVPS-2.

ERROR IN THE UPPER PLENUM FLUID VOLUME CALCULATION

Background

An error was found in the fluid volume calculation in the upper plenum where the support column outer diameter was being used instead of the inner diameter. The correction of this error lead to a reduction in the upper plenum fluid volume used in the Appendix K small break LOCA analyses. The corrected value represents a less than 1 percent change in the total RCS fluid volume and will be incorporated on a forward-fit basis, based on the evaluated impact on the current licensing basis analysis results. This change represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1. 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP (Applicable to BVPS-1 and BVPS-2)

Estimated Effect

The differences in the upper plenum fluid volume are relatively minor and have been evaluated to have a negligible effect on small break LOCA analysis results, leading to an estimated PCT impact of 0°F for BVPS-1 and BVPS-2.

INCONSISTENT APPLICATION OF NUMERICAL RAMP APPLIED TO THE ENTRAINED LIQUID/VAPOR INTERFACIAL DRAG COEFFICIENT

Background

A numerical ramp, which was used to account for the disappearance of the entrained liquid phase, was applied to the entrained liquid/vapor interfacial drag coefficient. The numerical ramp was applied such that the interfacial drag coefficient used in the solution of the entrained liquid and vapor momentum equations was not consistent. WCOBRA/TRAC was updated to apply the numerical ramp prior to usage of the interfacial drag coefficient in the momentum equations, such that a consistent interfacial drag coefficient was used in the entrained liquid and vapor momentum equations.

This item represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1. 1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model (Applicable to BVPS-2)

2. 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM (Applicable to BVPS-1)

Estimated Effect

Based on the code validation results, the impact of correcting the error is estimated to have a 0°F impact on PCT for both BVPS-1 and BVPS-2.

INAPPROPRIATE RESETTING OF TRANSVERSE LIQUID MASS FLOW

Background

In the WCOBRA/TRAC routine, which evaluates the mass and energy residual error of the time step solution, the transverse liquid mass flow is reset as the liquid phase disappears. The routine is updated to remove the resetting of the transverse liquid mass flow since the routine is to only evaluate the residual error based on the time step solution values.

This item represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1. 1996 Westinghouse Best-Estimate Large Break LOCA Evaluation Model (Applicable to BVPS-2)

2. 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM (Applicable to BVPS-1)

Estimated Effect

Based on the code validation results and limited applicability of the logic removed, correcting the error is estimated to have a 0°F impact on PCT for both BVPS-1 and BVPS-2.

STEADY-STATE FUEL TEMPERATURE CALIBRATION METHOD

Background

In the ASTRUM best-estimate (BE) large break LOCA evaluation model, the steady-state fuel pellet temperature calibration method involves solving for the hot gap width to calibrate the fuel temperature for each fuel rod. In some infrequent situations, small non-conservatisms can occur in the calibration process such that the resulting fuel pellet temperature will be slightly lower than intended and outside the acceptable range defined by Table 12-6 of WCAP-16009-P/NP-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," January 2005.

This issue has been evaluated to estimate the impact on ASTRUM BE large break LOCA 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)

1. 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM (Applicable to BVPS-1)

Estimated Effect

A review of licensing basis analyses concluded that the potential non-conservatisms in the fuel pellet temperature calibration did not occur for the limiting analysis cases. Therefore, an estimated PCT impact of 0°F is assigned for 10 CFR 50.46 reporting purposes for BVPS-1.