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L-13-206

10 CFR 50.46(a)(3)(ii)

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
10 CFR 50.46 Report of Changes or Errors in ECCS Evaluation Models

In accordance with 10 CFR 50.46(a)(3)(ii), FirstEnergy Nuclear Operating Company (FENOC) provides the attached report as annual notification of changes or errors in emergency core cooling system (ECCS) evaluation models or the application of the models for the Beaver Valley Power Station, Unit Nos. 1 (BVPS-1) and 2 (BVPS-2). Current information for both large and small break loss-of-coolant accident (LOCA) transients is provided to satisfy 10 CFR 50.46 reporting requirements.

Attachment 1 provides a listing of each change or error in an acceptable evaluation model or the application of the models that affects the peak cladding temperature (PCT) calculation for particular transients. It quantifies the effects of the changes that have occurred since the previous annual report in letter dated August 21, 2012 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML12234A736] for the specified transients and provides an index to Attachment 2. Attachment 2 provides a description for each model change or error.

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 – 1834°F
BVPS-1 Small Break LOCA – 1895°F
BVPS-2 Large Break LOCA – 1837°F
BVPS-2 Small Break LOCA – 1917°F

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

Sincerely,

Eric. A Larson

Attachments:
1 Summary of Peak Cladding Temperature Effects for Beaver Valley Power Station Loss-of-Coolant Accident (LOCA) Transients
2 Descriptions of Model Changes or Errors

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

Attachment 1
L-13-206

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


| Description | PCT Effect (°F) | Attachment 2 Page |
|---|---|---|
| BVPS-1 LARGE BREAK LOCA using 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM | | |
| General Code Maintenance | 0 | 1 |
| Hotspot Burst Temperature Calculation for ZIRLO Cladding | 0 | 2 |
| Hotspot Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature | 0 | 3 |
| WCOBRA/TRAC Automated Restart Process Logic Error | 0 | 4 |
| Rod Internal Pressure Calculation | 0 | 5 |
| WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER | 0 | 6 |
| Initial Fuel Pellet Average Temperature Uncertainty Calculation | 0 | 8 |
| BVPS-1 SMALL BREAK LOCA using 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP | | |
| NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation | 0 | 7 |
| BVPS-2 LARGE BREAK LOCA using 1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model | | |
| General Code Maintenance | 0 | 1 |
| Hotspot Burst Temperature Calculation for ZIRLO Cladding | 0 | 2 |

Summary of Peak Cladding Temperature Effects for Beaver Valley Power Station
Loss-of-Coolant Accident (LOCA) Transients (continued)

| Description | PCT Effect (°F) | Attachment 2 Page |
|---|---|---|
| Hotspot Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature | 0 | 3 |
| WCOBRA/TRAC Automated Restart Process Logic Error | 0 | 4 |
| Rod Internal Pressure Calculation | 0 | 5 |
| WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER | 0 | 6 |
| BVPS-2 SMALL BREAK LOCA using 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP | | |
| NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation | 0 | 7 |

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, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break Loss-of-Coolant Accident (LOCA) Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)

Estimated Effect

The nature of these changes leads to an estimated peak cladding temperature (PCT) impact 0 degrees Fahrenheit (°F).

# HOTSPOT BURST TEMPERATURE CALCULATION FOR ZIRLO CLADDING

## Background

A problem was identified in the calculation of the burst temperature for **ZIRLO®** cladding in the HOTSPOT code when the cladding engineering hoop stress exceeds 15,622 pounds per square inch (psi). This problem results in either program failure or an invalid extrapolation of the burst temperature versus engineering hoop stress table. This problem has been evaluated for impact on existing analyses, and its resolution represents a nondiscretionary change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

## Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

## Estimated Effect

The evaluation of existing analyses demonstrated no impact on the overall PCT results, leading to an estimated effect of 0°F.

## HOTSPOT ITERATION ALGORITHM FOR CALCULATING THE INITIAL FUEL PELLET AVERAGE TEMPERATURE

### Background

The HOTSPOT code has been updated to incorporate the following corrections to the iteration algorithm for calculating the initial fuel pellet average temperature: (1) bypass the iteration when the input value satisfies the acceptance criterion; (2) prevent low-end extrapolation of the gap heat transfer coefficient; (3) prevent premature termination of the iteration that occurred under certain conditions; and (4) prevent further adjustment of the gap heat transfer coefficient after reaching the iteration limit. These changes represent a closely-related group of nondiscretionary changes in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

### Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

### Estimated Effect

Sample calculations and engineering judgment lead to an estimated PCT impact of 0°F.

## WCOBRA/TRAC AUTOMATED RESTART PROCESS LOGIC ERROR

### Background

A minor error was identified in the WCOBRA/TRAC Automated Restart Process logic for defining the Double-Ended Guillotine break tables. The error has been evaluated for impact on current licensing-basis analysis results and will be incorporated into the plant-specific analyses on forward-fit basis. These changes represent a closely-related group of nondiscretionary changes in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

### Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

### Estimated Effect

These errors were evaluated to have a negligible impact on the large break LOCA analysis results, leading to an estimated PCT impact of 0°F.

ROD INTERNAL PRESSURE CALCULATION

Background

Several issues that affect the calculation of rod internal pressure (RIP) have been identified for certain best-estimate (BE) large-break loss-of-coolant accident (LBLOCA) evaluation models (EMs). These issues include the sampling of rod internal pressure uncertainties, updating HOTSPOT to consider the effect of transient RIP variations in the application of the uncertainty, and generating RIPs at a consistent rod power. These issues have been evaluated to estimate the impact on existing LBLOCA analysis results. The resolution of these issues represents a closely-related group of nondiscretionary changes in accordance Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

These errors described above are either judged to have a negligible effect on existing LBLOCA analysis results or have been adequately incorporated into the thermal conductivity degradation evaluations, leading to an estimated PCT impact of 0°F.

## WCOBRA/TRAC THERMAL-HYDRAULIC HISTORY FILE DIMENSION USED IN HSDRIVER

### Background

A problem was identified in the dimension of the WCOBRA/TRAC thermal-hydraulic history file used in HSDRIVER. The array that is used to store the information from the WCOBRA/TRAC thermal-hydraulic history file is dimensioned to 3000 in HSDRIVER. It is possible for this file to contain more than 3000 curves. If that is the case, it is possible that the curves would not be used correctly in the downstream HOTSPOT execution. An extent-of-condition review indicated that resolution of this issue does not impact the PCT calculation for prior LBLOCA analyses. This represents a discretionary change in accordance with Section 4.1.1 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

### Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

### Estimated Effect

As discussed in the Background Section, resolution of this issue does not impact the PCT calculation for prior LBLOCA analyses, which leads to a PCT impact of 0°F.

NOTRUMP-EM EVALUATION OF FUEL PELLET THERMAL CONDUCTIVITY DEGRADATION

Background

An evaluation has been completed to estimate the effect of fuel pellet thermal conductivity degradation (TCD) on peak cladding temperature for plants in the United States with analyses using the 1985 Westinghouse Small Break LOCA [SBLOCA] Evaluation Model with NOTRUMP [NOTRUMP-EM]. This change represents a nondiscretionary change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP.

Estimated Effect

Based on the phenomena and physics of the SBLOCA transient, in combination with limited sensitivity calculations, it is concluded that TCD has a negligible effect on the limiting cladding temperature transient, leading to an estimated PCT impact of 0°F.

# INITIAL FUEL PELLET AVERAGE TEMPERATURE UNCERTAINTY CALCULATION

## Background

In the 2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM, uncertainties are applied to the gap heat transfer coefficient and pellet thermal conductivity to capture the uncertainty in the initial fuel pellet average temperature. This approach was compared to the initial fuel pellet average temperature uncertainties predicted by the PAD code at beginning-of-life conditions and found to be conservative in Section 25-4-2-4 of WCAP-12945-P-A. However, the initial fuel pellet average temperature uncertainty range analyzed at higher burnups in the ASTRUM EM is much wider than the uncertainty range predicted by the PAD code, which may result in excessively low or high analyzed initial fuel pellet average temperatures. This has been evaluated to estimate the impact on existing ASTRUM LBLOCA analysis results. The resolution of this issue represents a nondiscretionary change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

## Affected Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

## Estimated Effect

The issue described above was evaluated with plant-specific sensitivity studies resulting in an estimated PCT impact of 0°F.