FENOC™
FirstEnergy Nuclear Operating Company

Beaver Valley Power Station
P.O. Box 4
Shippingport, PA 15077

Eric A. Larson
Site Vice President

724-682-5234
Fax: 724-643-8069

November 5, 2014
L-14-211

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 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) 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 list 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 various transients. It also quantifies the effects of the changes that have occurred since the previous annual report in letter dated July 10, 2013 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML13192A078]. Attachment 2 provides a description for each model change or error.

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

BVPS-1 Large Break LOCA – 1840°F
BVPS-1 Small Break LOCA – 1895°F
BVPS-2 Large Break LOCA – 1832°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: Nuclear Regulatory Commission (NRC) Region I Administrator
NRC Resident Inspector
Nuclear Reactor Regulation Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Atachment 1
L-14-211

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
Burst Elevation Selection	0	2
Elevations for Heat Slab Temperature Initialization	0	3
Heat Transfer Logic Correction for Rod Burst Calculation	0	4
WCOBRA/TRAC U19 File Dimension Error Correction	0	5
Heat Transfer Model Error Corrections	0	6
Correction to Heat Transfer Node Initialization	0	7
Mass Conservation Error Fix	0	8
Correction to Split Channel Momentum Equation	0	9
Changes to Vessel Superheated Steam Properties	0	10
Update to Metal Density Reference Temperatures	0	11
Decay Heat Model Error Corrections	0	12
Correction to the Pipe Exit Pressure Drop Error	0	13
Vessel Section 7 Mid-Level Elevation Modeling	0	14

Description	PCT Effect (°F)	Attachment 2 Page
Grid Heat Transfer Enhancement Calculation	0	15
Revised Heat Transfer Multiplier Distributions	-1	16
Error in Burst Strain Application	7	17
Changes to Grid Blockage Ratio and Porosity	0	18
BVPS-1 SMALL BREAK LOCA using 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP		
SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0	19
BVPS-2 LARGE BREAK LOCA using 1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model		
General Code Maintenance	0	1
Elevations for Heat Slab Temperature Initialization	0	3
Heat Transfer Logic Correction for Rod Burst Calculation	0	4
WCOBRA/TRAC U19 File Dimension Error Correction	0	5
Heat Transfer Model Error Corrections	0	6
Correction to Heat Transfer Node Initialization	0	7
Mass Conservation Error Fix	0	8

Description	PCT Effect (°F)	Attachment 2 Page
Correction to Split Channel Momentum Equation	0	9
Changes to Vessel Superheated Steam Properties	0	10
Update to Metal Density Reference Temperatures	0	11
Decay Heat Model Error Corrections	0	12
Correction to the Pipe Exit Pressure Drop Error	0	13
Vessel Section 7 Mid-Level Elevation Modeling	0	14
Grid Heat Transfer Enhancement Calculation	0	15
Revised Heat Transfer Multiplier Distributions	-35	16
Error in Burst Strain Application	30	17
Changes to Grid Blockage Ratio and Porosity	0	18
BVPS-2 SMALL BREAK LOCA using 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP		
SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0	19
Beaver Valley Unit 2 Accumulator Tank Volume Input Assessment	0	20

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 of 0 degrees Fahrenheit (°F).

BURST ELEVATION SELECTION

Background

It is stated on page 11-20 of WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)" that the burst option is applied at the elevation corresponding to the thermal hydraulic computer code (WCOBRA/TRAC) burst elevation for the hot assembly rod. This approach was modified to apply the burst option at the HOTSPOT predicted burst elevation as described on page 19 of Attachment 1 to LTR-NRC-06-8, "U.S. Nuclear Regulatory Commission – 10 CFR 50.46 Annual Notification and Reporting for 2005." The HOTSPOT code has been updated to incorporate the following changes to the burst elevation selection logic if multiple nodes burst at the same time: (1) the node that has the highest cladding temperature at the time of burst is selected; (2) if multiple nodes have the same burst time and cladding temperature at the time of burst, the lowest ordered elevation of those nodes is selected. These changes represent a closely related group of 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

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

The improvement in burst elevation selection is a forward-fit change, leading to an estimated PCT impact of 0°F.

ELEVATIONS FOR HEAT SLAB TEMPERATURE INITIALIZATION

Background

An error was discovered in the thermal hydraulic computer code WCOBRA/TRAC whereby an incorrect value would be used in the initial fuel rod temperature calculation for a fuel rod heat transfer node if that node elevation was specified outside of the bounds of the temperature initialization table. This problem has been evaluated for impact on existing analyses, and its resolution 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

Based on inspection of plant analysis input, the input decks for existing analyses are not impacted by this error, leading to an estimated peak cladding temperature impact of 0°F.

HEAT TRANSFER LOGIC CORRECTION FOR ROD BURST CALCULATION

Background

A change was made to the thermal hydraulic computer code WCOBRA/TRAC coding to correct an error that had disabled rod burst in separate effect test simulations. This change 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

Based on the nature of the change and the evaluation model requirements for plant modeling in Westinghouse best estimate large break LOCA analyses with WCOBRA/TRAC, it is judged that existing analyses are not impacted by this change, leading to an estimated peak cladding temperature impact of 0°F.

WCOBRA/TRAC U19 FILE DIMENSION ERROR CORRECTION

Background

A problem was identified in the dimension of an array used to generate the u19 file the thermal hydraulic computer code WCOBRA/TRAC. The u19 file is read during HSDRIVER execution and provides information needed to generate the HOTSPOT thermal-hydraulic history and user input files. The array used to write the desired information to the u19 file is dimensioned to 2000 in WCOBRA/TRAC. It is possible, however, for more than 2000 curves to be written to the u19 file. If that is the case, it is possible that the curves would not be stored correctly on the u19 file. A survey of current Best Estimate Large Break LOCA analyses indicated that the majority of plants had less than 2000 curves in their u19 files; therefore these plants are not affected by the change. For those plants with more than 2000 curves, plant specific sensitivity calculations indicated that resolution of this issue does not impact the peak cladding temperature calculations for prior 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 peak cladding temperature calculation for prior LBLOCA analyses, leading to an estimated PCT impact of 0°F.

HEAT TRANSFER MODEL ERROR CORRECTIONS

Background

Several related changes were made to the thermal hydraulic computer code WCOBRA/TRAC to correct errors discovered that affect the heat transfer models. These errors included calculations of the entrained liquid fraction used in calculation of the drop wall heat flux, application of the grid enhancement factor for grid temperature calculation, calculation of the Reynold's number used in the Wong-Hochrieter correlation for the heat transfer coefficient from fuel rods to vapor, fuel rod initialization and calculation of cladding inner radius with creep, application of grid and two phase enhancement factors and radiation component in single phase vapor heat transfer, and reset of the critical heat flux temperature when J=2. These errors have been evaluated to estimate the impact on existing LBLOCA analysis results. Correction of these errors represents a closely-related group on non-discretionary 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

Based on the results of representative plant calculations, separate effects and integral effects test simulations, it is concluded that the error corrections have a negligible local effect on heat transfer, leading to an estimated PCT impact of 0°F.

CORRECTION TO HEAT TRANSFER NODE INITIALIZATION

Background

An error was discovered in the heat transfer node initialization logic in the thermal hydraulic computer code WCOBRA/TRAC whereby the heat transfer node center locations could be inconsistent with the geometric node center elevations. The primary effects of this issue are the interpolated fluid properties and grid turbulent mixing enhancement at the heat transfer node. This problem has been evaluated for impact on existing analyses, and its resolution represents a non-discretionary 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

Based on engineering judgment and the results from a matrix of representative plant calculations, the effect of the error is within the code resolution, leading to an estimated PCT calculation for prior LBLOCA analyses, which leads to a PCT impact of 0°F.

MASS CONSERVATION ERROR FIX

Background

It was identified that mass was not conserved in the thermal hydraulic computer code WCOBRA/TRAC one-dimensional component cells when void fraction values were calculated to be slightly out of the physical range (greater than 1.0 or smaller than 0.0). This was observed to result in artificial mass generation on the secondary side of steam generator components. Correction of this problem represents a non-discretionary 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

This error was observed to primarily affect the mass on the secondary side of the steam generator. This issue was judged to have a negligible impact on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

CORRECTION TO SPLIT CHANNEL MOMENTUM EQUATION

Background

An error was discovered in the momentum equation calculations for split channels in the thermal hydraulic computer code WCOBRA/TRAC. This error impacts the (1) continuity area of the phantom/boundary bottom cell; (2) bottom and top continuity area correction factors for the channel inlet at the bottom of a section and for the channel outlet at the top of a section; and (3) drop entrainment mass rate per unit volume and drop de-entrainment mass rate per unit volume contributions to the momentum calculations for split channels. This problem has been evaluated for impact on existing analyses, and its resolution represents a non-discretionary 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

Based on the results from the matrix of representative plant calculations, the effects of this error on the quantities directly impacted by the momentum equation calculations for split channels—velocities, flows, et cetera—is negligible, leading to an estimated PCT impact of 0°F.

CHANGES TO VESSEL SUPERHEATED STEAM PROPERTIES

Background

Several related changes were made to the thermal hydraulic computer code WCOBRA/TRAC coding for the vessel superheated water properties, including updating the HGAS subroutine coding to be consistent with WCAP-12945-P-A, "Westinghouse Code Qualification Document for Best Estimate Loss of Coolant Accident Analysis," Equation 10-6, updating the approximation of the enthalpy of the TGAS subroutine to be consistent with the HGAS subroutine coding, and updating the temperature iteration method and convergence criteria in the TGAS subroutine. These changes represent a closely related group of non-discretionary 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

The updates to the calculations of the superheated steam properties had generally less than 1°F impact on the resulting steam temperature values, leading to an estimated PCT impact of 0°F.

UPDATE TO METAL DENSITY REFERENCE TEMPERATURES

Background

For one-dimensional components in which heat transfer to stainless steel 304 or 316 is modeled, the reference temperature for the metal density calculation was allowed to vary and as a result, the total metal mass was not preserved. Correction of this problem represents a non-discretionary 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

This change primarily impacts the reactor coolant system loop piping model in the large break LOCA WCOBRA/TRAC models. It was judged that the effect of this change on the PCT was negligible, leading to an estimated PCT impact of 0°F.

DECAY HEAT MODEL ERROR CORRECTIONS

Background

The decay heat model in the thermal hydraulic computer code WCOBRA/TRAC was updated to correct the erroneously coded value of the yield fraction directly from fission for Group 19 of Pu-239, and to include the term for uncertainty in the prompt energy per fission in the calculation of the decay heat power uncertainty. Correction of these errors represents a closely related group of non-discretionary 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 changes have a negligible impact on the calculated decay heat power, leading to an estimated PCT impact of 0°F.

CORRECTION TO THE PIPE EXIT PRESSURE DROP ERROR

Background

An error was discovered in the thermal hydraulic computer code WCOBRA/TRAC whereby the frictional pressure drop at the split break TEE connection to the BREAK component was incorrectly calculated using the TEE hydraulic diameter instead of the BREAK component length input. This error has been evaluated for impact on existing analyses, and its resolution represents a non-discretionary 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

Based on the results from a matrix of representative plant calculations, the effect of this error on the pressure at the break and the break flow is negligible, leading to an estimated PCT impact of 0°F.

VESSEL SECTION 7 MID-LEVEL ELEVATION MODELING

Background

Documentation deficiencies have been identified that are associated with Large Break LOCA Evaluation Models and plant specific analyses.

The first is an incorrect statement made on page 20-4-5 of topical report WCAP-12945-P-A, "Code Qualification Document for Best Estimate LOCA Analysis". The section 7 mid-level elevation utilized in the sample analysis, discussed in that subsection, was incorrectly stated as being at the bottom of the deep beam. Instead, the level coordinate is at the top of the top flowslot of the support columns. In addition, the bottom of section 7 is first described as extending from the top of the hot leg and is later characterized as being at the bottom of the hot legs, but the description should read that the bottom of the section is set at the top of the hot legs. The similar statement regarding the deep beam made on page 12-6 of topical report WCAP-16009-P-A, "Realistic Large Break Loss of Coolant Accident Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method," is also incorrect.

The second deficiency is an incorrect statement made on page 3-4 of the BVPS-2 plant specific report for the LBLOCA Analysis (WCAP-15900, Revision 1). The correct statement for Section 3.2.1 should be "Vessel section 7 ... with the lower cell extending from the top of the hot legs to the top of the top flowslot of the support column," rather than "Vessel section 7 ... with the lower cell extending from the top of the hot legs to the bottom of the deep beam." Similarly, there is an incorrect statement made on page 3-4 of the BVPS-1 plant specific report for the LBLOCA Analysis (WCAP-17052).

Westinghouse considers that for 3 or 4 loop plants with the deep beam design (those with Upper Support Plates of design type "Flat" and "Top Hat" in nature), the choice of setting the level breakpoint at either position is equally correct because there are no geometry aspects in this axial position of the vessel that warrant a critical modeling decision to capture LBLOCA transient phenomena, and the level difference is approximately 5 inches for typical applications, including both BVPS-1 and BVPS-2. Future analyses can use either coordinate. These are not considered changes to the methodology, but rather corrections of the documentation. These changes represent a closely related group of non-discretionary 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

Because either model is appropriate, there is no PCT penalty to assess for 10 CFR 50.46 reporting purposes for BVPS.

GRID HEAT TRANSFER ENHANCEMENT CALCULATION

Background

An issue was identified that could affect the calculation of the heat transfer at gridded elevations for Best-Estimate LBLOCA evaluation models. For a specific input condition, the grid heat transfer enhancement factor is calculated based on an erroneous core geometry, which can cause an over-prediction of the heat transfer coefficient at gridded elevations. This issue has been evaluated to estimate the impact on the existing LBLOCA analysis results. The resolution of this issue represents a non-discretionary 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 effect described above was judged to have a negligible effect on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

REVISED HEAT TRANSFER MULTIPLIER DISTRIBUTIONS

Background

Several changes and error corrections were made to the thermal hydraulic computer code WCOBRA/TRAC, and the impacts of these changes on the heat transfer multiplier uncertainty distributions were investigated. During the investigation, errors were discovered in the development of the original multiplier distributions, including errors in the grid locations specified in the WCOBRA/TRAC models for the G2 refill and G2 reflood tests and errors in processing test data used to develop the reflood heat transfer multiplier distribution. Therefore, the blowdown heatup, blowdown cooling, refill, and reflood heat transfer multiplier distributions were redeveloped. For the reflood heat transfer multiplier development, the evaluation time windows for each set of test experimental data and each test simulation were separately defined based on the time at which the test or simulation exhibited dispersed flow film boiling heat transfer conditions characteristic of the reflood time period. The revised heat transfer multiplier distributions have been evaluated for impact on existing analyses. Resolution of these issues represents a closely related group of non-discretionary 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

A plant transient calculation representative of BVPS-1 transient behavior was performed with the latest version of WCOBRA/TRAC. Using this transient, a matrix of HOTSPOT calculations was performed to estimate the effect of the heat transfer multiplier distribution changes. Using these results and considering the heat transfer multiplier uncertainty attributes from limiting cases for BVPS-1, an estimated PCT effect of -1°F has been established for 10 CFR 50.46 reporting purposes for BVPS-1.

A plant transient calculation representative of BVPS-2 transient behavior was performed with the latest version of WCOBRA/TRAC. Using this transient, HOTSPOT calculations were performed with both the original and revised heat transfer multiplier distributions. Based on the change in the 95th percentile results, estimated PCT effects of -5°F for blowdown, 5°F for reflood 1, and -35°F for reflood 2, have been established for 10 CFR 50.46 reporting purposes for BVPS-2. FENOC correspondence dated February 25, 2014, (ML14057A550), previously reported the -35°F change based on cumulative PCT changes exceeding the reporting criteria.

ERROR IN BURST STRAIN APPLICATION

Background

An error in the application of the burst strain was discovered in HOTSPOT. The equation for the application of the burst strain is given as Equation 7-69 in WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)" and in WCAP-12945-P-A, "Code Qualification Document for Best Estimate LOCA Analysis, Volume I: Models and Correlations." The outer radius of the cladding after burst occurs should be calculated based on the burst strain, and the inner radius of the cladding should be calculated based on the outer radius. In HOTSPOT, the burst strain is applied to the calculation of the cladding inner radius. The cladding outer radius is then calculated based on the inner radius. As such, the burst strain is incorrectly applied to the inner radius rather than the outer radius, which impacts the resulting cladding geometry at the burst elevation after burst occurs. Correction of the erroneous calculation results in thinner cladding at the burst node and more fuel relocating into the burst node, leading to an increase in the PCT at the burst node. This issue has been evaluated to estimate the impact on existing BE LBLOCA analysis results. The resolution of this issue represents a non-discretionary 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

For BVPS-1, the issue described above was evaluated by executing the most limiting plant specific HOTSPOT runs with a HOTSPOT version that includes the correction of this error. This plant specific sensitivity study resulted in an estimated PCT impact of 7°F.

A representative BVPS-2 case was run using HOTSPOT versions that only differ in the burst strain application. Based on the change in the 95th percentile results, estimated PCT effects of 0°F for Blowdown, 20°F for Reflood 1, and 30°F for Reflood 2 have been established for 10 CFR 50.46 reporting purposes for BVPS-2. FENOC correspondence dated February 25, 2014, (ML14057A550), previously reported the 30°F change based on cumulative PCT changes exceeding the reporting criteria.

CHANGES TO GRID BLOCKAGE RATIO AND POROSITY

Background

A change in the methodology used to calculate grid blockage ratio and porosity for Westinghouse fuel resulted in a change to the grid inputs for LBLOCA analyses. Grid inputs affect heat transfer in the core during a LBLOCA. This change represents a non-discretionary 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 updates to the methodology to calculate grid blockage ratio and porosity used as input in Westinghouse LBLOCA models resulted in a negligible change to heat transfer in the core for the fuel type used in BVPS-1. The estimated penalty associated with the change is 0°F for 10 CFR 50.46 reporting purposes.

The updates to the methodology to calculate grid blockage ratio and porosity used as input in Westinghouse LBLOCA models resulted in a negligible change heat transfer in the core for the fuel type in BVPS-2. The estimated penalty associated with the changes is 0°F for both Reflood 1 and Reflood 2 for 10 CFR 50.46 reporting purposes.

SBLOCTA CLADDING STRAIN REQUIREMENT FOR FUEL ROD BURST

Background

An error was discovered in the minimum local strain required for the burst for ZIRLO® cladding in the SBLOCTA code. The coding does not enforce reaching the minimum percent local strain threshold prior to calculating fuel rod burst. However, a review of licensing basis analyses revealed no instances of this error impacting calculated results. Resolution of this issue represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

Based on a review of current licensing basis analyses and the phenomena and physics of a SBLOCA transient, this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

BEAVER VALLEY UNIT 2 ACCUMULATOR TANK VOLUME INPUT ASSESSMENT

Background

The accumulator tank volume input into the BVPS-2 SBLOCA NOTRUMP analysis incorrectly included the undeliverable volume. The small reduction in the accumulator tank volume (<1%) was evaluated against the SBLOCA analysis of record. This change represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting."

Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The impact of the reduction of the accumulator tank volume on the SBLOCA analysis results was determined to be negligible with an estimated PCT impact of 0°F.