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Our ref: LTR-NRC-08-24

May 15, 2008

U. S. Nuclear Regulatory Commission
10 CFR 50.46 Annual Notification and Reporting for 2007

Dear Mr. Cranston,

The purpose of this letter is to report the impact of changes or errors in the emergency core cooling system (ECCS) evaluation models used by Westinghouse Electric Company. A description of the changes to the Westinghouse small-break LOCA and large-break LOCA ECCS evaluation models for 2007 is provided as an attachment. Westinghouse has categorized these changes or errors into two separate groups:

- Non-Discretionary Changes
- Discretionary Changes

This annual notification is being provided since it affects information previously submitted in Westinghouse Topical Reports. It is noted that plant-specific peak cladding temperature (PCT) variations are not addressed in this letter. These should be treated, as appropriate, on a plant-specific basis in accordance with the applicable sections of 10 CFR 50. Westinghouse has notified licensees utilizing these Westinghouse ECCS evaluation models in their plant licensing basis of the appropriate reportable changes.

For future referencing convenience, the 2007 10 CFR 50.46 reportable changes provided in the attachment, together with the "2006 Formulation" offered in Reference 2 constitute the "2007 Formulation" of the Westinghouse ECCS evaluation models.

References:

1. ET-NRC-92-3755, "W Methodology for Implementation of 10 CFR 50.46 Reporting," N. J. Liparulo, Westinghouse to NRC Document Control Desk, October 30, 1992. (WCAP-13451)

2. LTR-NRC-07-23, "U.S. Nuclear Regulatory Commission, 10 CFR 50.46 Annual Notification and Reporting for 2006," B. F. Maurer, May 15, 2007.

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Sincerely,

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing Engineering

Attachment:

1. Standard Format Text for Changes and Enhancements to the Westinghouse Evaluation Models for 2007 (32 pages)

cc: J. Thompson/NRC O-7E1A, 1L

Attachment

Standard Format Text for Changes and Enhancements to the Westinghouse Evaluation Models for 2007

Discretionary Changes

General Code Maintenance
LOCBART Oxide-to-Metal Ratio
PBOT and PMID Sampling
Flow Path Enthalpy Transport Numerical Stability in CEFLASH-4A
Upgrade to the Auto-Axial Power Shape Option in STRIKIN-II
Auto-Generation of the STRIKIN-II Base and Case Decks
Increase the Number of Radial Regions for COMZIRC
Implementation of Cathcart-Pawel Oxidation Model and Pre-Transient Oxidation Model
Update to the Auto-Generation of the STRIKIN-II Base and Case Decks

Non-Discretionary Changes

BASH-EM Accumulator Water Temperature
LOCBART Pellet Volumetric Heat Generation Rate
BASH Pellet Volumetric Heat Generation Rate
Errors in Reactor Vessel Nozzle Data Collections
LOCBART Specific Heat Model for Optimized Zirlo™ Cladding
Pump Weir Resistance Modeling
NOTRUMP-EM Refined Break Spectrum
HOTSPOT Fuel Relocation
Revised Upper Plenum Volume Inputs
Steam Generator Nozzle Volume Accounting Error
Cold Leg Volume Discrepancy
Core Barrel Heat Slab Error
Safety Injection Delay Time Issue
Lower Plenum Unheated Conductors
Proprietary Notations in Source and Output
Implementation of Optimized ZIRLO™ Cladding Specific Heat
Correction of an Incorrect Error Message in CEFLASH-4A
Assignment of CEFLASH-4A Regions in COMZIRC
Implementation of Final SER Limitations and Conditions for the Optional Spacer Grid Steam Cooling Heat Transfer Model Improvement in STRIKIN-II
Core Inlet Side-Entry Orifice Modeling Error

BASH-EM ACCUMULATOR WATER TEMPERATURE
(Non-Discretionary Change)

Background
Reference 1 provided 10 CFR 50.46 reporting information regarding the specification of accumulator water temperature in Appendix K large break LOCA analyses. Reference 1 identified a sensitivity of 1.3°F PCT per 1°F accumulator water temperature that can no longer be supported on a generic basis. Existing analyses have been reviewed to identify any usage of this sensitivity, with plant-specific evaluations completed as required to reflect its elimination. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect
The effect of this change was determined on a plant-specific basis.

Reference(s)
1. NTD-NRC-95-4409, "1994 Annual Notification of Changes to the Westinghouse Small Break LOCA ECCS Evaluation Model and Large Break LOCA ECCS Evaluation Model, Pursuant to 10 CFR 50.46 (a)(3)(ii)," February 22, 1995.

LOCBART PELLET VOLUMETRIC HEAT GENERATION RATE (Non-Discretionary Change)

Background

The LOCBART code has been modified to correct an inverted term in the calculation of the pellet volumetric heat generation rate. This change affects the steady-state and transient heat generation for all three rods and could result in either an increase or decrease in peak cladding temperature for a given calculation. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

The effect of this change was determined on a plant-specific basis.

BASH PELLET VOLUMETRIC HEAT GENERATION RATE (Non-Discretionary Change)

Background

The BASH code has been modified to correct an inverted term in the calculation of the pellet volumetric heat generation rate. This change affects the steady-state and transient heat generation for the core average rod prior to bottom-of-core recovery and could result in either an increase or decrease in the cladding temperatures at the beginning of reflood. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Sensitivity calculations using BASH and SMUUTH indicated a negligible effect on the core inlet flooding rate during reflood, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes.

ERRORS IN REACTOR VESSEL NOZZLE DATA COLLECTIONS (Non-Discretionary Change)

Background

Some minor errors were discovered in the reactor vessel nozzle data collections that potentially affect the vessel inlet and outlet nozzle fluid volume, metal mass and surface area. The corrected values have been evaluated for impact on current licensing-basis analysis results and will be incorporated into the plant-specific input databases on a forward-fit basis. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

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

Estimated Effect

The differences in the vessel inlet and outlet nozzle fluid volume, metal mass and surface area are relatively minor and would be expected to produce a negligible effect on large break and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

LOCBART SPECIFIC HEAT MODEL FOR OPTIMIZED ZIRLO™ CLADDING (Non-Discretionary Change)

Background

An option has been added to the LOCBART code to model the specific heat of Optimized ZIRLO™ cladding. The model is described in the response to Request for Additional Information (RAI) #21 in Section D of Reference 1 and will facilitate compliance with Condition and Limitation #9 of the Safety Evaluation Report for plants with a peak cladding temperature that occurs during blowdown or early reflood. (Note that the extrapolation algorithm described in the RAI response was replaced with an error message and code abort for temperatures below 73°F or above 2400°F.) This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

No domestic plant with a BASH-EM analysis maintained by Westinghouse has both Optimized ZIRLO™ cladding and a peak cladding temperature that occurs during blowdown or early reflood, so there is no impact on any existing analysis results.

Reference(s)

1. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™," July 2006.

PUMP WEIR RESISTANCE MODELING
(Non-Discretionary Change)

Background
Review of the reactor coolant pump data collections identified instances of either including a weir resistance for a design without a weir or double-counting the weir resistance for a design with a weir. The corrected resistances have been evaluated for impact on existing analysis results 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 Model(s)
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect
Resolving the identified discrepancies has been evaluated as having a negligible effect on existing results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

GENERAL CODE MAINTENANCE
(Discretionary Change)

Background
Various changes have been made to enhance the usability of the codes and to help preclude errors in analyses. This includes items such as 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)
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.

LOCBART OXIDE-TO-METAL RATIO
(Discretionary Change)

Background
An option has been added to the LOCBART code to convert the user-specified zirconium-oxide thickness to equivalent cladding reacted. This adjustment is made during problem initialization, and the cladding outside diameter is modified accordingly. This change represents a Discretionary Change that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect
This change is expected to produce a minimal effect on the limiting peak cladding temperature, leading to an estimated effect of 0°F.

NOTRUMP-EM REFINED BREAK SPECTRUM (Non-Discretionary Change)

Background

During the course of reviewing several extended power uprate and replacement steam generator Small Break LOCA (SBLOCA) analyses, the Nuclear Regulatory Commission (NRC) questioned the break spectrum analyzed in the NOTRUMP evaluation model (EM). The NRC was concerned that the resolution of the break spectrum used in the NOTRUMP EM (1.5, 2, 3, 4, and 6 inch cases) may not be fine enough to capture the worst break with regard to limiting peak clad temperature as per 10 CFR 50.46. That is, the plant could be SBLOCA limited with regard to overall LOCA results.

In response to this, Westinghouse performed some preliminary work indicating that in some cases more limiting results could be obtained from non-integer break sizes; however, the magnitude of the impact was far less than that shown in preliminary work performed by the NRC. Based on this, Westinghouse performed evaluations to determine if all currently operating plants would maintain compliance with the 10 CFR 50.46 acceptance criteria when considering a refined SBLOCA break spectrum. It should be noted that use of a refined break spectrum is not an error, but a change, since evaluating only integer break sizes has been the standard practice since the initial licensing of NOTRUMP.

This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

Consistent with the method described in Reference 1, for plants with low SBLOCA peak cladding temperatures (PCTs) (i.e., less than 1700°F) and overall SBLOCA results that are significantly non-limiting when compared with large break LOCA (LBLOCA) results, no explicit refined break spectrum calculations were performed, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes. For plants with high SBLOCA PCTs (i.e., equal to or greater than 1700°F), explicit refined break spectrum calculations were performed, and PCT penalties were assessed, if necessary.

Reference(s)

1. LTR-NRC-06-44, "Transmittal of LTR-NRC-06-44 NP-Attachment, 'Response to NRC Request for Additional Information on the Analyzed Break Spectrum for the Small Break Loss of Coolant Accident (SBLOCA) NOTRUMP Evaluation Model (NOTRUMP EM), Revision 1,' (Non-Proprietary)," July 14, 2006.

PBOT AND PMID SAMPLING
(Discretionary Change)

Background
The portrayal of the PBOT and PMID sampling in the ASTRUM topical (Reference 1) as uniform was slightly misleading in relationship to the actual sampling algorithm used for analyses, which is the same as approved for the CQD (Reference 2). As such, the sampling algorithm for ASTRUM was modified to coincide explicitly with the depiction in the topical. This change represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
This change is considered a forward-fit improvement, and as such has no impact on existing analyses.

Reference(s)
1. WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," January 2005.
2. WCAP-12945-P- A, Volume 1, Revision 2, and Volumes 2 through 5, Revision 1, "Code Qualification Document for Best Estimate LOCA Analysis," 1998.

HOTSPOT FUEL RELOCATION
(Non-Discretionary Change)

Background
In the axial node where burst is predicted to occur, a fuel relocation model in HOTSPOT is used to account for the likelihood that additional fuel pellet fragments above that elevation may settle into the burst region. It was discovered that the effect of fuel relocation on local linear heat rate was being calculated, but then cancelled out later in the coding. This change 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
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
1996 and 1999 BELOCA EMs analyses were assessed on a plant-specific basis, via the HOTSPOT reanalysis of a representative WCOBRA/TRAC case using the corrected code version at the burst elevation/burst model enabled sub-case. The HOTSPOT 95% probability PCT results were used to establish the plant-specific PCT penalty.

2004 ASTRUM EM analyses were assessed on a plant-specific basis, via the reanalysis of all of the burst cases from the original HOTSPOT calculations using the corrected HOTSPOT code version.

REVISED UPPER PLENUM VOLUME INPUTS
(Non-Discretionary Change)

Background
An error was identified during the course of a Best Estimate Large Break LOCA analysis. The volume of the global channels in the upper head was incorrectly calculated in the analysis, resulting in extra water volume being modeled in the upper plenum. The error has been corrected and a representative steady state and transient rerun was performed to quantify the effect on PCT. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

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

Estimated Effect
A representative reference transient was rerun using WCOBRA/TRAC to establish an estimated effect on the PCT. The estimated effect is 0°F for both blowdown and reflood.

STEAM GENERATOR NOZZLE VOLUME ACCOUNTING ERROR (Non-Discretionary Change)

Background

It was discovered that many plant-specific WCOBRA/TRAC calculations shared a common error of double accounting of the volume of one or both SG Plenum Nozzles. The extent of over-accounting is plant-specific but would be in the vicinity of 7-9 ft^3 per nozzle. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

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

RCS Loop inventory does not significantly contribute to core cooling during blowdown since most of the fluid in both the intact and broken RCS loops will exit the break without entering the core, making RCS Loop volume a tertiary player in system behavior. A small volume error of this nature is anticipated to be negligible throughout the transient, such that an estimated effect of 0°F is assigned for 10 CFR 50.46 reporting purposes.

COLD LEG VOLUME DISCREPANCY
(Non-Discretionary Change)

Background
An error was identified during the course of a Best Estimate Large Break LOCA analysis. An extra cell was modeled in one of the intact cold leg components, resulting in extra water volume being modeled in the loop piping. The error was corrected and representative WCOBRA/TRAC steady state and transient reruns were performed to quantify the effect on PCT. This change 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

Estimated Effect
The results of the representative WCOBRA/TRAC steady state and transient runs yielded an estimated PCT impact of 0°F for both blowdown and reflood for the affected plant.

ERRORS IN REACTOR VESSEL NOZZLE DATA COLLECTIONS
(Non-Discretionary Change)

Background
Some minor errors were discovered in the reactor vessel nozzle data collections that potentially affect the vessel inlet and outlet nozzle fluid volume, metal mass, and surface area. The corrected values have been evaluated for impact on current licensing-basis analysis results and will be incorporated into the plant-specific input databases on a forward-fit basis. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)
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
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 for 10 CFR 50.46 reporting purposes.

CORE BARREL HEAT SLAB ERROR
(Non-Discretionary Change)

Background
A plant specific Large Break LOCA analysis was completed which utilizes the 1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model. A calculation error was made in the core barrel metal heat slab, resulting in the volume of some of the core barrel heat slabs being moderately overestimated. This represents an error in the application of the model for a specific plant.

Affected Evaluation Model(s)
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect
The error is conservative, since extra metal heat would promote downcomer boiling during reflood. However, the extent of the over-conservatism is minimal since the analysis does not exhibit significant downcomer boiling and associated late reflood PCT excursions. A conservative 0°F is assigned for 10 CFR 50.46 reporting purposes.

SAFETY INJECTION DELAY TIME ISSUE
(Non-Discretionary Change)

Background
An error was identified in an ASTRUM analysis where the SI delay time used was overly conservative. This change 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
Based on a plant-specific evaluation, the impact of the error is conservatively estimated to be 0 °F.

LOWER PLENUM UNHEATED CONDUCTORS
(Non-Discretionary Change)

Background
Two modeling discrepancies were discovered in several BELOCA analyses for plants with Upper Plenum Injection. These discrepancies individually resulted in both an under-prediction and over-prediction of metal mass in the lower plenum. These changes represent a closely related group of non-discretionary changes in accordance with Section 4.1.2 of WCAP-13451.

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

Estimated Effect
Based on plant-specific evaluations, the estimated impact of the metal mass modeling errors is 0 °F.

PROPRIETARY NOTATIONS IN SOURCE AND OUTPUT (Non-Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). Modifications to the source file notation and output edit headers for the major computer codes of the 1999 EM have been made to indicate the copyright status and proprietary class in conformance with Westinghouse policy, WCAP-7211.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

IMPLEMENTATION OF OPTIMIZED ZIRLO™ CLADDING SPECIFIC HEAT (Non-Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). The evaluation of fuel designs that use Optimized ZIRLO™ cladding was described in Reference 1 and approved by NRC in Reference 2. In compliance with SER Limitation/Constraint #9 from Reference 2, the Optimized ZIRLO™ cladding specific heat has been implemented into all of the computer codes of the 1999 EM as described by Westinghouse in the response to RAI #21 in Reference 3. The Optimized ZIRLO™ cladding specific heat has been implemented as an option for any future LBLOCA analysis of a Westinghouse fuel rod design that uses this cladding.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

Since this change has already been approved by NRC, the licensed methodology of the 1999 EM is not affected. With the selection of this option for analyses using the 1999 EM, all of the computer codes are brought into compliance with the SER Limitation/Constraint imposed on the modeling of Optimized ZIRLO™ cladding. The impact of the change on PCT becomes integrated with the plant-specific and reload-specific analysis results used in the 10 CFR 50.46 reporting process.

Reference(s)

1. WCAP-12610-P-A and CENPD-404-P-A Addendum 1, "Addendum 1 to WCAP-12610-P-A and CENPD-404-P-A Optimized ZIRLO™," LTR-NRC-03-2, February 14, 2003. (ADAMS Accession No. ML030520455)

2. Letter from H. N. Berkow (NRC) to J. A. Gresham (Westinghouse), "Final Safety Evaluation for Addendum 1 to Topical Report WCAP-12610-P-A and CENPD-404-P-A, 'Optimized ZIRLO™,' (TAC No. MB8041)," June 10, 2005.

3. Letter from J. A. Gresham (Westinghouse) to U.S. Nuclear Regulatory Commission, "Westinghouse Responses to NRC Request for Additional Information (RAIs) on Optimized ZIRLO™ Topical – Addendum 1 to WCAP-12610-P-A," LTR-NRC-04-44, August 4, 2004. (ADAMS Accession No. ML042240408)

FLOW PATH ENTHALPY TRANSPORT NUMERICAL STABILITY IN CEFLASH-4A (Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). Appendix I of CENPD-133 P (Reference 1) documents the flow path enthalpy transport model used in the CEFLASH-4A computer code for calculating the blowdown thermal-hydraulics response during a LBLOCA transient. An upgrade to the flow path enthalpy transport model has been implemented as an optional process improvement to give the user additional numerical stability control other than modifying time step size. The optional improvement has been implemented to automatically control numerical convergence during time periods where the system flow rates are nearly zero, such as near end of blowdown, and the stability of the calculation is more difficult to maintain.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. The improvement is made available to the user as an option and is designed to maintain a numerically stable solution. Use of the option will prevent abnormal code operation requiring manual time step adjustments with the current logic to achieve convergence. The impact on PCT for 10 CFR 50.46 reporting purposes is not significant when compared to converged results.

Reference(s)

1. CENPD-133P, "CEFLASH-4A, A FORTRAN-IV Digital Computer Program for Reactor Blowdown Analysis," August 1974.

CORRECTION OF AN INCORRECT ERROR MESSAGE IN CEFLASH-4A (Non-Discretionary Change)

Background
The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). The editing logic in CEFLASH-4A, the blowdown thermal-hydraulics systems code of the 1999 EM, has been modified to prevent an incorrect error message from causing the utility script, which manages the operation of the 1999 EM, from an improper termination. In CEFLASH-4A, the error message should have been only a debug warning message and should not cause the utility script to stop execution.

Affected Evaluation Model(s)
Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect
This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

UPGRADE TO THE AUTO-AXIAL POWER SHAPE OPTION IN STRIKIN-II (Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). The 1999 EM is required to specify the axial power shape for LBLOCA analyses consistent with the methodology documented in Appendix A of CENPD-132 Supplement 3-P-A. Also, the specification of the axial power shape must be in compliance with an SER Limitation/Constraint on the use of this methodology.

As part of the Advanced Automated Integrated Code System (AAICS) for the 1999 EM, an option was implemented previously to automatically determine the axial power shape that complies with the core design characteristics of the analysis and also meets the methodology requirements. One aspect of the automatic process involves achieving a particular power distribution consistent with the target value for the minimum ASI, the limiting axial shape index prescribed for top peaked power distributions that are worst for LBLOCA. An upgrade to the computer logic has been implemented to improve the process for matching the prescribed target ASI for the 1999 EM. The improvement more accurately achieves the target ASI over a broader range of conditions than before. This improved computer logic replaces the previous logic. However, it still remains the responsibility of the user to examine the axial power shape generated by the automatic process on a case by case basis.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

AUTO-GENERATION OF THE STRIKIN-II BASE AND CASE DECKS
(Discretionary Change)

Background
The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). Computer code base and case decks provide the inputs to the operation of the 1999 EM. One of the advancements of the 1999 EM has been the auto-generation of base decks that can be created using inputs provided elsewhere in the 1999 EM code system. This eliminates some documentation and quality assurance and improves quality control by eliminating sources of error. The hot rod heatup computer code of the 1999 EM is STRIKIN-II. A process improvement has been implemented to automatically generate the STRIKIN-II base and case decks in a manner consistent with the fuel performance data set from the FATES3B computer code, which provides initial conditions for fuel rod stored energy and rod internal pressure.

Affected Evaluation Model(s)
Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect
This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

INCREASE THE NUMBER OF RADIAL REGIONS FOR COMZIRC (Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). The core-wide cladding oxidation is calculated using the COMZIRC computer code. COMZIRC represents the core fuel pin census with a table of values of fuel rod power versus fraction of rods. The current version allows a maximum of only 12 radial intervals to represent the core. The purpose of this change is to increase the radial detail from 12 to 120 intervals, thus allowing enhanced control of the discretionary conservatism needed to bound the core pin census with the COMZIRC input table.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

ASSIGNMENT OF CEFLASH-4A REGIONS IN COMZIRC (Non-Discretionary Change)

Background

The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). The core-wide cladding oxidation is calculated using the COMZIRC computer code. COMZIRC represents the core fuel pin census with a table of values of fuel rod power versus fraction of rods. COMZIRC initializes the radial core regions using information provided by the CEFLASH-4A computer code for its radial distribution in the core. The assignment of the CEFLASH-4A radial regions to the radial pin census in COMZIRC was previously a manual operation performed by the user. Computer logic has been implemented in COMZIRC to automatically confirm and/or provide the assignment of the CEFLASH-4A radial regions to the pin census.

Affected Evaluation Model(s)

Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect

This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

IMPLEMENTATION OF CATHCART-PAWEL OXIDATION MODEL AND PRE-TRANSIENT OXIDATION MODEL
(Discretionary Change)

Background
A new UCI parameter ('oxidation_model') is added to the UCI File Parameter List to facilitate the selection of the Cathcart-Pawel model for cladding oxidation as an option for non-licensing applications. The Cathcart-Pawel oxidation model is a best estimate model utilized by the industry as an alternative to the Appendix K required Baker-Just model. This new UCI option is not permitted for licensing applications of the 1999 EM, which must use the Appendix K required Baker-Just model.

A new UCI parameter ('pre_tran_oxidation') is added to the UCI File Parameter List to facilitate the specification of the initial oxide layer thickness through the UCI input file instead of through the base decks for non-licensing applications. This option may also be used to link the input specification to an interface output file from the HIDUTYDRV computer code, which provides maximum oxide thickness as a function of burnup (coordinated with FATES3B cycle numbers) and cladding type. In addition, this UCI parameter contains a new cladding conductivity option, which includes the impact of the oxide layer on the cladding conductivity, thereby directly linking the initialization of the fuel stored energy with the amount of pre-transient oxidation. The initial oxide layer thickness is a user-specified required input to the evaluation model as a constraint on the acceptability of the model for licensing applications. Therefore, this new UCI option is not permitted for licensing applications of the 1999 EM, which must use the required input.

The alternate oxidation model and pre-transient oxidation model are used to study various aspects of new embrittlement criteria being suggested by NRC and to provide an alternate means to address NRC questions regarding the calculation of the peak cladding oxidation percentage in applications of the 1999 EM to CE plants. The new UCI options provide for automatic activation of input vector changes and ensure consistency among the other computer codes of the 1999 EM.

Affected Evaluation Model(s)
Non-Licensing Applications using the Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect
This process improvement is for non-licensing applications. Therefore, this change has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC for licensing applications. For licensing applications, there is no impact on PCT for 10 CFR 50.46 reporting purposes since these changes are intended only for use in non-licensing calculations.

IMPLEMENTATION OF FINAL SER LIMITATIONS AND CONDITIONS FOR THE OPTIONAL SPACER GRID STEAM COOLING HEAT TRANSFER MODEL IMPROVEMENT IN STRIKIN-II
(Non-Discretionary Change)

Background
The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). An improved optional steam cooling heat transfer model for core reflood rates less than 1 in/sec was submitted to NRC in May 2006, to calculate the effects of spacer grids on steam cooling heat transfer mechanisms, CENPD-132, Supplement 4-P-A, Addendum 1-P. NRC acceptance of this improvement to the 1999 EM was documented in the final SER received by Westinghouse in June 2007.
The final SER from NRC requires that several changes be made to the methodology. All future licensing applications that utilize the optional spacer grid steam cooling heat transfer model will be required to implement these changes by using STRIKIN-II, Version STR.2.11 or higher. The following changes bring this version of STRIKIN-II into full compliance with the SER limitations and conditions on the use of the optional steam cooling model as imposed by NRC:

Grid Rewet Temperature Criterion – The final model approved by NRC requires that the spacer grid rewet temperature criterion be reset to a slightly different value than originally proposed.
Grid Model Output File – The final model approved by NRC requires that additional information be plotted and submitted for NRC review prior to the initial application of the model to a particular CE plant. To facilitate this documentation requirement, an additional output file is added to streamline generation of the needed plots.
Update Reynolds Number Formulation – The final model approved by NRC requires that the Reynolds number formulation for the wetted spacer grid heat transfer calculation be revised.
Diagnostic Edit Statements – The final model approved by NRC requires that the blockage fraction and Reynolds number ranges of applicability be confirmed for each application of the model. Diagnostic edit statements to display the range of validity checks are upgraded to alert the user if the use of the model is outside the range of applicability.

These changes have an insignificant impact on the overall calculated results with no impact on PCT. The revised methodology is activated with the selection of the user-specified option that is referred to as the "NRC-approved model." These changes have no effect on the calculated results if the optional steam cooling model is not used in the analysis.

Affected Evaluation Model(s)
Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect
These NRC-required changes to the optional steam cooling model have no impact on PCT for 10 CFR 50.46 reporting purposes for any application that utilizes the optional methodology.

UPDATE TO THE AUTO-GENERATION OF THE STRIKIN-II BASE AND CASE DECKS (Discretionary Change)

Background
The Appendix K ECCS Performance Analysis for LBLOCA for CE plants is performed with the 1999 Evaluation Model (1999 EM). Computer code base and case decks provide the inputs to the operation of the 1999 EM. One of the advancements of the 1999 EM has been the auto-generation of base decks that can be created using inputs provided elsewhere in the 1999 EM code system. This eliminates some documentation and quality assurance and improves quality control by eliminating sources of error. The hot rod heatup computer code of the 1999 EM is STRIKIN-II. A process improvement has been previously implemented to automatically generate the STRIKIN-II base and case decks in a manner consistent with the fuel performance data set from the FATES3B computer code, which provides initial conditions for fuel rod stored energy and rod internal pressure. For licensing applications, an update has been made to the auto-generation of these input decks for LBLOCA. These updates are categorized as general code maintenance changes to improve the operation and flexibility of this feature of the code.

Affected Evaluation Model(s)
Appendix K LBLOCA Evaluation Model, 1999 EM

Estimated Effect
This process improvement has no impact on the licensed methodology of the 1999 EM and does not conflict with the SER limitation/constraints imposed on the methodology by NRC. There is no impact on PCT for 10 CFR 50.46 reporting purposes.

CORE INLET SIDE-ENTRY ORIFICE MODELING ERROR
(Non-Discretionary Change)

Background
Westinghouse has identified that the side-entry orifice orientation was modeled incorrectly in respect to the modeling of counter-current flow limitation (CCFL). Westinghouse identified that the analysis of record (AOR) should model the core bundle inlet side-entry orifice with a vertical orientation instead of a horizontal orientation. This change represents a nondiscretionary change in accordance with section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)
Westinghouse BWR LOCA Evaluation Model, Applicable to HOPE CREEK and COLUMBIA

Estimated Effect
Based on evaluation results it has been concluded that there is no PCT impact for 10 CFR 50.46 reporting purposes.