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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Attention: J. S. Wermiel, Chief, Reactor Systems
Branch Office of Nuclear Reactor Regulation

Subject: 1998 Annual Notification of Changes to the Westinghouse Small Break LOCA and Large Break LOCA ECCS Evaluation Models, Pursuant to 10 CFR 50.46 (a)(3)(ii)

Reference:
1. ET-NRC-92-3755, "W Methodology for Implementation of 10CFR50.46 Reporting", Liparulo (W) to NRC Document Control Desk, 10/30/92. (WCAP-13451)

2. NSD-NRC-98-5575, "1997 Annual Notification of Changes to the Westinghouse Small Break LOCA and Large Break LOCA ECCS Evaluation Models, Pursuant to 10 CFR 50.46 (a)(3)(ii)", Sepp (W) to NRC Document Control Desk, 4/8/98.

Dear Mr. Wermiel:

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. A description of these changes, "1998 Annual Notification of Changes to the Westinghouse Small Break LOCA and Large Break LOCA ECCS Evaluation Models", is provided as Attachment 1. Westinghouse has categorized these changes or errors into three separate groups:

- Errors with PCT Impact
- Errors with no PCT Impact
- Enhancements/Forward Fit Discretionary Changes

This information 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 other 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 1998 10 CFR 50.46 Reportable changes provided in Attachment 1, together with the originally approved Evaluation Models and compilation of 10 CFR 50.46 Reportable changes through the "1997 Formulation" designated in Attachment 2 of Reference 2, constitute the "1998 Formulation" of the Westinghouse ECCS Evaluation Models.

If you have any questions or comments, please contact James A. Gresham at (412) 374-4643.

Very truly yours,

J. S. Galembush, Acting Manager
Regulatory and Licensing Engineering

Attachment 1: 1998 Annual Report

**Non-Discretionary Changes with PCT Impact**

Vessel Channel DX Error (Including Investigation of Code Uncertainties)

**Non-Discretionary Changes with no PCT Impact**

SATIMP Truncation Error
SATAN-VI Momentum Flux Logic Errors
SATAN-VI Transition Boiling Liquid Density Error
BASHER Heat Link Area Error
SBLOCTA Programming Error in Rod-to-Rod Radiation Model
Investigation of Code Uncertainties for SECY UPI WCOBRA/TRAC

**Enhancements/Forward-Fit Discretionary Changes**

NOTRUMP Droplet Fall Model
NOTRUMP Pump Model Modification
NOTRUMP Steam Generator Tube Heat Transfer and Reflux Modifications
NOTRUMP Vapor Region Point Kinetics Properties
NOTRUMP Fixed Restart and Edit Logic Modification
SBLOCTA Asymmetric Annular Blanket Modeling
Improved Code I/O and Diagnostics, and General Coding Maintenance

## VESSEL CHANNEL DX ERROR (INCLUDING INVESTIGATION OF CODE UNCERTAINTIES)

Background:
Incorrect cell height is used in calculating gap flow wall friction and interfacial drag coefficients at gap level J. The error is that only cell 1 DX value is used, rather than cell heights specific to each level, 1 through J.

This was determined to be a Non-discretionary change as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect
The impact of a WCOBRA/TRAC code error potentially has two effects, one on plant calculation results and one on the calculated code uncertainties. It was determined that this code error does not require any modifications to the uncertainty distributions used to propagate global or local model uncertainties. The estimated effects on the final 95% probability PCT for the plant calculations are shown in Table 1. For the purpose of this evaluation, plants were classified into two types. "Early reflood" plants are those which exhibit no significant core heatup after downcomer boiling begins. "Late reflood" plants are those which have at least some transients with late core heatup resulting from loss of reflood driving head after downcomer boiling begins.

These results will be incorporated on a plant specific basis. The licensing basis PCT (i.e., the limiting $PCT^{95\%}$) will be reported.

The SER requirement to verify the normality of the code bias uncertainty distribution has been satisfied.

This error was previously assessed for the SECY UPI LBLOCA Evaluation model in 1997 50.46 report (NSD-NRC-98-5575) and has no impact for 1998.

**Table 1**
**Effect on 95% Probability PCT**

| | $\Delta PCT^{95\%}$ | | |
|---|---|---|---|
| Plant Type | Blowdown PCT (°F) | First Reflood PCT (°F) | Second Reflood PCT (°F) |
| Plants with early Reflood PCT | N/A[a] | +0 | N/A[b] |
| Plants with late Reflood PCT | N/A[a] | +56 | -4 |

a) Adder for blowdown PCT was not assessed since the blowdown PCT is far below the limiting reflood PCT.
b) First reflood PCT was confirmed to remain limiting for all early reflood PCT plants.

## SATIMP TRUNCATION ERROR

Background

Various methods exist for entering input data to the SATIMP code, which is used to generate the plant-specific input models for SATAN-VI. An error was discovered in SATIMP whereby different methods of entering the input data could lead to minor differences in the resulting SATAN-VI input values, due to differences in truncation methods. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

The nature of this error leads to an estimated PCT impact of 0°F.

## SATAN-VI MOMENTUM FLUX LOGIC ERRORS

Background

An error in the SATAN-VI initialization logic caused momentum flux calculations to be skipped for the flow paths on the vessel side of the break, which is contrary to the guidelines that apply for modelling momentum flux in the 1981 EM version of SATAN-VI. This error has been corrected in the latest version of the code, along with two closely related errors in the momentum flux pressure drop calculations which were discovered during the course of the model review. These error corrections were determined to be a closely related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations showed that the corrections to the SATAN-VI momentum flux logic generally result in a small PCT benefit that is conservatively being tracked as 0°F for 10 CFR 50.46 reporting purposes.

## SATAN-VI TRANSITION BOILING LIQUID DENSITY ERROR

Background

In SATAN-VI, the cladding surface heat transfer coefficient in the transition boiling regime is computed using the Westinghouse Transition Boiling Correlation. A minor error was discovered in the calculation of the liquid density that is used with this correlation under certain conditions. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

The nature of this error leads to an estimated PCT impact of 0°F.

## BASHER HEAT LINK AREA ERROR

Background

BASHER is used in the 1981 Westinghouse Large Break LOCA Evaluation Model with BASH to generate the plant-specific input models for BASH. An error was discovered in the BASHER calculation of the lower plenum metal-to-fluid heat transfer area. This error only applies for plants with square holes in the lower core plate, a configuration which is atypical of Westinghouse plants. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

A review of existing plant analyses found no cases with square holes in the lower core plate. For a hypothetical case with square holes in the lower core plate, the nature of the error leads to an estimated PCT impact of 0°F.

## SBLOCTA PROGRAMMING ERROR IN ROD-TO-ROD RADIATION MODEL

Background

An error was discovered in the SBLOCTA code related to the calculations for rod-to-rod radiation heat transfer. The code was using incorrect units for the rod-to-rod pitch when computing the view factors. This was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

Due to the conservative methodology for specifying the power ratios among the fuel rods in a licensing basis small break LOCA analysis, there is little difference between the temperatures calculated for the hot rod and the surrounding rods which form the basis for the radiation heat transfer temperature sink in the problem. For a small break LOCA transient, the contribution to the peak cladding temperature from rod-to-rod radiation is at most a few degrees, even for conditions with temperatures approaching the 2200°F limit. As a result, rod-to-rod radiation is not modelled in licensing basis analyses, and there is no effect on any past or current analyses. Further, sensitivity calculations confirmed that correcting the error would have a negligible effect on results for a hypothetical case modelling rod-to-rod radiation, as expected.

## INVESTIGATION OF CODE UNCERTAINTIES FOR SECY UPI WCOBRA/TRAC

Background:

A subset of the test simulations used to determine the code uncertainty for the SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model were reanalyzed utilizing the latest code version (Revision 12) consistent with the current methodology used in plant calculations. The results were used to recalculate the code bias, X, and uncertainty, δ, for the blowdown and reflood peaks. These new values, in turn, were used to recalculate the WC/T code uncertainty for blowdown, $\delta_{WC/T,BD}$, and reflood, $\delta_{WC/T,RF}$. The code unceratinites were used to recalculate the 95$^{th}$ percentile WCOBRA/TRAC SECY UPI code uncertainty for blowdown, $\delta_{95th,BD}$, and reflood, $\delta_{95th,RF}$. These values are used to demonstrate compliance with the SER for SECY Appendix K calculations and to determine the licensing basis PCT for Superbounded calculations.

These changes were determined to be a Non-Discretionary change as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

Estimated Effect

Recalculation of the 95$^{th}$ percentile WCOBRA/TRAC SECY UPI code uncertainty for blowdown and reflood for the current code version (Revision 12) using a subset of the test simulations used in the original determination of code uncertainty showed a negligible change in values. This recalculation has shown that the original 95$^{th}$ percentile code uncertainty for blowdown and reflood for the WCOBRA/TRAC SECY UPI Evaluation Model remains valid for the current code version (Revision 12) and there is no PCT impact on plant results.

## NOTRUMP DROPLET FALL MODEL

Background

In order to facilitate future code maintenance, logic simplification was done to the droplet fall model utilized in standard Evaluation Model applications. This change was shown to produce insignificant differences in results and so will be implemented on a forward fit basis as a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of this change has led to the conclusion that no impact is to be assessed for standard Westinghouse PWR EM applications.

## NOTRUMP PUMP MODEL MODIFICATION

Background
The distribution of the pump heat in NOTRUMP has been changed to a more realistic basis within the applicable node. This change has been determined to be a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

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

Estimated Effect
Since the standard EM assumption is to not model pump heat, this change has no impact on results for standard Westinghouse PWR EM applications.

## NOTRUMP STEAM GENERATOR TUBE HEAT TRANSFER AND REFLUX MODIFICATIONS

Background

The condensation heat transfer logic in the steam generator and the number of links feeding the core reflux flow links in NOTRUMP were modified to allow for the modelling of the Temelin plant. The modifications consist of allowing for horizontal stratified flow link pairs in the steam generators and for direct accumulator and safety injection flow into the upper plenum. These models do not impact standard Westinghouse PWR calculations. This change was determined to be a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of this change has led to the conclusion that no impact is to be assessed for standard Westinghouse PWR EM applications.

## NOTRUMP VAPOR REGION POINT KINETICS PROPERTIES

Background

The point kinetics modelling in NOTRUMP, as described in Appendix T of WCAP-10079-P-A, assumed mixture region properties for all point kinetics calculations. This was extended to allow for cases where the core would be calculated to experience uncovery prior to reactor trip and consequent use of the Appendix K decay heat. This change has been determined to be a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

For typical SBLOCA analyses, the reactor trip setpoint is reached long before any threat of core uncovery occurs. Therefore, there is no impact for this change on any calculated PCT.

## NOTRUMP FIXED RESTART AND EDIT LOGIC MODIFICATION

Background
The logic for writing restart or edit information at fixed times during a transient was modified so that it did not interfere with the time step control in NOTRUMP. Instead of arbitrarily reducing the time step to ensure that the exact time specified was used in the restart or edit write, the logic was changed to write the restart or edit on the first normally calculated timestep where the time exceeded the requested write time. This was determined to be a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

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

Estimated Effect
Representative plant calculations led to an estimate of no PCT impact for this change.

## SBLOCTA ASYMMETRIC ANNULAR BLANKET MODELLING

Background

The capability to explicitly model fuel rod designs with annular pellets was previously incorporated into the SBLOCTA code as documented and approved in the reference. In the original application, the code was programmed to set up the problem from user input based on the assumption that the fuel rod would always have equal-length annular blankets in both the top and bottom ends of the pellet stack. Subsequently, a variation on that fuel product was introduced with blankets only on the top, and the SBLOCTA code has been reprogrammed to allow modelling of variable length blankets on either end of the rod. This was determined to be a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The code update is merely a change to the program logic for purposes of properly accounting for the location of the annular blankets. It involves no changes to the fundamental solution technique nor any thermal-hydraulic fuel rod models. As a result, there is no effect on any previous results, and the appropriate model for axial blankets will be applied as needed on a forward-fit basis.

Reference

WCAP-14710-P-A, "1-D Heat Conduction Model for Annular Fuel Pellets", D.J. Shimeck, May 1998.

## IMPROVED CODE I/O AND DIAGNOSTICS, AND GENERAL CODING MAINTENANCE

Background

Various changes in code input and output format have been made to enhance useability and help preclude errors in analyses. This includes both input changes (i.e., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to perform initial checks on input values to preclude unreasonable values from being used. In addition, various blocks of coding were rewritten to eliminate inactive coding, optimize the active coding, and improve commenting, both for enhanced calculational efficiency and to facilitate code debugging when necessary. These changes were determined to be Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

Since these changes only affect input and output formats, code commenting, and calculational efficiency, there is no effect on calculated results.