

## **Attachment 1**

# **Standard Format Text for Changes and Enhancements to the Westinghouse Evaluation Models for 2018**

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**Discretionary Changes with Negligible PCT Impact**

- GENERAL CODE MAINTENANCE

**Non-Discretionary Changes with Negligible PCT Impact**

- UO<sub>2</sub> FUEL PELLETT HEAT CAPACITY
- ERRATA IN NODING DIAGRAMS IN METHODOLOGY TOPICAL REPORT
- RADIATION HEAT TRANSFER TO LIQUID
- VAPOR TEMPERATURE RESETTING
- ERROR IN CCTF MODEL USED IN WCOBRA/TRAC VALIDATION FOR UPI PLANTS

**DISCRETIONARY CHANGES WITH NEGLIGIBLE PCT IMPACT**

## **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 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)**

2016 Westinghouse FULL SPECTRUM LOCA Evaluation Model

### **Estimated Effect**

The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

## **Non-Discretionary Changes with Negligible PCT Impact**

## **UO<sub>2</sub> FUEL PELLETT HEAT CAPACITY**

### **Background**

A typographical error was discovered in the implementation of the UO<sub>2</sub> fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA evaluation models. The erroneous formulation results in an over-prediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. This 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

1985 Westinghouse Advanced Plant Small Break LOCA Evaluation Model with NOTRUMP

### **Estimated Effect**

The small over-prediction in UO<sub>2</sub> fuel pellet heat capacity has been evaluated to have a negligible effect on existing large and small break LOCA analysis results due to the small magnitude of the change, leading to an estimated PCT impact of 0°F.

### **Reference**

1) WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis," June 1974.

**ERRATA IN NODING DIAGRAMS IN METHODOLOGY TOPICAL REPORT****Background**

A number of errata were discovered in the demonstration plant nodding diagrams (Figure 26.2-3 and Figure 26.3-3) in the FULL SPECTRUM Loss-of-Coolant Accident (FSLOCA) evaluation model (EM) topical report. A few of the elevations are incorrectly portrayed in these nodding diagrams by no more than two inches. The resolution of these errata represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

**Affected Evaluation Model(s)**

2016 Westinghouse FULL SPECTRUM LOCA Evaluation Model

**Estimated Effect**

In all instances, it was confirmed that the WCOBRA/TRAC-TF2 inputs were correct, and the errata were isolated to the nodding diagrams. As such, there is no impact on analyses performed using the FSLOCA EM, and no reporting is required pursuant to 10 CFR 50.46.

## **RADIATION HEAT TRANSFER TO LIQUID**

### **Background**

It was discovered that under certain conditions, the radiation heat transfer to liquid could be incorrectly calculated by the thermal-hydraulic codes within the Westinghouse Automated Statistical Treatment of Uncertainty Method (ASTRUM) and FULL SPECTRUM LOCA (FSLOCA) best-estimate LOCA evaluation models. The radiation heat transfer to liquid is generally a small portion of the overall heat transfer. The correction of this error represents a Non-Discretionary Change in the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

### **Affected Evaluation Model(s)**

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

2016 Westinghouse FULL SPECTRUM LOCA Evaluation Model

### **Estimated Effect**

Engineering judgement supported by sensitivity calculations exercising the heat transfer package showed that correcting this error had minimal impact on LOCA calculations, leading to an estimated peak cladding temperature impact of 0°F.



## VAPOR TEMPERATURE RESETTING

### Background

In the WCOBRA/TRAC and WCOBRA/TRAC-TF2 codes, when the vapor temperature is greater than the wall temperature, and several other conditions are met, the vapor temperature is reset to the saturation temperature for heat transfer calculations. It was discovered that this vapor temperature resetting logic results in an inconsistency between the conduction solution and the hydraulic solution, such that energy is not conserved between the two solutions. The correction of this error represents a Non-Discretionary Change in the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

### Affected Evaluation Model(s)

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model  
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM  
2016 Westinghouse FULL SPECTRUM LOCA Evaluation Model

### Estimated Effect

Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations, leading to an estimated peak cladding temperature impact of 0°F.

**ERROR IN CCTF MODEL USED IN WCOBRA/TRAC VALIDATION FOR UPI PLANTS****Background**

WCAP-14449-P-A, Revision 1 [1] documents the extension of the Best-Estimate Large-Break Loss-of-Coolant Accident methodology using WCOBRA/TRAC to 2-loop Westinghouse Pressurized Water Reactors (PWRs) equipped with Upper Plenum Injection (UPI), and supports the application of the ASTRUM methodology to 2-loop PWRs equipped with UPI. WCOBRA/TRAC calculations for two Cylindrical Core Test Facility (CCTF) upper plenum injection tests were performed as part of the code validation. The test report for these tests indicated that the accumulator and high pressure coolant injects into the lower plenum for some time, then ramps down to zero and injection switches entirely into the cold legs. In the WCOBRA/TRAC model for these tests, the accumulator and high pressure coolant flow into the lower plenum was not modeled consistent with the test conditions. Therefore, the total amount of injected flow into the lower plenum was higher in the WCOBRA/TRAC calculations than in the tests. This item 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**

Calculations using the modified accumulator and high pressure coolant flow confirm that the error does not impact the conclusions made in Reference 1 relative to the simulations, leading to an estimated peak cladding temperature impact of 0°F.

**Reference**

- 1) WCAP-14449-P-A, Revision 1, "Application of Best Estimate Large Break LOCA Methodology to Westinghouse PWRs with Upper Plenum Injection," October 1999.