AREVA

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2008 – Annual Reporting of Changes and Errors in ECCS Evaluation Models

Attached is a summary report of the changes and error corrections implemented in the AREVA NP ECCS evaluation models for the period of January 1, 2008 to December 31, 2008.

AREVA NP Inc. (AREVA NP) considers the BWR and PWR ECCS evaluation models to include both the codes and the methodology for using the codes. Changes to inputs that result from fuel or plant changes and that are treated according to the methodology are not considered model changes and, therefore, are not reported in the attachment. Changes in peak cladding temperatures (PCTs) due to LOCA evaluation model changes and errors are reported on a plant specific basis by AREVA NP to affected licensees. The licensees have the obligation under 10 CFR Part 50.46 to report the nature of changes and errors affecting PCT. This report is provided for information only.

Sincerely,

Ronnie L. Gardner, Manager
Corporate Regulatory Affairs
AREVA NP Inc.

Enclosure

cc: H. D. Cruz
Project 728

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NRR

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Attachment A

Listing of AREVA NP LOCA Evaluation Models

EXEM BWR-2000 Large and Small Break LOCA Evaluation Model
This model is applicable to jet-pump boiling water reactors for both large and small break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2361PA Rev 0.

CRAFT2 PWR Large Break LOCA Evaluation

This model is applicable to all B&W designed pressurized water reactors for large break LOCA analyses of zircaloy clad fuel. The NRC approved topical report for this evaluation model is BAW-10104PA Rev 5.

CRAFT2 PWR Small Break LOCA Evaluation Model

This model is applicable to all B&W designed pressurized water reactors for small break LOCA analyses of zircaloy clad fuel. The NRC approved topical report for this evaluation model is BAW-10154PA Rev 0.

RELAP5/MOD2-B&W Once Through Steam Generator Large and Small Break LOCA Evaluation Model

This model is applicable to all B&W designed pressurized water reactors for large and small break LOCA analyses of zircaloy or M5 clad fuel. The NRC approved topical report for this evaluation model is BAW-10192PA Rev 0. The NRC has approved this evaluation model for M5 clad fuel in BAW-10227PA Rev 0.

RELAP5/MOD2-B&W Re-Circulating Steam Generator Large and Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large and small break LOCA analyses. The NRC approved topical report for this evaluation model is BAW-10168PA Rev 3.

SEM-PWR-98 PWR Large Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2087PA Rev 0.

ANF-RELAP PWR Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 2, 3, and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for small break LOCA analyses. The NRC approved topical report for this evaluation model is XN-NF-82-49PA Rev 1 Supplement 1.

S-RELAP5 PWR Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 2, 3, and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for small break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2328PA Rev 0.

Realistic PWR Large Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2103PA Rev 0.

Attachment B

Annual Reporting of AREVA NP LOCA Evaluation Model Changes and Error Corrections (2008)

EXEM BWR-2000 Large and Small Break LOCA Evaluation Model

This model is applicable to jet-pump boiling water reactors for both large and small break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2361PA Rev 0.

The Evaluation Model consists of three computer codes: (1) RELAX to compute the system and hot channel response during blowdown and to calculate the time for refill of the lower plenum and reflood of the core, (2) HUXY to calculate the heatup of the peak power plane and (3) RODEX2 to determine the rod conditions at the start of the transient.

There were no code or methodology error corrections or changes implemented during the reporting period.

CRAFT2 PWR Large Break LOCA Evaluation Model

This model is applicable to all B&W designed pressurized water reactors for large break LOCA analyses of zircaloy clad fuel. The NRC approved topical report for this evaluation model is BAW-10104PA Rev 5.

The Evaluation Model consists of five computer codes: (1) CRAFT2 to compute the system and core response during blowdown, (2) REFLOD3 to calculate the time for refill of the lower plenum and core reflood rate, (3) CONTEMPT to compute the containment pressure response (4) FLECSET to calculate the hot pin heat transfer coefficients, and (5) THETA1-B to determine the hot pin thermal response for the entire transient. An NRC-approved fuel code (currently TACO3) is used to supply the fuel rod steady-state conditions at the beginning of the transient.

There were no evaluation model changes or error corrections made during the reporting period.

CRAFT2 PWR Small Break LOCA Evaluation Model

This model is applicable to all B&W designed pressurized water reactors for small break LOCA analyses of zircaloy clad fuel. The NRC approved topical report for this evaluation model is BAW-10154PA Rev 0.

The Evaluation Model consists of three computer codes: (1) CRAFT2 to compute the system and core response during blowdown, (2) FOAM2 to calculate the core mixture level and average channel steaming rate, and (3) THETA1-B to determine the hot pin thermal response for the entire transient. An NRC-approved fuel code (currently TACO3) is used to supply the fuel rod steady-state conditions at the beginning of the transient.

There were no evaluation model changes or error corrections made during the reporting period.

RELAP5/MOD2-B&W Once Through Steam Generator Large and Small Break LOCA Evaluation Model

This model is applicable to all B&W designed pressurized water reactors for large and small break LOCA analyses of zircaloy and M5 clad fuel. The NRC approved topical report for this evaluation model is BAW-10192PA Rev 0.

The large break LOCA Evaluation Model consists of four computer codes: (1) BAW-10164P-A, RELAP5/MOD2-B&W to compute the system, core, and hot rod response during blowdown, (2) BAW-10171P-A, REFLOD3B to calculate the time for refill of the lower plenum and core reflood rate, (3) BAW-10095-A, CONTEMPT to compute the containment pressure response, and (4) BAW-10166P-A, BEACH (RELAP5/MOD2-B&W reflood heat transfer package) to determine the hot pin thermal response during refill and reflood phases.

The small break LOCA Evaluation Model consists of two codes: (1) BAW-10164P-A, RELAP5/MOD2-B&W to compute the system, core, and hot rod response during the transient and (2) BAW-10095-A, CONTEMPT to compute the containment pressure response, if needed. An NRC-approved fuel code (currently BAW-10162P-A, TACO3 or BAW-10184P-A, GDTACO) is used to supply the fuel rod steady-state conditions at the beginning of the small or large break LOCA. These codes are approved for use with M5 cladding via the SER on BAW-10227P-A.

There were no evaluation model changes or error corrections made during the reporting period.

RELAP5/MOD2-B&W Re-Circulating Steam Generator Large and Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large and small break LOCA analyses. The NRC approved topical report for this evaluation model is BAW-10168PA Rev 3.

The large break LOCA Evaluation Model consists of three computer codes: (1) RELAP5/MOD2-B&W to compute the system, core and hot rod response during blowdown, (2) REFLOD3B to calculate the time for refill of the lower plenum and core reflood rate, and (3) BEACH (RELAP5/MOD2-B&W reflood heat transfer package) to determine the hot pin thermal response during refill and reflood phases. The small break LOCA Evaluation Model consists of one code: RELAP5/MOD2-B&W to compute the system, core and hot rod response during the transient. A NRC-approved fuel code (currently TACO3 or GDTACO) is used to supply the fuel rod steady state conditions at the beginning of the small or large LOCA transient.

There were no evaluation model changes or error corrections made during the reporting period.

SEM/PWR-98 PWR Large Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2087PA Rev 0.

The SEM/PWR-98 LBLOCA Evaluation Model consists of four primary computer codes: (1) RELAP4 to compute the system and hot channel response, (2) RFPAC to compute the containment pressures, reflood rates, and axial shape factors, (3) TOODEE2 to calculate the hot rod heatup, and (4) RODEX2 to determine the rod conditions at the start of the transient.

There were no evaluation model changes or error corrections made during the reporting period.

ANF-RELAP PWR Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 2, 3, and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for small break LOCA analyses. The NRC approved topical report for this evaluation model is XN-NF-82-49PA Rev 1 Supplement 1.

The ANF-RELAP SBLOCA Evaluation Model consists of three computer codes: (1) ANF-RELAP to compute the system response, (2) TOODEE2 to calculate the hot rod heatup, and (3) RODEX2 to determine the rod conditions at the start of the transient.

There were no evaluation model changes or error corrections made during the reporting period.

S-RELAP5 PWR Small Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 2, 3, and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for small break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2328PA Rev 0.

There were no evaluation model changes or error corrections made during the reporting period.

Realistic PWR Large Break LOCA Evaluation Model

This model is applicable to Westinghouse designed 3 and 4 loop pressurized water reactors and Combustion Engineering designed pressurized water reactors for large break LOCA analyses. The NRC approved topical report for this evaluation model is EMF-2103PA Rev 0.

The following error correction and model changes were made in 2008:

1. Cold Leg Condensation

   Cold Leg Condensation Evaluation with Downcomer Boiling Consequence Downcomer boiling is one of the main NRC issues related to the AREVA RLBLOCA methodology. As part of the Revision 0/Revision 2 transition package for the methodology, additional work was done to evaluate downcomer wall heat release and axial and azimuthal fluid volume discretization. These studies showed that

   1) The wall heat release was conduction limited and adequately modeled,
   2) Axial resolution of the fluid volumes was sufficient, and
   3) Azimuthal resolution within the base model was conservative.

   The NRC agreed with our conclusions. However, as part of this work, S-RELAP5 performance and the supporting code assessments used to evaluate condensation in

the cold legs and the downcomer have been reviewed. The resulting conclusion is that, for the case of a single train of pumped injection (single failure assumption), S-RELAP5 significantly under-predicts condensation in the cold leg during the later reflood phase, after the accumulators empty. Because of this, the ECCS water entering the downcomer is sufficiently subcooled to absorb the downcomer wall heat release without significant boiling. The expected scenario is that the ECCS water would enter the downcomer in a saturated or only slightly subcooled state and that heat release from the downcomer wall would lead to substantial boiling and might reduce the reflood driving head. The model was adjusted to better match test data (UPTF) during the later reflood phase, which resulted in S-RELAP5 producing a better prediction of this phenomenon.

The impact on RLBLOCA PCT was 0°F. Even though the PCT did not increase, the observed impact on the transient from the cold leg condensation model change was that the quench time occurred later.