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Gentlemen:

DOCKETS 50-266 AND 50-301
ECCS EVALUATION MODEL CHANGES, 10 CFR 50.46
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

As required by Title 10 of the Code of Federal Regulations Part 50.46 (a) (3) (ii), Wisconsin Electric Power Company (Licensee) is submitting this annual report of changes to, and errors discovered in the emergency core cooling system (ECCS) evaluation models for Point Beach Nuclear Plant, Units 1 and 2. This letter provides a summary of ECCS evaluation model changes and errors identified since the last annual report dated February 23, 1993. Model changes include changes to the small break and large break loss of coolant accident (LOCA) models. A summary of the changes is provided below with additional details and a summary sheet of peak cladding temperature (PCT) margin in the attachment.

Small Break LOCA Evaluation Model

As discussed in letter VPNPD-93-188, dated November 3, 1993, the effect of safety injection (SI) in the broken loop of the reactor coolant system (RCS) during a small break LOCA modeled by NOTRUMP has been assessed a PCT penalty of 150 °F. Delivery of SI to the cold leg has been found to be a penalty in the NOTRUMP evaluation model because competition between steam leaving and SI entering the break increases the RCS pressure. The higher pressure reduces the amount of SI delivered by the centrifugal SI pumps which increases the PCT. The PCT penalty for SI injection in the broken loop is compensated for by a PCT benefit of 150 °F from the effect of an improved condensation model in NOTRUMP.

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Condensation reduces the RCS pressure and increases the amount of SI delivered by the centrifugal SI pumps. The Westinghouse Owners Group is reviewing this issue and development of a generic program for resolution is possible.

Also discussed in letter VPNPD-93-188 are drift flux flow regime errors in NOTRUMP which have been assessed a PCT benefit of 13 °F. Errors in the coding of the drift flux flow regime map caused discontinuities in the map under certain circumstances.

Component databases generated from raw data in the VESCAL subroutine of LUCIFER have been assessed a PCT benefit of 16 °F. The errors concern the geometric and mass calculations of the vessel and steam generator portions of the needed data.

Other minor errors in the small break LOCA evaluation model which are not assessed a PCT penalty or benefit include: ISHII drift flux error; NOTRUMP point kinetics error; core node initialization error; NOTRUMP heat link pointer error; and various fuel rod model errors in the SBLOCA analysis. Additional details for these errors are contained in the attachments.

There is no change to the PCT from double-disk gate valve pressure equalization since the valves of concern at Point Beach (1&2SI-852A&B, Low Head SI Core Deluge Isolation) are connected to the upper plenum and not the hot leg, are used for normal injection and remain open for long-term recirculation. Also, no penalty is assessed for hot assembly average rod burst effects and zirc/water oxidation temperature excursion since the PCT for Point Beach in the small break LOCA evaluation model is well below the temperatures where these effects can occur.

Large Break LOCA Evaluation Model

No penalty is assessed to PCT for large break LOCA rod internal pressure issues. Westinghouse completed an evaluation of a potential issue concerning beginning of life (BOL) rod internal pressure (RIP) uncertainties on LOCA analysis. The BOL fuel pressure and temperature uncertainties are based on end of life considerations which are potentially non-conservative. Since Point Beach uses an initial fill pressure of 275 psig, the nominal RIP (with an upper bound bias) should be used. This is consistent with past LOCA analysis. Additional information is found in attachment 1.

The current cumulative changes in PCT are 33°F for small break LOCA and -76°F for large break LOCA. There is no plan for reanalysis of the ECCS models at this time due to the significant PCT margins to the licensing limit.

Please contact us if you have any questions about this information.

Sincerely,

GMKrieser

Gary M. Krieser
Manager
Industry and Regulatory Services

Attachments

cc: NRC Resident Inspector
NRC Regional Administrator, Region III

ATTACHMENT 1

ECCS EVALUATION MODEL CHANGES AND ERRORS

- NOTRUMP Drift Flux Flow Regime Map Errors:

Errors were discovered in both WCAP-10079-P-A and related coding in NOTRUMP subroutine DFCORRS where the improved TRAC-P1 vertical flow regime map is evaluated. In Evaluation Model applications, this model is only used during counter-current flow conditions in vertical flow links. The affected equation in WCAP-10079-P-A is Equation G-65 which previously allowed for unbounded values of the parameter Cinf contrary to the intent of the original source of this equation. This allowed a discontinuity to exist in the flow regime map under some circumstances. This was corrected by placing an upper limit of 1.3926 on the parameter Cinf as reasoned from the discussion in the original source. This correction returned NOTRUMP to consistency with the original source for the affected equation.

Further investigation of the DFCORRS subroutine uncovered an additional closely related logic error which led to discontinuities under certain other circumstances. This error was also corrected and returned the coding to consistency with WCAP-10079-P-A.

Representative plant calculations indicated PCT effects of -13 °F.

- Vessel and Steam Generator Calculation Errors in LUCIFER:

The LUCIFER code is used to generate the component databases, from raw input data, to be used in the small and large break LOCA analyses. Errors were found in the VESCAL subroutine of the LUCIFER code. These errors were in the geometric and mass calculations of the vessel and steam generator portions of the needed data. All LOCA analyses using the LUCIFER code outputs are affected by these error corrections. The errors were corrected in a manner to maintain the consistency of the LUCIFER code.

Representative plant calculations indicate a net PCT effect of -16 °F for small break LOCA.

- ISHII Drift Flux Error:

An error was discovered both in WCAP-10079-P-A and the relevant coding in NOTRUMP subroutine ISHIIA which led to an incorrect calculation of the drift flux in NOTRUMP when a laminar film annular flow was predicted. The affected equation in WCAP-10079-P-A is Equation G-74 wherein a factor of 'g', the gravitational constant, was inadvertently omitted from both the documentation and the equivalent coding. The correction of this error returned NOTRUMP to consistency with the ultimate reference for the affected correlation.

Representative plant analysis were used to estimate a PCT effect of 0 °F.

- NOTRUMP Point Kinetics Error:

An error was discovered in the coding used in the NOTRUMP user external subroutine VOLHEAT. The coding did not correctly perform the calculation described by Equation 13-12-28 of WCAP-10054-P-A. This calculation is only used during the time when the Point Kinetics option is used to determine the core power before reactor trip. Therefore, any analysis which used the more conservative assumption of constant core power until reactor trip time is not affected by this error. The correction of this error returned NOTRUMP to consistency with WCAP-10054-P-A.

Representative plant analyses were used to estimate a PCT effect of 0 °F.

- Core Node Initialization Error:

An error was discovered in how the properties of CORE NODE components were initialized for non-existent regions in the adjoining FLUID NODE. In particular, this led to artificially high core temperatures during the timestep when the core mixture level crossed a node boundary, conservatively causing slightly more core mixture level depression than appropriate during this timestep. Correction of this error allows for a smoother mixture level uncovery transient during node crossings.

The nature of this error led to an estimated PCT effect of 0 °F.

- NOTRUMP Heat Link Pointer Error:

An error was discovered in how NOTRUMP initialized certain HEAT LINK pointer variables at the start of a calculation. Correction of this error returned NOTRUMP to consistency with the original intent of this section of coding.

Representative plant analyses were used to estimate a PCT effect of 0 °F.

- Fuel Rod Model Errors in SBLOCA:

A number of minor programming errors were corrected in the fuel rod heat up code used in SBLOCA analyses. These corrections were related to:

1. Individual rod plenum temperatures
2. Individual rod stack lengths
3. Cladding thinning logic

4. Pellet/cladding contact logic
5. Corrected gamma redistribution
6. Including ZrO_2 thickness at t=0 initialization
7. Numerics and convergence criteria of initialization.

The cumulative effect of the error corrections and convergerce criteria change was judged to have a estimated effect on PCT of 0 °F.

- Double-Disk Gate Valve Pressure Equalization:

Westinghouse completed the evaluation of a potential issue concerning use of double-disk gate valves in the emergency core cooling system (ECCS) as hot leg isolation valves. Use of these double-disk gate valves may involve an inner disc pressure equalization line that could set up a leak path into the hot leg during cold leg injection following a loss of coolant accident (LOCA). This condition could lead to inadequate cold leg injection resulting in an increase in PCT.

The design characteristic of a double-disk gate valve provides isolation by the downstream disk sealing against the valve seat. The mechanical seating force and the hydraulic force from the upstream pressure (SI pump) act to provide force to the valve seal surfaces. The double-disk gate valve design results in a volume of fluid which is enclosed between the discs when the valve is closed. As the fluid volume heats up, pressure greater than system pressure may develop and may cause the disks to bind against the seats to the extent that the valves can not be opened. To avoid this, many double-disk gate valves have been modified to include a pressure equalization line of a small hole in one of the disks to relieve the pressure between the disks. Based on generic leakage calculations it was determined that the double-disk gate valves modified to eliminate concerns for thermal binding could leak as much as 30 gpm per valve. This leakage into the RCS hot legs will increase steam binding during reflood and result in an increase in the calculated peak cladding temperature.

This is not a concern with Point Beach because the double disk gate valves used are on the low head safety injection lines that are connected to the vessel upper plenum. These valves are used for normal injection and remain open for recirculation. The ECCS Model demonstrates that steam binding does not occur at PBNP with flow into the upper plenum. The PCT penalty for Point Beach is 0°F.

- Hot Assembly Average Rod Burst Effects:

The rod heat up code used in Small Break LOCA calculations contains a model to calculate the amount of cladding strain that accompanies rod burst. However, the methodology which has historically been used is to not apply this burst strain model to the hot assembly average rod. This was done so as to minimize the rod gap and therefore maximize the heat transferred to the fluid channel, which in turn would maximize the hot rod temperature. However, due to mechanisms governing the zirc-water temperature excursion (which is the subject of the SBLOCA Limiting Time-in-Life penalty for the hot rod), modeling of cladding burst strain for the hot assembly average rod can result in a penalty for the hot rod by increasing the channel enthalpy at the time of PCT. Therefore, the methodology has been revised such that burst strain will also be modeled on the hot assembly average rod.

There is no change in PCT for this effect since the PCT for the small break LOCA evaluation model is well below the temperatures where rod burst effects would occur.

- Revised Burst Strain Limit Model:

A revised burst strain limit model which limits strains is being implemented into the rod heat up codes used in both Large Break and Small Break LOCA. This model is identical to that previously approved for use for Appendix K analyses of Upper Plenum Injection plants with WCOBRA/TRAC, as described in WCAP-10924-P-A, Rev. 1, Vol. 1, Add. 4, "Westinghouse Large Break LOCA Best Estimate Methodology: Volume 1: Model Description and Validation, Addendum 4: Model Revisions," 1991.

There is no change in PCT for this effect since the PCT for the small break LOCA evaluation model is well below the temperatures where rod burst effects would occur.

- Small Break LOCA Limiting Time in Life - Zirc/Water Oxidation Temperature Excursion:

Westinghouse recently completed an evaluation of a potential issue with regard to burst/blockage modeling in the Westinghouse small break LOCA evaluation model. This potential issue involved a number of synergistic effects, all related to the manner in which the small break model accounts for the swelling and burst of fuel rods, modeling of the rod burst strain, and resulting effects on cladding temperature and oxidation from the metal/water reaction models and channel blockage.

There is no change in PCT for this effect since the PCT for the small break LOCA evaluation model is well below the temperature where rod burst effects would occur.

- Large Break LOCA Rod Internal Pressure Issues:

Westinghouse recently completed an evaluation of a potential issue concerning the impact of increased beginning of life rod internal pressure (RIP) uncertainties on LOCA analyses. Historically, beginning of life fuel pressure and temperature uncertainties, were based upon end of life considerations. These RIP uncertainties were found to be potentially nonconservative.

During the evaluation of this issue, a second issue related to the applicability of generic IFBA fuel analyses to updated LOCA Evaluation Models was also identified and combined with this issue since the underlying mechanisms were the same.

It was concluded that only nominal RIP (with an upper bound bias) should be used in the LOCA analyses for fuel designs with an initial cold fill pressure > 200 psig. This is consistent with past LOCA analysis. The fuel at PBNP has a normal RIP of 275 psig. The PCT penalty for Point Beach is 0°F.

ATTACHMENT 2

PEAK CLAD TEMPERATURE SUMMARY INFORMATION

- Small Break PCT Margin Utilization:

A. Analysis of Record (7/88)	PCT= 809 °F
B. Prior Permanent ECCS Model Assessments	ΔPCT=37 °F
C. 10 CFR 50.59 Safety Evaluations	ΔPCT=25 °F
D. 1993 10 CFR 50.46 Model Assessments (Permanent Assessment of PCT Margin)	ΔPCT=0 °F
1. Effect of SI in Broken Loop	ΔPCT=150 °F
2. Effect of Improved Condensation Model	ΔPCT=-150 °F
3. Drift Flux Flow Regime Errors	ΔPCT=-13 °F
4. LUCIFER Error Corrections	ΔPCT=-16 °F
E. Temporary ECCS Model Issues	
1. Effect of Leaking Double Disk Gate Valves	ΔPCT=0 °F
F. Other Margin Allocations	
1. None	ΔPCT=0 °F
LICENSING BASIS PCT + MARGIN ALLOCATION	PCT= 842 °F

- Large Break PCT Margin Utilization:

A.	Analysis of Record (2/91)	PCT= 2028 °F
B.	Prior Permanent ECCS Model Assessments	ΔPCT=-76 °F
C.	10 CFR 50.59 Safety Evaluations	ΔPCT=0 °F
D.	1993 10 CFR 50.46 Model Assessments (Permanent Assessment of PCT Margin)	
	1. None	ΔPCT=0 °F
E.	Temporary ECCS Model Issues	
	1. Effect of Leaking Double Disk Gate Valves	ΔPCT=0 °F
F.	Other Margin Allocations	
	1. None	ΔPCT=0 °F
LICENSING BASIS PCT + MARGIN ALLOCATION		PCT= 1952 °F