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

10 CFR part 50
Section 50.46

Prairie Island Nuclear Generating Plant
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Corrections to ECCS Evaluation Models

Attached is a report of corrections to Westinghouse Emergency Core Cooling System (ECCS) Evaluation Models which documents an absolute cumulative effect upon the Small Break LOCA analysis of greater than 50°F. This report is being submitted in accordance with the provisions of 10 CFR 50, section 50.46.

The corrections noted in Attachment 1 have been applied to our current ECCS analyses of record, and all analyses were found to be in compliance with the applicable acceptance criteria (Attachment 2).

Please contact Mel Opstad (612-295-1653) if you require further information related to this submittal.

Sincerely,

Melford T. Opstad

for Roger O Anderson
Director
Licensing and Management Issues

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c: Regional Administrator - Region III, NRC
NRR Project Manager, NRC
Senior Resident Inspector, NRC
State of Minnesota
Attn: Kris Sanda
J E Silberg

Attachments:

#1 50.46 Summary Report of Emergency Core Cooling System Evaluation Model Changes and Errors

#2 Prairie Island Units 1 & 2 LOCA Peak Clad Temperature (PCT) Margin Utilization Sheets

References:

Westinghouse ESBU Nuclear Safety Advisory Letter NSAL-94-022Q, dated 10/25/94

Westinghouse ESBU Nuclear Safety Advisory Letter NSAL-94-018Q, dated 8/17/94

(These references were transmitted to NSP via Westinghouse letter NSP-94-224 dated 10/27/94 from T W Wallace to R L Lindsey)

ATTACHMENT 1

50.46 Summary Report of Emergency Core Cooling System
Evaluation Model Changes and Errors

Prairie Island Units 1 & 2

NOTRUMP Boiling Heat Transfer Correlation Errors
NOTRUMP Steam Line Isolation Logic Errors
SBLOCTA Axial Nodalization, Rod Internal Pressure Model
Revisions, and SBLOCTA Error Corrections

BOILING HEAT TRANSFER CORRELATION ERRORS

Background

This closely related set of errors deals with how the mixture velocity is defined for use in various boiling heat transfer regime correlations. The previous definition for mixture velocity did not properly account for drift and slip effects calculated in NOTRUMP. This error particularly affected NOTRUMP calculations of heat transfer coefficient when using the Westinghouse Transition Boiling Correlation and the Dougall-Rohsenow Saturated Film Boiling Correlation.

In addition, a minor typographical error was also corrected in the Westinghouse Transition Boiling Correlation.

This was determined to be a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451 and was corrected in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Model

1985 Small Break LOCA Evaluation Model

Estimated Effect

Representative plant calculations for this issue resulted in the estimated PCT effect documented in the attached Margin Utilization Sheet.

STEAM LINE ISOLATION LOGIC ERRORS

Background

This error consists of two portions: a possible plant specific effect which only applies to analyses which assumed Main Feedwater Isolation (FWI) to occur on S-signal, and a generic effect applying to all previous analyses.

The possible plant specific effect was the result of incorrect logic which caused the main steam line isolation to occur on the same signal as FWI. Therefore, when the S-signal was chosen through user input to be the appropriate signal for FWI, it also caused the steam line isolation to occur on S-signal. This is inconsistent with the standard conservative assumption of steam line isolation on Loss of Offsite Power coincident with the earlier Reactor Trip signal.

The generic effect was the result of incorrect logic which always led to the isolation functions occurring at a slightly later time than when the appropriate signal was generated.

This was determined to be a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451 and was corrected in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Model

1985 Small Break LOCA Evaluation Model

Estimated Effect

Representative plant calculations for this issue resulted in the estimated PCT effect (+12°F for the plant specific portion, if applicable, and +18°F for the generic portion) documented in the attached Margin Utilization Sheet.

AXIAL NODALIZATION, RIP MODEL REVISIONS AND SBLOCTA ERROR CORRECTIONS ANALYSIS

Background

10CFR50.46, Appendix K prescribes the acceptable features and required documentation for ECCS Evaluation Models. More specifically, Section II.3 requires that documentation be in place to verify that sensitivity studies have demonstrated the adequacy of nodalization schemes used in the analysis models. A study was recently undertaken with the Westinghouse small break LOCA Evaluation Model to examine the sensitivity of predicted results to the nodalization used for the hot rod model. The results of that study raised concerns regarding the adequacy of the standard axial nodalization prescribed for use in the SBLOCTA code for licensing basis analyses. As a result of this concern, Westinghouse investigated this as a Potential Issue per 10 CFR 21.

Issue Description

The standard rod model (developed in the 1970's) used in performing SBLOCTA calculations has 19 axial nodes with a finer distribution in the top elevations. However, sensitivity studies to justify the number and distribution of these nodes can not be documented. A series of calculations were performed using increasingly finer axial nodalizations than prescribed for the 19 node model and indicated that the standard SBLOCTA 19 node model was not conservative. Nearly all cases demonstrated a significantly non-conservative behavior with respect to PCT. The penalty is attributed to a net increase in single-phase steam enthalpy rise as these nodes uncover sooner and heat up more than coarser nodes partially covered by the mixture level. Thus, it was concluded that a revised model that included a much finer axial nodalization could potentially lead to less favorable results than those predicted in the current analyses, possibly challenging the 10 CFR 50.46 acceptance criteria.

As a result of further investigation into the SBLOCTA code, several additional related issues associated with nodalization and the overall solution of the fluid conservation equations were subsequently identified and corrected. As a separate, but related issue, Westinghouse has implemented a revised model for calculating transient fuel rod internal pressure in the SBLOCTA code. Fuel rod pressure is a governing factor in defining the clad creep, burst and blockage behavior for small break LOCA transients. The NRC was informed of this modeling change per Westinghouse letter NTD-NRC-94-4253, "Revision to the Rod Internal Pressure Model in the Westinghouse SBLOCTA Code (Proprietary)". The letter also informed the NRC that Westinghouse has validated and instituted the model as a methodology improvement to the small break LOCA model for standard implementation on a forward-fit basis in accordance with WCAP-13451, Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting, October, 1992.

Technical Evaluation

At this time Westinghouse has completed the generic technical evaluation of the fuel rod axial nodalization methodology. A revised standard for rod nodalization has been established which insures an adequate solution to the hot channel calculation by specifying a fine nodalization of 0.25 ft nodes for all elevations that are predicted to uncover during the transient.

In addition to this issue, corrections have been made to the SBLOCTA methodology concerning the logic used to initialize the fuel rods at the start of the transient. A small penalty has been assessed to track potential margin utilization from this change. Normally this item would have been reported in the 10CFR50.46 year-end reporting summary along with estimates of effects. However, since all of

the issues relate to portions of the SBLOCTA code and/or its associated input methodology, they are being reported as a single closely-related group of changes. Attached to this letter is a revised Small Break LOCA Margin Utilization Summary table which contains a compilation of the net effect of this evaluation, as item "Axial Nodalization, RIP Model Revision and SBLOCTA Error Corrections", which assesses the net effect of both changes.

Recommendation

For those plants for which Westinghouse performs the licensed SBLOCA analyses, Westinghouse has determined that this issue is not a substantial safety hazard pursuant to 10 CFR 21 because the PCT penalty does not result in a loss of safety function to the extent that there is a major reduction in the degree of protection provided to public health and safety. However, for those plants that have been assessed either a PCT penalty or benefit, the plant licensees should review their reporting obligations under 10 CFR 50.46. To facilitate this, the updated Small Break PCT Margin Utilization Summary sheets are attached to this letter for those plants.

ATTACHMENT 2

Prairie Island Units 1 & 2
LOCA Peak Clad Temperature (PCT)
Margin Utilization Sheets

Revision Date: 10/06/94

Plant Name: Prairie Island Units 1 and 2
Utility Name: Northern States Power

Eval. Model: NOTRUMP
Fuel: 14x14 OFA ZIRLO(TM)
FQ=2.80 FΔH=2.00 SGTP=25%

	Reference*	Clad Temperature		Notes
A. ANALYSIS OF RECORD (7/93)	1	PCT=	1195 °F	1
B. PRIOR PERMANENT ECCS MODEL ASSESSMENTS	2	ΔPCT=	−29 °F	
C. 10 CFR 50.59 SAFETY EVALUATIONS	Table A	ΔPCT=	0 °F	
D. 1994 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessment of PCT Margin)				
1. Boiling Heat Transfer Correlation Error		ΔPCT=	−6 °F	
2. Steam Line Isolation Logic Error		ΔPCT=	18 °F	
3. Axial Nodalization, RIP Model Revision and SBLOCTA Error Corrections Analysis		ΔPCT=	−32 °F	
E. TEMPORARY ECCS MODEL ISSUES**				
1. Effect of Leaking Double Disk Gate Valves	3	ΔPCT=	0 °F	2
F. OTHER MARGIN ALLOCATIONS				
1. None		ΔPCT=	0 °F	
LICENSING BASIS PCT + MARGIN ALLOCATIONS		PCT=	1146 °F	

* References for the Peak Clad Temperature Margin Utilization summary can be found in Table B.
** It is recommended that these temporary PCT allocations which address current LOCA model issues not be considered with respect to 10 CFR 50.46 reporting requirements.

Notes:
1. Includes annular pellet evaluation.
2. A temporary penalty of 0 °F will be assessed for this issue until the exact configuration of the Prairie Island Units 1 and 2 double disk gate valves have been verified.

Revision Date: 10/06/94

Plant Name: Prairie Island Units 1 and 2
Utility Name: Northern States Power

Eval. Model: WCOBRA/TRAC, Addendum 4
Fuel: 14x14 OFA ZIRLO(TM)
FQ=2.40 FΔH=1.75 SGTP=15%

	Reference*	Clad Temperature		Notes
A. ANALYSIS OF RECORD (11/93)	4	PCT=	2089 °F	
B. PRIOR PERMANENT ECCS MODEL ASSESSMENTS		ΔPCT=	0 °F	
C. 10 CFR 50.59 SAFETY EVALUATIONS	Table A	ΔPCT=	0 °F	
D. 1994 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	3	ΔPCT=	0 °F	1
F. OTHER MARGIN ALLOCATIONS				
1. None		ΔPCT=	0 °F	
LICENSING BASIS PCT + MARGIN ALLOCATIONS		PCT=	2089 °F	

* References for the Peak Clad Temperature Margin Utilization summaries can be found in Table B.
** It is recommended that these temporary PCT allocations which address current LOCA model issues not be considered with respect to 10 CFR 50.46 reporting requirements.

Notes:
1. A temporary penalty of 0 °F will be assessed for this issue until the exact configuration of the Prairie Island Units 1 and 2 double disk gate valves have been verified.

Table A – 10 CFR 50.59 Safety Evaluations

Revision Date: 10/06/94

Plant Name: Prairie Island Units 1 and 2
Utility Name: Northern States Power

	Reference	Clad Temperature		Notes
I. SMALL BREAK ECCS SAFETY EVALUATIONS		ΔPCT=	0 °F	
A. None				
TOTAL 10 CFR 50.59 SMALL BREAK ASSESSMENTS		PCT=	0 °F	
II. LARGE BREAK ECCS SAFETY EVALUATIONS		ΔPCT=	0 °F	
A. None				
TOTAL 10 CFR 50.59 LARGE BREAK ASSESSMENTS		PCT=	0 °F	

Notes:
None

Table B – References

1. NSP–93–521, "Northern Power Company Prairie Island Units 1 and 2 Small Break Loss–of–Coolant Accident Final Engineering Report for the ZIRLO(TM) Fuel Upgrade," July 30, 1993.

2. NSP–94–204, "Northern Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Notification and Reporting Information," February 8, 1994.

3. NSP–93–216, "Northern States Power Company Prairie Island Units 1 and 2 Double Disk (DD) Gate Valve Pressure Equalization," June 23, 1993.

4. NSP–93–529, "Northern Power Company Prairie Island Units 1 and 2 Large Break Loss–of–Coolant Accident Final Engineering Report for the ZIRLO(TM) Fuel Upgrade," November 3, 1993.