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10 CFR Part 50
Section 50.46

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Annual Report of Corrections to ECCS Evaluation Models

Attached is the annual report of corrections to Northern States Power Company's (NSP) Emergency Core Cooling System (ECCS) Evaluation Models. In addition, since there is a reported error greater than 50 degrees F, this is a 30-day report. This report is being submitted in accordance with the provisions of 10 CFR 50, Section 50.46.

The applicable corrections noted in Attachment 1 have been applied to Prairie Island's current ECCS analyses of record, and all analyses were found to be in compliance with the applicable acceptance criteria (Attachment 2). Since all analyses remain in compliance, no reanalysis is required or planned.

In this letter we have made no new Nuclear Regulatory Commission commitments.

Please contact Jack Leveille (651-388-1121, Ext. 4142) if you have any questions related to this letter.

Joel P. Sorensen

Joel P. Sorensen
Site General Manager
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c: (see next page)

A001

c: Regional Administrator - Region III, NRC
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Attachments:
1. ECCS Evaluation Model Changes and Errors
2. LOCA Peak Clad Temperature Margin Utilization Sheets

ATTACHMENT 1

ECCS EVALUATION MODEL CHANGES AND ERRORS

(Westinghouse sheets marked up by NSP to show Prairie Island applicability)

ACCUMULATOR LINE/PRESSURIZER SURGE LINE DATA

Background

An issue was identified where the accumulator line piping schedule installed at a plant was different than the design value. This discovery led to a review of various geometric data related to the accumulator lines and pressurizer surge lines, and these revised data were compared to the LOCA analysis values to determine the effect on existing analysis results. For cases where erroneous data were identified, this issue 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~~
~~1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH~~
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP
~~1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model~~
~~1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection~~
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

Estimated Effect

For Small Break LOCA, the nature of this issue leads to an estimated PCT impact of 0°F, based on the following general characteristics of limiting small break transients: (1) only a small fraction of the available accumulator capacity is generally required to replenish vessel inventory to a level sufficient to terminate the cladding temperature excursion, and small variations in the rate of accumulator injection would be expected to have a minimal effect on results; and, (2) the pressurizer empties well before any core uncovery occurs, so variations in the rate of pressurizer discharge would also be expected to have a minimal effect on results.

For Large Break LOCA, the effect of this issue on existing results was determined on a plant-specific basis.

For Prairie Island, the determination was a 0°F effect on PCT.

SMALL BREAK LOCA BURST AND BLOCKAGE/TIME IN LIFE (SPIKE CORRELATION REVISION)

Background

The SPIKE computer program and the associated methodology are used as an evaluation tool in the 10 CFR 50.46 plant licensing process to estimate fuel rod burst peak cladding temperature penalties for Small Break LOCA analyses. (This evaluation tool was previously discussed in Reference 1.) The SPIKE code has been revised to reflect more recent data generated using the current Small Break LOCA Evaluation Model and methodology. The revision could result in a net PCT penalty for Small Break LOCA analyses which have utilized the SPIKE code. This revision 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

The current Small Break LOCA Evaluation Model was employed, and a series of plant types was considered at varying beginning-of-life non-burst PCTs to develop a new database of burst "data" points. The evaluation tool was updated and validated to reflect the new database information. Small Break LOCA analyses which include burst and blockage effects based on direct burnup studies are not impacted by the revision to SPIKE. Also, burst and blockage effects do not adversely impact Small Break LOCA analyses with PCTs less than 1700°F. Plant-specific evaluations have been performed for the affected Small Break LOCA analyses to assess the effect of the revision.

For Prairie Island, this determination was a 0°F effect on PCT

Reference

1. 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)", H.A. Sepp, April 8, 1998.

LUCIFER2 DOWNCOMER AZIMUTHAL FLOW PATH CALCULATIONS

Background

The LUCIFER2 code generates component databases that are used by the SATIMP, BASHER, and SPADES input processors to develop plant-specific input models for large and small break LOCA analyses. An error was discovered in LUCIFER2 whereby a vessel diameter below the hot/cold leg elevation was used for calculations that apply above the hot/cold leg elevation, resulting in incorrect values for various downcomer azimuthal flow path parameters. 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~~
~~1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH~~
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

For SBLOCA, this error has no impact on the calculated PCT for standard Westinghouse plant calculations, since the downcomer azimuthal flow paths defined in LUCIFER2 are not used.

For LBLOCA, this error only affects the SATAN6 code, since the downcomer azimuthal flow paths defined in LUCIFER2 are not used in BASH. Representative plant calculations using the SATAN6 code showed that this error correction has a negligible impact on end-of-blowdown results which is being reported as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

SPADES TRUNCATION ERROR

Background

Various methods exist for entering input data to the SPADES code, which is used to generate the plant-specific input models for NOTRUMP. An error was discovered in SPADES whereby different methods of entering the input data could lead to minor differences in the resulting NOTRUMP input values, due to differences in the 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

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

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

NOTRUMP ARRAY BOUNDARY ERROR

Background

An error was discovered that could potentially affect the data stored within arrays of the NOTRUMP executable. Areas of the NOTRUMP code, and the user externals, were coded such that references to data locations beyond defined array boundaries could possibly have been utilized. This could have led to inappropriate values being used instead of the intended values. To correct this problem, array range checking is now being enabled (during execution) via the use of specific compiler options. With these compiler options activated, attempts to use data outside of defined array boundaries results in code termination with the offending source code line identified to the user. To activate these compiler options, the dimensions on several dummy argument one-dimensional arrays were changed to utilize appropriate coding conventions. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

NOTRUMP models that were considered to encompass the range of array storage requirements were chosen and executed with both the erroneous and corrected code versions. From the results it was determined that the nature of these changes leads to an estimated PCT impact of 0°F.

NOTRUMP VOLUMETRIC/MASS BASED CONSISTENCY ERROR

Background

NOTRUMP contains user input options for either mass or volumetric flow bases in the momentum conservation equations. The latter is used in NOTRUMP for the AP600 Evaluation Model (EM) due to the low pressures experienced in the AP600 SBLOCA transient. When evaluating the use of certain AP600 model features for potential use in the standard Appendix K Evaluation Model, it was discovered that undesirable numerical oscillations were occurring when flow direction changes were predicted in certain flow links, causing the code to abort. The cause of the problem was determined to be an inconsistent method of updating certain mass and volumetric rate variables during portions of the SBLOCA transient. When reviewing the details of this error, it was discovered that other code locations were also affected by this error, which meant that both the standard NOTRUMP EM and the AP600 EM were affected. To correct the problem, several subroutines were modified to correctly update volumetric and mass-based flow calculations on a consistent basis. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

~~1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP (AP600 Implementation)~~

Estimated Effect

Representative PWR plant calculations show that the nature of these changes leads to an estimated PCT impact of 0°F.

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

Background

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculational results. In addition, various blocks of coding were rewritten to eliminate inactive coding, optimize the active coding, and improve commenting, both for enhanced usability 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

The nature of these changes leads to an estimated PCT impact of 0°F.

Prairie Island Units 1&2
10 CFR 50.46 Reporting Information

Plant Specific Accum Level & Line Volume / Plant Specific Restart Error

Background:

Two errors were discovered in the historic plant specific sensitivity studies performed to support the 1995 and 1997 10 CFR 50.46 Annual Reporting (Westinghouse Letters: NSP-96-202 , NSP-98-012). In the study supporting the 1995 Reporting, changes to the Accumulator input noding structure were instituted to address the mechanism by which the code determines that the accumulator water volume has been completely injected. This change was not intended to fundamentally change the amount of accumulator water volume intended to be discharged, however due to an analyst calculational error, the study modeled 50 ft3 too much water volume and 50 ft3 too little nitrogen gas volume. In the study supporting 1997 Reporting, a minor analyst error was made when extracting the mixture velocity results from one segment of the sensitivity study and generating input for the next segment.

Estimated Effect

A reanalysis sensitivity study to address the following was performed:

The two plant specific errors mentioned above
The revised PZR-Accum Geometry information provided by NSP (NSP letter from Camille Abboud to Bob Creighton, "Response to NSAL-98-004," 1/18/98)
Analysis standardization: The average accumulator line volume of the plant with the lower average was utilized (~29.5 ft3).

The study results in the assessing of an aggregate penalty of +113°F. This is applicable to the Large Break LOCA.

ATTACHMENT 2

LOCA Peak Clad Temperature Margin Utilization Sheets

Westinghouse LOCA Peak Clad Temperature Summary For SECY UPI Large Break

Plant Name: Prairie Island Units 1 & 2
Utility Name: Northern States Power
Revision Date: 2/14/00

Analysis Information

EM:	SECY UPI WC/T	**Analysis Date:**	03/95	**Limiting Break Size:**	Cd = 0.4
FQ:	2.4	**FdH:**	1.77		
Fuel:	OFA	**SGTP (%):**	15		
Notes:	Zirlo™				

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	**2180**	**1,2**	**(a)**
MARGIN ALLOCATIONS (Delta PCT)			
A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS			
1 . Fixed Heat Transfer Node Assignment Error / Accumulator Water Injection Error (1995 Report)	-175	3	
2 . 1-D Transition Boiling Heat Transfer Error (1997 Report)	59	5	
3 . Vessel Channel DX Error (1997 Report)	-14	5	
4 . Input Consistency (1997 Report)	-66	5	
5 . No Items for 1996 & 1998 Reports	0	4,6	
B. 10 CFR 50.59 SAFETY EVALUATIONS			
1 . None	0		
C. 1999 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessments of PCT Margin)			
1 . Accumulator Line Pressurizer Surge Line Data / Plant Specific Accumulator Level & Line Volume / Plant Specific Restart Error: Reanalysis	113	7	(b)
D. TEMPORARY ECCS MODEL ISSUES*			
1 . None	0		
E. OTHER			
1 . None	0		
LICENSING BASIS PCT + MARGIN ALLOCATIONS	**PCT =** 2097		

* 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.

References:

1 . 95NS-G-0021, "Updated UPI LBLOCA," March 24, 1995.

2 . WCAP-13919, Addendum 1, "Prairie Island Units 1 and 2 WCOBRA/TRAC Best Estimate UPI Large Break LOCA Analysis Engineering Report Addendum 1: Updated Results," December 1996.

3 . NSP-96-202, "Northern States Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Annual Notification and Reporting," February 20, 1996.

4 . NSP-97-201, "Northern States Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Annual Notification and Reporting," April 17, 1997.

5 . NSP-98-012, "Northern States Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Annual Notification and Reporting for 1997," February 27, 1998.

Plant Name:	Prairie Island Units 1 & 2
Utility Name:	Northern States Power
Revision Date:	2/14/00

6 . NSP-99-010, "Northern States Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Annual Notification and Reporting for 1998," April 29, 1999.

7 . 1999 Annual Report.

Notes:

(a) P-bar-HA increased from 1.57 to 1.59

(b) Renalysis for all listed issues

Westinghouse LOCA Peak Clad Temperature Summary For Small Break

Plant Name: Prairie Island Units 1 & 2
Utility Name: Northern States Power
Revision Date: 2/14/00

Analysis Information

EM:	NOTRUMP	**Analysis Date:**	07/93	**Limiting Break Size:**	6 inch
FQ:	2.8	**FdH:**	2		
Fuel:	OFA	**SGTP (%):**	25		
Notes:	Zirlo™ (14X14)				

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	1195	1	(a)
MARGIN ALLOCATIONS (Delta PCT)			
A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS			
1 . Effect of SI in Broken Loop (Plant Specific)	21	4	(b,c)
2 . Effect of Improved Condensation Model (Plant Specific)	4	4	(b)
3 . Plant-Specific Assessment to Rebaseline Limiting Case	218	4,7	(d,e,f)
4 . Annular Pellets Misapplication (1998 Report)	39	1,7	
5 . All Other Items in Reference 2 Except A.1 & A.2	0	7	(f)
B. 10 CFR 50.59 SAFETY EVALUATIONS			
1 . MFW Temperature	3	3	
2 . AFW Flow Reduction to 180 gpm	0	5	
C. 1999 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessments of PCT Margin)			
1 . None	0	6	
D. TEMPORARY ECCS MODEL ISSUES*			
1 . None	0		
E. OTHER			
1 . None	0		
LICENSING BASIS PCT + MARGIN ALLOCATIONS	**PCT =** 1480		

* 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.

References:

1 . WCAP-13920, "Small Break Loss-of-Coolant Accident Engineering Report for the Prairie Island ZIRLO™ Fuel Upgrade," November 1993 (Includes Update NSD-SAE-ESI-97-522).

2 . Annual Reports for 1993 through 1997 (NSP-94-204, NSP-95-202, NSP-96-202, NSP-97-201, NSP-98-012).

3 . NSP-97-504, "Northern States Power Company Prairie Island Units 1 and 2, Feedwater Temperature Increase/Net RCS Heat Input Addition Program, Transmittal of Final Safety Evaluation," September 23, 1997.

4 . NSP-98-031, " SBLOCA Evaluation for Elimination of AFW Flow for Prairie Island Units 1 and 2," September 8, 1998.

5 . NSP-98-046, " SBLOCA Evaluation for AFW Flow Reduction for Prairie Island Units 1 and 2 - Final," November 3, 1998.

6 . 1999 Annual Report.

Plant Name: Prairie Island Units 1 & 2

Utility Name: Northern States Power

Revision Date: 2/14/00

7 . NSP-99-010, "Northern States Power Company Prairie Island Units 1 and 2 10 CFR 50.46 Annual Notification and Reporting for 1998," April 29, 1999.

Notes:

(a) Annular pellet sensitivity study result.

(b) Plant-specific assessments for the effects that were originally estimated for these two items in NSP-93-222.

(c) Also includes the effect of relocation of the break location to the midplane of the cold leg (see WCAP-10054-P-A, Addendum 2, Revision 1). The original estimate (NSP-93-222) did not include this effect.

(d) Value requested by customer pending completion of Westinghouse investigation. Rebaseline study includes newer code versions, COSI condensation model and select input changes (e.g. more conservative power shape, solid fuel pellets).

(e) At the request of NSP, this line item was included in the 1998 50.46 section of the PCT Sheet and has been subsequently rolled into the Prior Permanent Section, consistent with the original request. This represents a deviation from Westinghouse's normal approach.

(f) The estimated effects of previous code changes (through the -19 °F accumulated as of 1997 Annual Report NSP-98-012) are superceded by the Items A.1, A.2 & A.3 plant-specific calculations performed to rebaseline the limiting case (1438 - 1195 = 21 + 4 + 218), originally summarized in the 1998 Report (NSP-99-010).