BALTIMORE GAS AND ELECTRIC

1650 CALVERT CLIFFS PARKWAY • LUSBY, MARYLAND 20657-4702

GEORGE C. CREEL
VICE PRESIDENT
NUCLEAR E[illegible]GY
(410) 260[illegible]

January 30, 1992

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Annual Report on ECCS Codes and Methods Required by 10 CFR 50.46

Gentlemen:

Attached are the 1989-1991 Annual Reports on Emergency Core Cooling System (ECCS) Codes and Methods required by 10 CFR 50.46. The 1992 report will be submitted after we receive it from our vendor.

Should you have any further questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

GCC/DWM/dwm/bjd

Attachments

cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
R. A. Capra, NRC
D. G. McDonald, Jr., NRC
T. T. Martin, NRC
P. R. Wilson, NRC
R. I. McLean, DNR
J. H. Walter, PSC

Cert No P807576292

A001
1/1

040052

CENPD - 279

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

COMBUSTION ENGINEERING

LEGAL NOTICE

THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED BY ABB COMBUSTION ENGINEERING. NEITHER ABB COMBUSTION ENGINEERING NOR ANY PERSON ACTING ON ITS BEHALF:

A. MAKES ANY WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, WITH RESPECT TO THE ACCURACY, COMPLETENESS, OR USEFULNESS OF THE INFORMATION CONTAINED IN THIS REPORT, OR THAT THE USE OF ANY INFORMATION, APPARATUS, METHOD, OR PROCESS DISCLOSED IN THIS REPORT MAY NOT INFRINGE PRIVATELY OWNED RIGHTS; OR

B. ASSUMES ANY LIABILITIES WITH RESPECT TO THE USE OR FOR DAMAGES RESULTING FROM THE USE OF, ANY INFORMATION, APPARATUS, METHOD OR PROCESS DISCLOSED IN THIS REPORT.

CENPD - 279

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

TRANSIENT METHODS AND LOCA
NUCLEAR FUEL ENGINEERING

APRIL 1989

COMBUSTION ENGINEERING

Abstract

This report describes changes and errors in the Combustion Engineering codes and analysis methodology for ECCS analysis from the last approved version through the end of 1988 per the requirements of 10CFR50.46. For this reporting period only one computer code had reportable changes or errors. The corrections and changes reduced the peak cladding temperature by less than $1^{\circ}F$.

Table of Contents

1.0 Introduction

This report addresses the NRC requirement to report changes or errors in licensed codes for ECCS analysis. The revision to the ECCS Acceptance Criteria[1] spells out reporting requirements and actions required when errors are corrected or changes are made in an evaluation model or in the application of a model for operating licensee or construction permittee of a nuclear power plant.

The action requirements in § 50.46(a)(3) are:

1. Each applicant for or holder of an operating license or construction permit shall estimate the effect of any change to or error in an acceptable evaluation model or in the application of such a model to determine if the change or error is significant. For this purpose, a significant change or error is one which results in a calculated peak fuel cladding temperature (PCT) different by more than 50°F from the temperature calculated for the limiting transient using the last acceptable model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50°F.

2. For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in § 50.4. This report is to be filed within one year of discovery of the error and must be reported each year thereafter until a revised evaluation model or a revised evaluation correcting minor errors is approved by the NRC staff.

3. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with § 50.46

requirements. This schedule may be developed using an integrated scheduling system previously approved for the facility by the NRC. For those facilities not using an NRC approved integrated scheduling system, a schedule will be established by the NRC staff within 60 days of receipt of the proposed schedule.

4. Any change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of § 50.46 is a reportable event as described in §§ 50.55(e), 50.72 and 50.73. The affected applicant or licensee shall propose immediate steps to demonstrate compliance or bring plant design or operation into compliance with § 50.46 requirements.

This report documents all the changes made to the presently licensed C-E LOCA analysis models and methodology which have not been reviewed by the NRC staff. This is specifically to satisfy the requirements described in the second item above.

2.0 Codes for ECCS Evaluation

C-E uses several digital computer codes for ECCS analysis that are described in topical reports, are licensed by the NRC and are covered by the provisions of CFR 50.46. Those for large break LOCA calculations are: CEFLASH-4A, COMPERC-II, PARCH, STRIKIN-II, and COMZIRC. CEFLASH-4AS is used in conjunction with COMPERC-II, STRIKIN-II, and PARCH for small break LOCA calculations.

3.0 Error Corrections and Model Changes in Computer Codes

This section discusses all error corrrections or model changes to the licensed codes which may affect calculated PCT. Only the STRIKIN-II computer code has been changed since the last approved submittal to the NRC. No changes to analysis procedures have been made since the last approved submittal to the NRC.

3.1. STRIKIN-II

A. Code Description

STRIKIN-II is a FORTRAN digital computer program which is used by Combustion Engineering, Inc. to calculate the core hot spot transient peak clad temperature (PCT) and peak local clad oxidation percentage for a large break LOCA. It is also used to provide initial fuel temperatures for the small break LOCA peak cladding temperature calculation. A detailed code description is presented in References 2 through 5.

B. Error in STRIKIN-II DNB Model Coding

An error in the approved version of STRIKIN-II which may potentially affect calculated PCT has been identified and corrected, Reference (6). A revised version has been prepared for licensing calculations.

Due to a coding error, STRIKIN-II formerly limited the fluid quality to a positive value for the MacBeth correlation. The revised version allows use of a negative fluid quality as appropriate. The impact of of this correction for a large break LOCA is a $0.19^{o}F$ decrease in the peak cladding temperature. The impact on a small break LOCA could be prediction of DNB slightly earlier than it would actually occur if MacBeth is used with a negative quality. Correction of the error actually produces no change in cladding temperature at the beginning of steam cooling, therefore no change in PCT.

C. Changes in STRIKIN-II Code

An option has been added to STRIKIN-II to limit the cladding strain rate for the pre-rupture strain model to a realistic strain rate instead of introducing the pre-rupture strain in a single time step. Without a strain rate limit, STRIKIN-II changes the fuel-cladding gap width too quickly when the pre-rupture strain model is invoked.

This challenges the gap conductivity and temperature model and can cause the code to abort. Use of this option produced no effect on PCT.

4.0 Conclusions

The error correction and the change to STRIKIN-II have the potential to affect the PCT. However, the actual effect of the two changes is to reduce PCT by less than $1^{\circ}F$. This is a very small change in PCT for the limiting transient. There were no significant changes in the sense of CFR 50.46.

This summarizes the error corrections and changes to the G-E LOCA codes and models from the last accepted versions through December 1988.

5.0 References

1. "Emergency Core Cooling System; Revisions to Acceptance Criteria," 10CFR50, Federal Register, Vol. 53, No. 180, September 16, 1988

2. CENPD-135P, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program," August, 1974

3. CENPD-135P, Supplement 2, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program (Modifications)," February, 1975

4. CENPD-135, Supplement 4-P, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program," August, 1976

5. CENPD-135, Supplement 5-P, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program," April, 1977

6. "STRIKIN-II 87316 from 85074," CD-TML-06[illegible], M. Michonski, January 20, 1988.

CENPD - 279
SUPPLEMENT 1

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

FEBRUARY 1990

COMBUSTION ENGINEERING

LEGAL NOTICE

THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED BY ABB COMBUSTION ENGINEERING. NEITHER ABB COMBUSTION ENGINEERING NOR ANY PERSON ACTING ON ITS BEHALF:

A. MAKES ANY WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, WITH RESPECT TO THE ACCURACY, COMPLETENESS, OR USEFULNESS OF THE INFORMATION CONTAINED IN THIS REPORT, OR THAT THE USE OF ANY INFORMATION, APPARATUS, METHOD, OR PROCESS DISCLOSED IN THIS REPORT MAY NOT INFRINGE PRIVATELY OWNED RIGHTS; OR

B. ASSUMES ANY LIABILITIES WITH RESPECT TO THE USE OR FOR DAMAGES RESULTING FROM THE USE OF, ANY INFORMATION, APPARATUS, METHOD OR PROCESS DISCLOSED IN THIS REPORT.

CENPD - 279
SUPPLEMENT 1

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

TRANSIENT METHODS AND LOCA
NUCLEAR FUEL ENGINEERING

FEBRUARY 1990

COMBUSTION ENGINEERING

Abstract

This report describes changes and errors in the Combustion Engineering codes and analysis methodology for ECCS analysis in 1989 per the requirements of 10CFR50.46. For this reporting period only one computer code had reportable changes or errors. The corrections and changes did not affect the peak cladding temperature. The cummulative temperature change for large break LOCA is a reduction of less than $1^{0}F$. No changes or errors that affect the peak cladding temperature for small break LOCA have occured. Per the criteria of 10CFR50.46, no action beyond this annual report is required.

Table of Contents

1.0 Introduction

This report addresses the NRC requirement to report changes or errors in licensed codes for ECCS analysis. The revision to the ECCS Acceptance Criteria[1] spells out reporting requirements and actions required when errors are corrected or changes are made in an evaluation model or in the application of a model for an operating licensee or construction permittee of a nuclear power plant.

The action requirements in § 50.46(a)(3) are:

1. Each applicant for or holder of an operating license or construction permit shall estimate the effect of any change to or error in an acceptable evaluation model or in the application of such a model to determine if the change or error is significant. For this purpose, a significant change or error is one which results in a calculated peak fuel cladding temperature (PCT) different by more than $50^{o}F$ from the temperature calculated for the limiting transient using the last acceptable model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than $50^{o}F$.

2. For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in § 50.4. This report is to be filed within one year of discovery of the error and must be reported each year thereafter until a revised evaluation model or a revised evaluation correcting minor errors is approved by the NRC staff.

3. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with § 50.46

requirements. This schedule may be developed using an integrated scheduling system previously approved for the facility by the NRC. For those facilities not using an NRC approved integrated scheduling system, a schedule will be established by the NRC staff within 60 days of receipt of the proposed schedule.

4. Any change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of § 50.46 is a reportable event as described in §§ 50.55(e), 50.72 and 50.73. The affected applicant or licensee shall propose immediate steps to demonstrate compliance or bring plant design or operation into compliance with § 50.46 requirements.

This report documents all the changes made to the presently licensed C-E LOCA analysis models and methodology which have not been reviewed by the NRC staff. This is specifically to satisfy the requirements described in the second item above.

2.0 Codes for ECCS Evaluation

C-E uses several digital computer codes for ECCS analysis that are described in topical reports, are licensed by the NRC and are covered by the provisions of CFR 50.46. Those for large break LOCA calculations are: CEFLASH-4A, COMPERC-II, PARCH, STRIKIN-II, and COMZIRC. CEFLASH-4AS is used in conjunction with COMPERC-II, STRIKIN-II, and PARCH for small break LOCA calculations.

3.0 Error Corrections and Model Changes in Computer Codes

This section discusses all error corrrections or model changes to the licensed codes which may affect the calculated PCT. Only the COMPERC-II for a large break has been changed in 1989. No changes to analysis procedures have been made since the last approved submittal to the NRC.

3.1. COMPERC-II

A. Code Description

COMPERC-II is a FORTRAN digital computer program which is used by Combustion Engineering, Inc. to calculate the core refill and reflood transient portion of a PWR loss of coolant accident (LOCA). A detailed code description is presented in References 2 through 4.

B. Model Change in COMPERC-II for SI Spillage

The model for the spillage calculation in COMPERC-II has been changed to reflect a more realistic physical representation. The change is as described below:

Present Model (Page 10 of Reference 2)

If $Z_{A,MAX} < Z_A \leq Z_{A,MAXI}$

$$W_{spill} = \left[\frac{(Z_{A,MAXI} - Z_{A,MAX})\ 2\ g_c\ \rho_A^2\ A_{B,F}^2}{K_{spill}} \right]^{1/2} \qquad (1)$$

where W_{spill} : Rate of water spillage out of the break,
K_{spill} : Loss coefficient for the spillage of water out of the break
$A_{B,F}$: Flow area in the core,
Z_A : Height of the water in the downcomer,
$Z_{A,MAX}$: Distance between bottom of core and bottom of inlet pipe,
$Z_{A,MAXI}$: Distance between bottom of core and top of inlet pipe,
ρ_A : Density of water in the downcomer/lower plenum,
g_c : Conversion constant.

Modification

Equation (1) was modified as

$$W_{spill} = \left[\frac{(Z_A - Z_{A,MAX})\ 2\ g_c\ \rho_A^2\ A_{B,F}^2}{k_{spill}} \right]^{1/2} \qquad (2)$$

The difference between Equations (1) and (2) is the first term of the numerator on the right hand side of the equations. This change uses the real head term instead of the fixed head term while the mixture level is in the span of the cold leg.

C. Reasons for the Modification

As indicated in the previous section, this change reflects a better physical representation than the model described in Reference 1. However, a more important reason for this modification is to remove low-amplitude flow oscillations introduced by the discontinuity of the fixed head in the old model.

D. Impact of the Spillage Model Change on PCT

The change in downcomer spillage head term has the possibility to affect PCT through two effects -- reflood rate and two-phase level. Comparison of the reflood rates for cases without and with the change in head term shows that the small oscillations in the reflood rate are removed. However, the reflood rate selected for subsequent use is not changed; therefore, there is no change in PCT from this effect. The change in the head term for downcomer spillage also eliminates oscillations in the two phase-level but does not change the base two-phase level. Elimination of the oscillations reduces the uncertainty in the two-phase level selected for the next step in the analysis. However, due to the small sensitivity of the C-E methodology to two-phase level changes, the change in the two-phase

level due to the change in the head term for spillage has no effect on PCT.

4.0 Conclusions

The change to COMPERC-II has the potential to affect the PCT by changing the reflood rate or the two-phase level. However, an evaluation of the reflood rates and effect of the two-phase level for cases before and after the change in head term for the downcomer spillage shows that there is no change in PCT.

The cummulative change in PCT for large break LOCA including that from the previous annual report, Reference 5, is a reduction of less than $1^{o}F$. There have been no changes in the small break LOCA results to date. Therefore, there was no significant change in the sense of CFR 50.46 in 1989 and no action beyond the submission of this report is needed.

5.0 References

1. "Emergency Core Cooling System; Revisions to Acceptance Criteria," 10CFR50, Federal Register, Vol. 53, No. 180, September 16, 1988.

2. CENPD-134P, "COMPERC-II, A Program for Emergency-Refill-Reflood of the Co. August, 1974.

3. CENPD-134P, Supplement 1, "COMPERC-II, A Program for Emergency Refill-Reflood of the Core (Modifications)," February, 1975.

4. CENPD-134, Supplement 2, "COMPERC-II, A Program for Emergency Refill-Reflood of the Core," June, 1985.

5. CENPD-279, Annual Report on C-E ECCS Codes and Methods for 10CFR50.46, April, 1989.

CENPD - 279
SUPPLEMENT 2

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

APRIL, 1991

ABB Combustion Engineering Nuclear Power

LEGAL NOTICE

THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED BY ABB COMBUSTION ENGINEERING. NEITHER ABB COMBUSTION ENGINEERING NOR ANY PERSON ACTING ON ITS BEHALF:

A. MAKES ANY WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, WITH RESPECT TO THE ACCURACY, COMPLETENESS, OR USEFULNESS OF THE INFORMATION CONTAINED IN THIS REPORT, OR THAT THE USE OF ANY INFORMATION, APPARATUS, METHOD, OR PROCESS DISCLOSED IN THIS REPORT MAY NOT INFRINGE PRIVATELY OWNED RIGHTS; OR

B. ASSUMES ANY LIABILITIES WITH RESPECT TO THE USE OR FOR DAMAGES RESULTING FROM THE USE OF, ANY INFORMATION, APPARATUS, METHOD OR PROCESS DISCLOSED IN THIS REPORT.

CENPD - 279
SUPPLEMENT 2

ANNUAL REPORT
ON
C-E ECCS CODES AND METHODS
FOR 10CFR50.46

LOCA ANALYSIS AND METHODS
NUCLEAR FUEL ENGINEERING

APRIL, 1991

Abstract

This report describes changes and errors in the ABB Combustion Engineering codes and analysis methodology for ECCS analysis in 1990 per the requirements of 10CFR50.46. For this reporting period only one computer code had reportable changes or errors. The corrections and changes did not affect the peak cladding temperature. The cumulative temperature change for large break LOCA is a reduction of less than $1^{o}F$. No changes or errors that affect the peak cladding temperature for small break LOCA have occured. Per the criteria of 10CFR50.46, no action beyond this annual report is required.

Table of Contents

1.0 Introduction

This report addresses the NRC requirement to report changes or errors in licensed codes for ECCS analysis. The revision to the ECCS Acceptance Criteria[1] spells out reporting requirements and actions required when errors are corrected or changes are made in an evaluation model or in the application of a model for an operating licensee or construction permittee of a nuclear power plant.

The action requirements in § 50.46(a)(3) are:

1. Each applicant for or holder of an operating license or construction permit shall estimate the effect of any change to or error in an acceptable evaluation model or in the application of such a model to determine if the change or error is significant. For this purpose, a significant change or error is one which results in a calculated peak fuel cladding temperature (PCT) different by more than $50^{o}F$ from the temperature calculated for the limiting transient using the last acceptable model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than $50^{o}F$.

2. For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in § 50.4.

3. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with § 50.46 requirements. This schedule may be developed using an integrated scheduling system previously approved for the facility by the NRC. For those facilities not using an NRC approved integrated scheduling

system, a schedule will be established by the NRC staff within 60 days of receipt of the proposed schedule.

4. Any change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of § 50.46 is a reportable event as described in §§ 50.55(e), 50.72 and 50.73. The affected applicant or licensee shall propose immediate steps to demonstrate compliance or bring plant design or operation into compliance with § 50.46 requirements.

This report documents all the changes, made in the year covered by this report, to the presently licensed ABB C-E LOCA analysis models and methodology which have not been reviewed by the NRC staff. This document is provided to satisfy the reporting requirements of the second item above.

2.0 Codes for ECCS Evaluation

ABB C-E uses several digital computer codes for ECCS analysis that are described in topical reports, are licensed by the NRC, and are covered by the provisions of 10CFR50.46. Those for large break LOCA calculations are CEFLASH-4A, COMPERC-II, PARCH, STRIKIN-II, and COMZIRC. CEFLASH-4AS is used in conjunction with COMPERC-II, STRIKIN-II, and PARCH for small break LOCA calculations. The codes for post-LOCA long term cooling analysis are BORON, CEPAC, NATFLOW, and CELDA.

3.0 Error Corrections and Model Changes in Computer Codes

This section discusses all error corrrections or model changes to the licensed codes which may affect the calculated PCT. Only the BORON code for long term cooling analysis of large break LOCAs has been changed in 1990. This change was made to correct an error. No changes to analysis procedures have been made since the last approved submittal to the NRC.

3.1. BORON

A. Code Description

BORON is a FORTRAN digital computer program which is used by Combustion Engineering, Inc. to calculate the boric acid concentration in the reactor core after a LOCA. This information is used to determine the point in time, if ever, at which boric acid concentration will reach the solubility limit before core flushing is initiated by starting combined hotside/coldside safety injection. A detailed code description is presented in Reference 2.

B. Coding Error in BORON

The coding that calculates the total boric acid content of the system was found to have the variable VRCS mistyped as VCRS, where VRCS is the mass of solution in the reactor coolant system (RCS). Correct coding is used if there is a boric acid storage tank (BAST) in the system, if it empties after the refueling water tank (RWT), and if the BAST can't supply as much water as is being boiled-off in the core. Normally the BAST can't supply as much water as is being boiled off in the core under these conditions. Otherwise, the incorrect coding is used.

The correct and erroneous equations are described below.

Correct Equation (Page C-9 of Reference 2)

$$BTOTL1 = VRCS*BRCS/100.0+0.9*VRWT*BRWT/100.0+VSIT*BSIT/100.0 \quad (1)$$

$$BTOTAL = BTOT1 + BBAST*VBAST/100.0 \quad (2)$$

where BTOTAL : Total boric acid mass in system (lbm),
BBAST : Boric acid concentration in BAST (w/o),
BRCS : Boric acid concentration in RCS (w/o),

BRWT : Boric acid concentration in RWT (w/o),
BSIT : Boric acid concentration in safety injection tank (SIT) (w/o),
VBAST : Mass of solution in BAST (lbm),
VRCS : Mass of solution in RCS (lbm),
VRWT : Mass of solution in RWT (lbm),
VSIT : Mass of solution in SIT (lbm),

Incorrect Equation

BTOTL1 = VCRS*BRCS/100.0+0.9*VRWT*BRWT/100.0+VSIT*BSIT/100.0 (3)

The difference between Equations (1) and (3) is the first term on the right hand side of the equations. The error was introduced in 1983 and was detected and corrected in 1990.

C. Impact of RCS Mass Error on PCT

The coding error in BORON caused the code to use undefined input for the RCS solution mass for some transients under the conditions described above. This error could affect the PCT by over-predicting the time available before core flushing must be initiated to prevent precipitation of boric acid and possible blockage of the coolant channels in the fuel. However, an evaluation of the effect of this error for those analyses that were performed with the code version with the erroneous coding shows that precipitation does not occur before flushing is started. Since cooling water circulation is not impeded by boric acid precipitation throughout the post-LOCA period, the coding error has no effect on PCT for a large break LOCA.

4.0 Conclusions

The error in BORON had the potential to affect the PCT by over-predicting the time until core flushing must be initiated. However, it is the case that precipitation will not occur before flushing is initiated by

starting combined hotside/coldside safety injection. Consequently, there is no change in PCT for a large break LOCA due to the code error.

The cumulative change in PCT for large break LOCA including that from the previous annual reports, References 3 and 4, is a reduction of less than $1^{o}F$. There have been no changes in the small break LOCA results to date. Therefore, there was no significant change in the sense of 10CFR50.46 in 1990 and no action beyond the submission of this report is needed.

5.0 References

1. "Emergency Core Cooling System; Revisions to Acceptance Criteria," 10CFR50, Federal Register, Vol. 53, No. 180, September 16, 1988

2. CENPD-254-P-A, "Post-LOCA Long Term Cooling Evaluation Model," June, 1980.

3. CENPD-279, "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," April, 1989.

4. CENPD-279, Supplement 1, "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," February, 1990.