CENPD - 279

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

TRANSIENT METHODS AND LOCA
NUCLEAR FUEL ENGINEERING

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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 $1^{\circ}F$.

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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°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 C-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-064, M. Michonski, January 20, 1988.