UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MAR 18 1986

MEMORANDUM FOR: Paul Boehnert
Senior Staff Engineer, ACRS

FROM: Carl H. Berlinger, Chief
Reactor Systems Branch, PWR-A

SUBJECT: DRAFT SER FOR THE PROPOSED OPERATION OF MCGUIRE UNITS 1 AND 2 WITHOUT UPPER HEAD INJECTION

Enclosed is a draft SER and its supporting documents for your consideration in anticipation of a March 26, 1986 meeting with the ECCS subcommittee.

As reflected in this draft SER we are in final stages of our technical review and are reasonably confident that upon completion, we will be able to conclude that operation of the McGuire units at 100% power with UHI isolated or removed is acceptable. However, prior to concluding this review, we wish to have the benefit of ACRS comments. We believe that the enclosed SER, although in draft form at this time, provides the basis for a meeting to this end, and is responsive to the request of the Committee during the February 21, 1985 meeting for further discussions prior to completion of the staff's review.

Carl H. Berlinger

Carl H. Berlinger, Chief
Reactor Systems Branch, PWR-A

Enclosures:
1. March 17, 1986, letter from Rahe to Berlinger transmitting (a) responses to NRC staff questions about UHI removal at McGurie and (b) revisions to Chapter 15 of the McGuire FSAR starting with page 15.6-7.
2. March 17, 1986, letter from H.B. Tucker to H.R. Denton, regarding UHI removal/isolation.
3. January 29, 1986, SNL letter Dobranich to Watt, TRAC-PFI/MOD1 calculations
4. March 12, 1986, SNL transmittal Dobranich to Watt, UHI PWR with UHI removal.
5. November 20, 1985, memo Rowsome to Novak reliability assessment of USI auto-isolation capability.
6. March 5, 1986, memo Rossi to Hood, McGuire radiological safety evaluation report.

cc: H. Thompson
C. Rossi

	Ltr	Encl
ACRS	1	1
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Per S. Hood Phone Chang:

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PDR ADOCK 05000369
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SAFETY EVALUATION OF THE PROPOSED OPERATION OF MCGUIRE UNITS 1 & 2 WITHOUT UPPER HEAD INJECTION

INTRODUCTION

In a letter dated May 9, 1985, the Duke Power Company (licensee) proposed license amendments for McGuire Nuclear Station Units 1 and 2 to change the Technical Specifications in accordance with a program to delete Upper Head Injection (UHI) systems at McGuire. In the May letter, the licensee described the results of a feasibility study (for UHI removal) and outlined its program for obtaining NRC approval.

The proposed Technical Specification changes were modified December 17, 1985 to provide for levels of modification achievable in successive fuel reloads. Options included: (1) operation with UHI available, (2) operation with UHI locked out, and (3) operation with UHI components external to the reactor vessel effectively removed. The licensee committed to support the proposed Technical Specification changes through confirmatory studies.

By letter of October 2, 1985, the licensee submitted proposed revision to the McGuire Nuclear Station Safety Analysis for UHI Elimination. The FSAR reanalyses of the large break LOCA had utilized the computer code "BASH" which was then under review by the staff. The licensee noted that the reanalysis confirmed the proposed revisions to the technical specifications conservative but also that they may be relaxed to allow full operational flexibility. They intended to propose further changes following NRC approval of deletion of UHI.

Problems were encountered by Westinghouse with BASH reflood heat transfer in February 1986. Accordingly, on March 17, 1986, the licensee submitted a reanalysis and update of the October 2, 1985 safety analysis. This reanalysis utilized BART, a previously accepted Westinghouse evaluation model. It is the March 17, 1986 submittal which provides the principal basis for this Safety Evaluation.

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EVALUATION

A large break LOCA spectrum consisting of three double-ended cold-leg guillatine breaks with discharge coefficients (C_D) of .4, .6, and .8 were analyzed. An NRC-approved BART code was utilized. The UHI system had been disconnected externally leaving the components inside the reactor vessel unchanged. The cold leg accumulator system had been modified to more closely approximate other non-UHI plants. Accumulator pressure had been increased, water volume decreased slightly and the restriction between accumulator and primary system reduced to minimize the length of refill. For the limiting discharge coefficient, both minimum and maximum safety injection were considered. An F_Q of 2.26 was assumed, coinciding with the current technical specification value.

We have reviewed the elements of these calculations and conclude that an appropriate methodology was used for analyzing ECCS performance under these conditions. The results of the analyses are within the performance limits of 10 CFR 50.46. The analyses took credit for retention of UHI components internal to the reactor vessel.

A spectrum of three small breaks were analyzed using the NRC-approved NOTRUMP. The fuel performance was well within all acceptance criteria.

Two accidents were reanalyzed without UHI system actuation because it had previously been indicated that the system pressure could dip to below UHI initiation. DNBR limits were safely avoided for both events. (Inadvertent Opening of a Steam Generator Relief or Safety Valve, 15.1.4 and Steam System Piping Failure, 15.1.5.)

Containment analysis for Large Break LOCA and Steamline Breaks were also adequately addressed.

We therefore conclude that the LOCA analysis for non-UHI operation is acceptable. Other Chapter 15 events potentially effected by UHI have been evaluated without exceeding limits.

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JUSTIFICATION

The action supported by this evaluation would permit removal of an element of the emergency core cooling system (ECCS) as originally designed for the McGuire units. General Design Criterion 35 describes a system to provide abundant core cooling. The following discussion is intended to provide some insight into how removal is justified.

By design, the UHI could inject up to 1000 FT^3 of water into the upper head of the reactor vessel during a postulated LOCA. Vessel internals were provided to obtain uniform mixing with flow from the hot legs during blowdown. It was expected that UHI would enhance core cooling during blowdown and assure rewet or quench at the start of refill of the lower plenum.

In the process of developing an evaluation model for plants containing UHI, uncertainties were identified in modeling and in the supporting experiments. Conservative or bounding or in some cases "alternate approaches" were built into the evaluation model to compensate for the uncertainties and assure that the peak clad temperatures calculated were bounding, Reference NUREG-0297. The limited credit for heat transfer allowed for in the UHI model has subsequently been exceeded by the enhanced cooling or reduced heatup derived from improved analytical models (as reflected in BART).

NRC consultants and Westinghouse have performed studies using both best estimate and NRC-approved evaluation model codes to characterize the difference between UHI and non-UHI response to the LOCA.

Figure 1 compares evaluation model calculations. The plant transient shown as case 2 has been superseded by an analysis submitted on March 17, 1986 as a safety analysis revision. Unfortunately, the revised figure was not presently available. The peak clad temperatures for Case 2 and the revised Case 2 during blowdown are essentially identical because they occur before UHI system injection. The hot rod is somewhat cooler at the end of blowdown with UHI. UHI delays reflood and the hot rod reaches a higher temperature.

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The best estimate calculations shown in Figure 2 produce about the same PCT during blowdown as with the evaluation model. The UHI case remains quenched, while the non-UHI case shows a reheat to 1430°F (some 600°F cooler than the EM results).

Table 1 lists some of the conservatisms in the evaluation model. These are discussed further in the March 17 submittal from Westinghouse (Rahe to Berlinger) entitled "Responses to NRC Staff Questions about UHI Removal at McGuire".

The maximum safety injection case (without UHI and Cd of .6) provided the highest calculated peak clad temperature. Although this is within 10 CFR 50.46 limits, we are still evaluating the significance.

We believe the non-UHI peak clad temperature to be conservative and acceptable. We believe the UHI evaluation model to be excessively conservative.

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TABLE 1

SOME CONSERVATIVE ASPECTS OF THE EVALUATION MODEL

- The evaluation model conservatively prohibits quenching of the hot rod independent of blowdown fluid conditions. Thus, the benefit of UHI quench cooling is limited to the non-limiting fuel rods.

- The quench line is not a best estimate line. It is biased conservatively by providing 90% confidence that 50% of the true data population is above the line and also because the data is from electrically heated rods rather than fuel rods.

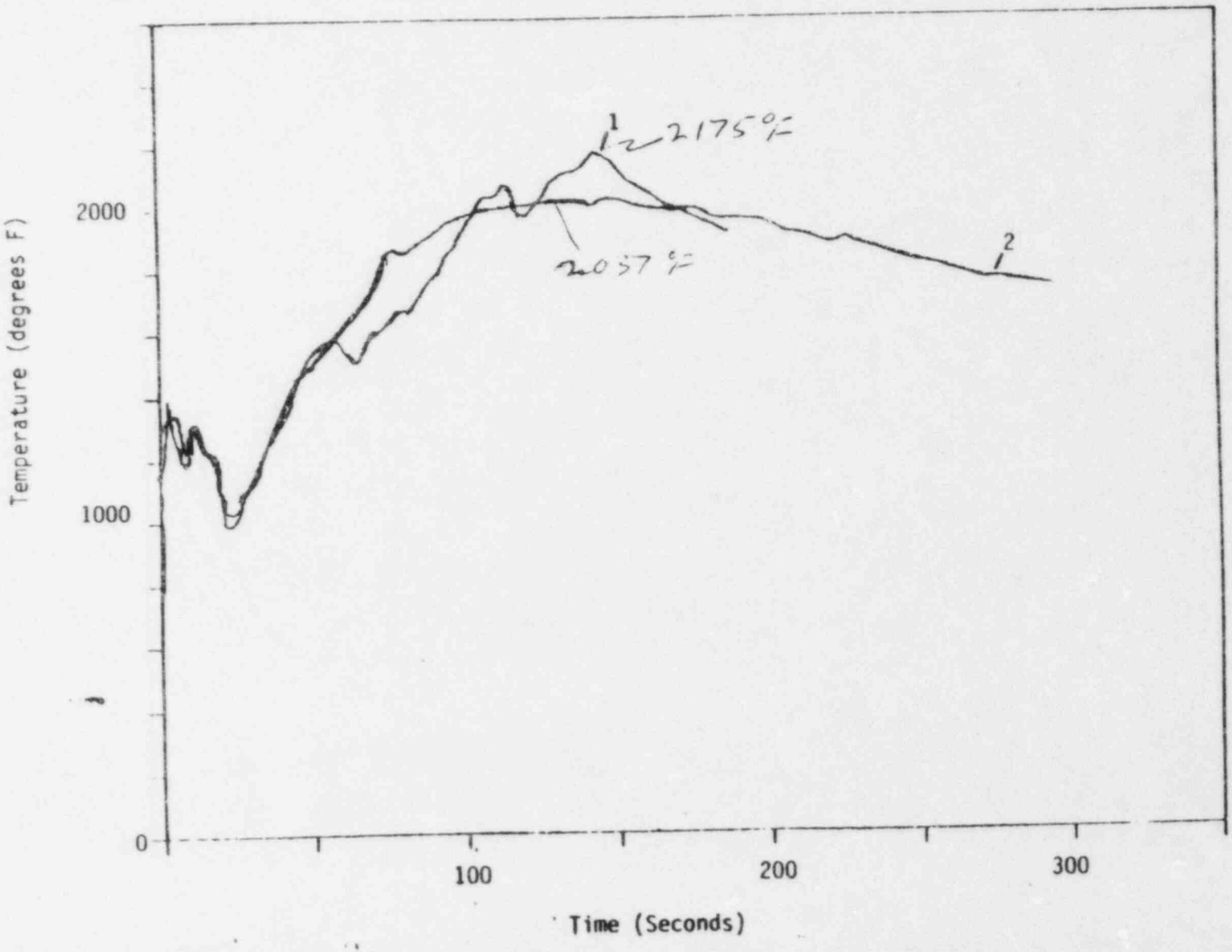
- The evaluation model prohibits quench in the upflow direction.

- A fictitious film boiling heat transfer coefficient is imposed. In a range of conditions the value is either 1.0 or 7 to 12 $B/HR\text{-}FT^2$ °F.

- Evaluation model usage requires that calculations be done for both perfect mixing and imperfect mixing in upper head to assure acceptably conservative results. This prohibits optimization of UHI systems.

Figure 1 Licensing Model Calculations

CASE 1. UHI FQ = 2.26 Hot Rod (BART)
CASE 2. No UHI FQ = 2.26 Hot Rod (BART)



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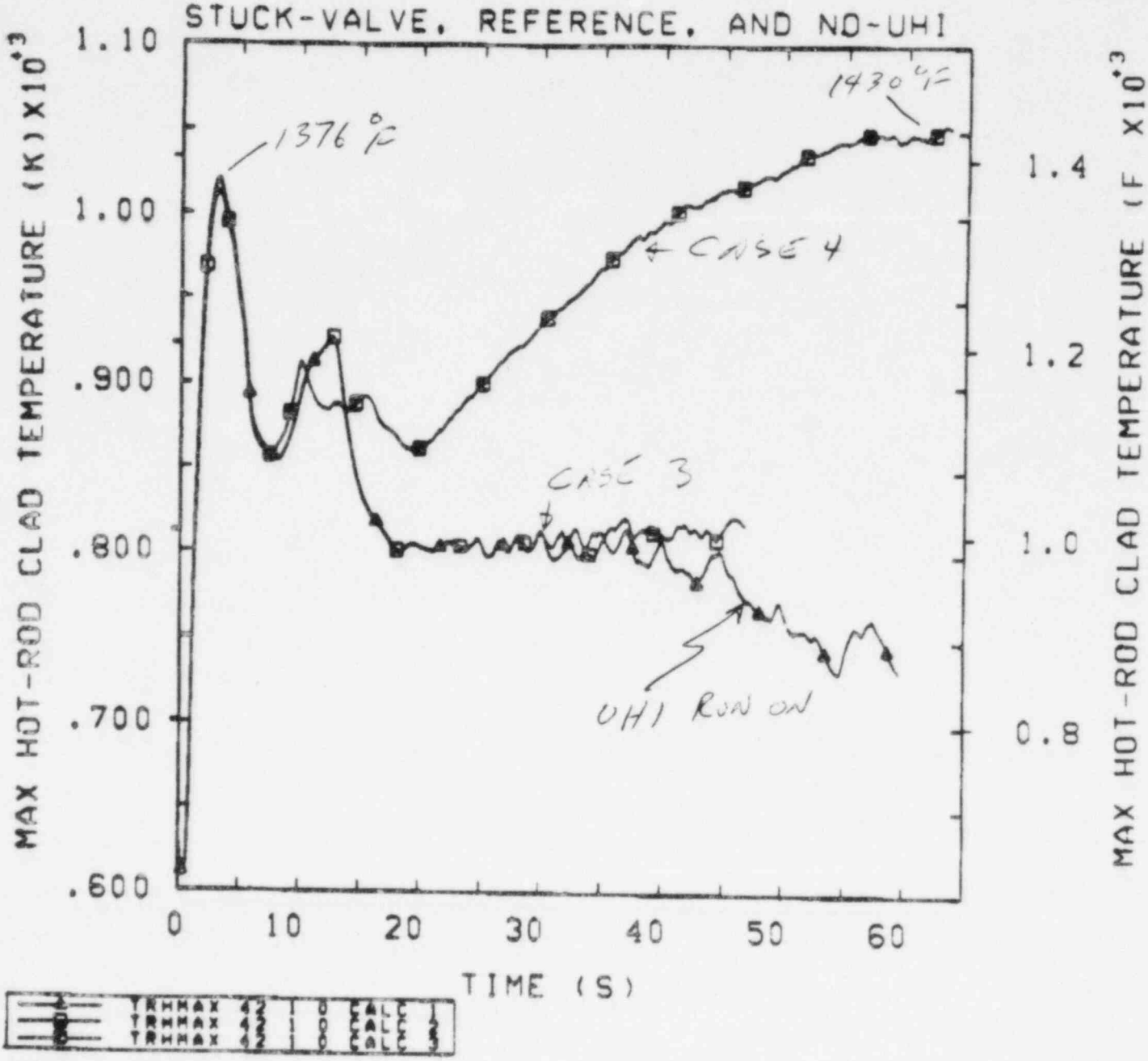

Figure 2