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January 29, 1997

Docket No. 50-336
B16062

Re:10CFR50.46(a)

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

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Reporting of Changes to, and Errors in,
Emergency Core Cooling System Models or Applications

In accordance with 10CFR50.46(a)(3)(ii), Northeast Nuclear Energy Company (NNECO) hereby submits changes to, and errors in, the emergency core cooling system (ECCS) evaluation model or application of the model for Millstone Unit No. 2.

The last update was submitted to the NRC Staff on March 22, 1996[1]. Based on notifications received from Siemens Power Corporation (SPC) dated December 22, 1996 and January 6, 1997, this report covers changes to, or errors in the large break loss of coolant accident (LBLOCA) and small break loss of coolant accident (SBLOCA) analyses performed for Millstone Unit No. 2, since March 22, 1996. The following is a synopsis of the information provided in the Attachments.

1. An error has been identified in the SPC 1986 EXEM PWR LBLOCA model modified in 1991 to eliminate a non-physical reflood heat transfer trend in the TOODEE2 code of the model. SPC observed a non-physical trend in the approved 1986 EXEM PWR LBLOCA evaluation model heat transfer coefficients computed by the Fuel Cooling Test Facility (FCTF) correlations in the reflood rate range of approximately 1.0 in/sec to 1.77 in/sec. In this range, as the reflood rate decreases, the calculated heat transfer coefficient can under certain conditions increase. In 1991, SPC made

[1] F. R. Dacimo letter to U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 2-Reporting of Changes to, and Errors in, Emergency Core Cooling System Models or Applications," dated March 22, 1996.

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changes to the FCTF reflood heat transfer correlations in the TOODEE2 code in the approved 1986 EXEM PWR LBLOCA evaluation model. These changes were made to eliminate the non-physical trend in the heat transfer coefficients as a function of reflood rate. The NRC rejected those changes and also concluded, based on information available to the Staff, that the FCTF correlation model includes an unacceptable error not only because of the non-physical heat transfer trend but also because of non-conservative heat transfer model predictions.

2. To correct the unacceptable error, SPC implemented an interim modification to the FCTF reflood heat transfer correlations in the TOODEE2 code in the 1986 EXEM PWR LBLOCA evaluation model to eliminate the non-physical trend. The modification restricts the reflood heat transfer coefficients to increase linearly between the values calculated by the FCTF reflood heat transfer correlations for reflood rates of 1.0 in/sec and 1.77 in/sec. The interpolated heat transfer coefficient is also restricted to be no greater than the value corresponding to the reflood rate of 1.77 in/sec. Using this linear interpolation approach, SPC analyzed the 0.4, 0.6, 0.8, and 1.0 double ended cold leg guillotine (DECLG) breaks with both a middle and an end of cycle axial power profile. Single failures were reviewed and a bounding analysis was performed. The resulting peak clad temperature (PCT) was 2111°F, an increase of 189°F from the previously calculated PCT of 1922°F. This increase in PCT is considered significant with respect to 10CFR50.46(a)(3)(i) and, as such, is being reported as required by 10CFR50.46(a)(3)(ii).

3. By copy of letter dated December 3, 1996[2], the NRC requested additional information regarding the LBLOCA model error described above and further requested that NNECO provide this information to the Staff at least one month prior to the restart of Unit 2. The requested information is as follows:

   a. Submit data to justify an LBLOCA evaluation model that is conservative for heat transfer coefficients over the entire range of reflood rates during an LBLOCA, including 1"/sec to 1.77"/sec,

   b. Reanalyze the LBLOCA for the unit using the evaluation model proposed in item a., and,

   c. Provide the following information:

      (1) Maximum linear heat generation rate
      (2) Reflood rate as a function of time
      (3) Core collapsed level as a function of time

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[2] U.S. Nuclear Regulatory Commission letter to B. D. Kenyon, "10CFR50.46 Large Break Loss-of-Coolant Accident Evaluation Model for Millstone Nuclear Power Station, Unit No. 2, Request for Additional Information (TAC No. M96355)," dated December 3, 1996.

(4) Quench time as a function of core height
(5) Core pressure as a function of time
(6) Core subcooling as a function of time
(7) Heat transfer coefficient for PCT location as a function of time
(8) Clad temperature for PCT location as a function of time

In response to items a. and b., SPC reanalyzed the Millstone Unit No. 2 LBLOCA using an interim modification to the FCTF reflood heat transfer correlations as described above. In response to item c., the maximum linear heat generation rate used in the reanalysis was 15.1 kw/ft. Core inlet subcooling is 132.1°F. This value of subcooling is used in the FCTF correlations throughout the reflood period. The remaining requested information is provided in Attachment 1 in the form of plots for the limiting LBLOCA.

4. In late 1992, an error was discovered in the z-equivalent model in the TOODEE2 code. This model uses equivalent energy deposition to allow TOODEE2 to adjust between axial power shapes. The z-equivalent model was coded with the axial shape for the FLECHT test rod instead of the FCTF test rod. At the time of error discovery, test cases analyzing the impact of the correct coding showed that the PCT using the incorrect FLECHT shape as the basis provided either conservative or insignificant (+15°F) changes in calculated PCT. The NRC was notified of this error in early 1994 as part of SPC's annual reporting for 1993. SPC reevaluated the limiting LBLOCA case using the interim analysis model,described above, with the correct z-equivalent model. The result was estimated to be a decrease in PCT of about 2°F. NNECO chooses to conservatively report this effect as a PCT benefit of 0.0°F.

5. SPC submitted a new reflood heat transfer model for NRC review on December 20, 1996. This model will correct the non-physical trend of the heat transfer coefficient as a function of reflood rate and the z-equivalent model error. It is expected that NRC review and approval will be completed within three months following submittal. Subsequent to NRC approval, SPC will reanalyze the Millstone Unit 2 LBLOCA event. SPC will provide NNECO with a new LBLOCA analysis report and the changes in PCT for 10 CFR 50.46 reporting. SPC will set the completion date for this work as soon as the NRC review/approval are completed.

6. SPC identified three input errors in the SBLOCA analysis performed for Millstone Unit 2. The errors in the SBLOCA analysis are as follows:

   a. Analyst failed to replace the steady-state steam generator pressure control system with the transient pressure controls when the SBLOCA transient was initiated.

   b. The 1% uncertainty applied to the main steam safety valve (MSSV) setpoints does not support the current Technical Specification value of 3%.

c. The time of scram in the decay heat tables for TOODEE2 was not updated for break sizes other than the limiting small break size.

The errors in the steady-state pressure control and safety valve setpoint uncertainty were discovered during SPC's ongoing activities supporting NNECO's 10 CFR 50.54 review efforts. The error in the scram time used for the TOODEE2 analysis was discovered when the analysis was reviewed in response to the first two errors. SPC reanalyzed the Millstone Unit 2 SBLOCA spectrum with the correct inputs to verify that the limiting break size was the same. The resulting PCT for the limiting small break was calculated to be 2010°F, an increase of 303°F from the previously calculated PCT of 1707°F. This increase in PCT is considered significant with respect to 10CFR50.46(a)(3)(i) and, as such, is being reported as required by 10CFR50.46(a)(3)(ii).

7. Attachment 2 provides both the small and large break ECCS Evaluation Model Margin Utilization sheets which account for (A) the analysis of record, (B) prior permanent 10CFR50.46 LOCA model assessments, (C) 1996 10CFR50.46 LOCA model assessments including those for which this notification is being performed, and (D) margin utilization attributable to 10CFR50.59 evaluations up to the present.

8. Considering the changes summarized in Attachment 2, the corrected PCTs for the limiting LBLOCA and SBLOCA remain below the 2200°F limit as defined by 10CFR50.46(b)(1).

We believe that this information satisfies the 30 day reporting requirements of 10CFR50.46(a)(3)(ii) and fully meets the requirements for information requested in reference (2) to be supplied prior to unit restart. Based on the above information, the Millstone Unit No. 2 FSAR will be updated as necessary. If you have any questions, please contact contact Mr. Richard T. Laudenat at (860) 444-5248.

Very truly yours,
NORTHEAST NUCLEAR ENERGY COMPANY

M. L. Bowling
Recovery Officer
Millstone Unit No. 2

cc: W. D. Travers, Dr., Director, Special Projects Office
H. J. Miller, Region I Administrator
P. F. McKee, Deputy Director of Licensing, Special Projects Office
W. D. Lanning, Director, Millstone Oversight Team
D. G. McDonald, Jr., NRC Project Manager, Millstone Unit No. 2
D. Beaulieu, Acting Senior Resident Inspector, Millstone Unit No. 2

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Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Request for Additional Information

10 CFR 50.46 Large Break Loss-of-Coolant Accident (LBLOCA) Evaluation Model

with

Linear Interpolation of Reflood Heat Transfer Correlation

Plots of:

Figure 1:	Reflood rate as a function of time
Figure 2:	Core collapsed level as a function of time
Figure 3:	Quench time as a function of core height
Figure 4:	Core pressure as a function of time
Figure 5:	Heat transfer coefficient for PCT location as a function of time
Figure 6:	Clad temperature for PCT location as a function of time

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FIGURE 1

Reflood Rate As A Function Of Time

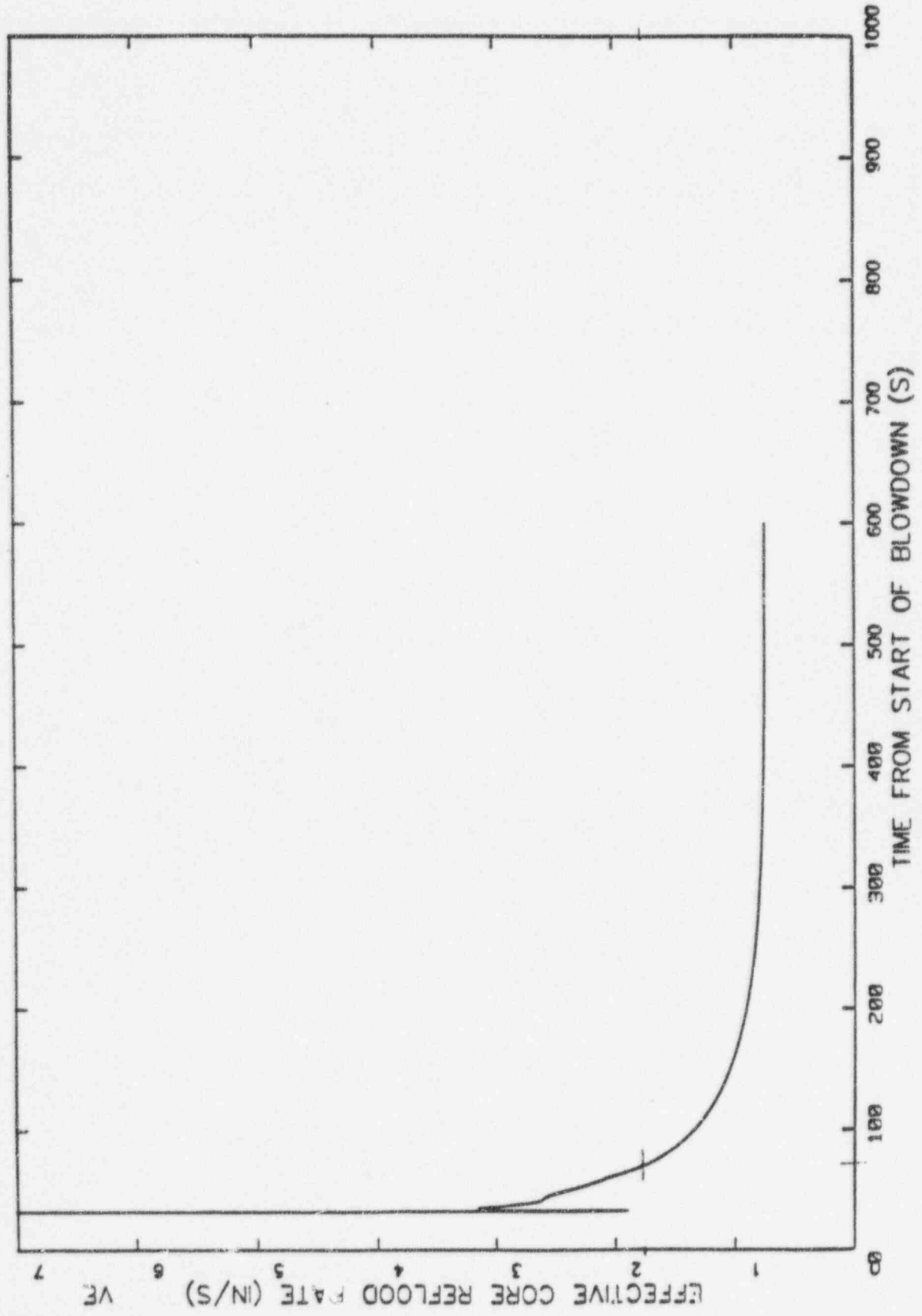


FIGURE 2

Core Collapsed Level As A Function Of Time

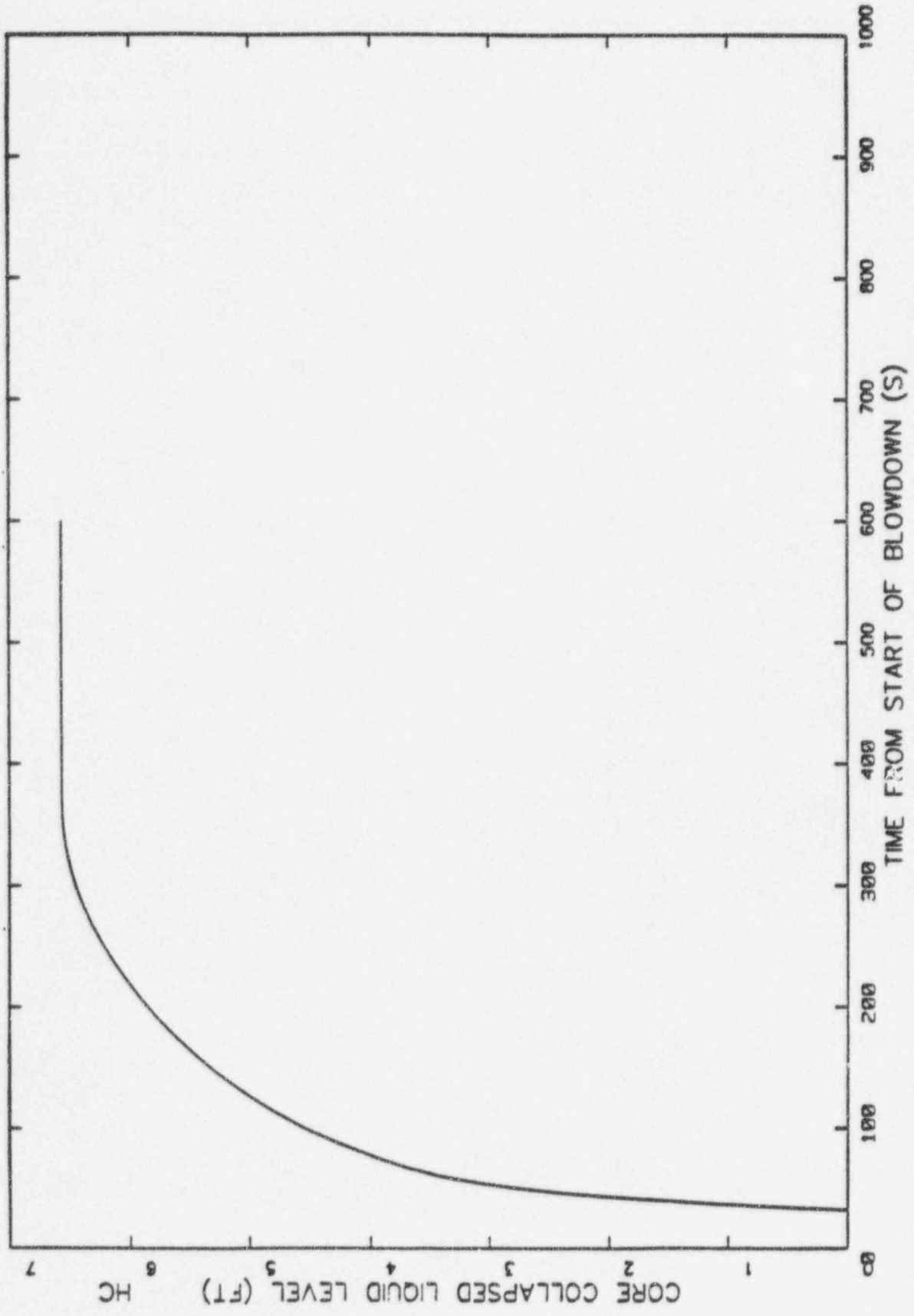


FIGURE 3

Quench Time As A Function Of Core Height

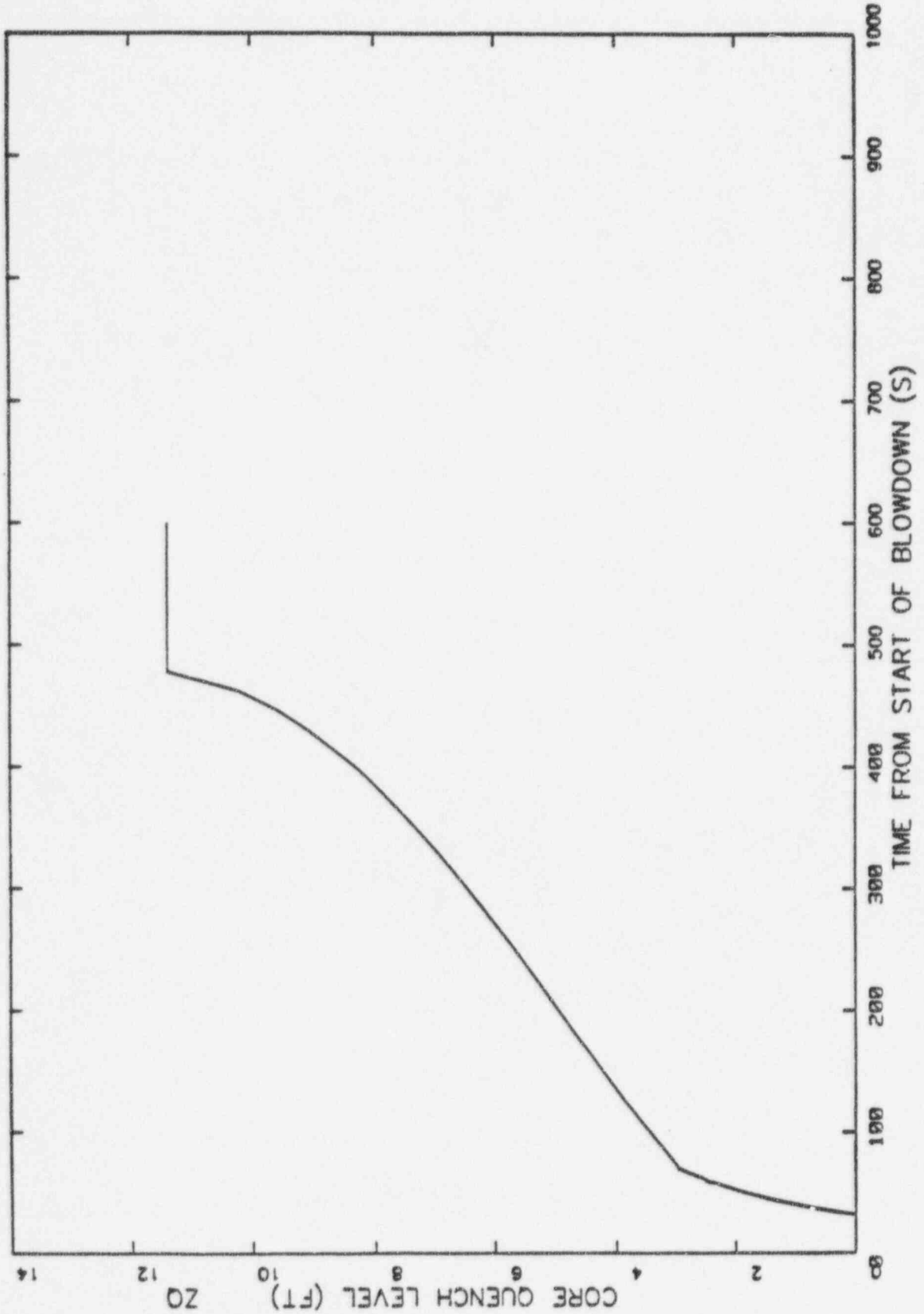


FIGURE 4

Core Pressure As A Function Of Time

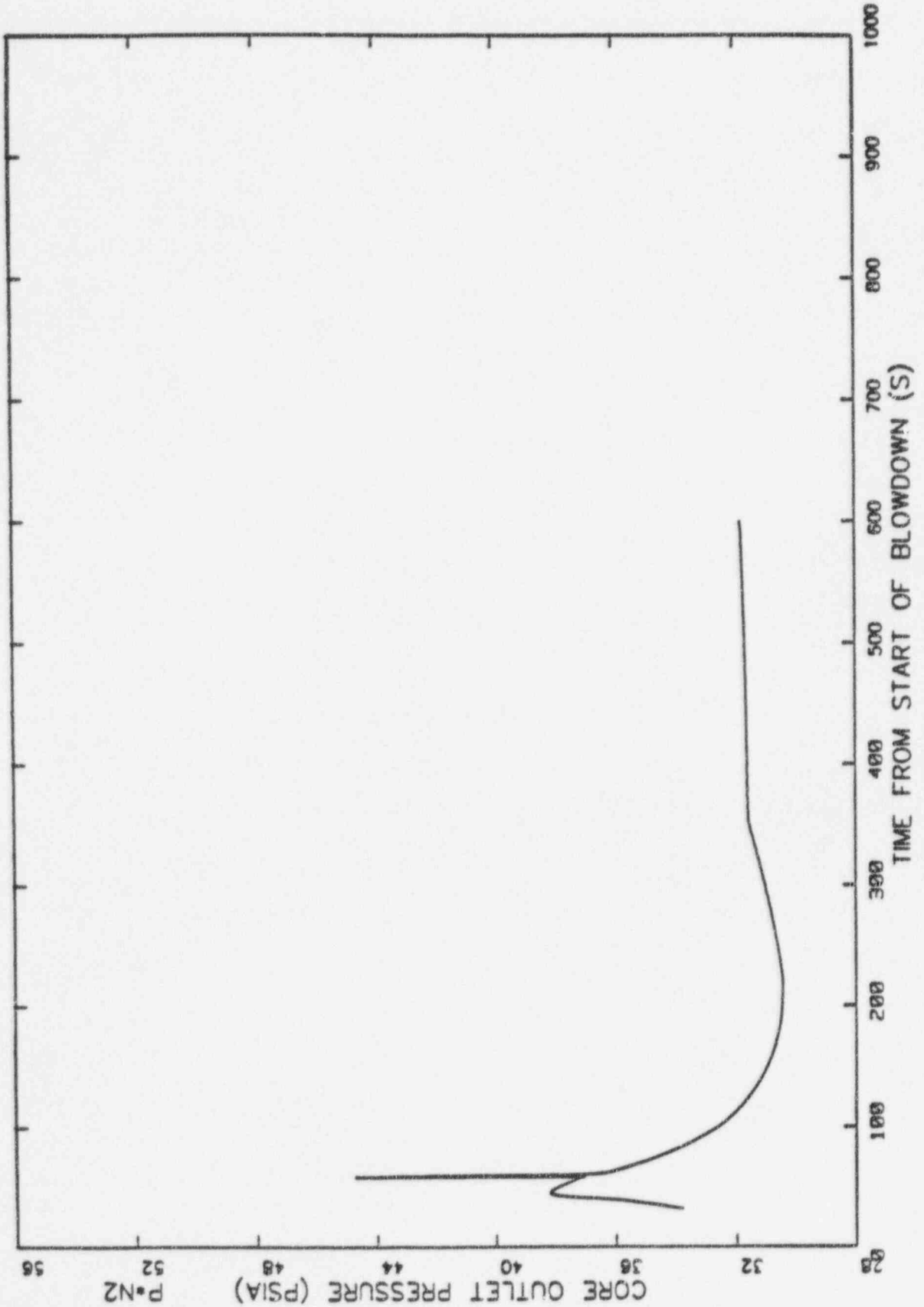


FIGURE 5

Heat Transfer Coefficient For PCT Location As A Function Of Time

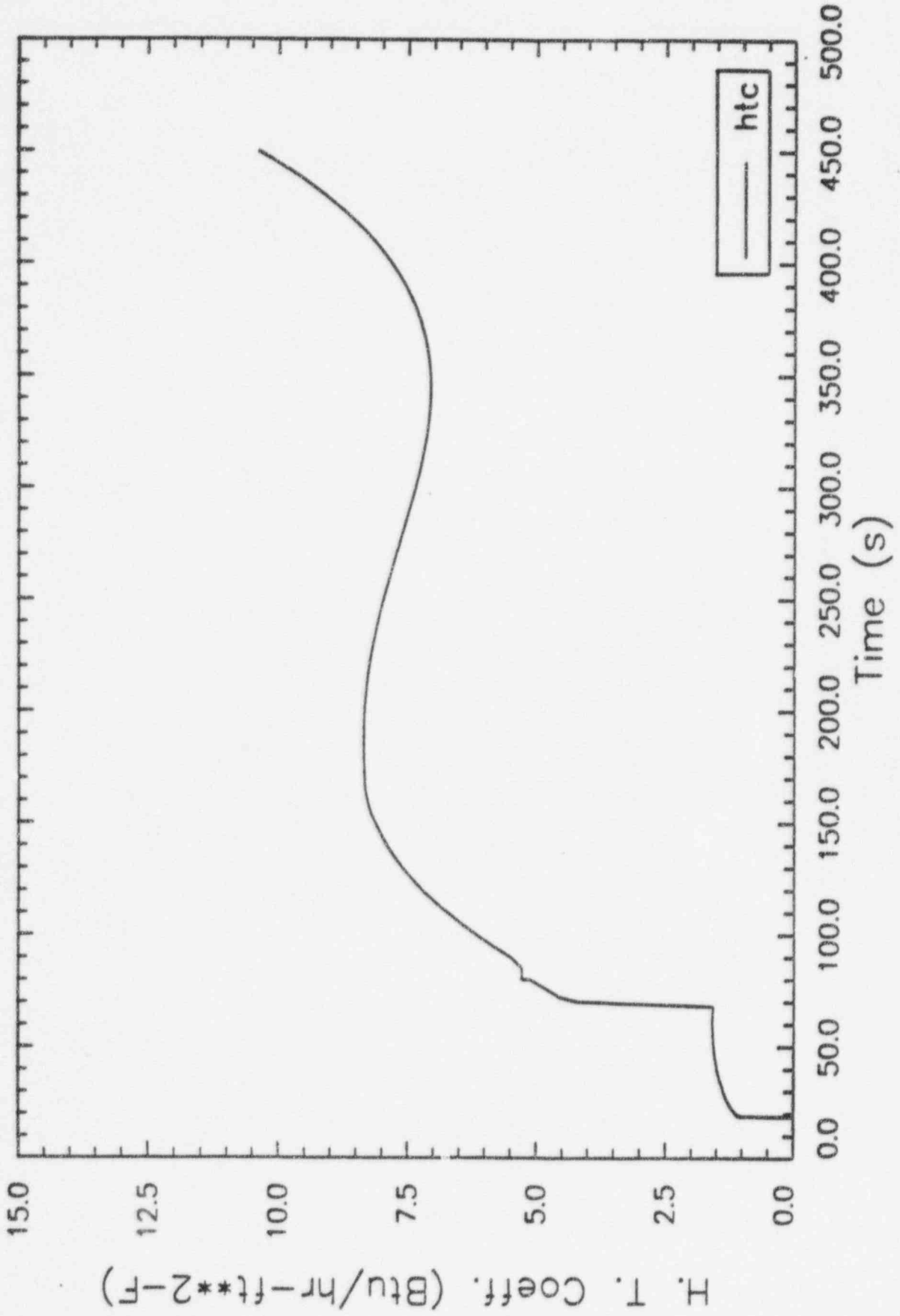
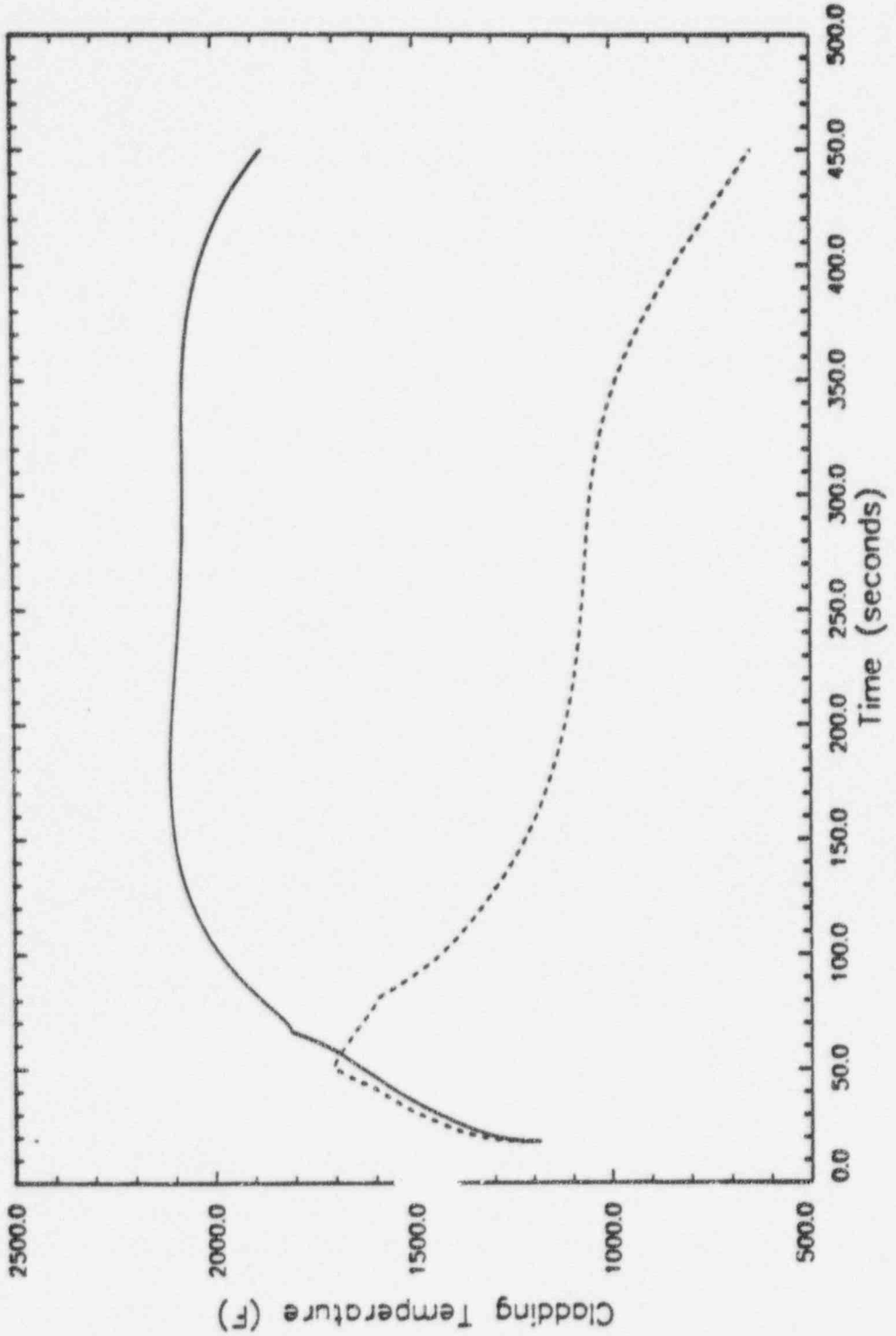


FIGURE 6

Clad Temperature For PCT Location As A Function Of Time



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Attachment 2

Millstone Nuclear Power Station, Unit No. 2

Reporting of 10CFR50.46 Margin Utilization

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Reporting of 10CFR50.46 Margin Utilization
Small Break LOCA

PLANT NAME: Millstone Unit No. 2

		Clad Temperature	Notes
A.	Analysis of Record (4/95)	PCT = 1707°F	(1)
	Eval. Model: EXEM/PWR Small Break Vendor: Siemens Peak Linear Power: 15.1 kw/ft Break: 0.1 ft^2		
B.	Prior Permanent LOCA Model Assessments-Thru 12/1995		
	1. None	ΔPCT= 0°F	
C.	Current Permanent LOCA Model Assessments-Thru 12/1996 (Permanent Assessment of PCT Margin)		
	1. SBLOCA Input Errors -SG steady-state pressure control system error -MSSV setpoint uncertainty error -Scram time error	ΔPCT= 303°F	
D.	10 CFR 50.59 Safety Evaluations	ΔPCT= 0°F	
	ANALYSIS OF RECORD PCT + MARGIN ALLOCATIONS	**PCT = 2010°F**	

Notes:

(1) New Analysis of Record.

Reporting of 10CFR50.46 Margin Utilization
Large Break LOCA

PLANT NAME: Millstone Unit No. 2

		Clad Temperature	Notes
A.	Analysis of Record (4/94)	PCT = 1811°F	
	Eval. Model: EXEM/PWR Large Break Vendor: Siemens Peak Linear Power: 15.1 kw/ft Break: 0.6 DECLG		
B.	Prior Permanent LOCA Model Assessments-Thru 12/1995		
	1. None	ΔPCT= 0°F	
C.	Current Permanent LOCA Model Assessments-Thru 12/1996 (Permanent Assessment of PCT Margin)		
	1. Hydraulic Diameter Input Error	ΔPCT= 111°F	
	2. Non-physical Trend in Reflood Heat Transfer Correlations	ΔPCT= 189°F	
	3. Z-Equivalent Model Error	ΔPCT= 0°F	(1)
D.	10 CFR 50.59 Safety Evaluations	ΔPCT= 0°F	
	ANALYSIS OF RECORD PCT + MARGIN ALLOCATIONS	**PCT = 2111°F**	

Notes:

(1) SPC reevaluated the limiting LBLOCA case using the interim analysis model with the correct z-equivalent model. The result was estimated to be a decrease in PCT of about 2°F. NNECO chooses to conservatively report this effect as a PCT benefit of 0.0°F.