NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

May 3, 1984

Docket No. 50-423
B11147

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

References: (1) J. H. Bickel (NU) letter to A. Garcia (LLL), NE-83-SAB-294, dated November 9, 1983.

(2) B. J. Youngblood letter to W. G. Counsil, dated January 6, 1984.

(3) W. G. Counsil letter to B. J. Youngblood, B11026, dated February 6, 1984.

(4) B. J. Youngblood letter to W. G. Counsil, dated February 3, 1984.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
Probabilistic Safety Study
Success Criteria for Large LOCA

Background

In Reference 1 NNECO provided a written response to questions raised by NRC consultants on October 13, 1983 at a Millstone 3 plant tour regarding the capability of successfully mitigating a large break LOCA with the High Pressure Safety Injection System (HPSI) given failure of the Low Pressure Injection System (LPSI). Our response at that time pointed out that the HPSI system had sufficient capacity and was not inhibited by any protective interlocks as had been assumed by NRC consultants. This issue was subsequently discussed again at a meeting held at our Berlin engineering offices on December 15, 1983. Reference 2 again questioned the capability of using the HPSI to mitigate a large LOCA given failure of LPSI. In Reference 3 NNECO representatives reiterated our position that based on best estimate LOCA analysis 2 HPSI pumps are sufficient to avert core melt and that there are no low pressure interlocks precluding HPSI usage.

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In Reference 4, Lawrence Livermore Laboratory in their draft evaluation of the Millstone 3 Probabilistic Safety Study (P.S.S.) asserted again that operation of 2 HPSI pumps could not be used to mitigate a large LOCA because in their opinion:

- o the HPSI pumps have protective logic which will shut them down automatically to avert cavitation.
- o should the pumps not have such protective logic their attempted operation against such a minimal head would cause total pump destruction.

Reference 4 also noted that no past Probabilistic Risk Assessment (PRA) for a Pressurized Water Reactor (PWR) had taken credit for such success criteria and that the assumptions in the Millstone 3 P.S.S. could not be allowed. Because of this, NRC consultants proposed modified success criteria, redrew the large LOCA event tree, and requantified the results.

At a meeting held on March 5, 1984 at our engineering offices in Berlin, NNECO representatives further discussed this issue with the NRC Staff and their consultants. The assertion that HPSI operation at low pressure leads to pump destruction is not only unfounded, but such operation is currently required by the surveillance requirements found in Standard Technical Specifications for many PWRs. To verify flow balance the HPSI pump is activated and run with the head removed from the reactor vessel while in the refueling mode. Such tests are routinely performed without any damage to the HPSI pump under conditions of lower RCS pressure than would occur during a large LOCA. NRC Staff and their consultants subsequently agreed to reevaluate the issue provided that NNECO provide more documentation on the best estimate plant response to large LOCA mitigated with 2 HPSI pumps. NNECO subsequently committed to provide a detailed plant specific analysis of such large LOCA events.

Best Estimate Analysis Assumptions

The analysis of large break LOCA provided herein by Westinghouse assumes the failure of all LPSI (RHR) systems. The only mitigation assumed is the operation of accumulator injection followed by operation of 2 Safety Injection (SI) pumps. No credit is taken for operation of the charging pumps in HPSI mode. The assumption of 2 SI pump operation bounds the other possible HPSI pump combinations.

The ANS 1979 Decay Heat Standard (plus two sigma uncertainty) was used instead of Appendix K type decay heat assumptions. The Cathcart-Pawel Zirconium-water reaction rate model was used instead of the Baker-Just model. All other models and input assumptions were in accordance with the approved Westinghouse Appendix K evaluation model assumptions. Consequently, the results obtained by this analysis are still conservative relative to a true best estimate prediction of plant response.

The plant parameters and blowdown conditions were taken from the most recent Millstone 3 ECCS analysis performed by Westinghouse. The worst break from that analysis was the double-ended cold leg guillotine break with a discharge

coefficient of 0.6 at a total core peaking factor of 2.32. The worst break was reanalyzed with the revised assumptions noted above. The BART code was used for the core reflooding portion of the transient in this analysis.

Results

The peak clad temperature for this case was calculated to be 2100°F. The time sequence of events for this transient is provided in Table 1 and a summary of key analysis inputs and results is provided in Table 2. Time history plots of the key parameters are also provided.

Summary

The enclosed analysis should clarify the technical bases of our assertion that should LPSI fail following a hypothetical large LOCA, the successful operation of two HPSI pumps is sufficient to prevent severe core damage. We trust that with this additional information the NRC Staff and their consultants will be able to reach a determination that the original large LOCA system success criteria, large LOCA event tree model, and event tree quantification provided initially in the Millstone 3 P.S.S. are an accurate reflection of true plant characteristics.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

C. F. Sears

By: C. F. Sears
Vice President
Nuclear and Environmental Engineering

TABLE 1

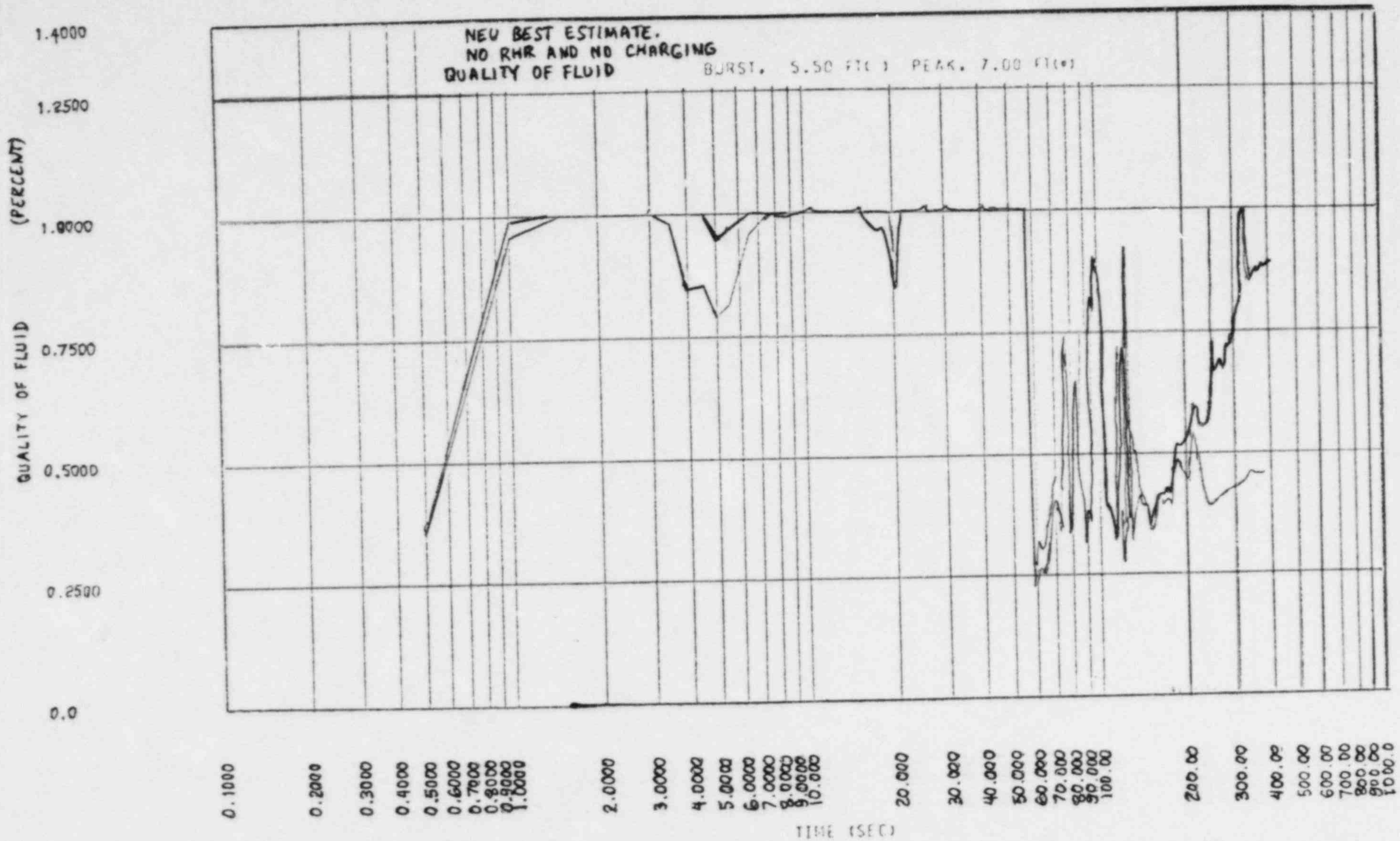
TIME SEQUENCY OF EVENTS

EVENT	OCCURRENCE TIME (SEC)
Accident Initiation	0.0
Reactor Trip Signal	0.6
Safety Injection Signal	2.5
Start Accumulator Injection	15.5
Start Pumped ECC Injection	27.5
End of ECCS Bypass	31.69
End of Blowdown	31.69
Bottom of Core Recovery	45.468
Accumulators Empty	55.2

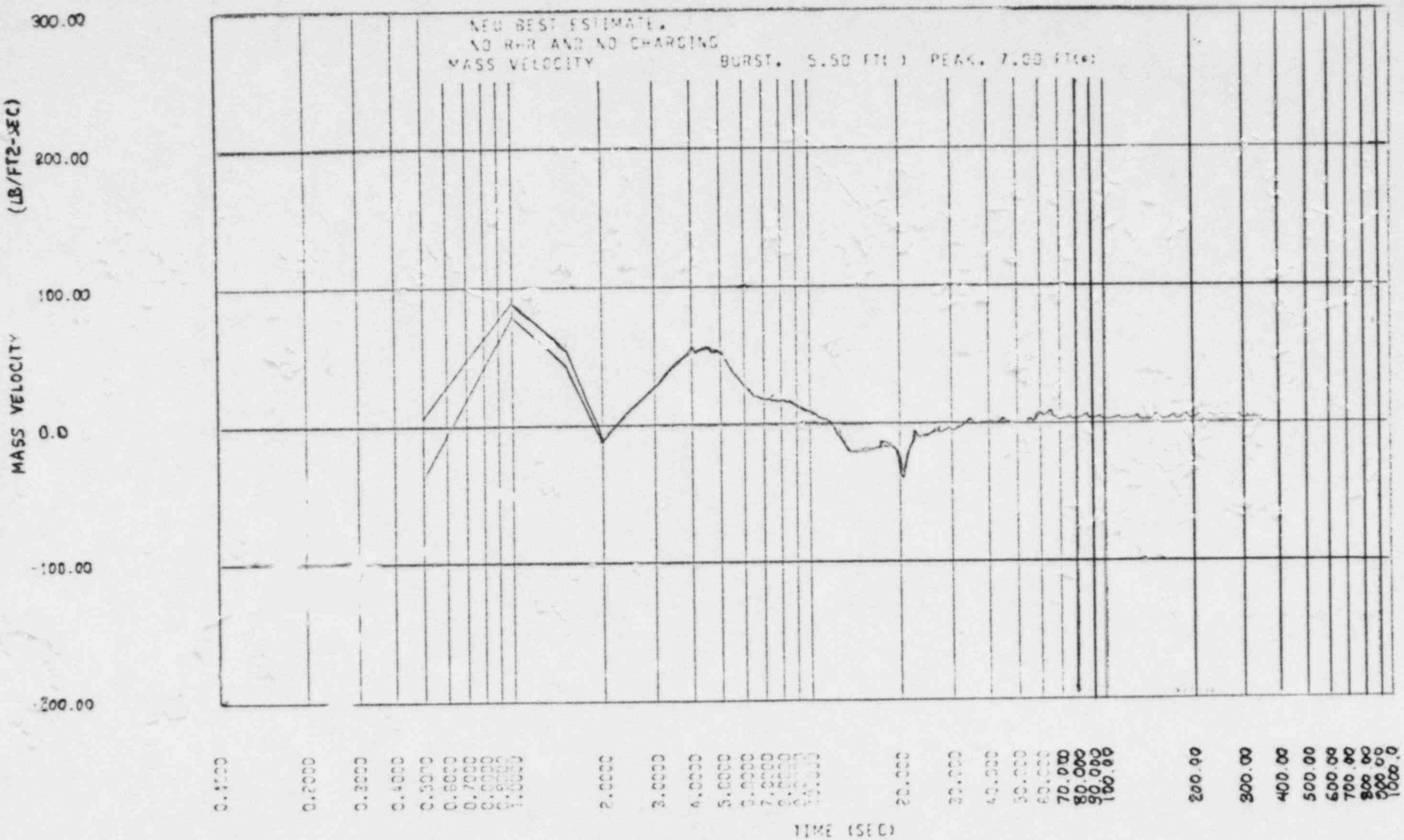
TABLE 2

ANALYSIS INPUT AND RESULTS

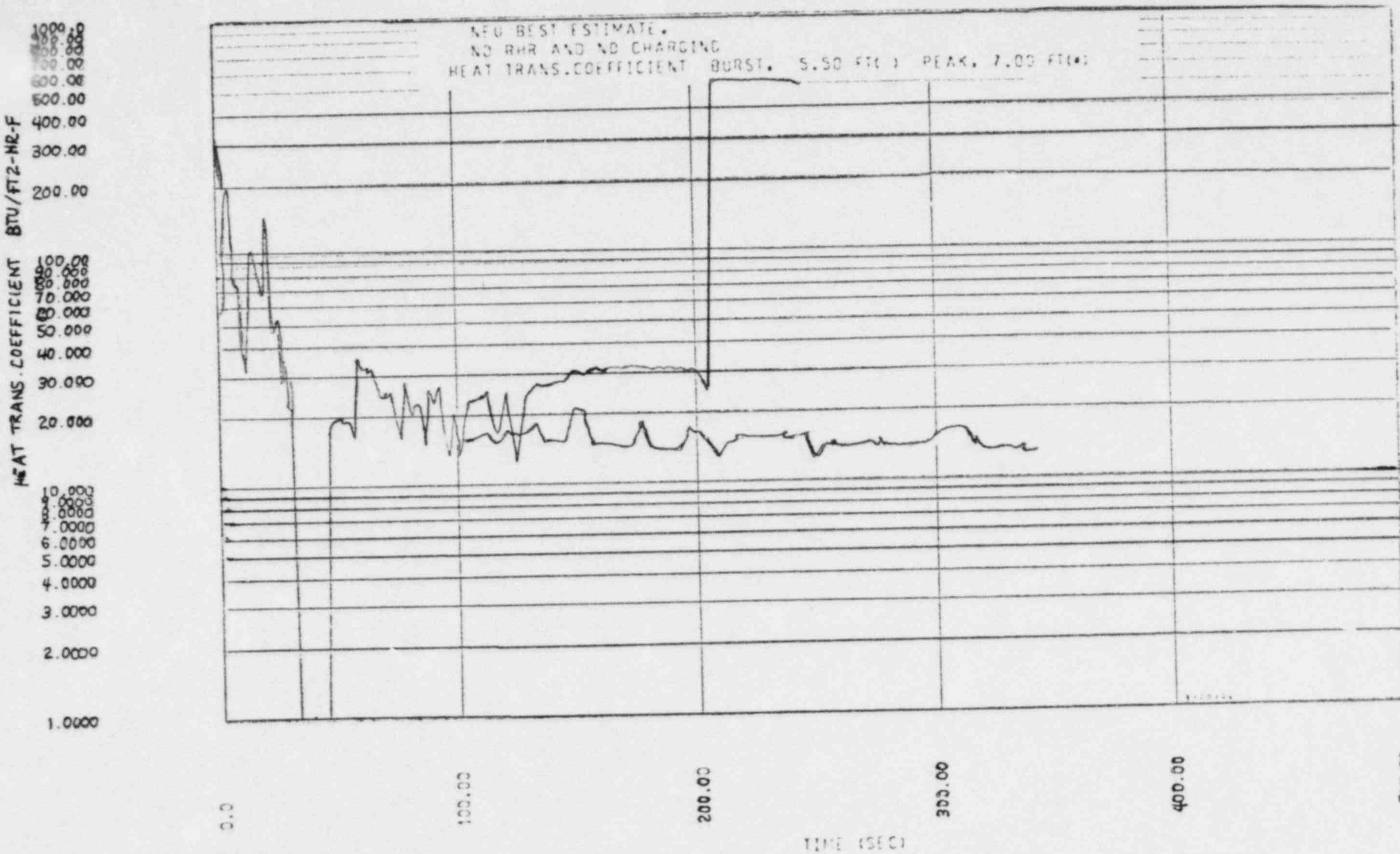
Licensed Core Power Rating	102% of 3411 MWT
Total Core Peaking Factor	2.32
Peak Linear Power	102% of 12.63 KW/FT
Accumulator Water Volume	900 FT^3
Accumulator Pressure	615 psia
Safety Injection	High Head - Both Trains
	No RHR, No Charging
Steam Generator Tube Plugging	0 Percent
Results for C_D = 0.6	
Peak Clad Temperature	2100°F
Location	7.0 ft.
Maximum Local Clad/Water Reaction	4.74 percent
Hot Rod Burst Time	51.8 seconds
Location	5.50 ft.



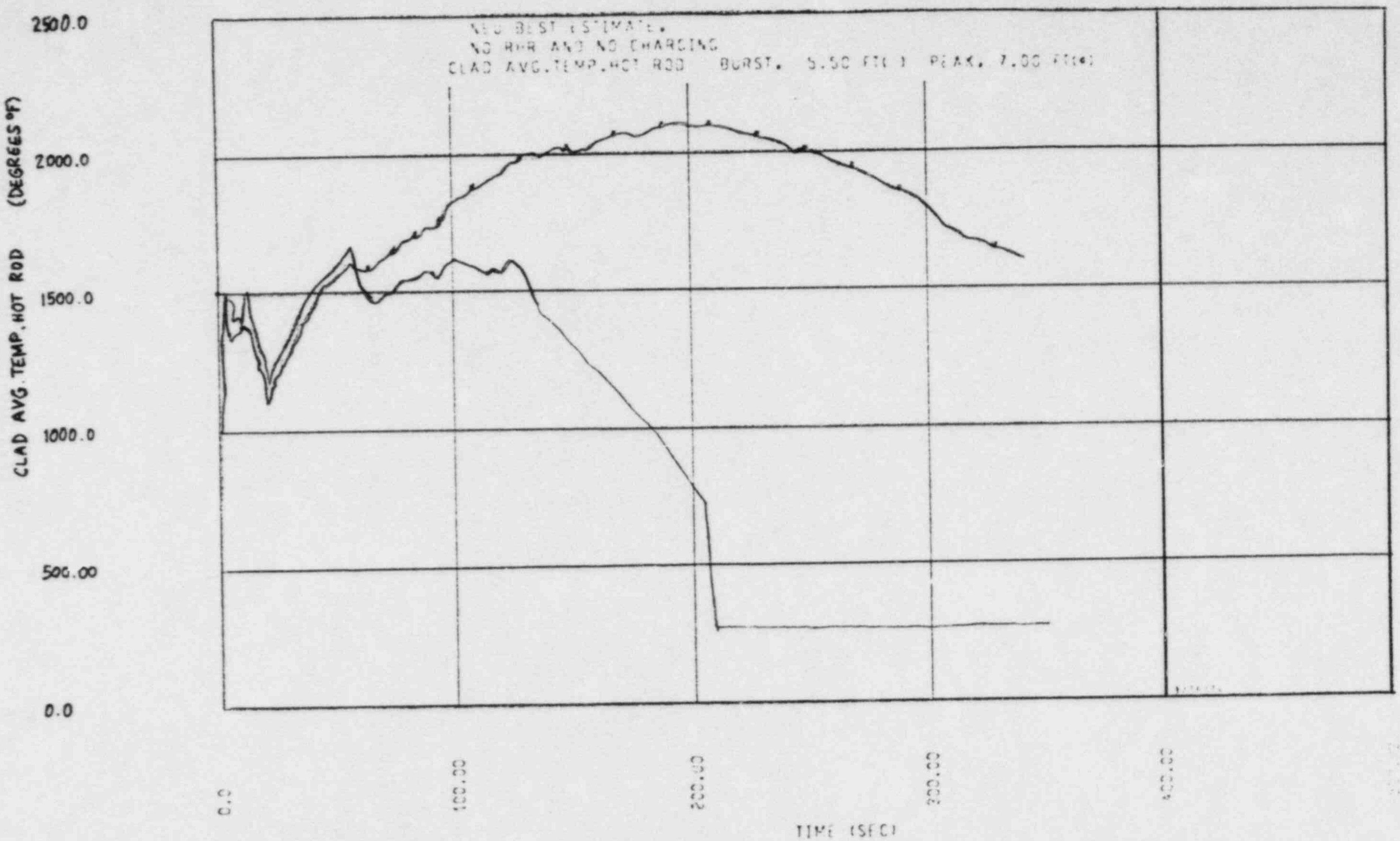
FLUID QUALITY
DECLG(CD = 0.6)



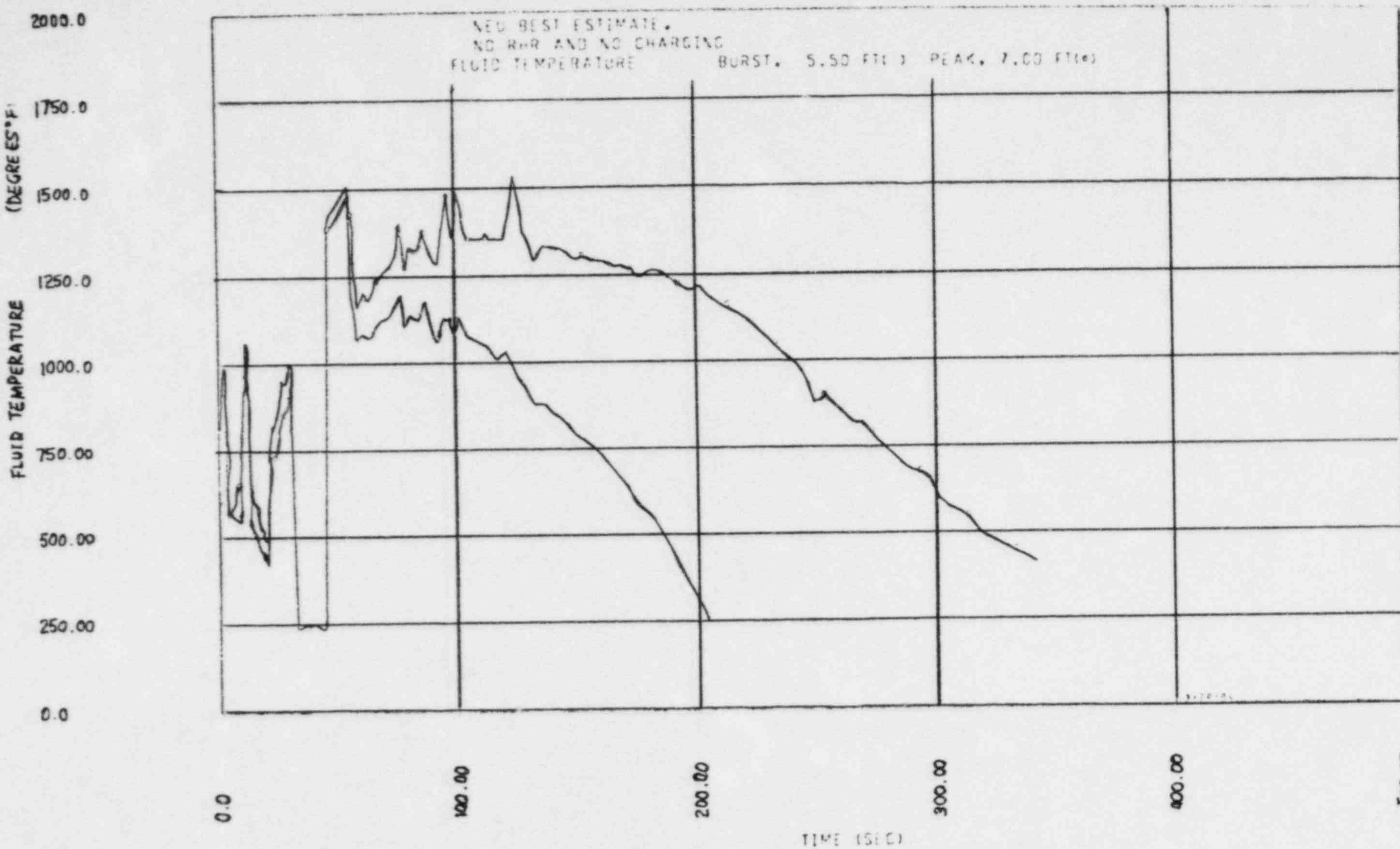
MASS VELOCITY
DECLG(CD = 0.6)



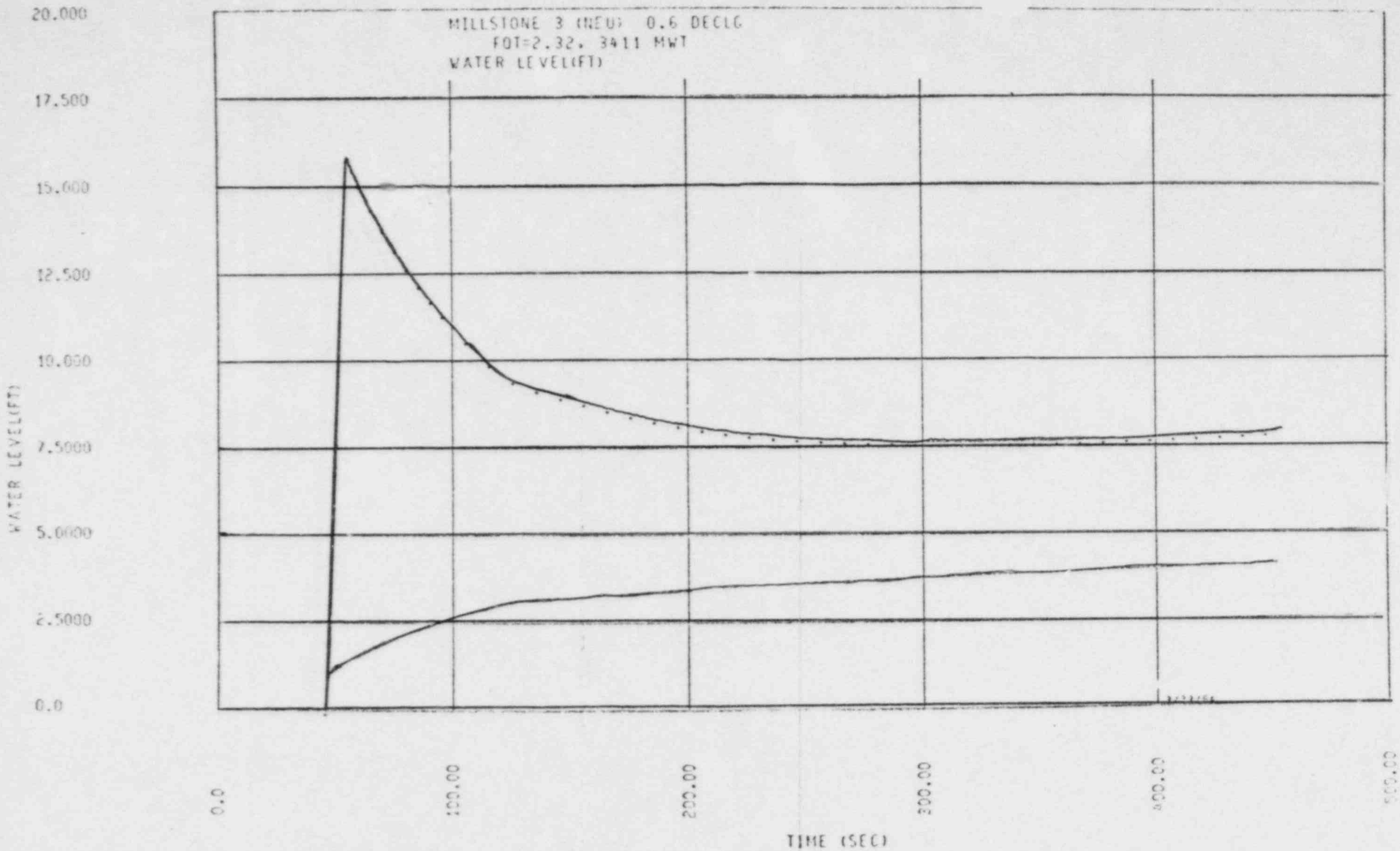
HEAT TRANSFER COEFFICIENT
DECLG(CD = 0.6)



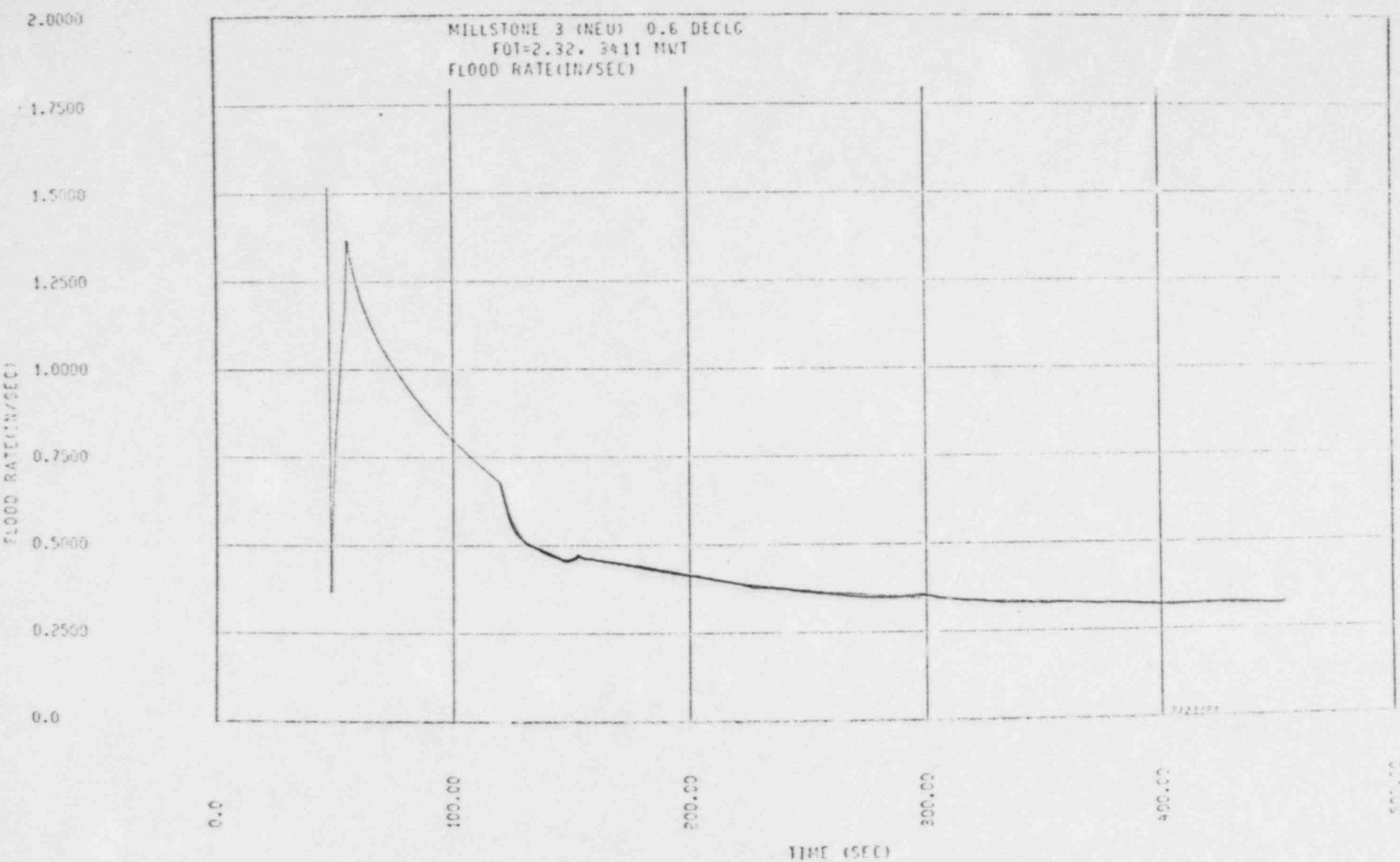
PEAK CLAD TEMPERATURE
DECLG(CD = 0.6)



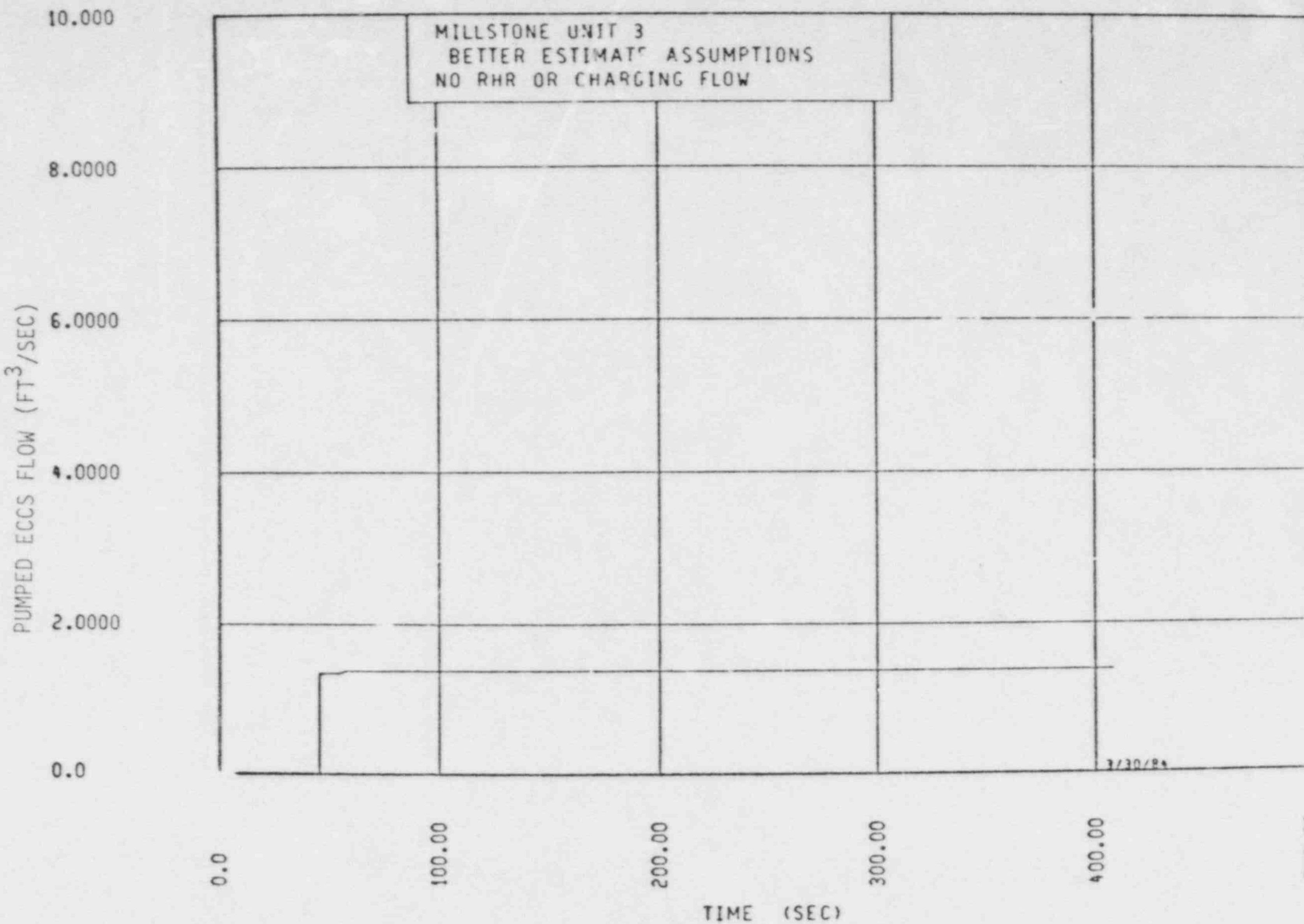
FLUID TEMPERATURE
DECLG(CD = 0.6)



REFLOOD TRANSIENT - CORE
& DOWNCOMER WATER LEVELS
DECLG(CD = 0.6)



REFLOOD TRANSIENT
CORE INLET VELOCITY



PUMPED ECCS FLOW(REFLOOD)
DECLG(CD = 0.6)