EXHIBIT E

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

License Amendment Request Dated January 13, 1986

DEMONSTRATION OF THE CONFORMANCE OF PRAIRIE ISLAND UNITS TO APPENDIX K AND 10CFR50.46 FOR LARGE BREAK LOCAs

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Nuclear Technology Division
Nuclear Safety Department
Safeguards Engineering and Development

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I. Introduction

This document reports the results of an analysis that was performed to demonstrate that Prairie Island, Units I and II, meet the requirements of Appendix K and 10CFR50.46 for Large Break Loss-of-Coolant-Accidents (LOCA). The analysis incorporates anticipated plant hardware modifications, i.e., the new upper reactor internals package and the thimble plug removal.

II. Method of Analysis

The analysis was performed using the Westinghouse 1981 Evaluation Model (Reference 6) for a spectrum of break coefficients. The Westinghouse 1981 ECCS Large Break Evaluation Model was developed to determine the RCS response to design basis large break LOCAs (see References 6-13,15,16). The hydraulic analyses and core thermal transient analyses were performed with the 1981 Evaluation Model code using 102 percent of licensed NSSS core power. The 1981 Evaluation Model is comprised of the SATAN-VI, WREFLOOD, COCO, and LOCTA IV computer codes (References 2,3,4 and 1, respectively, see also Reference 8). The SATAN-VI code was used to generate the blowdown portion of the transient, the WREFLOOD CODE was used to generate the refill/reflood system hydraulics, and the COCO code was used to evaluate the containment response. Cladding thermal analyses were performed with the LOCTA-IV code which uses the RCS pressure, fuel rod power history, steam flow past the uncovered part of the core, and mixture height history from the SATAN-VI and WREFLOOD codes as input.

The fuel parameters used as input for the LOCA analysis were generated using the Revised Thermal PAD Model. Due to the use of the Revised Thermal PAD Model, Westinghouse has evaluated the effect of burnup on peak cladding temperatures (PCT) predicted for the Loss-of-Coolant Accident through the maximum burnup level of cycle 11 using the currently approved LOCA models (1981 EM) as required by Reference 18. At a burnup of 22,000 MWD/MTU (maximum burnup for either Unit during cycle 11), the burnup evaluation predicted a PCT of 1934°F compared with a PCT of 2098°F for the Beginning-of-life (maximum densification) case, demonstrating that the time of maximum densification remains limiting in terms of peak clad temperature.

Table 1 shows the time sequence of events for the Large Break LOCA transients. Table 2 provides a brief summary of the important results of the LOCA analyses for each case. Figures 1 and 2 show important core characteristics during the blowdown phase of the transient (Core Pressure and Core Flow versus Time, respectively). Figures 3 and 4 indicate the flow of ECCS water into the RCS (Accumulator Flow and Pumped ECCS Flow versus Time, respectively). The flooding rate during the reflood portion of the transient are given in Figure 5. Clad Average Temperatures as a function of time indicating peak clad temperatures are given in Figure 6. The Safety Injection (SI) system was assumed to be delivering to the RCS 22 seconds after the generation of a safety injection signal. The 22-second delay includes time required for diesel startup and loading of the safety injection pumps onto the emergency buses. Minimum safeguards Emergency Core Cooling System capability and operability has, also, been assumed in this analysis.

Three break size coefficients were evaluated; C_D = 0.4, C_D = 0.6, and C_D = 0.8. These transients were considered to be terminated when the hot rod clad average temperature "turned around" (i.e. - hot rod clad average temperature began to decline) indicating that the peak clad temperature had been reached.

III. Results and Conclusions

Of the three break sizes evaluated, the C_D = 0.4 break proved to be the limiting (highest PCT) case with a peak clad temperature of 2098°F, compared with PCTs of 2000°F and 1999°F for the C_D = 0.6 and C_D = 0.8 cases, respectively. Current NRC restrictions require that a penalty be assessed and imposed for insufficient modeling of upper plenum injection (References 14,16,20,21). This penalty was assessed to be 78°F for the limiting case. In addition, a penalty of 10°F was imposed to account for hydaulic mismatch (crossflow) in the transition core. Imposition of these penalties results in a final peak clad temperature of 2186°F which is below the 2200°F Acceptance Criteria limit established by Appendix K of 10CFR50.46 (Reference 2).

REFERENCES

1. Bordelon, F. M., et al., LOCTA-IV Program: Loss-of-Coolant Transient Analysis, WCAP 8301 (Proprietary Version), WCAP 8305 (Non-Proprietary Version), June 1974.

2. "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Nuclear Power Reactors: 10CFR 50.46 and Appendix K of 10CFR 50.46," Federal Register, Vol. 39,No. 3, January 4, 1974.

3. Bordelon, F. M., et al., SATAN-VI Program: Comprehensive Space-Time Dependent Analysis of Loss-of-Coolant, WCAP 8302 (Proprietary Version), WCAP 8306 (Non-Proprietary Version), June 1974.

4. Kelly, R. D., et al., Calculational Model for Core Reflooding after a Loss-of-Coolant Accident (WREFLOOD Code), WCAP 8170 (Proprietary Version), WCAP 8171 (Non-Proprietary Version), June 1974.

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6. Eicheldinger, C., Westinghouse ECCS Evaluation Model, 1981 Version, WCAP 9220-P-A (Proprietary Version), WCAP 9221-A (Non-Proprietay Version), Rev. 1, 1981.

7. Bordelon, F. M., H. W. Massie, and T. A. Zordan, Westinghouse ECCS Evaluation Model-Summary, WCAP 8339, July 1974.

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9. Salvatori, R., Westinghouse ECCS - Plant Sensitivity Studies, WCAP 8340 (Proprietary Version), WCAP 8356 (Non-Proprietary Version), July 1974.

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11. Westinghouse ECCS Evaluation Model Sensitivity Studies, WCAP 8341 (Proprietary Version), WCAP 8342 (Non-Proprietary Version), 1974.

12. Kelly, R. D., C. M. Thompson, et al., Westinghouse Emergency Core Cooling System Evaluation Model for Analyzing Large LOCAs During Operation With One Loop Out of Service for Plants Without Loop Isolation Valves, WCAP 9166, February 1978.

13. Safety Evaluation Report on ECCS Evaluation Model for Westinghouse Two-Loop Plants, November 1977.

14. "NRC Questions Regarding the January 16, 1978 submittal by Westinghouse Designed Two-Loop Plant Operators," February 1, 1978.

15. Letter from T. M. Anderson, Westinghouse Electric Corporation, to J. Stolz, NRC, (NS-TMA-1830), dated June 1978.

16. Letter from T. M. Anderson, Westinghouse Elestric Corporation, to J. Stolz, NRC, (NS-TMA-1834), dated June 20, 1978.

17. "Safety Evaluation Report on Interim ECCS Evaluation Model for Westinghouse Two-Loop Plants," March 1978.

18. Letter from Cecil O. Thomas (NRC) to E. P. Rahe, Jr. (Westinghouse), "Acceptance for Referencing of Licensing of Topical Report WCAP-8720, Addendum 2, 'Revised PAD Code Thermal Safety Model'", Dated December 9, 1983.

19. "Westinghouse Revised PAD Code Thermal Safety Model," WCAP-8720, Addendum 2 (Proprietary), and WCAP-8785 (Non-Proprietary).

TABLE 1

LARGE BREAK

TIME SEQUENCE OF EVENTS

	DECLG (CD = 0.8) (Sec)	DECLG (CD = 0.6) (Sec)	DECLG (CD = 0.4) (Sec)
Start	0.0	0.0	0.0
Reactor Trip Signal	.568	.576	.590
S.I. Signal	.47	.53	.64
Acc. Injection	5.12	6.58	9.41
End of Blowdown	16.57	18.43	22.56
Pump Injection	22.47	22.53	22.64
Bottom of Core Recovery	29.11	31.14	35.39
Acc. Empty	38.8	40.7	44.3

TABLE 2

LARGE BREAK
RESULTS

	DECLG (CD = 0.8)	DECLG (CD = 0.6)	DECLG (CD = 0.4)
Peak Clad Temp., ^{o}F w/ penalties	2087.	2088.	2186.
Peak Clad Temp., ^{o}F	1999.	2000.	2098.
Peak Clad Temp. Location, ft	7.5	7.5	7.5
Local Zr/ H_2O Rxn (max), %	3.840	3.827	6.284
Local Zr/ H_2O Location, ft	7.5	7.5	7.5
Total Zr/H_2O Rxn, %	<0.3	<0.3	<0.3
Hot Rod Burst Time, sec	70.6	72.0	70.8
Hot Rod Burst Location, ft	7.0	7.25	6.5

Calculation:

NSSS Power, MWt, 102% of	1650
Peak Linear Power, kw/ft, 102% of	14.25
Peaking Factor (At Design Rating)	2.30
Accumulator Water Volume (Cubic Feet per Tank-Nominal)	1266.5
Accumulator Pressure, psia	715
Number of Safety Injection Pumps Operating	3
Steam Generator Tubes Plugged	5%

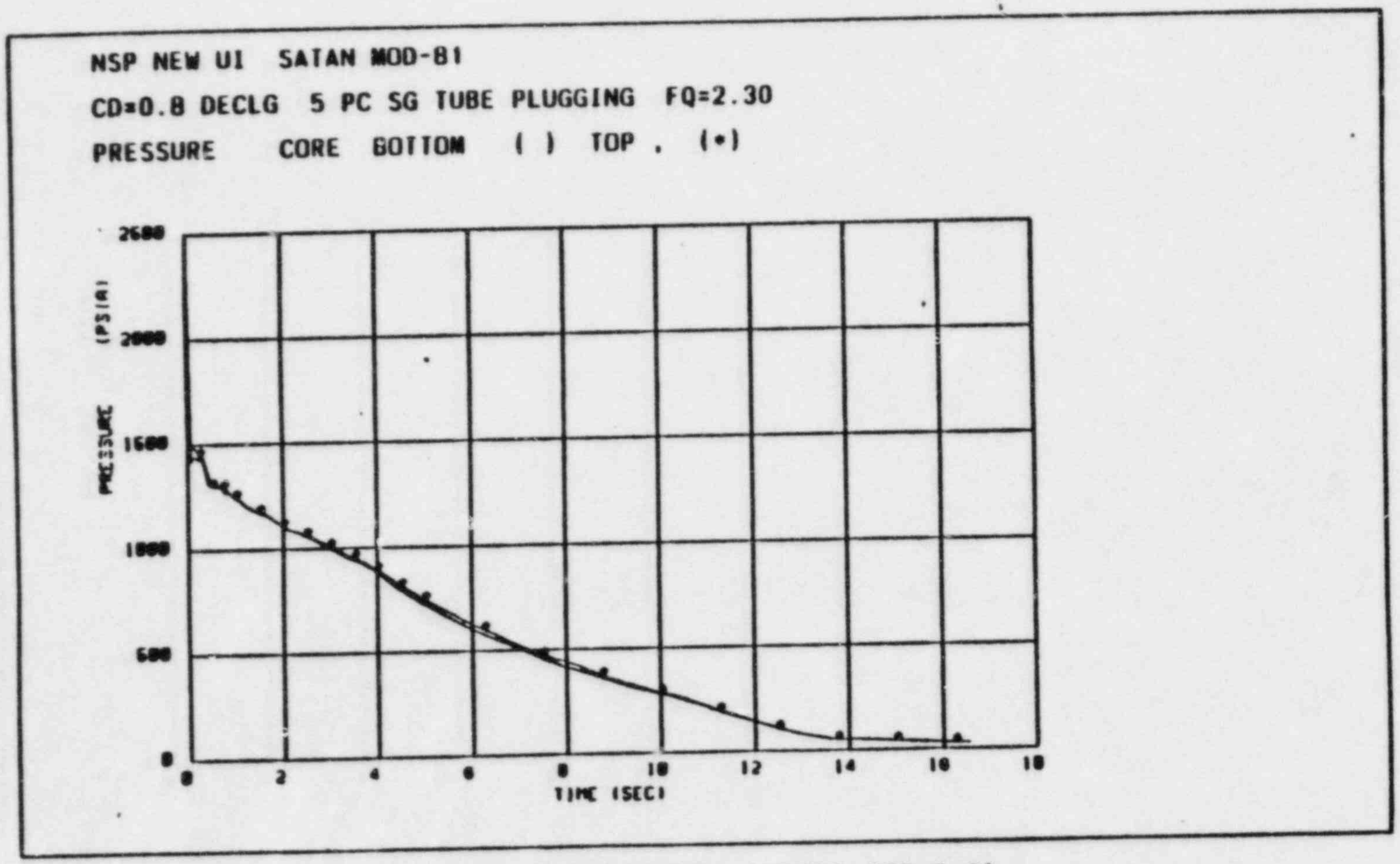


FIGURE 1a **CORE PRESSURE - DECLG (CD=0.8)**

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with pressure at the top of the core. Where top and bottom core pressures coincide, only one curve (with asterisk tracer) will be seen.

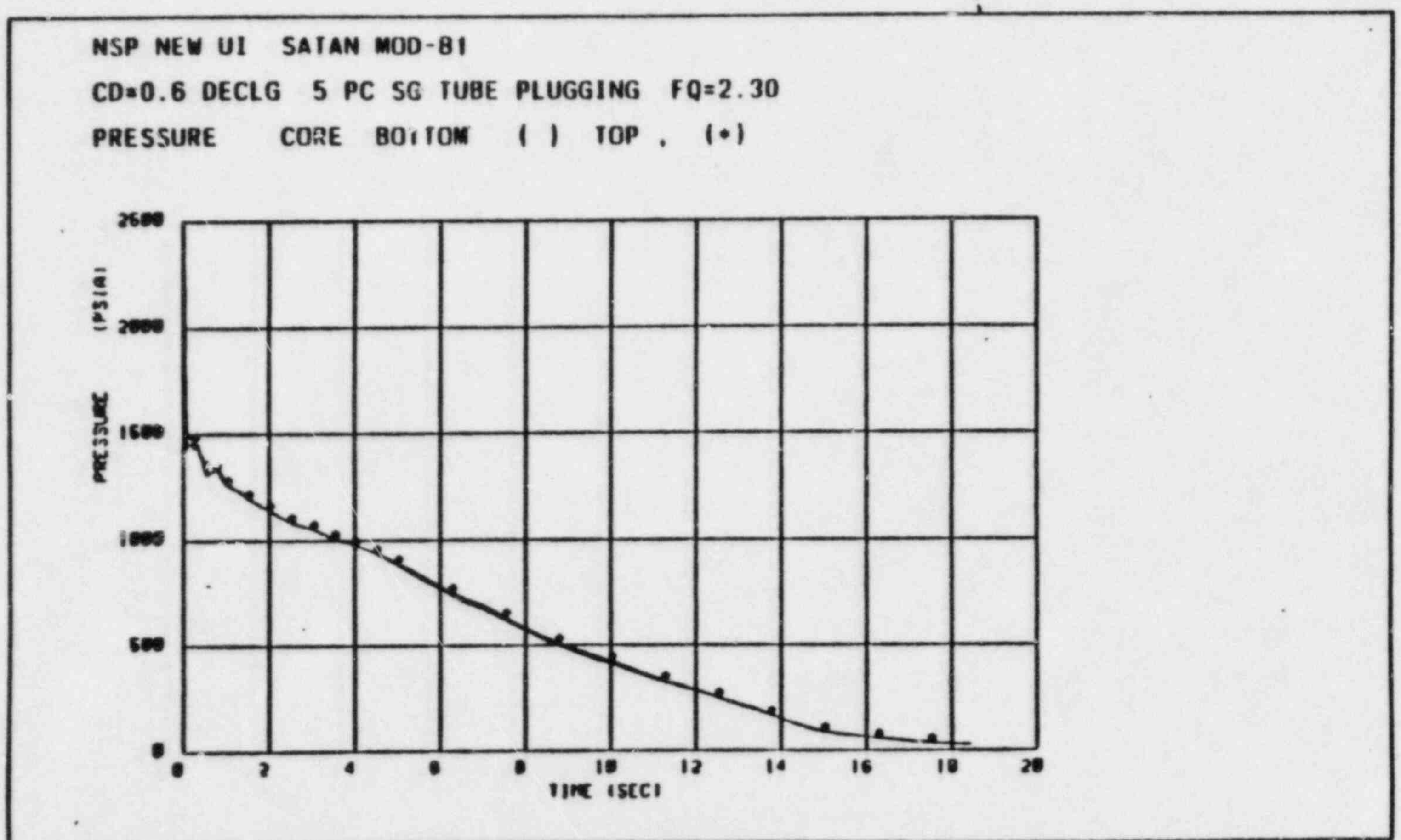


FIGURE 1b CORE PRESSURE - DECLG (CD=0.6)

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with pressure at the top of the core. Where top and bottom core pressures coincide, only one curve (with asterisk tracer) will be seen.

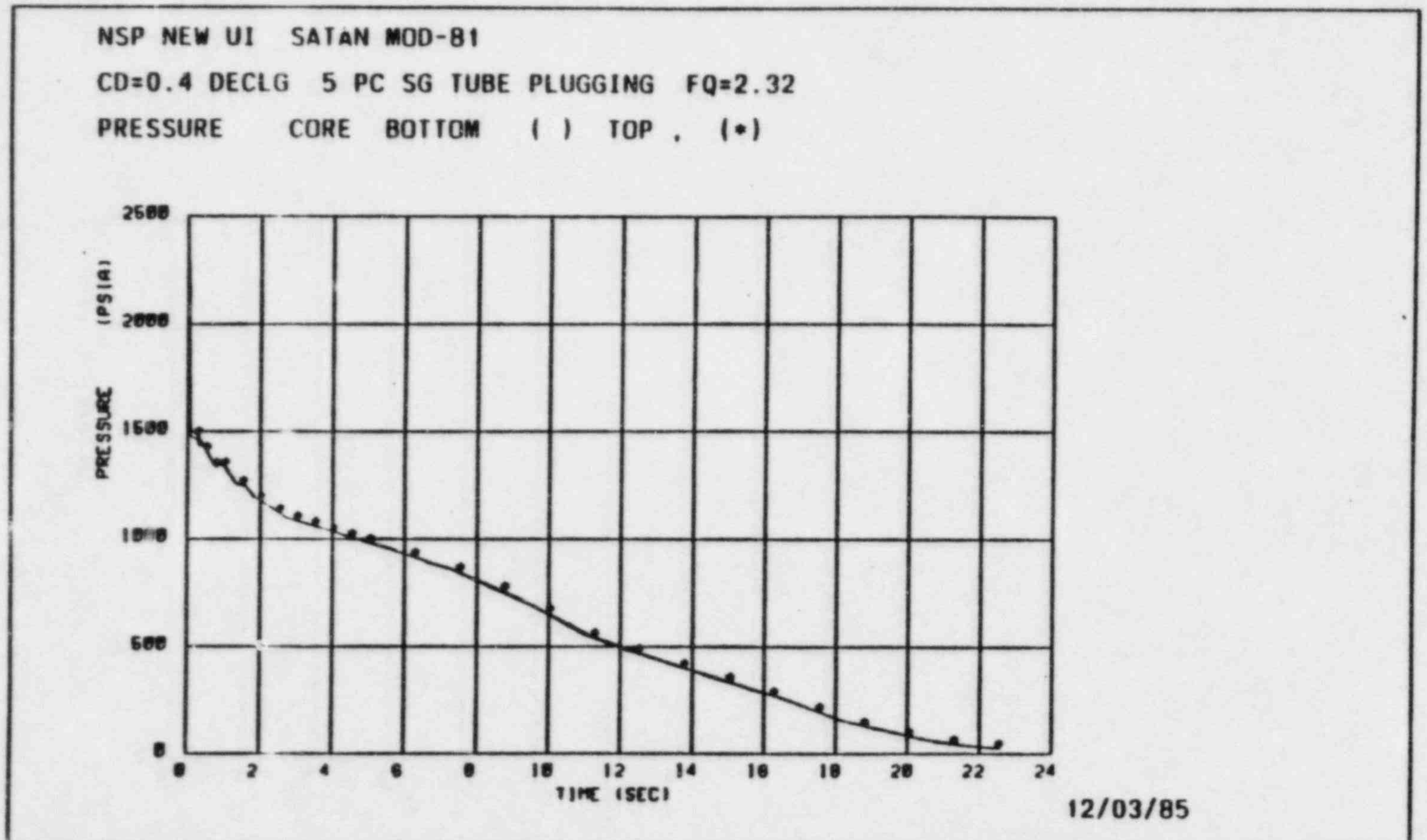


FIGURE 1c **CORE PRESSURE - DECLG (CD=0.4)**

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with pressure at the top of the core. Where top and bottom core pressures coincide, only one curve (with asterisk tracer) will be seen.

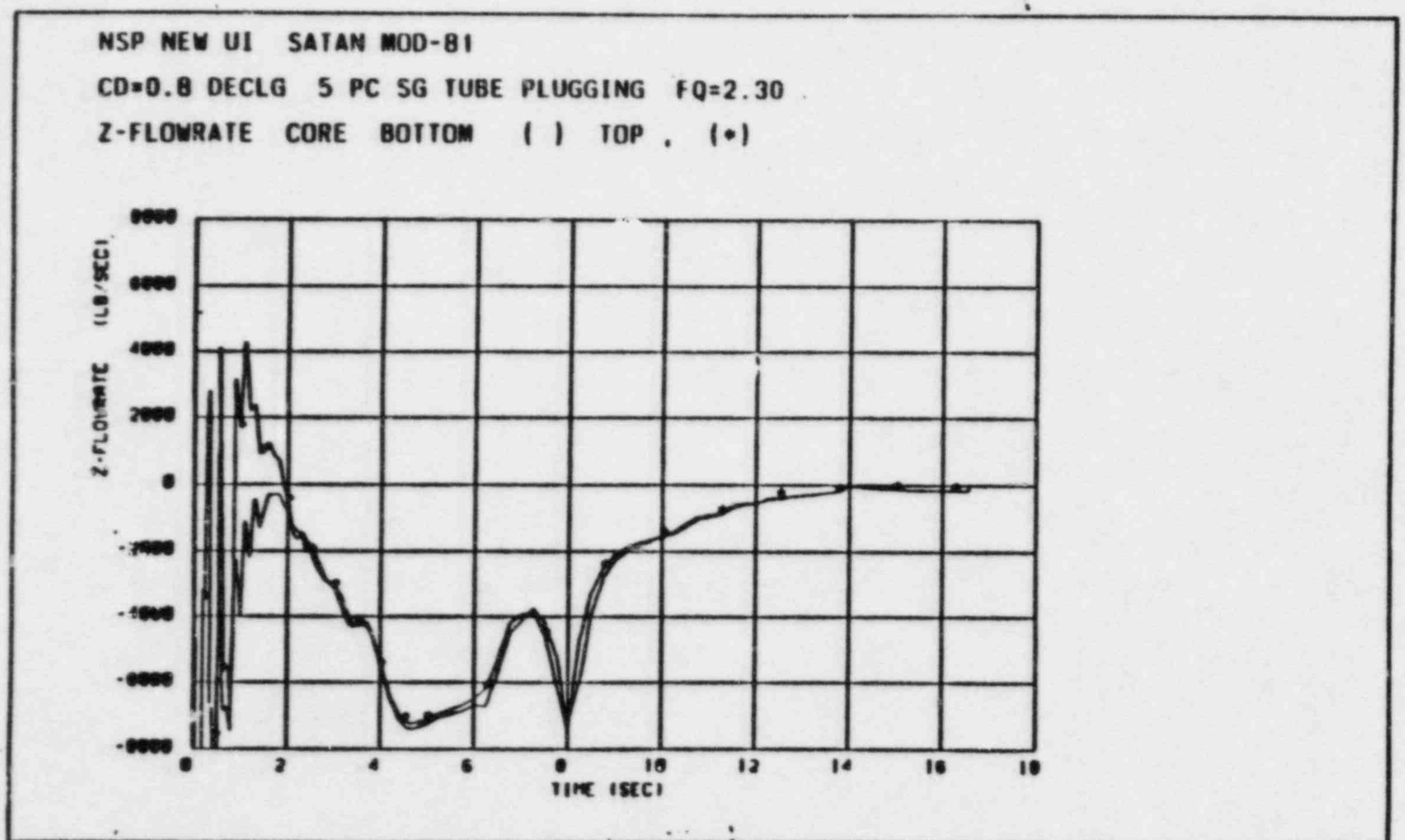


FIGURE 2a CORE FLOW - TOP & BOTTOM - DECLG (CD=0.8)

NOTE: Asterisks (*) do not represent a separate curve, but provide a tracer to identify the curve associated with the z-flowrate at the top of the core. Where top and bottom core z-flowrates coincide, only one curve (with asterisk tracer) will be seen.

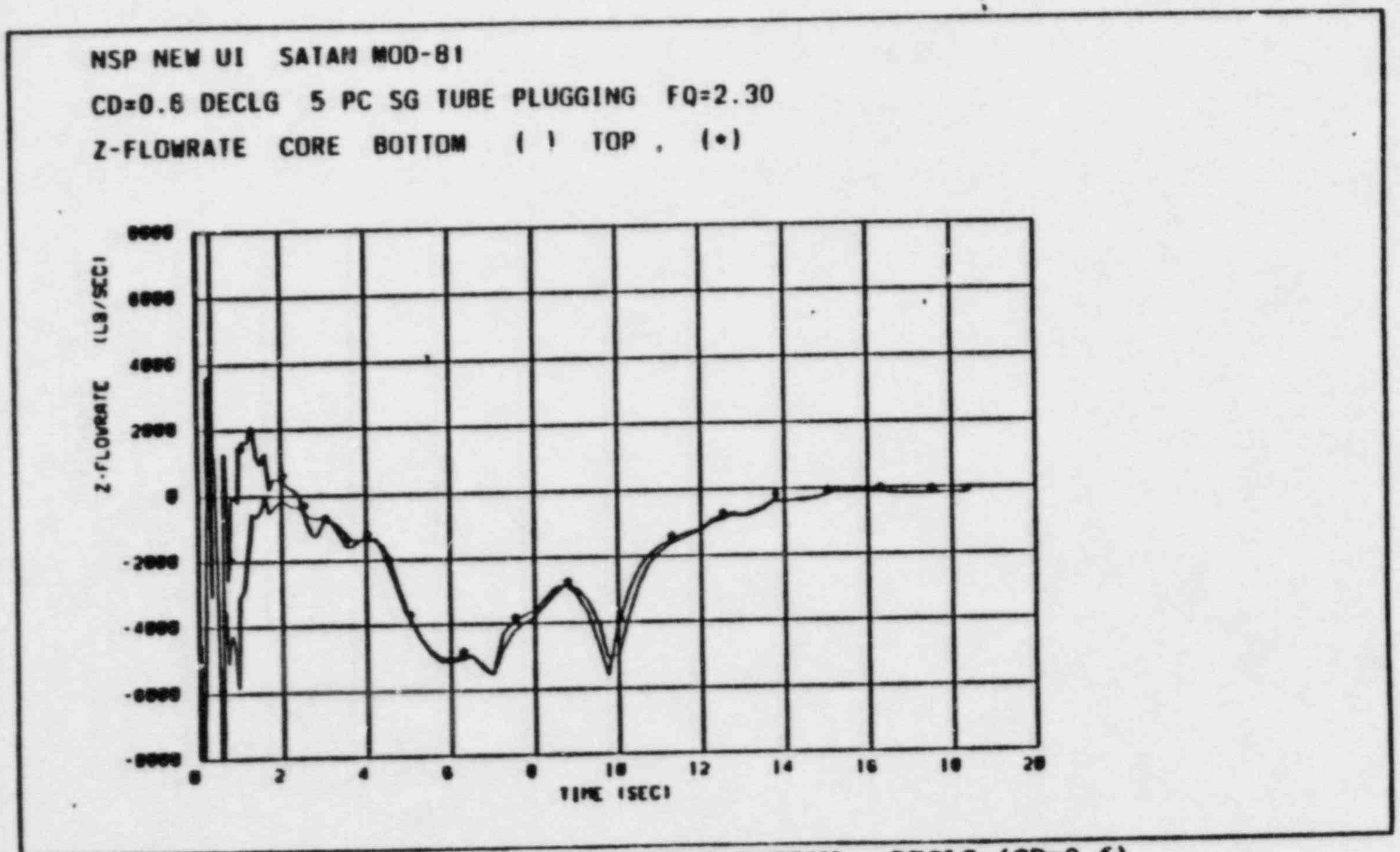


FIGURE 2b CORE FLOW - TOP & BOTTOM - DECLG (CD=0.6)

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with the z-flowrate at the top of the core. Where top and bottom core z-flowrates coincide, only one curve (with asterisk tracer) will be seen.

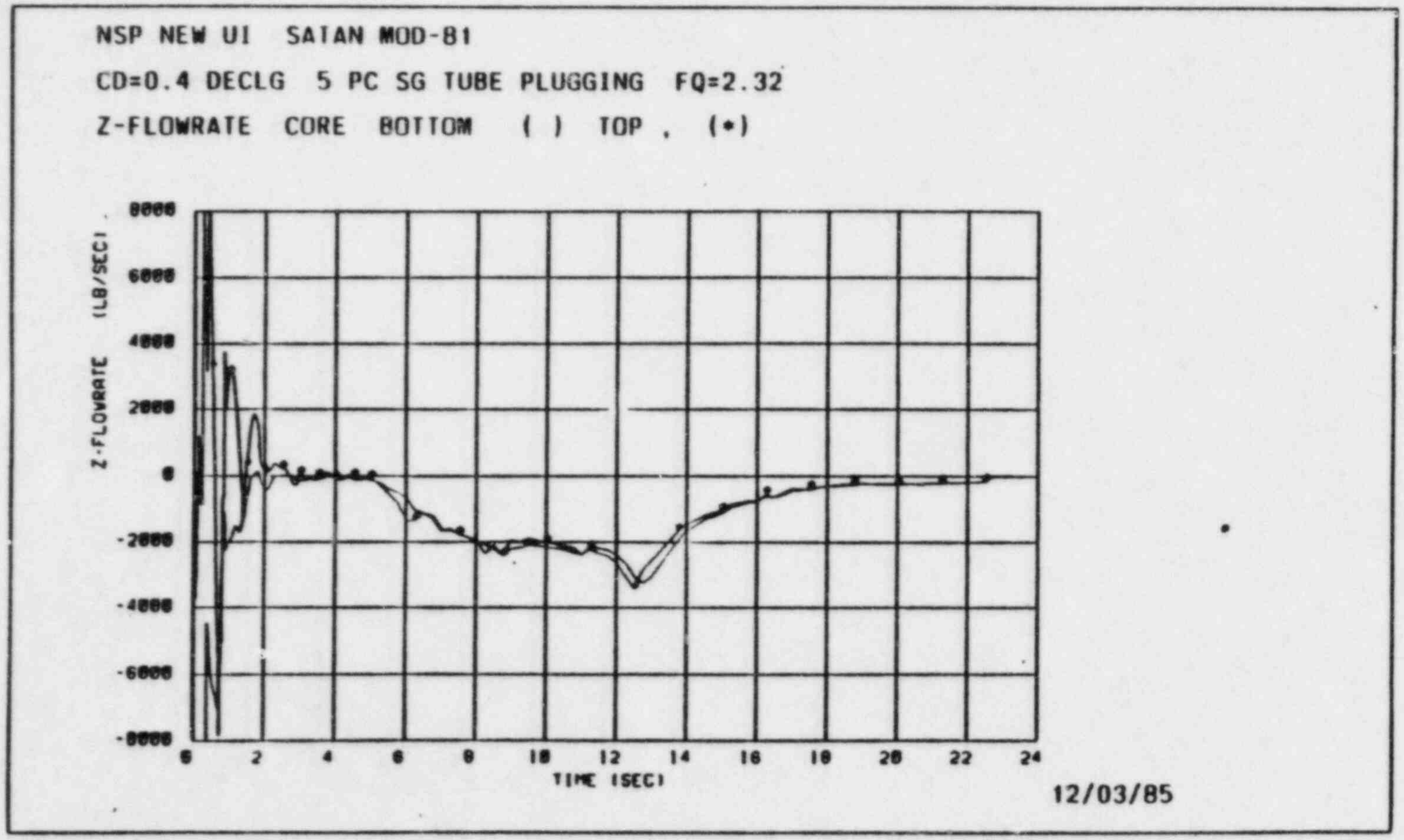


FIGURE 2c **CORE FLOW - TOP & BOTTOM - DECLG (CD=0.4)**

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with the z-flowrate at the top of the core. Where top and bottom core z-flowrates coincide, only one curve (with asterisk tracer) will be seen.

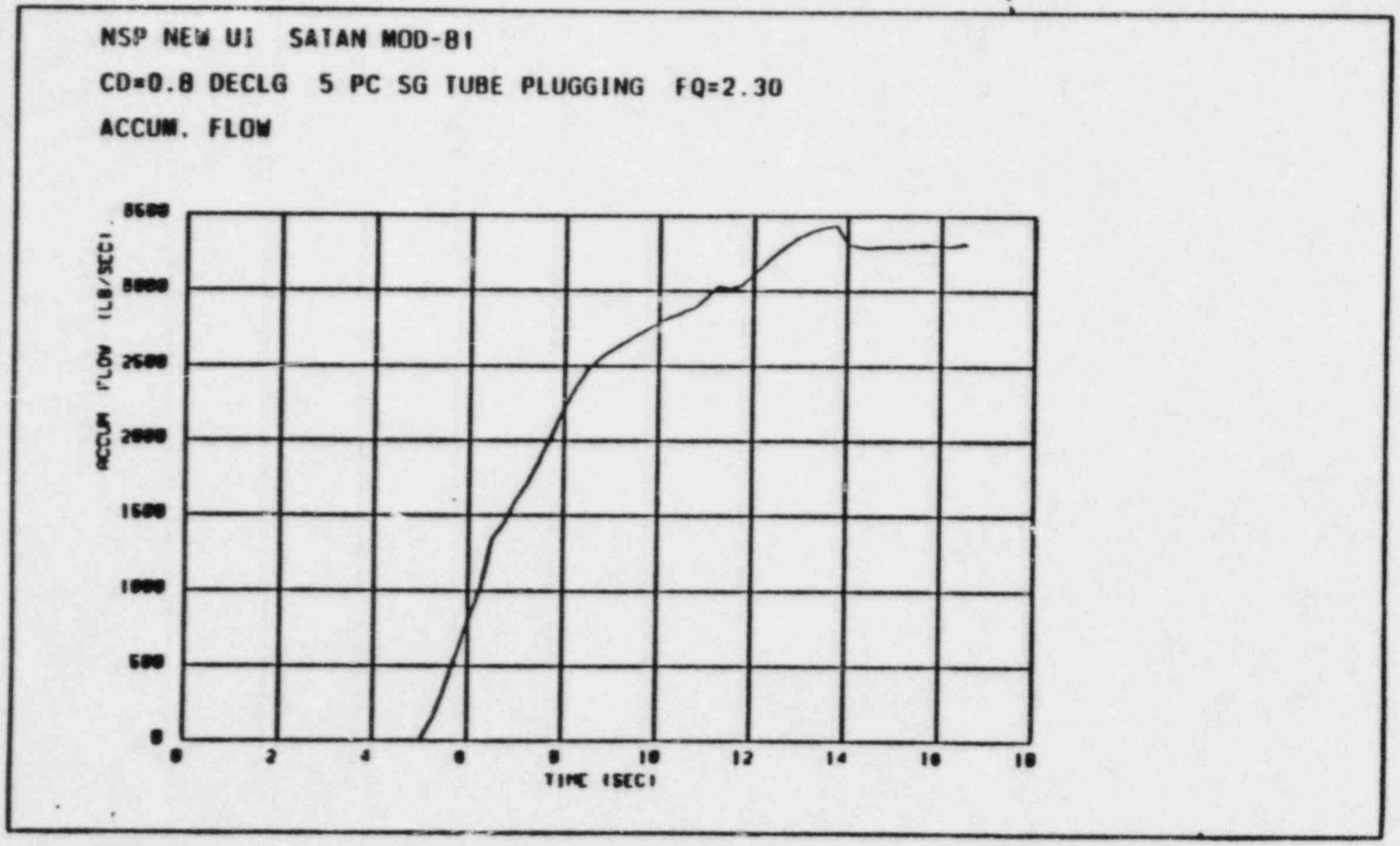


FIGURE 3a **ACCUMULATOR FLOW (BLOWDOWN) - DECLG (CD=0.8)**

NSP NEW UI SATAN MOD-81

CD=0.6 DECLG 5 PC SG TUBE PLUGGING FQ=2.30

ACCUM. FLOW

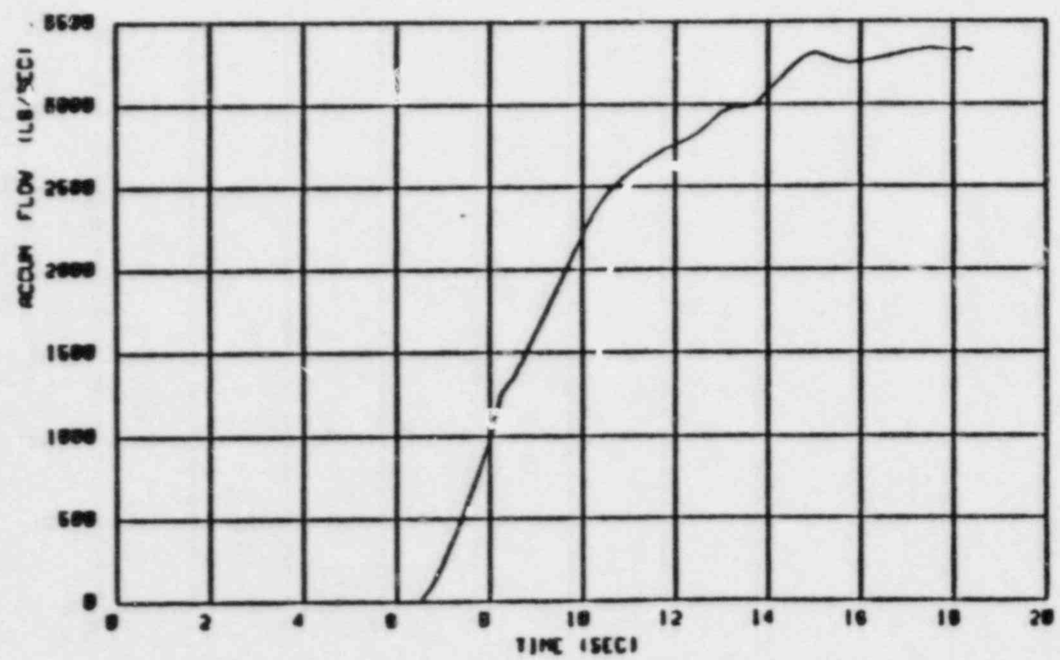


FIGURE 3b ACCUMULATOR FLOW (BLOWDOWN) - DECLG (CD=0.6)

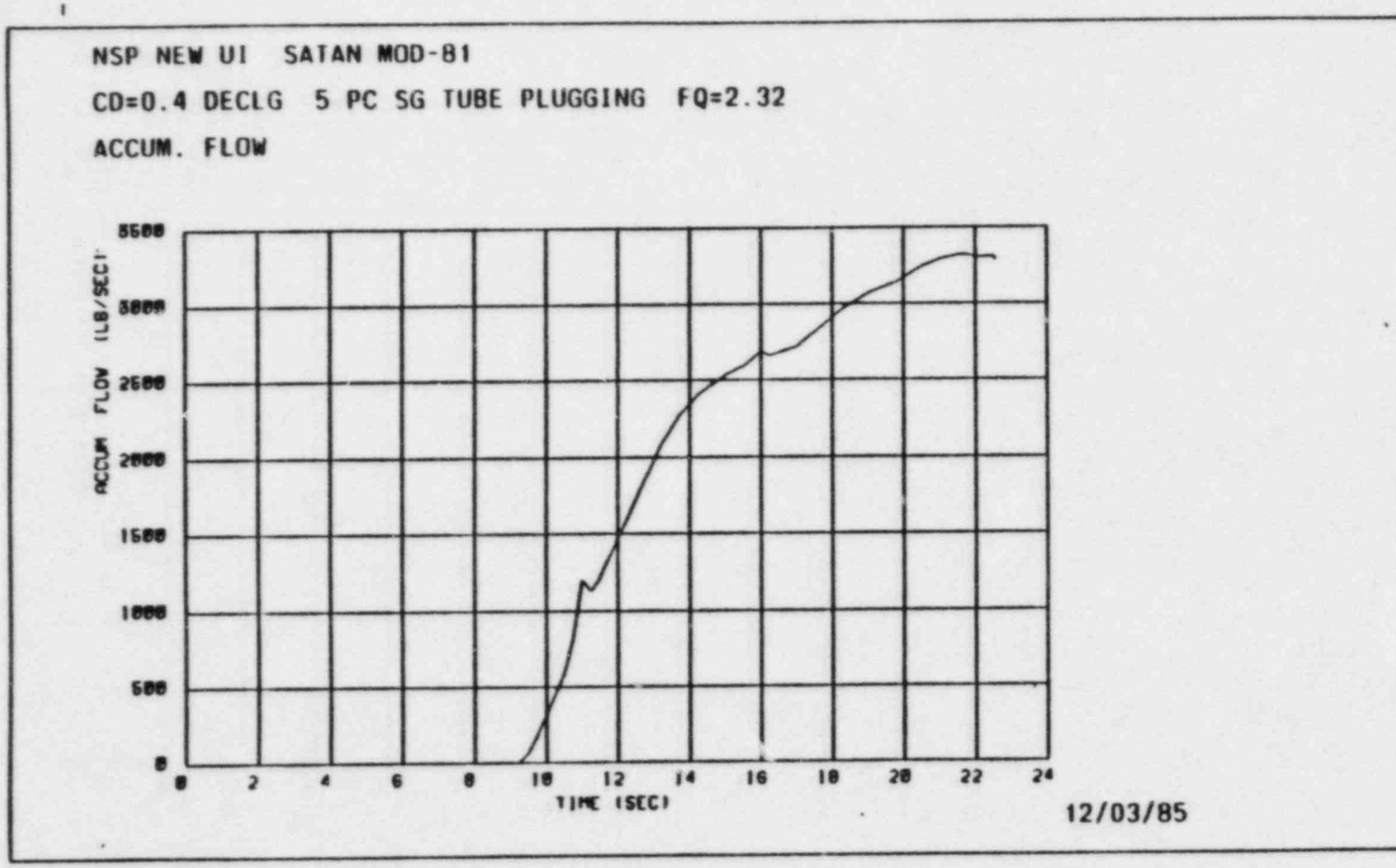


FIGURE 3c ACCUMULATOR FLOW (BLOWDOWN) - DECLG (CD=0.4)

14 BY 14 OFA 5% SG TUBE PLUGGING
1981 EVALUATION MODEL LOCA ANALYSIS
CD=0.8

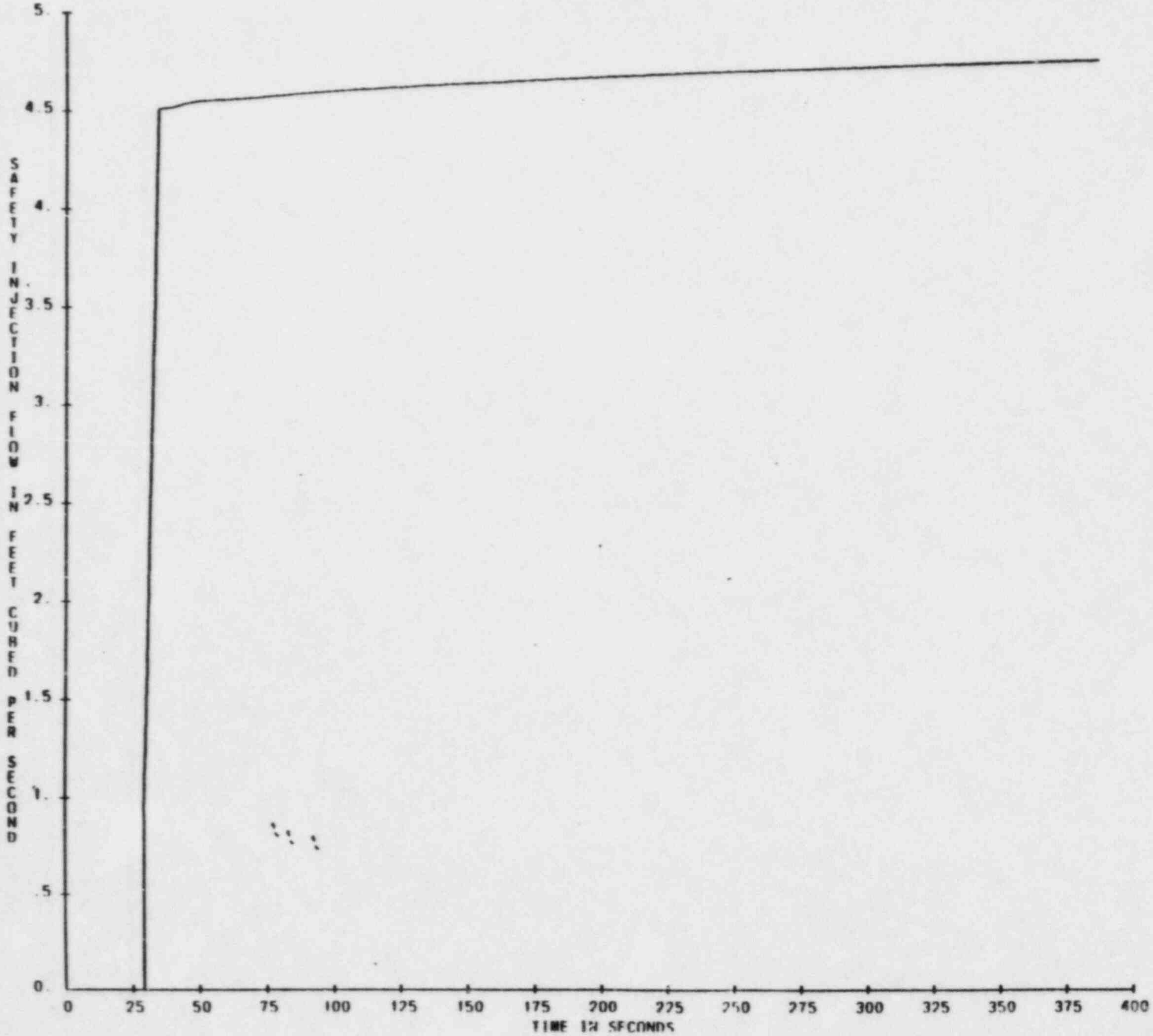
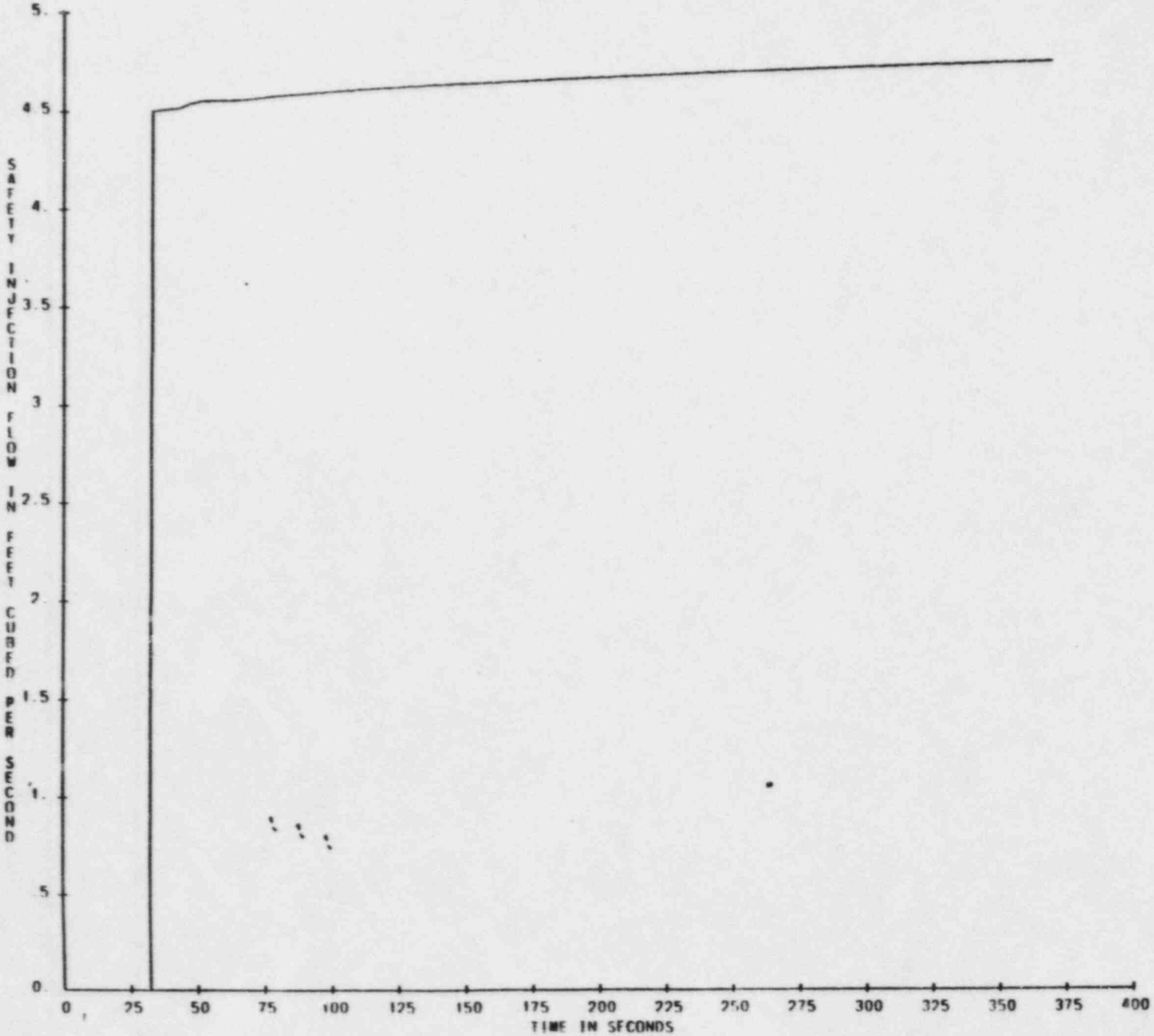
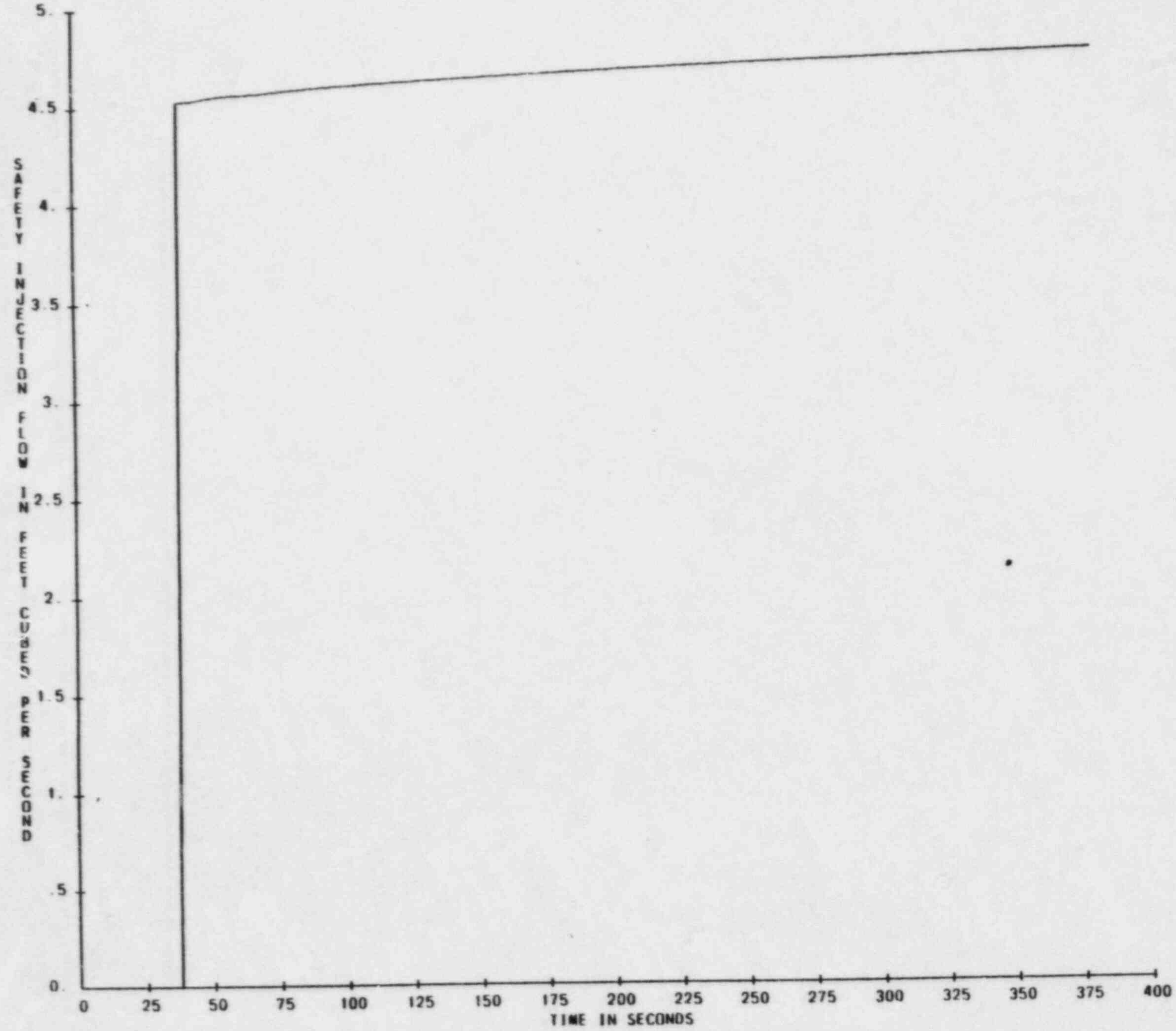


FIGURE 4-

14 BY 14 OFA 5% SG TUBE PLUGGING
1981 EVALUATION MODEL LOCA ANALYSIS
CD=0.6



14 BY 14 SPB 5% SG TUBE PLUGGING
1981 EVALUATION MODEL LOCA ANALYSIS
CD=0.4



PUMPED ECCS DECLG (CD=0.4) FIGURE 4c

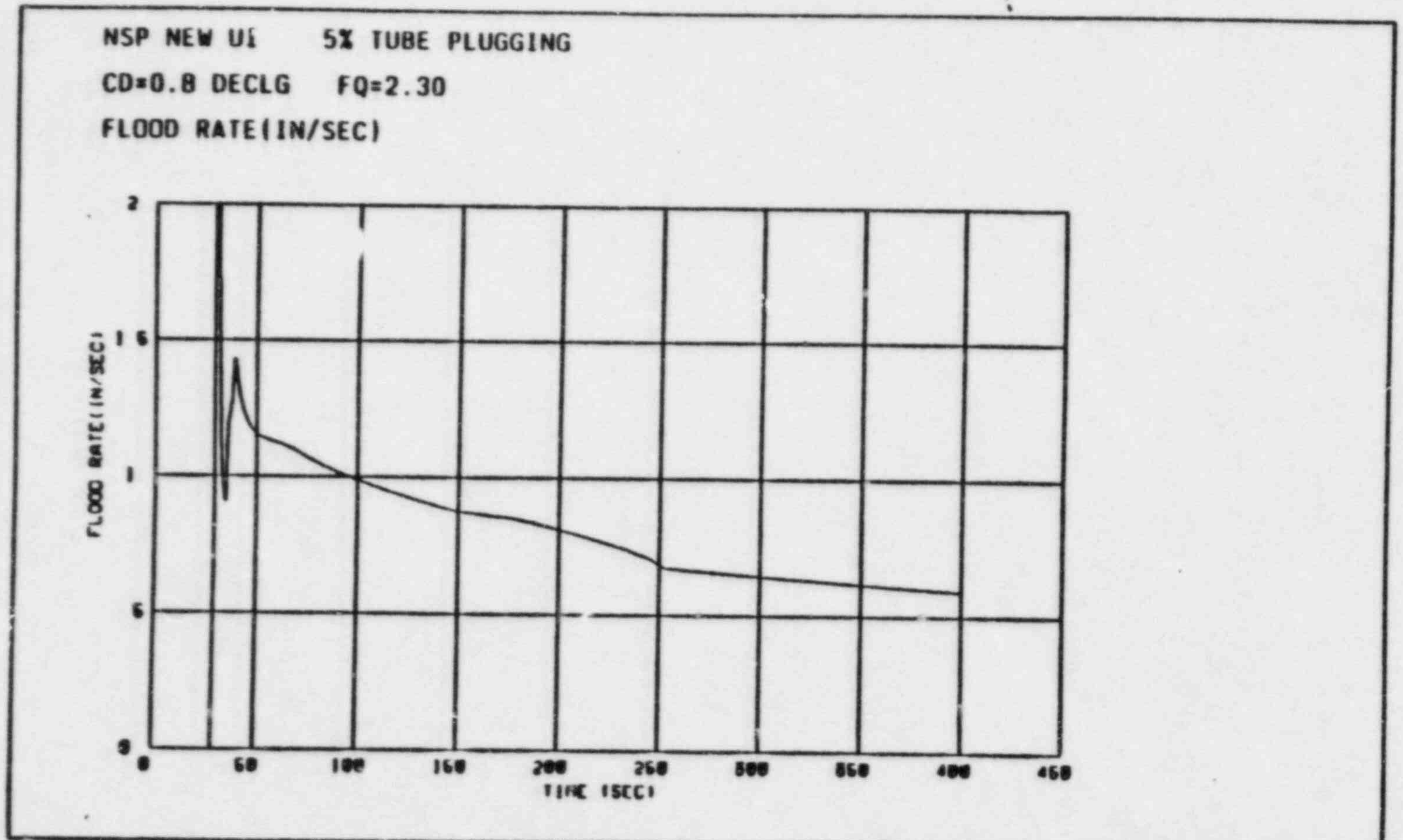


FIGURE 5a   **REFLOOD TRANSIENT - CORE INLET VELOCITY DECLG (CD=0.8)**

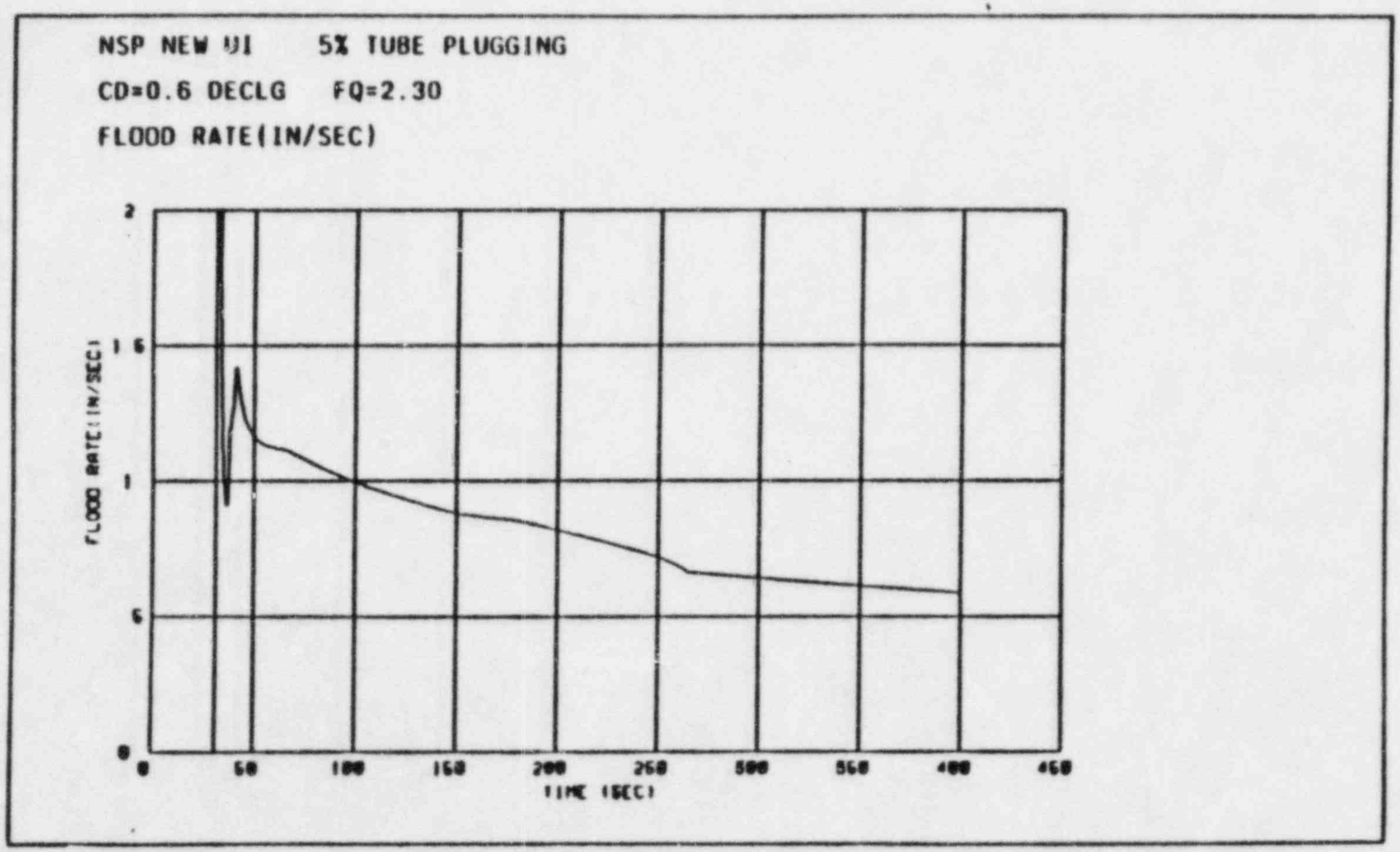


FIGURE 5b REFLOOD TRANSIENT - CORE INLET VELOCITY
DECLG (CD=0.6)

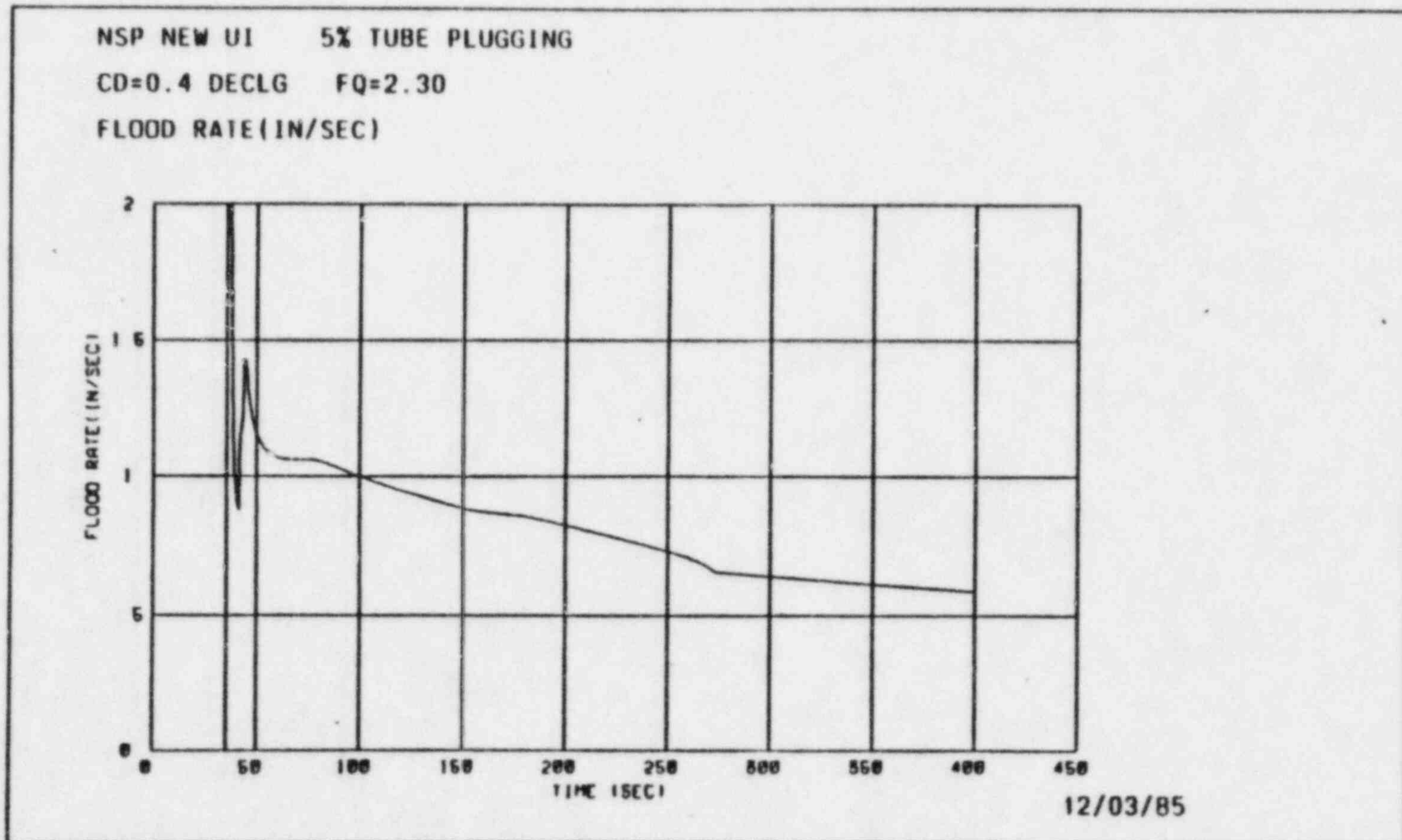


FIGURE 5c **REFLOOD TRANSIENT - CORE INLET VELOCITY DECLG (CD=0.4)**

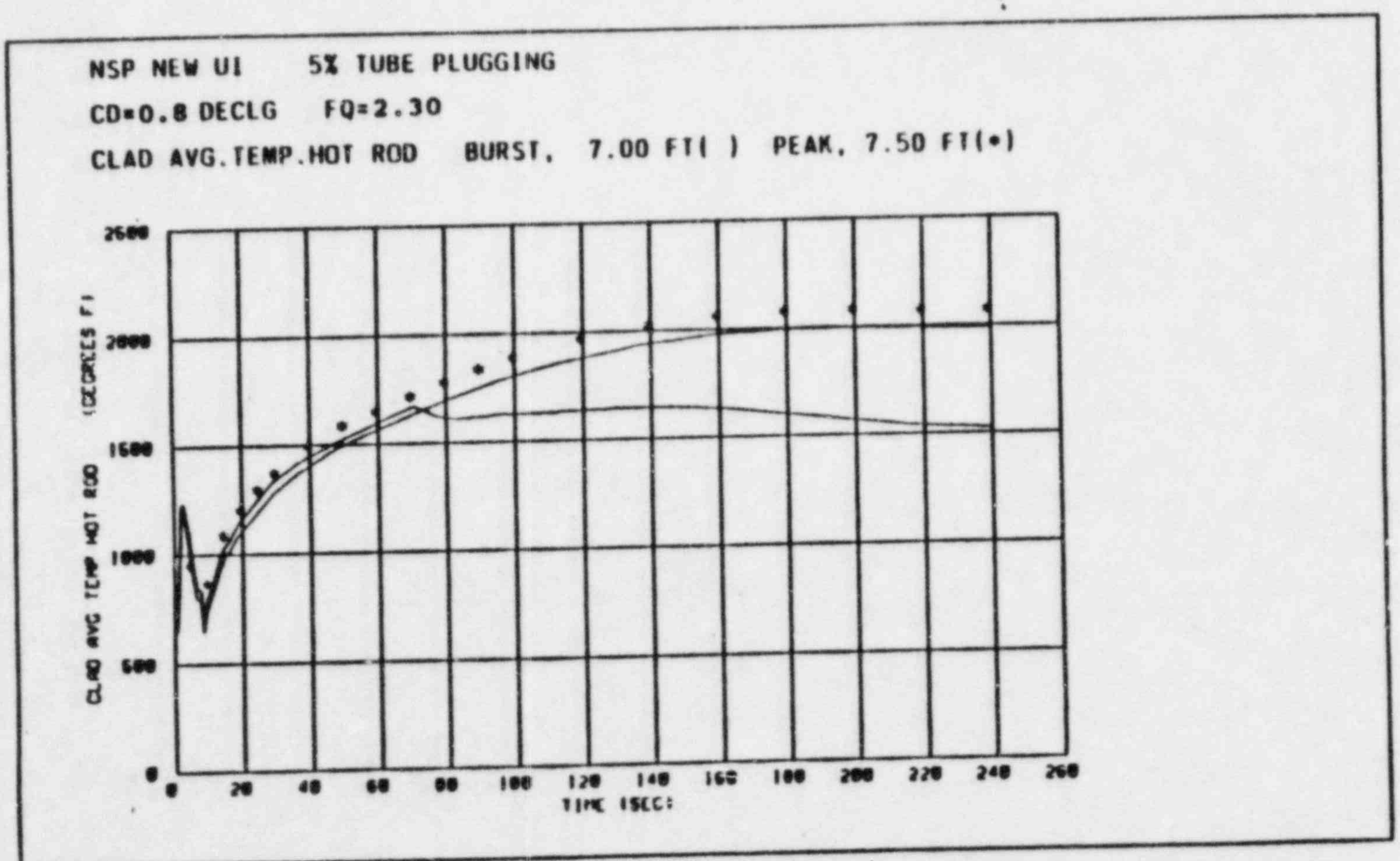


FIGURE 6a PEAK CLAD TEMPERATURE - DECLG (CD=0.8)

NOTE: Asterisks (*) do not represent a separate curve, but provide a tracer to identify the curve associated with the peak (highest PCT) node. Where peak and burst nodes coincide, only one curve (with asterisk tracer) will be seen.

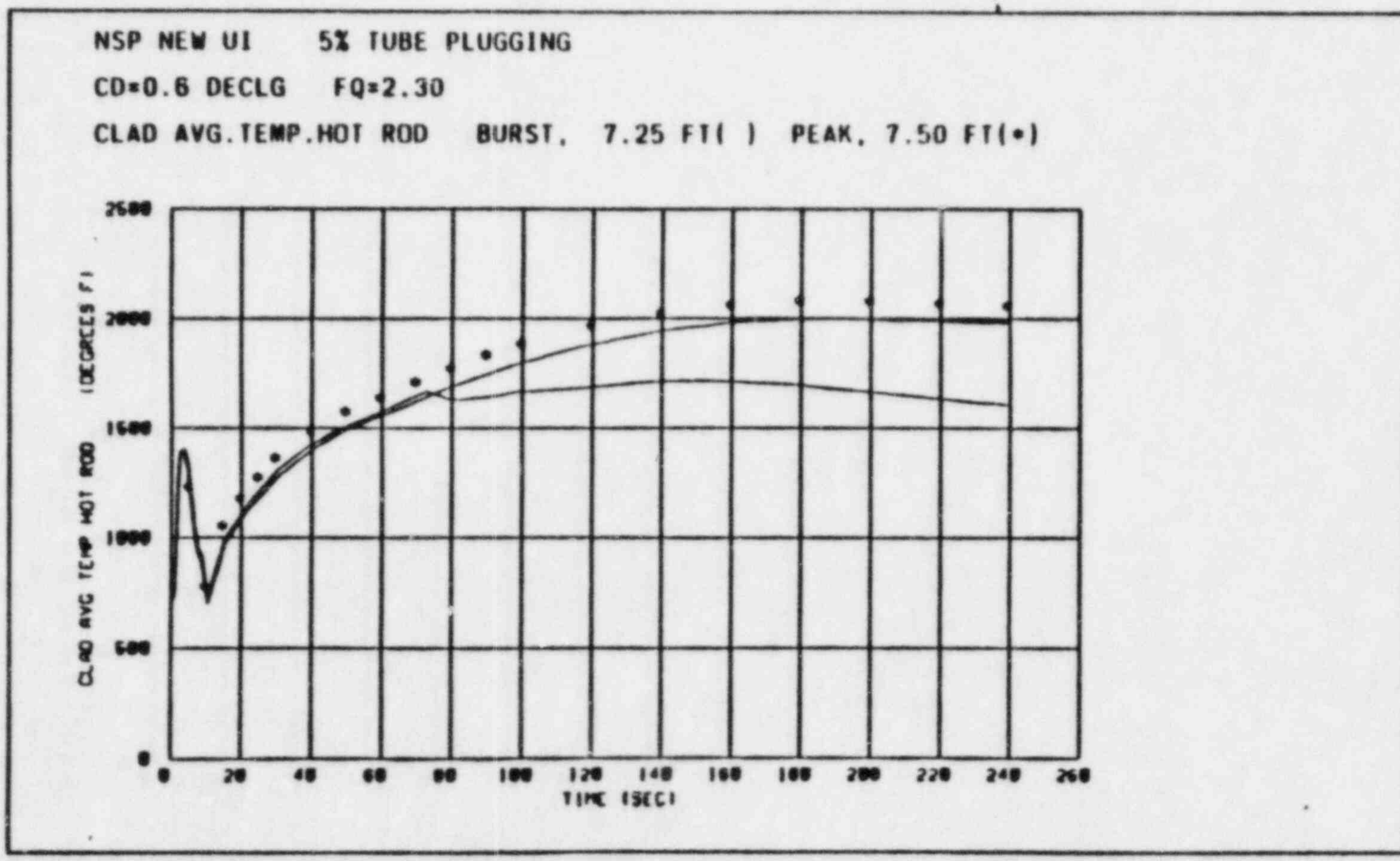


FIGURE 6b **PEAK CLAD TEMPERATURE - DECLG (CD=0.6)**

NOTE: Asterisks (*) do <u>not</u> represent a separate curve, but provide a tracer to identify the curve associated with the peak (highest PCT) node. Where peak and burst nodes coincide, only one curve (with asterisk tracer) will be seen.

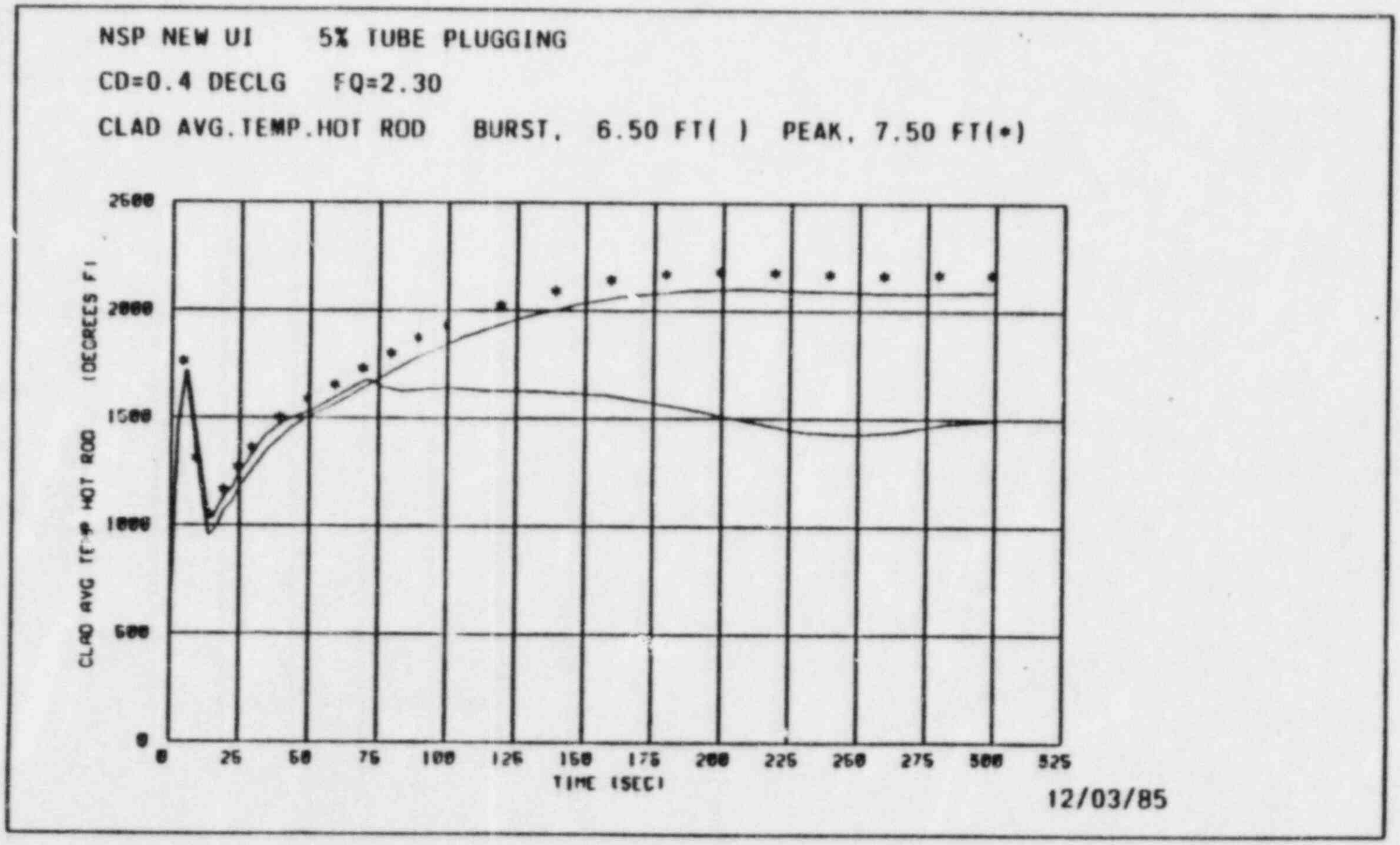


FIGURE 6c **PEAK CLAD TEMPERATURE - DECLG (CD=0.4)**

NOTE: Asterisks (*) do not represent a separate curve, but provide a tracer to identify the curve associated with the peak (highest PCT) node. Where peak and burst nodes coincide, only one curve (with asterisk tracer) will be seen.