VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

November 19, 1985

W. L. STEWART
VICE PRESIDENT
NUCLEAR OPERATIONS

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. Cecil O. Thomas, Chief
Standardization and Special
Projects Branch
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 85-753
E&C/NAS:asp
Docket Nos.: 50-280
50-281
50-338
50-339
License Nos.: DPR-32
DPR-37
NPF-4
NPF-7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY AND NORTH ANNA POWER STATIONS
REACTOR SYSTEM TRANSIENT ANALYSES

In our letter to you of April 14, 1981, Serial No. 215, we transmitted our Topical Report VEP-FRD-41, "Vepco Reactor System Transient Analysis Using the RETRAN Computer Code." The report, which was provided for review by your staff, describes the system transient analysis capability which Vepco is using in support of core reloads, and other operational or design changes at our nuclear units. Following a request for supplemental information, to which Vepco responded with letters dated February 27, 1984, July 12, 1984 and August 24, 1984, the staff issued a letter approving the report for referencing in license applications on April 11, 1985.

In the Safety Evaluation Report (SER) accompanying this approval, the staff referred to Vepco's RETRAN capability "for performing transient analyses using the RETRAN01/MOD03 Computer Code." Since no RETRAN02 analyses were presented in the topical report or the supplemental submittals, no reference to Vepco's use of RETRAN02 was made in the SER. Vepco has informally discussed its desire to have the SER for VEP-FRD-41 extended to RETRAN02/MOD03 applications informally with your staff (Mr. J. Guttmann, USNRC Reactor Systems Branch and Mr. D. Moran, USNRC Standardizations and Special Projects Branch) on April 2, 1985. Based on that discussion, we are submitting for your review an additional set of analyses performed by Vepco with the models documented in VEP-FRD-41 and the supplements discussed above. These analyses provide comparisons of results obtained for identical transients using RETRAN01 (the code version used to perform the analyses presented in VEP-FRD-41) and RETRAN02. As discussed in the attachment, the results are very nearly identical except in the area of nonequilibrium pressurizer behavior, where substantial improvements were made in the solution scheme in RETRAN02.

A001
1/20

We are requesting, based on these results, approval to reference VEP-FRD-41A and the associated SER in future licensing applications involving Surry and North Anna Power Stations where analyses have been performed using the RETRANO2 Computer Code. In order to support upcoming licensing submittals, we request your approval by February 1986.

Very truly yours,

W. L. Stewart

Attachment

cc: Dr. J. Nelson Grace
Regional Administrator
Region II

Mr. Harold Bernard
Standardization and Special Projects Branch

Mr. J. L. Carter
Reactor Systems Branch

Mr. J. Guttmann
Reactor Systems Branch

Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Mr. Edward J. Butcher, Acting Chief
Operating Reactors Branch No. 3
Division of Licensing

Mr. D. J. Burke
NRC Resident Inspector
Surry Power Station

Mr. M. W. Branch
NRC Resident Inspector
North Anna Power Station

ATTACHMENT 1

COMPARISON OF RETRAN01 AND RETRAN02 COMPUTER CODE RESULTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Reactor Trip

Turbine Trip No Rx Trip

LIST OF FIGURES (CONT.)

Loss of Flow

1.0 INTRODUCTION

Virginia Electric and Power Company (the Company) has performed analyses to compare the results calculated by RETRAN01 and RETRAN02, two versions of the RETRAN computer code which have been released by the Electric Power Research Institute (EPRI). Topical reports related to RETRAN have been submitted by the Utility Group for Regulatory Application and have been accepted by the NRC (Reference 1). The NRC approved the Company's licensing topical report VEP-FRD-41A,"Reactor System Transient Analyses using the RETRAN Computer Code", on April 11, 1985 (Reference 2). The analyses presented in VEP-FRD-41A were performed using RETRAN01. Since the Company intends to use RETRAN02 for its licensing analysis, the NRC requested comparative analyses using RETRAN01 and RETRAN02 to support extension to their review and approval to RETRAN02 (Reference 3). The three transients that were selected for this comparative study were:

1. Reactor Trip
2. Turbine Trip without Reactor Trip
3. Complete Loss of Flow

These transients demonstrate the significant features of the models (nonequilibrium pressurizer behaviour, point kinetics response, response to large flow variations, etc.) but are straightforward enough that differences in paramenter trends are readily identified and assessed. Section 2 describes the models used for the analysis. Sections 3 and 4 contain the results and conclusions.

2. DESCRIPTION OF MODEL

Two RETRAN input decks, a North Anna Single Loop Model compatible with RETRAN01 and a similar model compatible with RETRAN02, with nineteen control volumes and twenty-nine flow junctions were used for this analysis. A general description of these models was provided in References 4-7. RETRAN02 is an extension of RETRAN01 containing additional user conveniences, the ability to optionally model additional phenomena and upgrading of some of the RETRAN01 models. RETRAN02 can be used with the same options available in RETRAN01 with the exception of the following changes which represent an upgrade of the RETRAN01 models:

1. A revised solution technique for the nonequilibrium pressurizer model.

2. Analytical expressions for water properties (as opposed to a table).

3. The use of junction flow and fluid properties for the wall friction calculation.

Only the minimum changes required to convert the RETRAN01 data deck to RETRAN02 were made. Initial conditions for all transients are shown in Table 1.

3. RESULTS OF ANALYSIS

Comparison of the time zero edits shows that the two versions of RETRAN calculate steady state initialization parameters which match to within less than 1%. The transient results are described below.

a. Reactor Trip

The reactor was tripped at 0.0 second and the transient was executed for 10 seconds. Figures 1a through 8a show that the results of the two calculations are essentially identical except for pressurizer pressure. The difference in pressurizer pressure is due to the revised nonequilibrium pressurizer model solution technique. The significant events during the reactor trip transient are listed in Table 2.

b. Turbine Trip

The turbine was tripped at 0.0 second and the transient was executed for 10 seconds. Again figures 1b through 8b show that the results of the two calculations are essentially identical except for pressurizer pressure. The pressurizer pressure increases more rapidly during the transient in RETRAN02 than in RETRAN01, due to the revised nonequilibrium pressurizer model solution technique. The significant events during the turbine trip are listed in Table 3.

c. Complete Loss of Flow

The pumps were tripped at 0.0 second and the transient was executed for 10 seconds. Figures 1c through 8c show that the results of the two calculations are identical except pressurizer pressure. The primary coastdown flow rates calculated by the two versions of the code are essentially identical. The significant events occuring during the loss of flow transient are listed in Table 4.

4.0 CONCLUSIONS

The results of the three transients analyzed above using RETRAN01 and RETRAN02 show that the two codes produce essentially identical results except the primary side pressure calculation. The secondary side pressures predicted by the two codes are essentially identical. The following conclusions can be reached:

1. Steady state calculations show less than 1% difference in such parameters as temperatures, pressures and enthalpies.

2. RETRAN01 and RETRAN02 predicted essentially identical flow coastdown for the loss of flow transient using the same model and initial conditions.

3. RETRAN02 predicts larger and faster changes in the primary side pressure than RETRAN01. This is primarily due to the revised solution technique for the nonequilibrium pressurizer model.

5.0 REFERENCES

1. Letter from C. O. Thomas (NRC) to T. W. Schnatz (UGRA), "Acceptance for Referencing of Licensing Topical Reports EPRI CCM-5, 'RETRAN-A Program for One Dimensional Transient Thermal Hydraulic Analysis of Complex Fluid Flow Systems,' and EPRI NP-1850-CCM, 'RETRAN02-A Program for One Dimensional Transient Thermal Hydraulic Analysis of Complex Fluid Flow Systems,'" September 4, 1984.

2. Letter from C. O. Thomas (NRC) to W. L.Stewart (Vepco), Acceptance for Referring of Licensing Topical Report VEP-FRD-41, "Vepco Reactor System Transient Analysis Using the RETRAN Computer Code", April 11, 1985.

3. Conference between R. M. Berryman, K. L. Basehore and N. A. Smith (Vepco) and Messrs J. Guttmann and Chiu Liang, USNRC Reactor Systems Branch and D. Moran, USNRC Standardization and Special Projects Branch, Bethesda, Md., April 11, 1985.

4. Vepco Topical Report, VEP-FRD-41A, "Reactor System Transient Analyses Using the RETRAN Computer Code", submitted by letter from W. L. Stewart (Vepco) to H. L. Thompson, Jr. (NRC), Serial No. 85-77, July 3, 1985.

5. Letter from W. L. Stewart (Vepco) to H. R. Denton (NRC), "Vepco Reactor System Transient Analyses", Serial No. 060, February 27, 1984.

6. Letter from W. L. Stewart (Vepco) to H. R. Denton (NRC), "Vepco Reactor System Transient Analyses", Serial No. 376, July 12, 1984.

7. Letter from W. L. Stewart (Vepco) to H. R. Denton (NRC), "Vepco Reactor System Transient Analyses", Serial No. 376A, August 24,1984.

Table 1. Initial Conditions for Steady-State Operation

Parameters	Value	Units
Core Power	2830.50	Mwt
Total Loop Flow	104.25E+6	lb/hr
Pressurizer Pressure	2220	psia
Enthalpy at Lower Plenum	551.20	btu/lb
Steam/Feed Flow	12.464E+6	lb/hr
Steam Pressure	856.0	psia
Feedwater Enthalpy	418.50	btu/lb

Table 2. Significant Events During Reactor Trip Transient

Event	Setpoint Value	Time(seconds) RETRAN01	RETRAN02
Steady State Initialization	N/A	0.0	0.0
Steady State Operation	N/A	0.0	0.0
Reactor Trip	N/A	0.0	0.0
Turbine Trip	N/A	2.005	2.005
Pressurizer Heaters on	+10% Controller Span	3.445	3.429
Atmospheric Relief Valves Open	1050 psia	9.440	9.379

Table 3. Significant Events During Turbine Trip Transient

Event	Setpoint Value	Time(seconds) RETRAN01	RETRAN02
Steady State Initialization	N/A	0.0	0.0
Steady State Operation	N/A	0.0	0.0
Turbine Trip	N/A	0.0	0.0
PORV Open #2	50% of Controller Span	4.765	4.563
Atmospheric Relief Valves Open	1050 psia	6.610	6.552
PORV Open #1	2350 psia	6.695	6.393

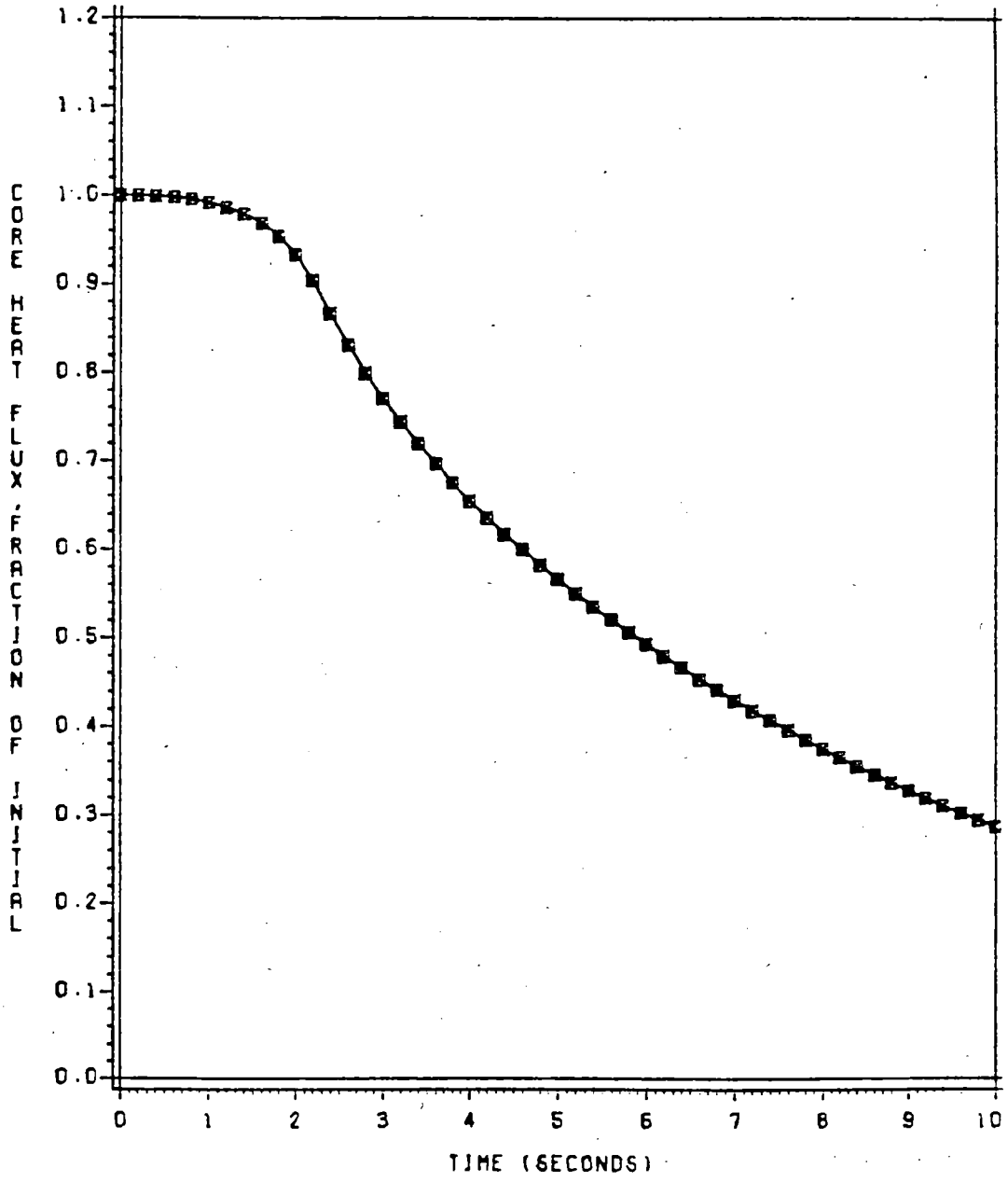
Table 4. Significant Events During Loss of Flow Transient

Event	Setpoint Value	Time(seconds) RETRAN01	RETRAN02
Steady State Initialization	N/A	0.0	0.0
Steady State Operation	N/A	0.0	0.0
Pump Trip	N/A	0.0	0.0
Low Flow Trip	25194.0 lb/sec	2.140	2.138
Reactor Trip	N/A	3.140	3.138
PORV Open #2	50% of Controller Span	******	4.882
Turbine Trip	N/A	5.145	5.138
Pressurizer Heaters on	-10% of Controller Span	8.770	8.941

FIGURE 1a
REACTOR TRIP

MIDCORE HEAT FLUX

RETRAN01 VS RETRAN02

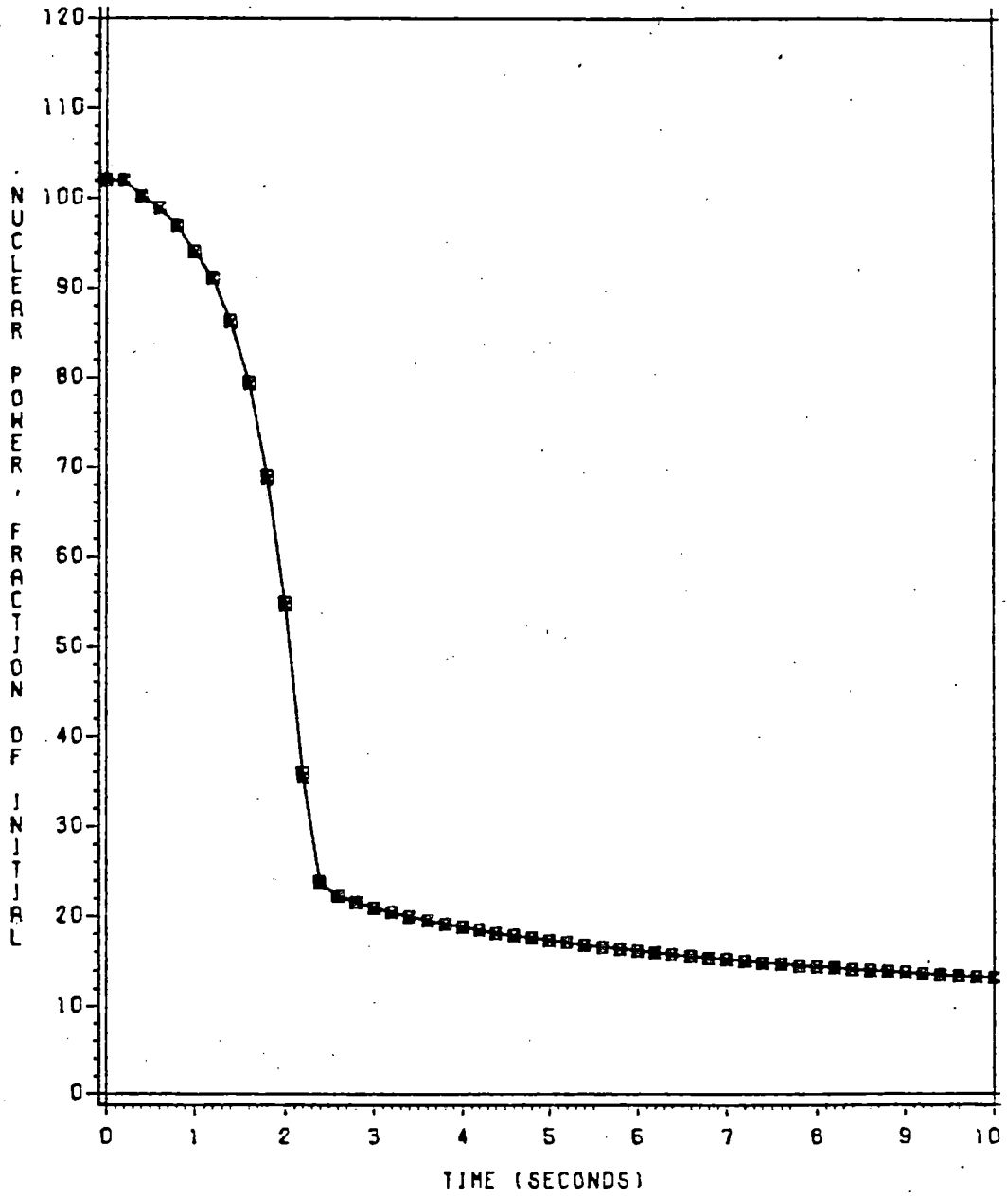


RETRAN01=X
RETRAN02=SQUARE

FIGURE 2a
REACTOR TRIP

NUCLEAR POWER

RETRAN01 VS RETRAN02

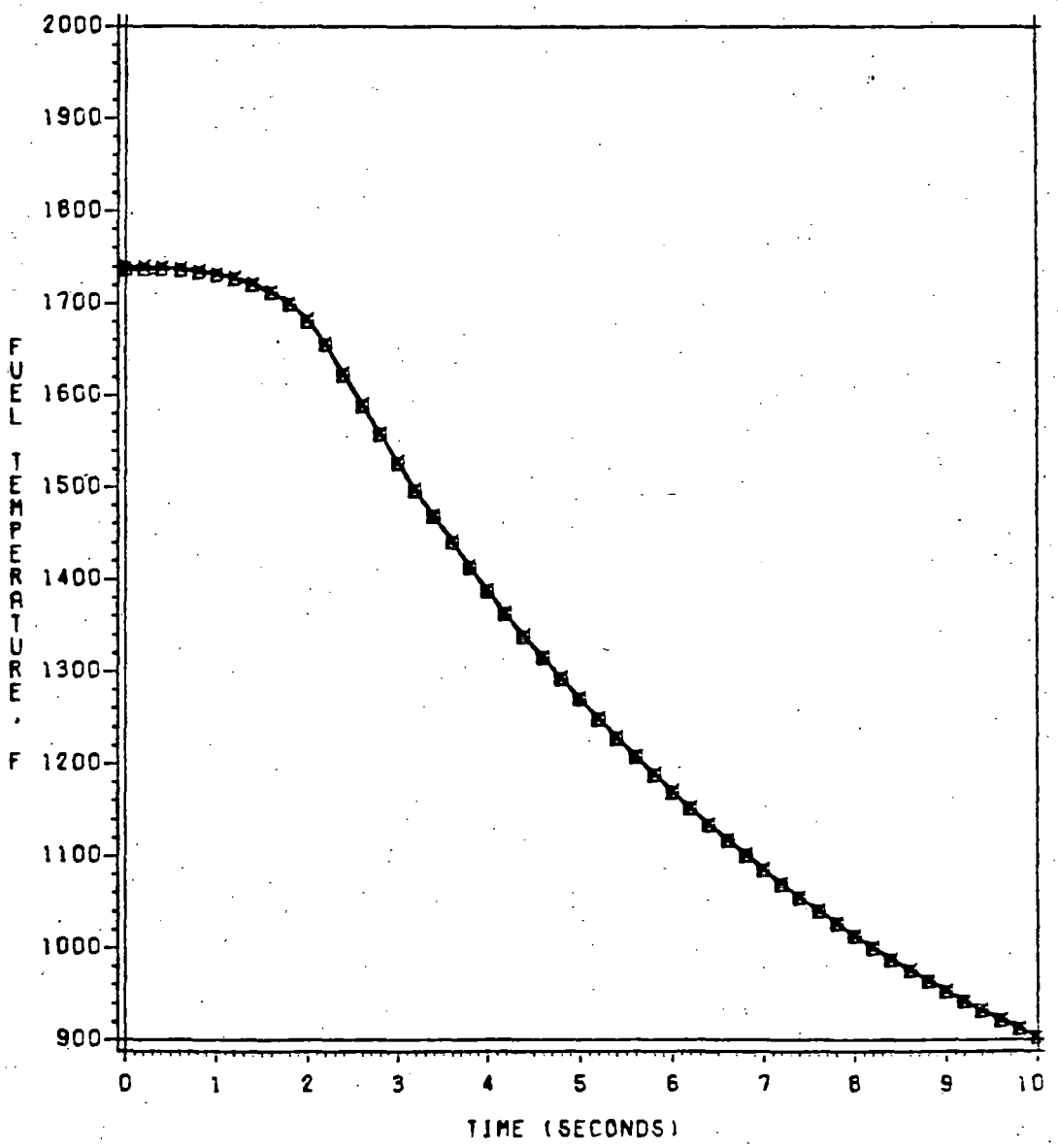


RETRAN01=X
RETRAN02=SQUARE

FIGURE 3a
REACTOR TRIP

MIDCORE FUEL TEMP

RETRAN01 VS RETRAN02

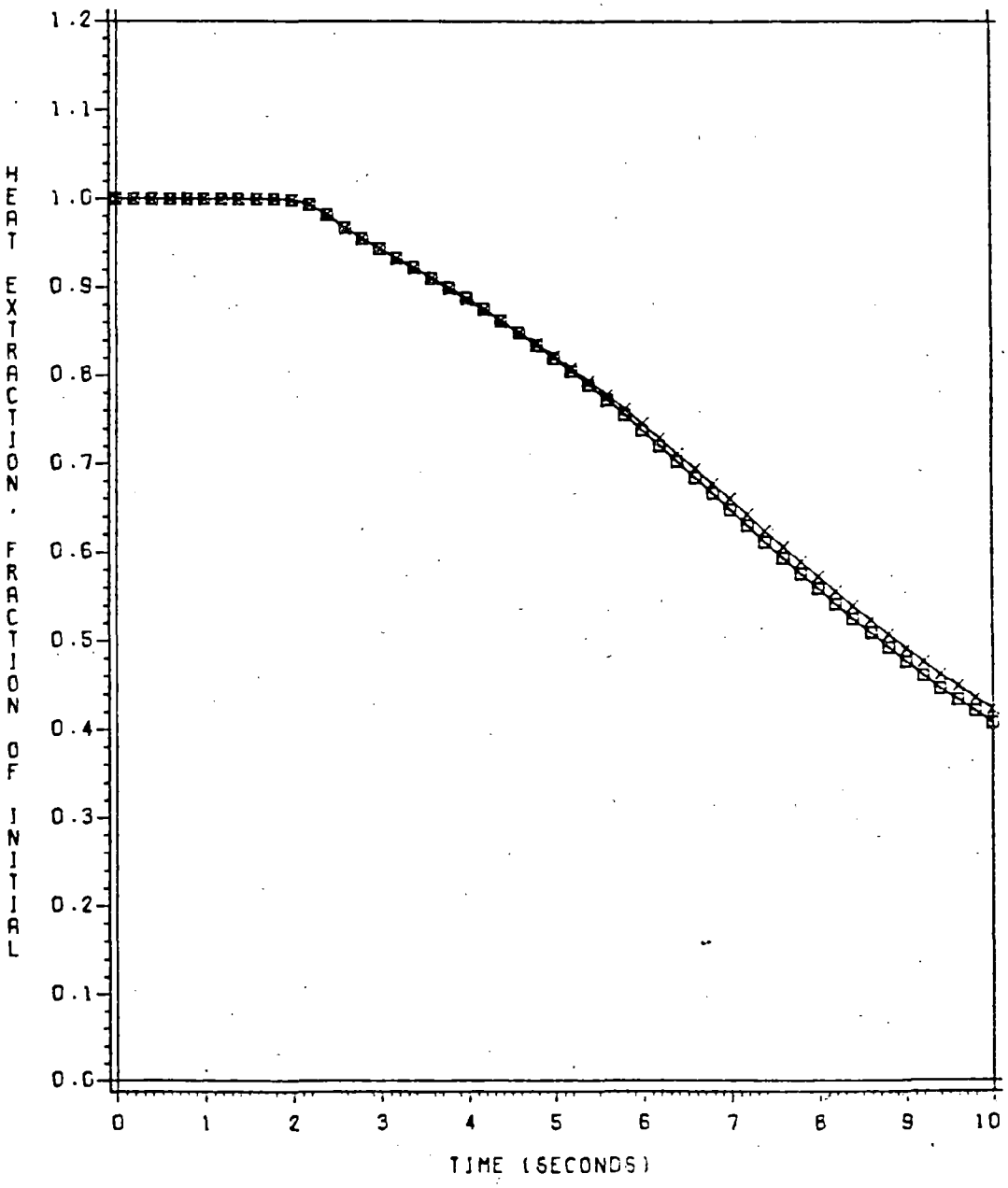


RETRAN01=X
RETRAN02=SQUARE

FIGURE 4a
REACTOR TRIP

SG HEAT EXTRACTION RATE

RETRAN01 VS RETRAN02

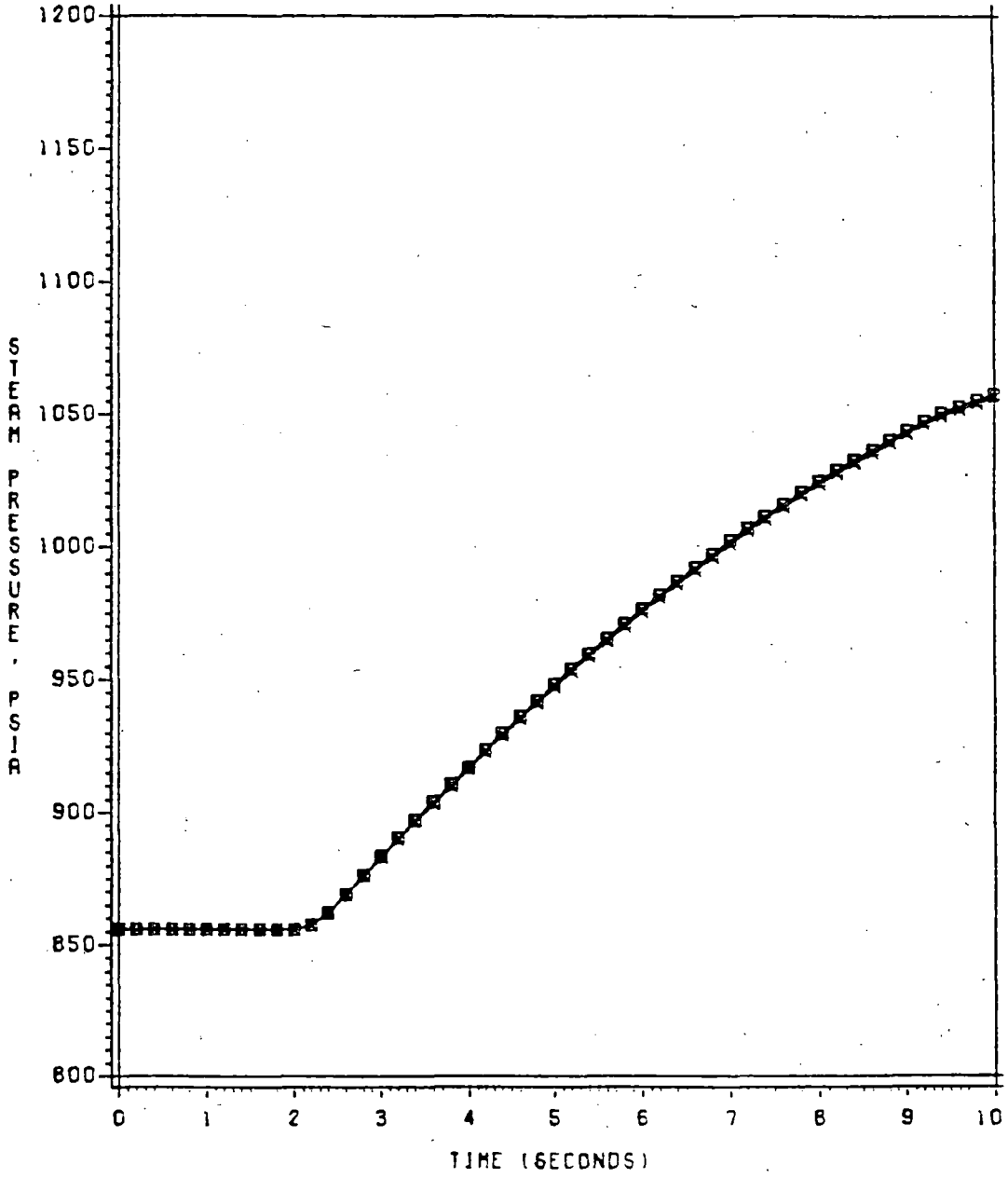


RETRAN01=X
RETRAN02=SQUARE

FIGURE 5a
REACTOR TRIP

STEAM PRESSURE

RETRAN01 VS RETRAN02



RETRAN01=X
RETRAN02=SQUARE

FIGURE 6a
REACTOR TRIP

INLET TEMPERATURE

RETRAN01 VS RETRAN02

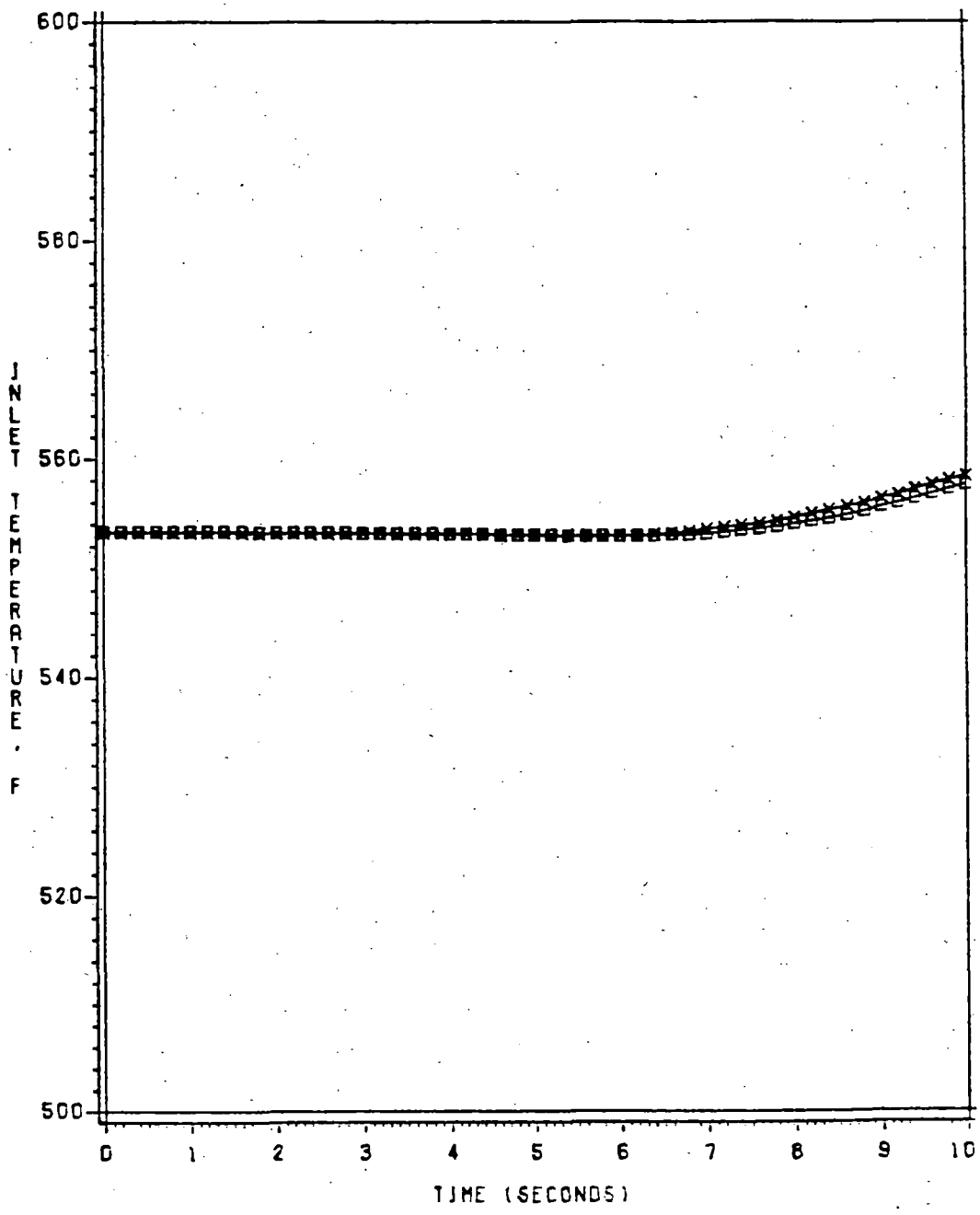


FIGURE 7a
REACTOR TRIP

PRESSURIZER PRESSURE

RETRAN01 VS RETRAN02

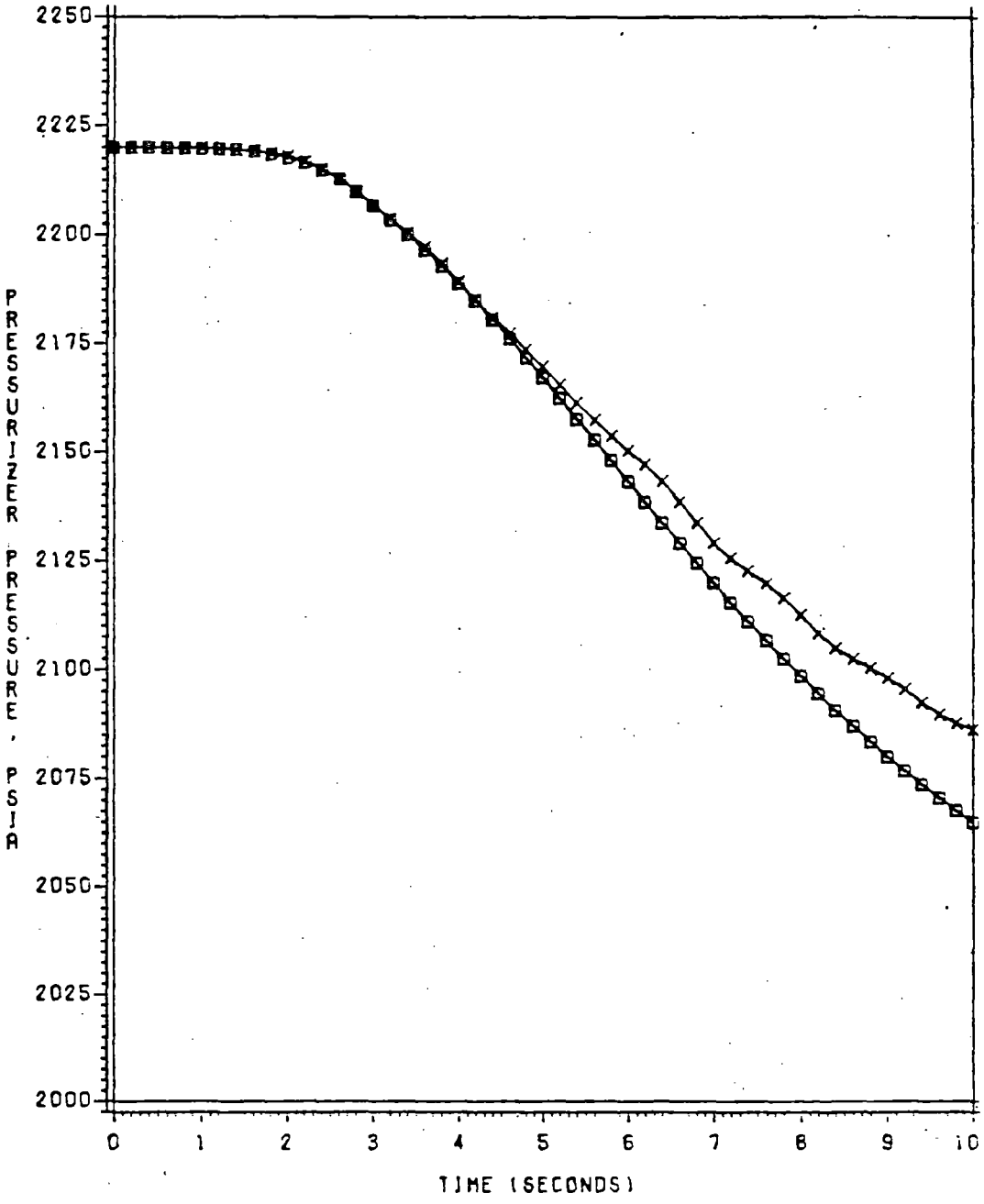
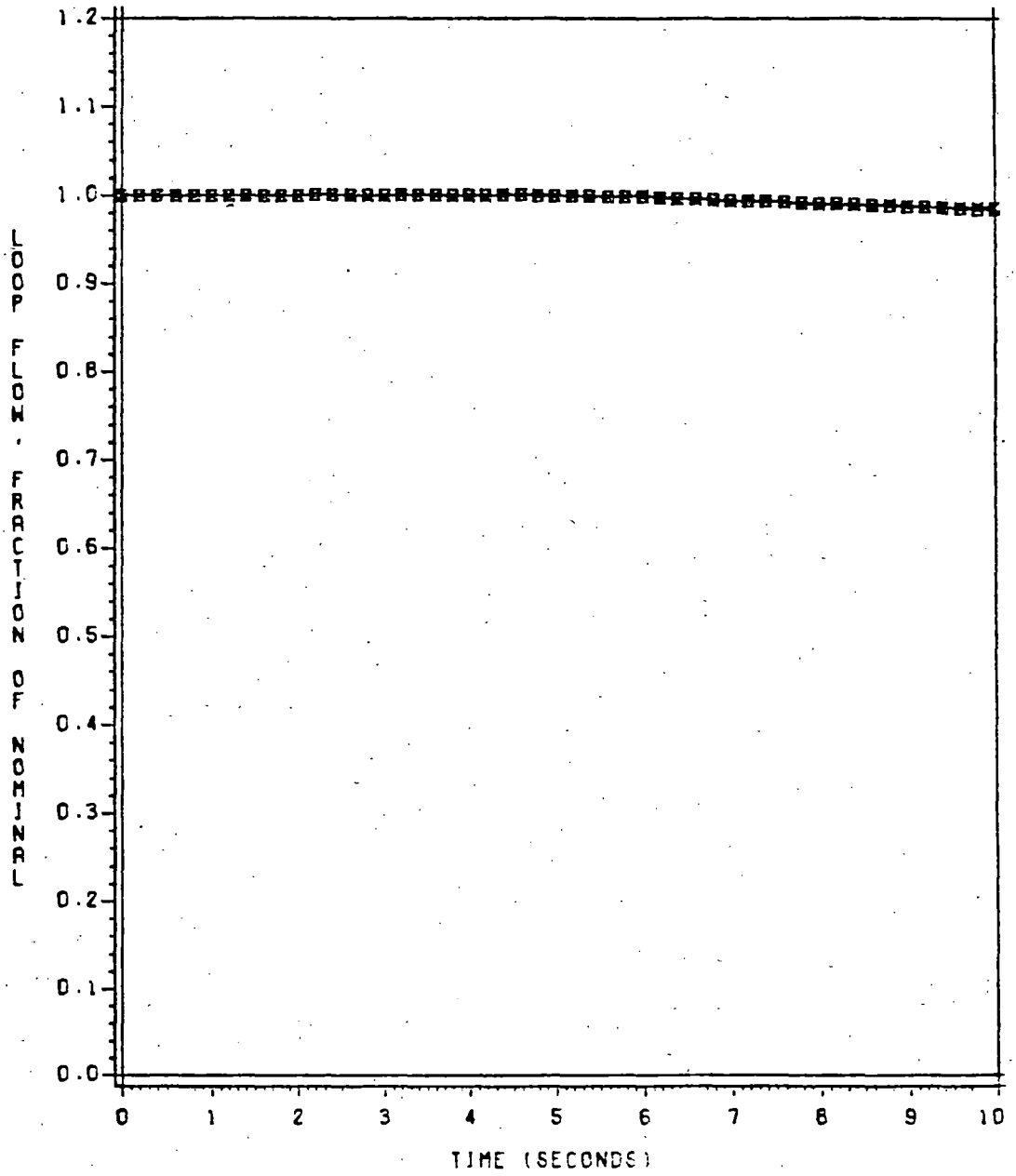


FIGURE 8a
REACTOR TRIP

LOOP FLOW

RETRAN01 VS RETRAN02

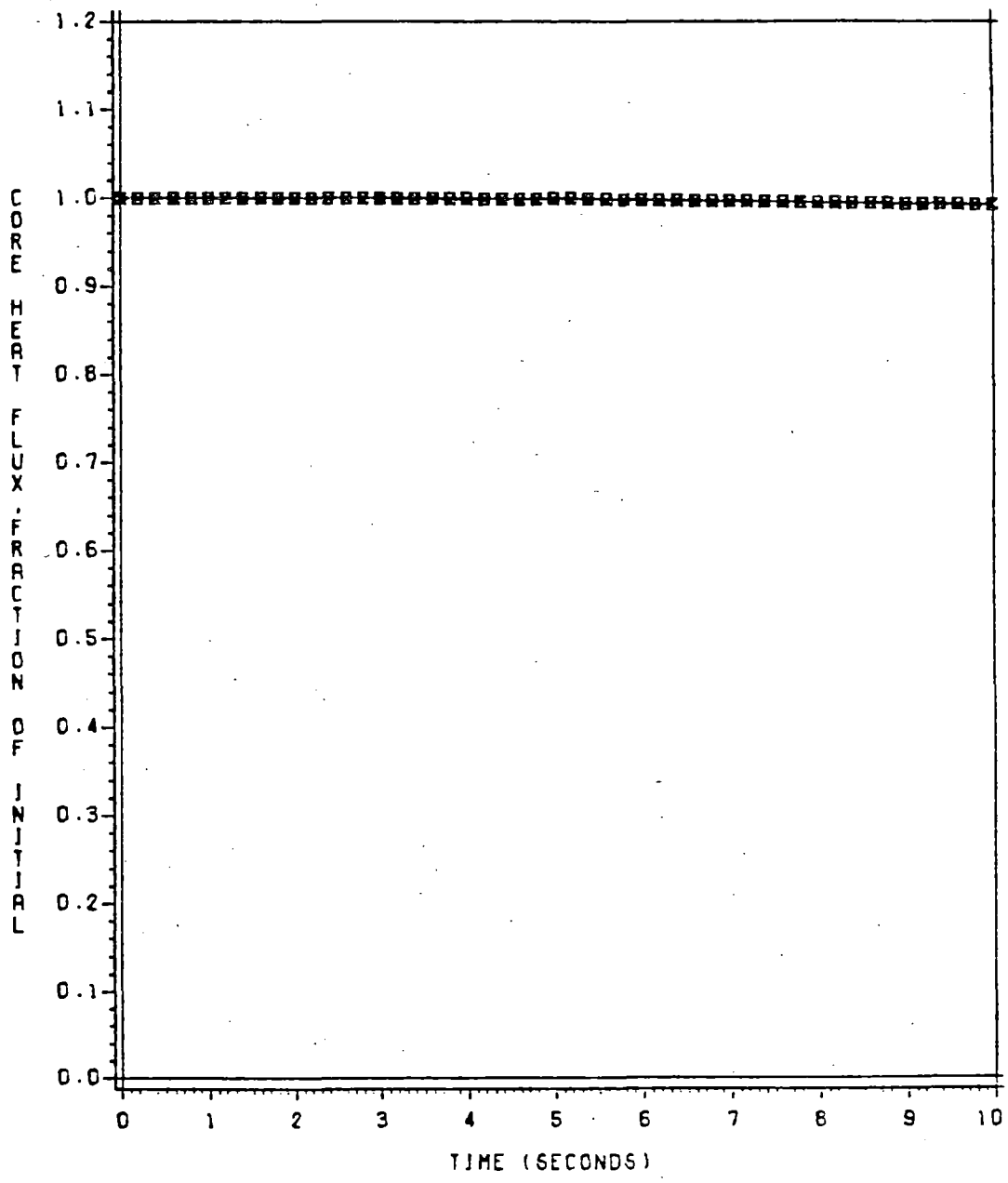


RETRAN01=X
RETRAN02=SQUARE

FIGURE 1b
TURBINE TRIP NO RX TRIP

MIDCORE HEAT FLUX

RETRAN01 VS RETRAN02



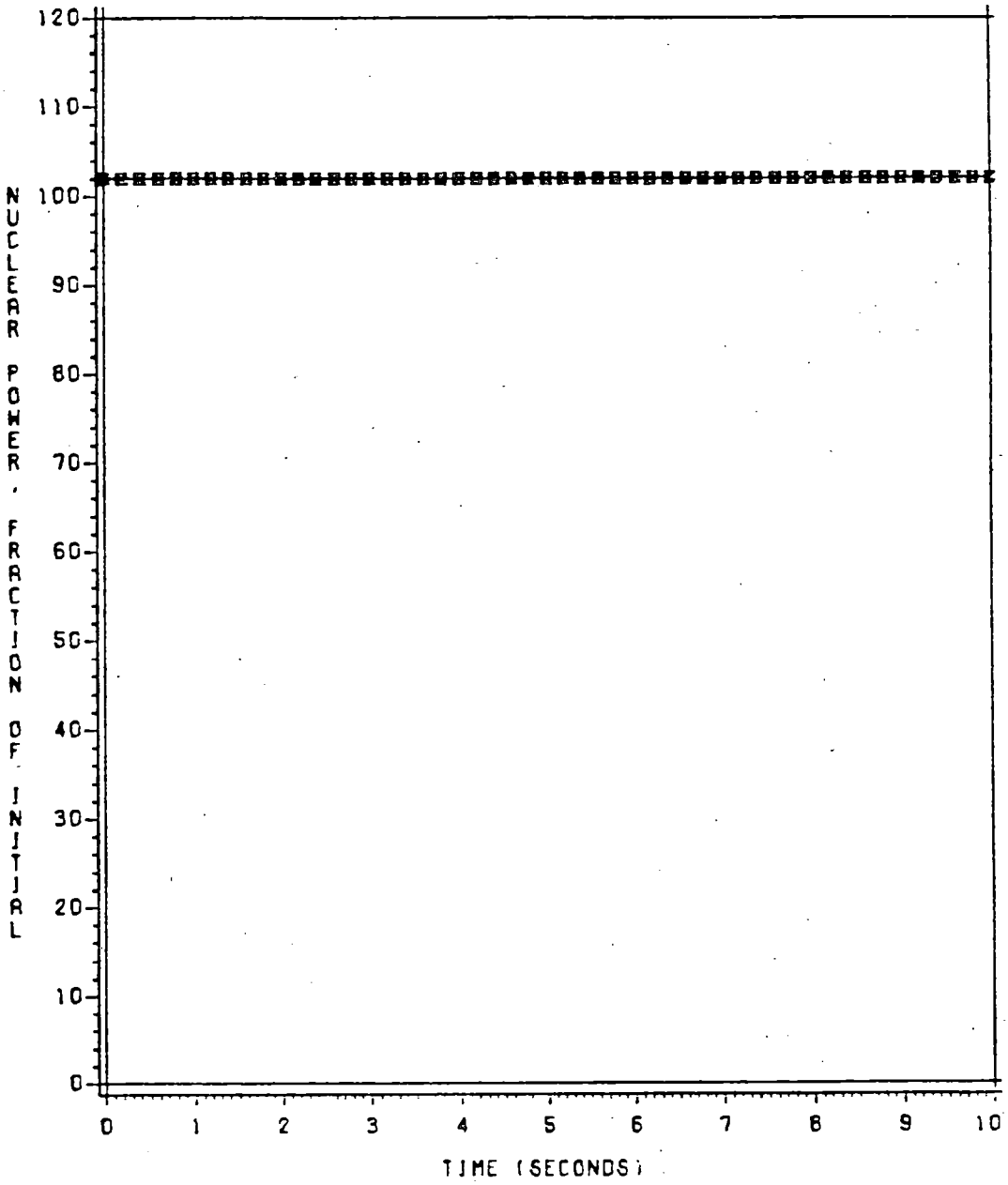
RETRAN01=X
RETRAN02=SQUARE

FIGURE 2b

TURBINE TRIP NO RX TRIP

NUCLEAR POWER

RETRAN01 VS RETRAN02



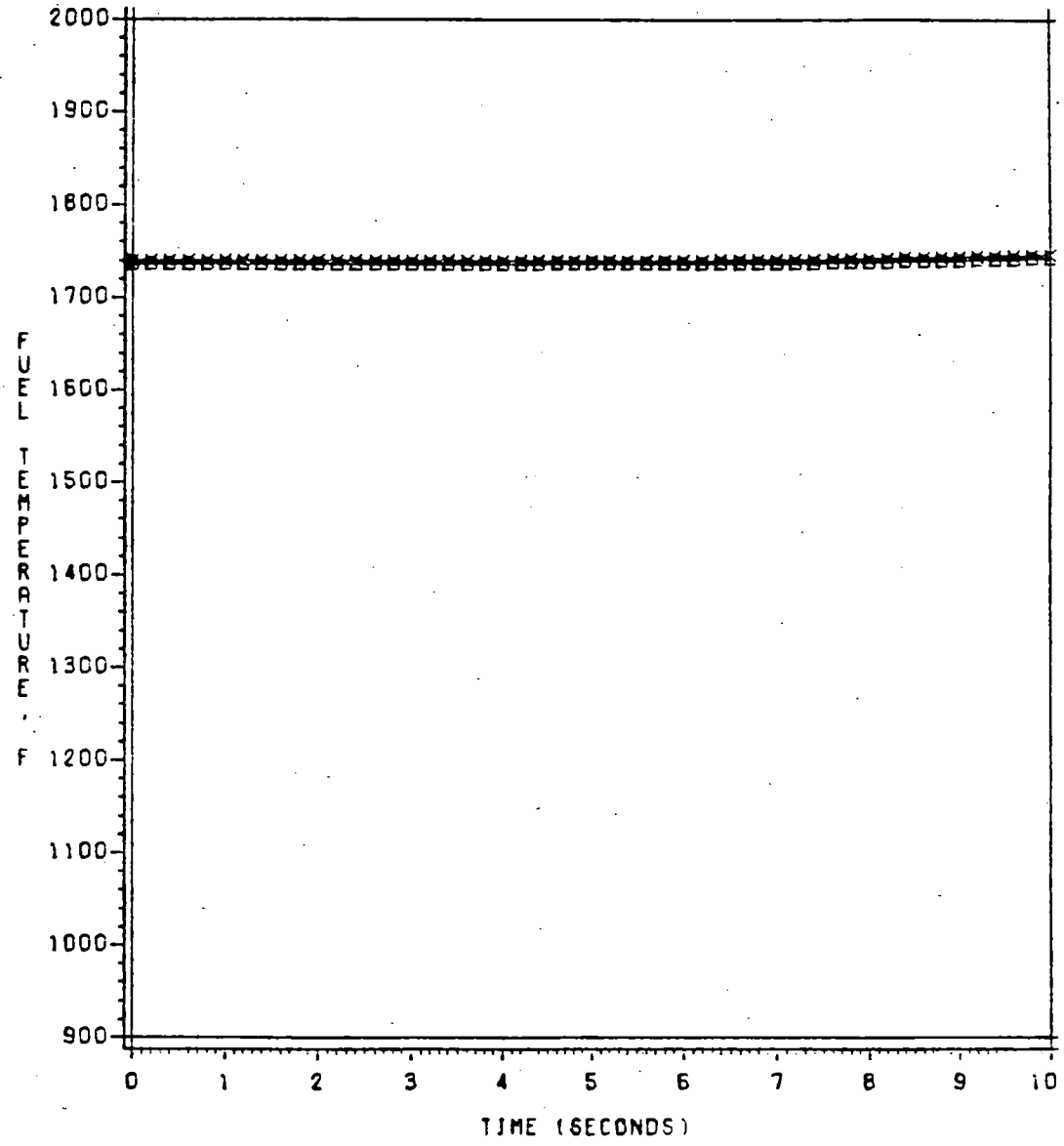
RETRAN01=X
RETRAN02=SQUARE

FIGURE 3b

TURBINE TRIP NO RX TRIP

MIDCORE FUEL TEMP

RETRAN01 VS RETRAN02

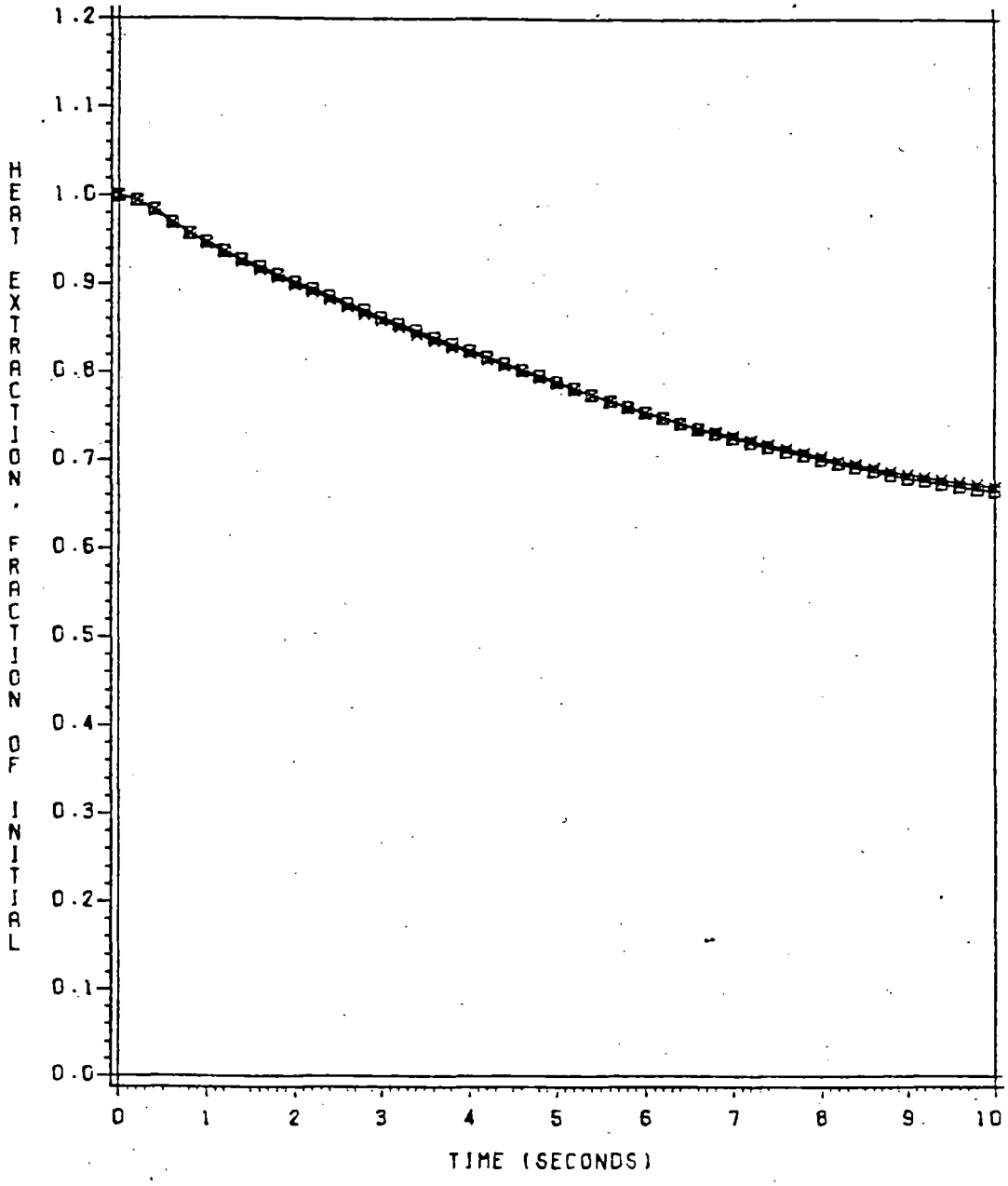


RETRAN01=X
RETRAN02=SQUARE

FIGURE 4b
TURBINE TRIP NO RX TRIP

SG HEAT EXTRACTION RATE

RETRAN01 VS RETRAN02



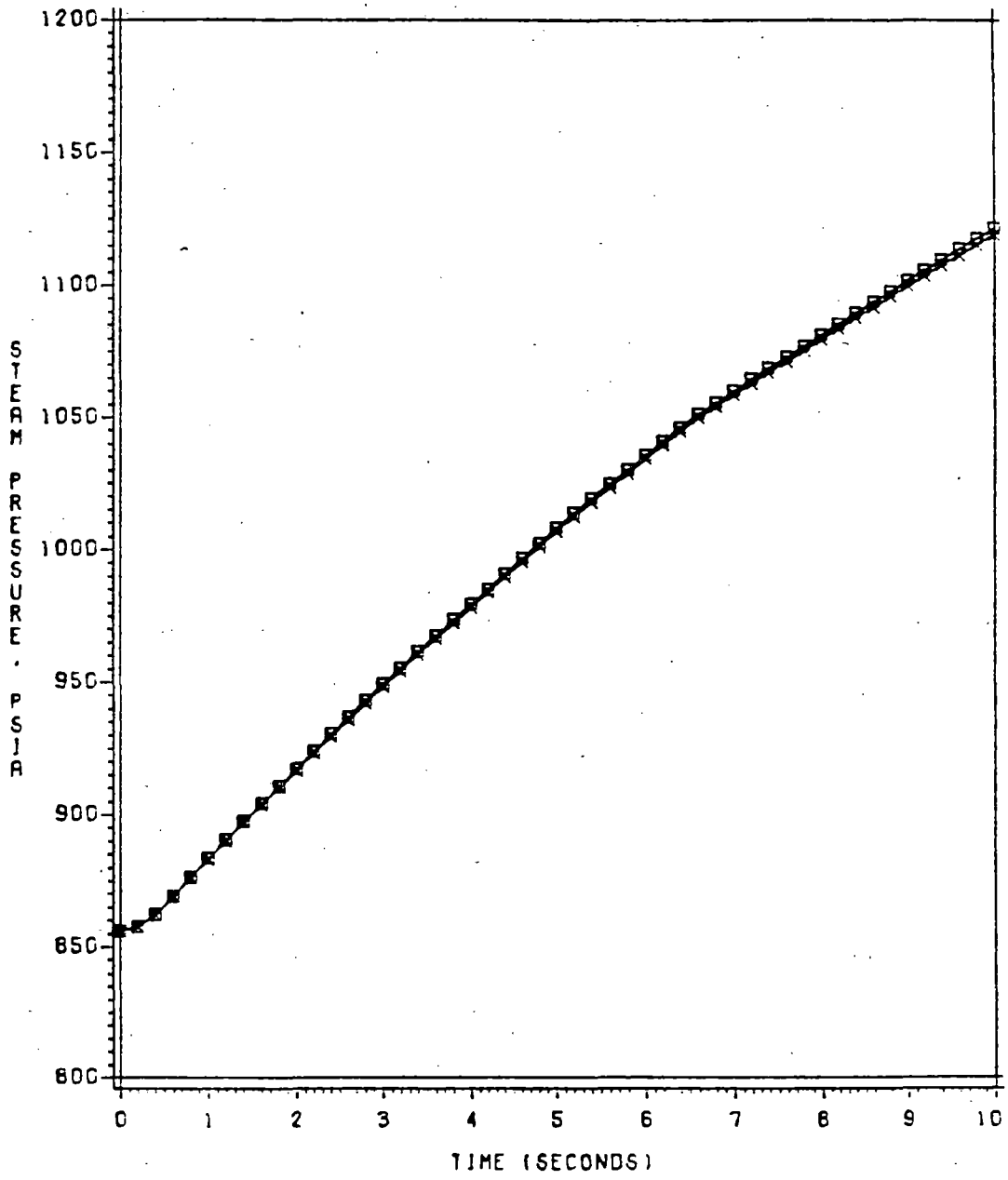
RETRAN01=X
RETRAN02=SQUARE

FIGURE 5b

TURBINE TRIP NO RX TRIP

STEAM PRESSURE

RETRAN01 VS RETRAN02



RETRAN01=X
RETRAN02=SQUARE

FIGURE 6b

TURBINE TRIP NO RX TRIP

INLET TEMPERATURE

RETRAN01 VS RETRAN02

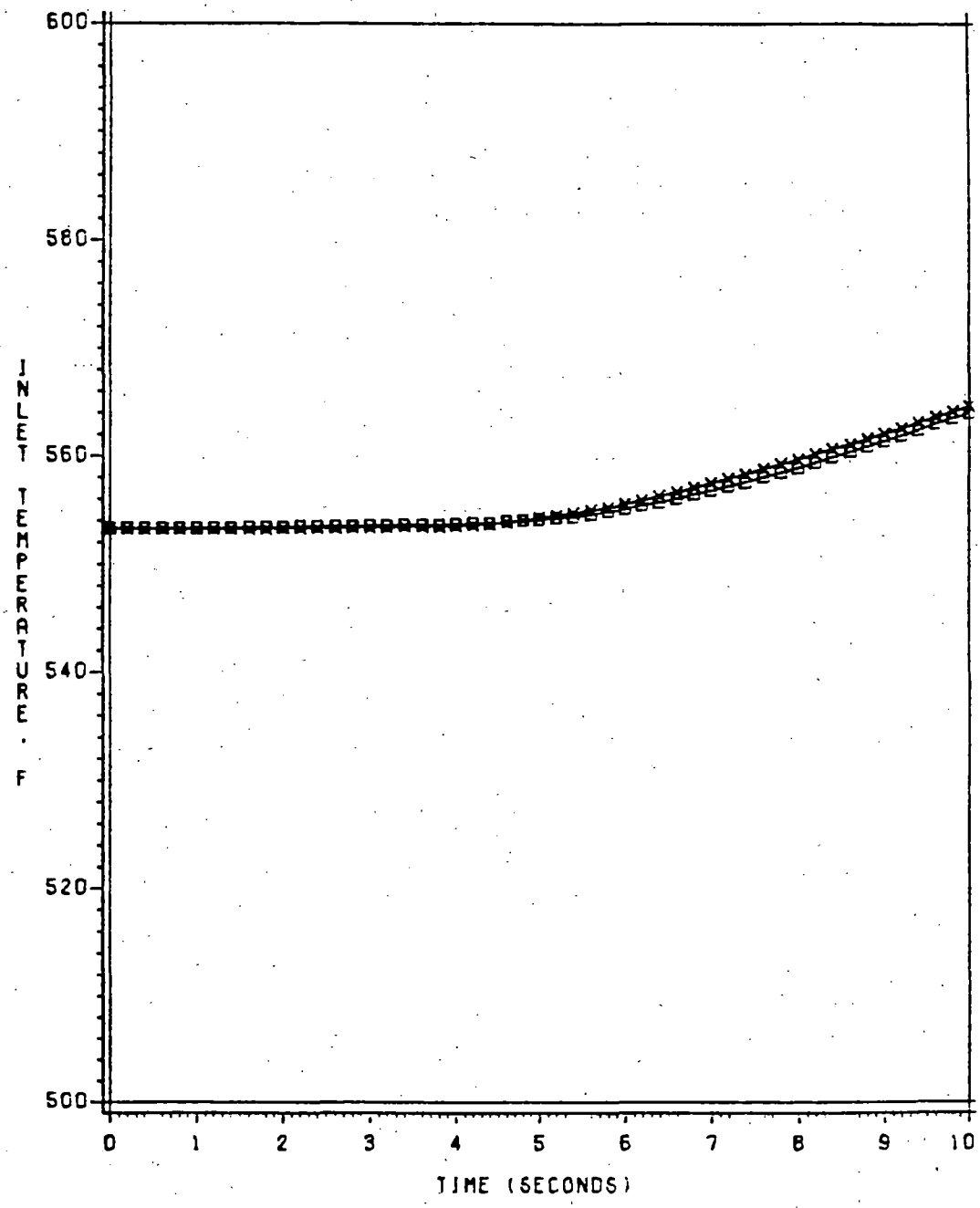
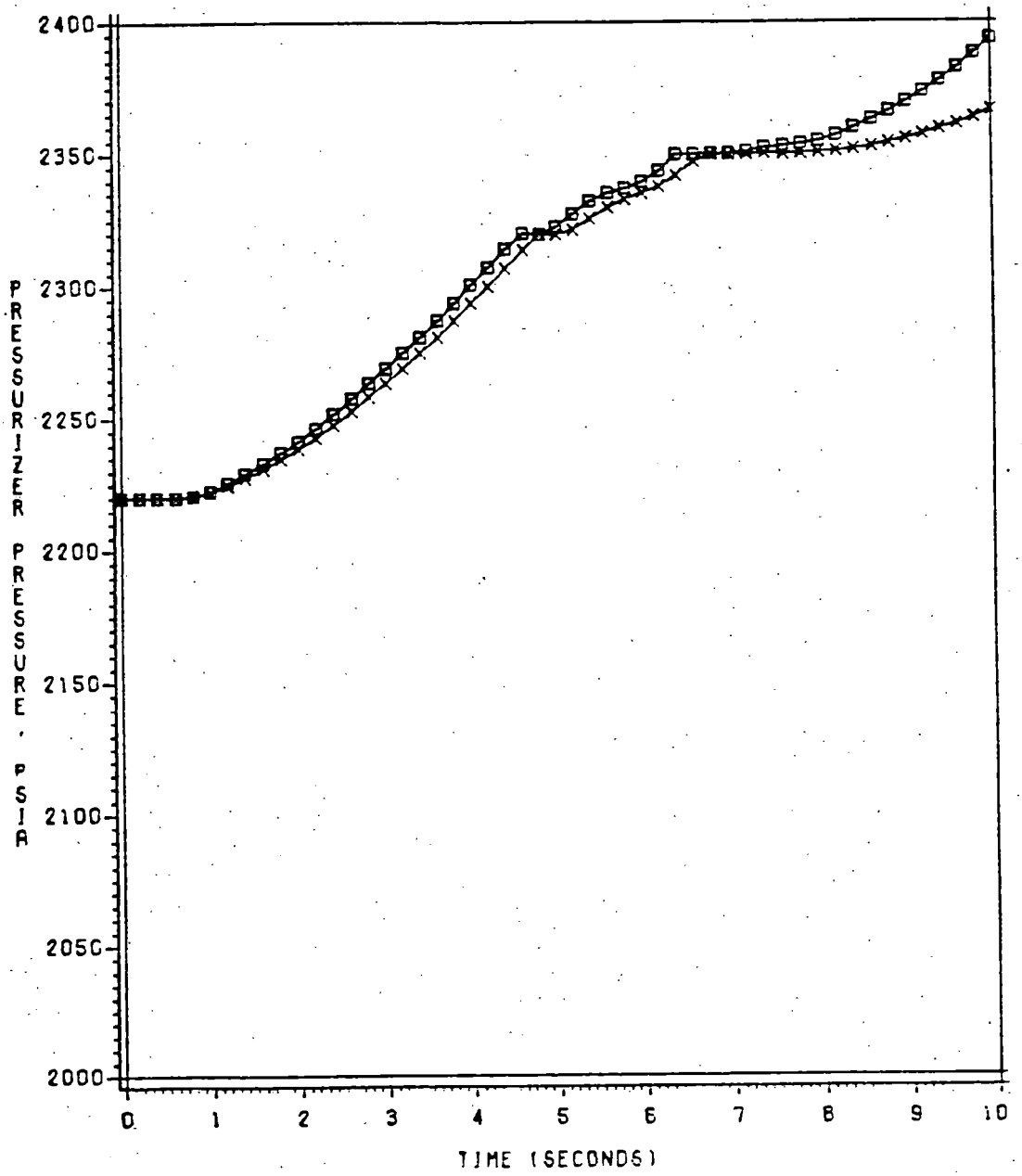


FIGURE 7b

TURBINE TRIP NO RX TRIP

PRESSURIZER PRESSURE

RETRAN01 VS RETRAN02



RETRAN01=X
RETRAN02=SQUARE

FIGURE 8b

TURBINE TRIP NO RX TRIP

LOOP FLOW

RETRAN01 VS RETRAN02

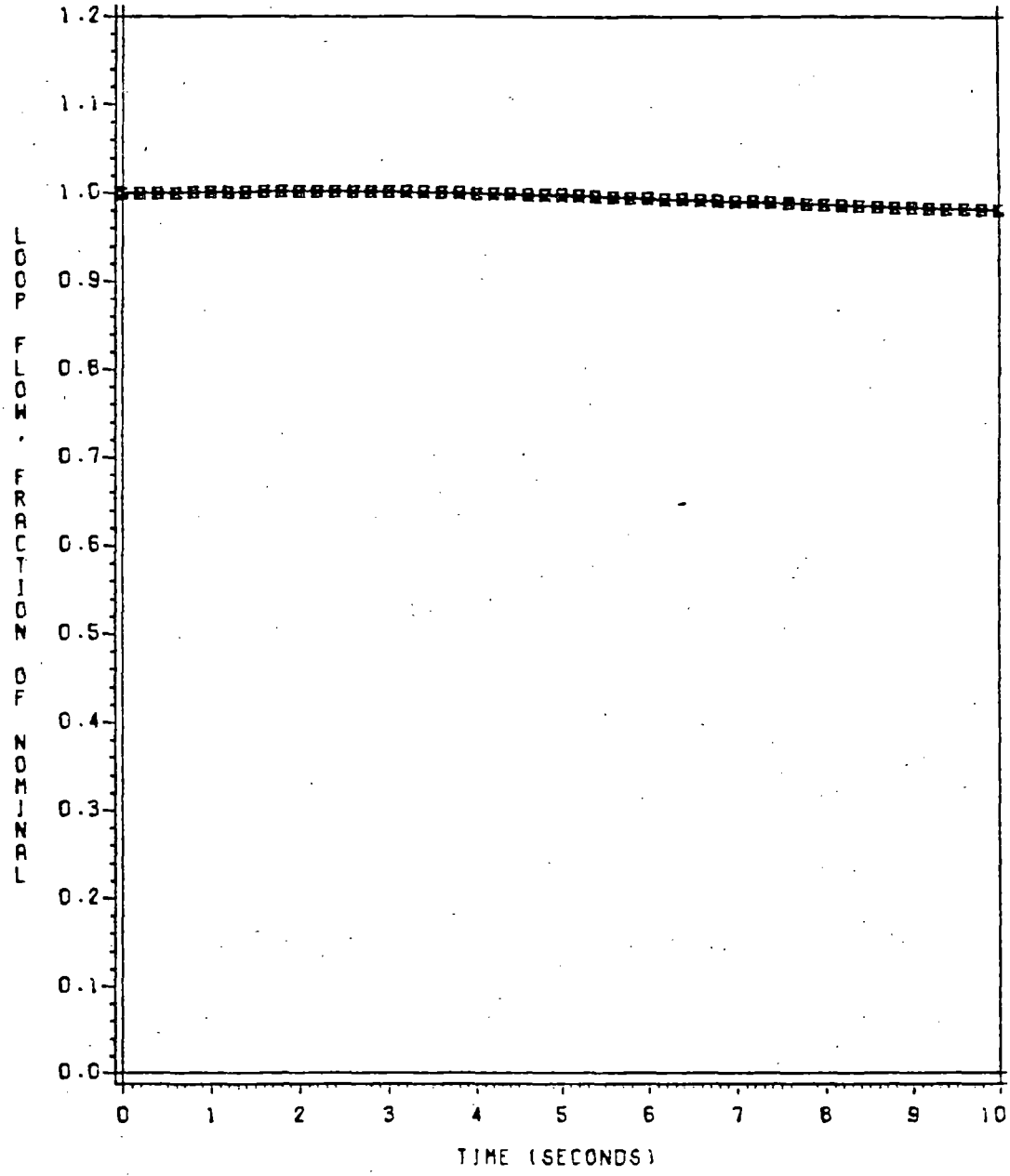
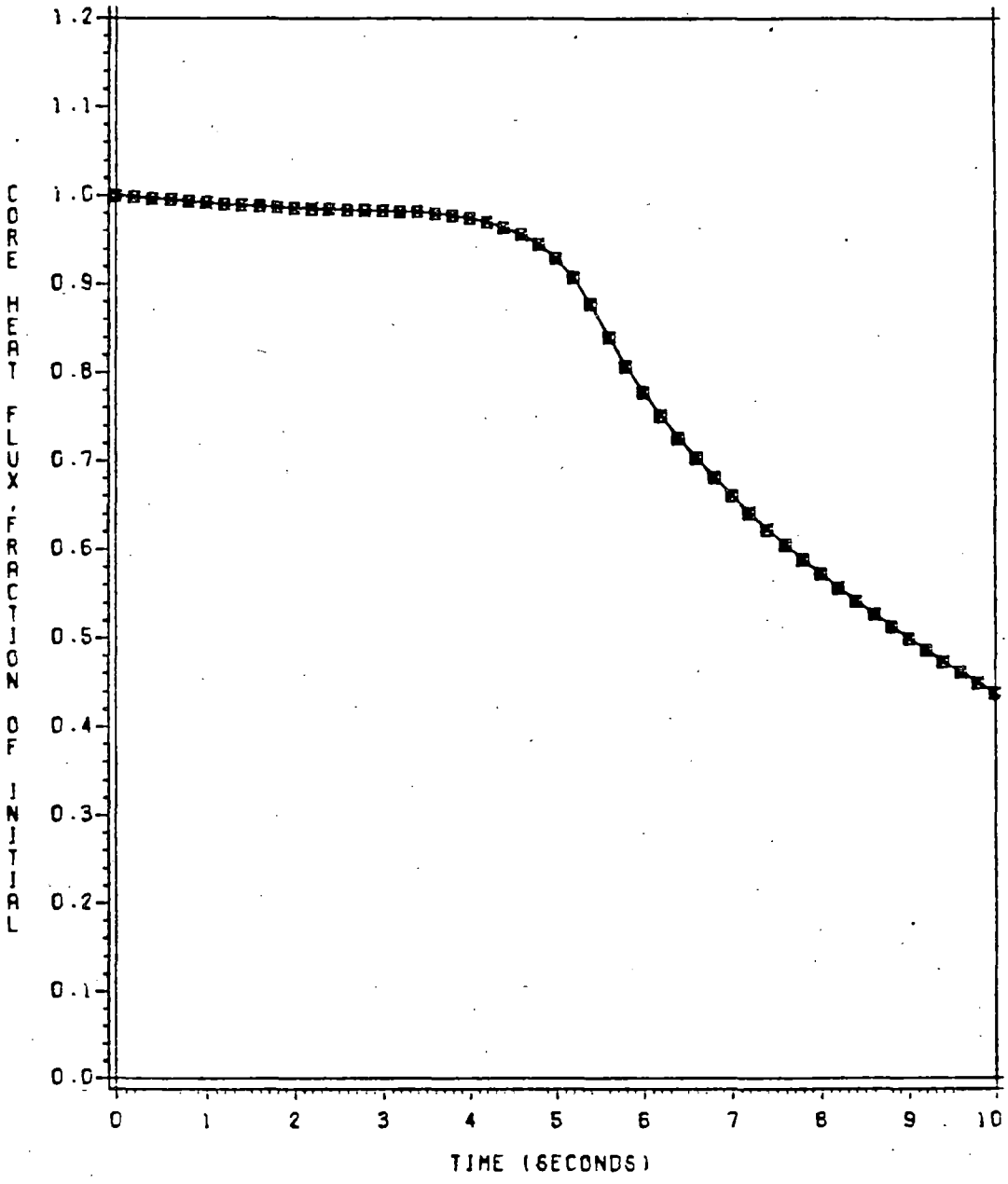


FIGURE 1C
LOSS OF FLOW

MIDCORE HEAT FLUX

RETRAN01 VS RETRAN02

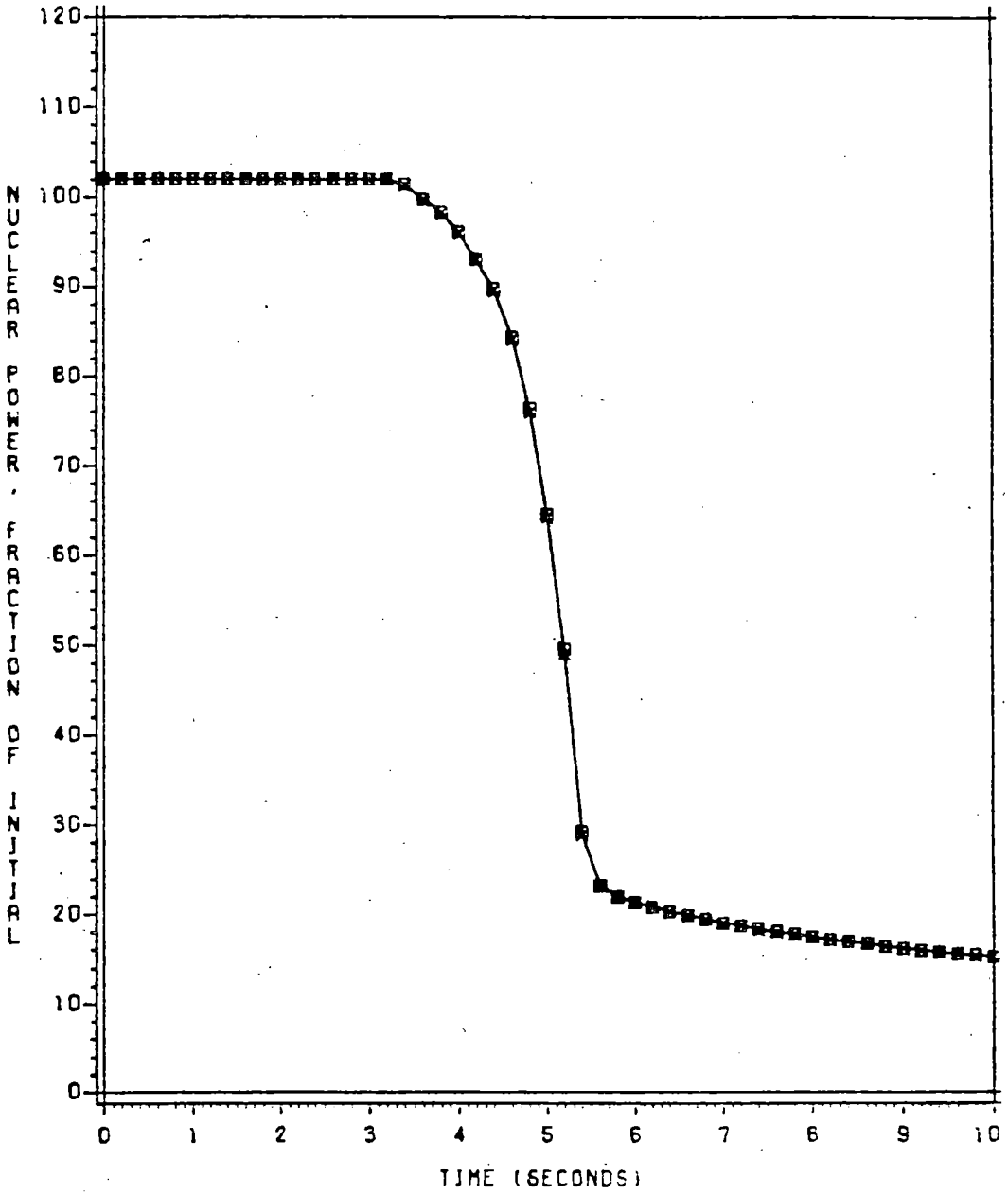


RETRAN01=X
RETRAN02=SQUARE

FIGURE 2C
LOSS OF FLOW

NUCLEAR POWER

RETRAN01 VS RETRAN02

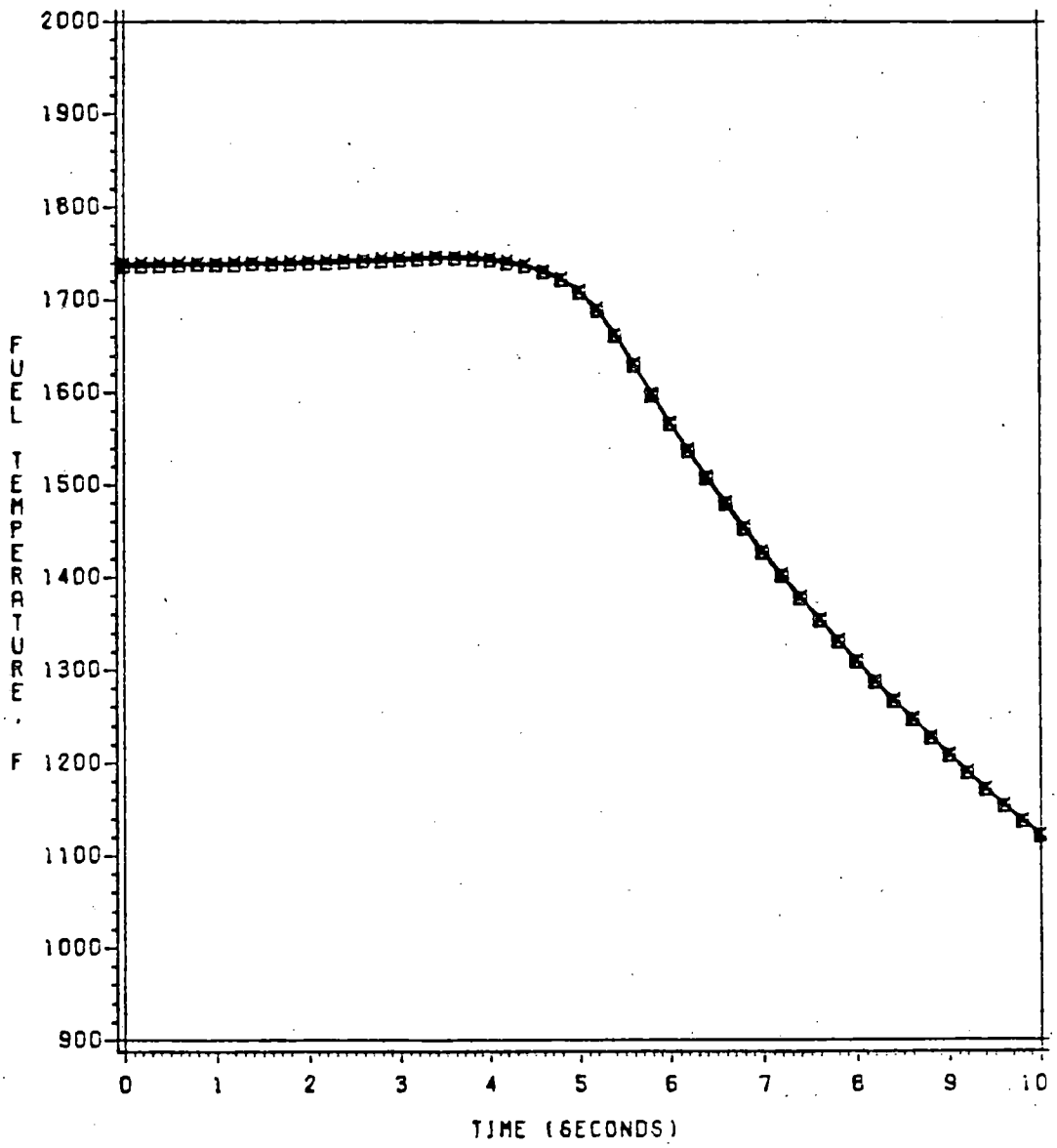


RETRAN01=X
RETRAN02=SQUARE

FIGURE 3 C
LOSS OF FLOW

MIDCORE FUEL TEMP

RETRAN01 VS RETRAN02

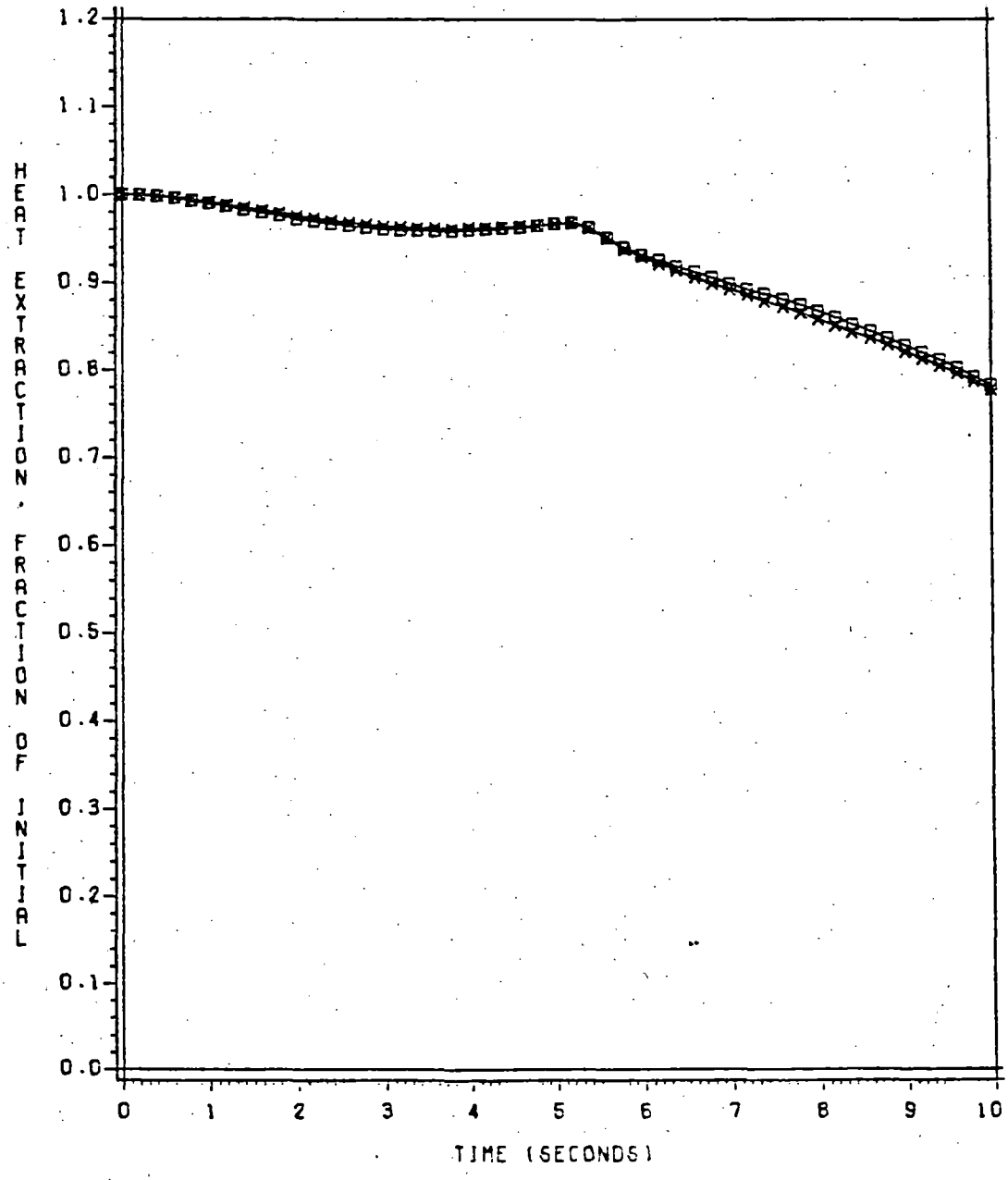


RETRAN01=X
RETRAN02=SQUARE

FIGURE 4C
LOSS OF FLOW

SG HEAT EXTRACTION RATE

RETRAN01 VS RETRAN02

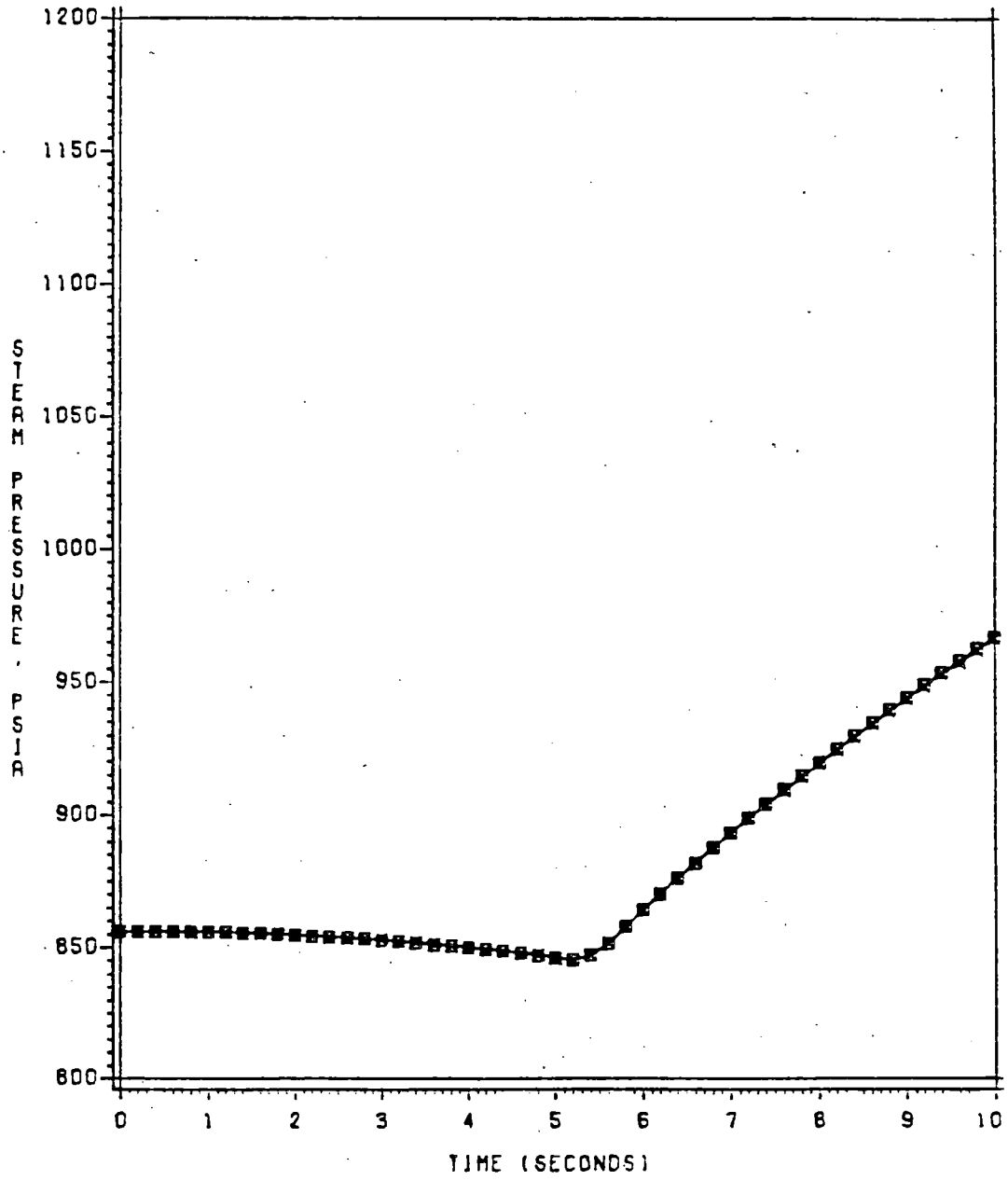


RETRAN01=X
RETRAN02=SQURRE

FIGURE 5C
LOSS OF FLOW

STEAM PRESSURE

RETRAN01 VS RETRAN02



RETRAN01=X
RETRAN02=SQUARE

FIGURE 6C
LOSS OF FLOW

INLET TEMPERATURE

RETRAN01 VS RETRAN02

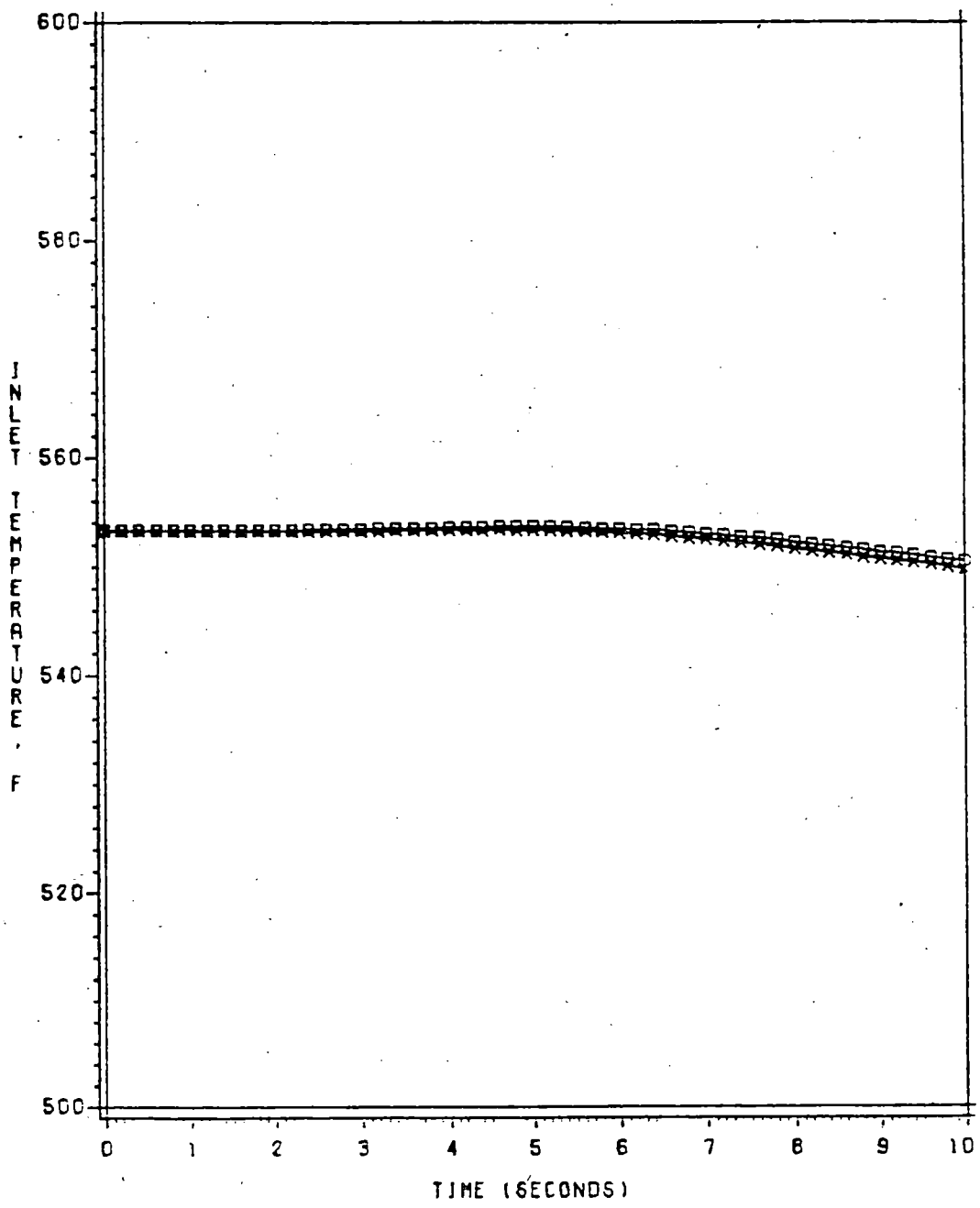
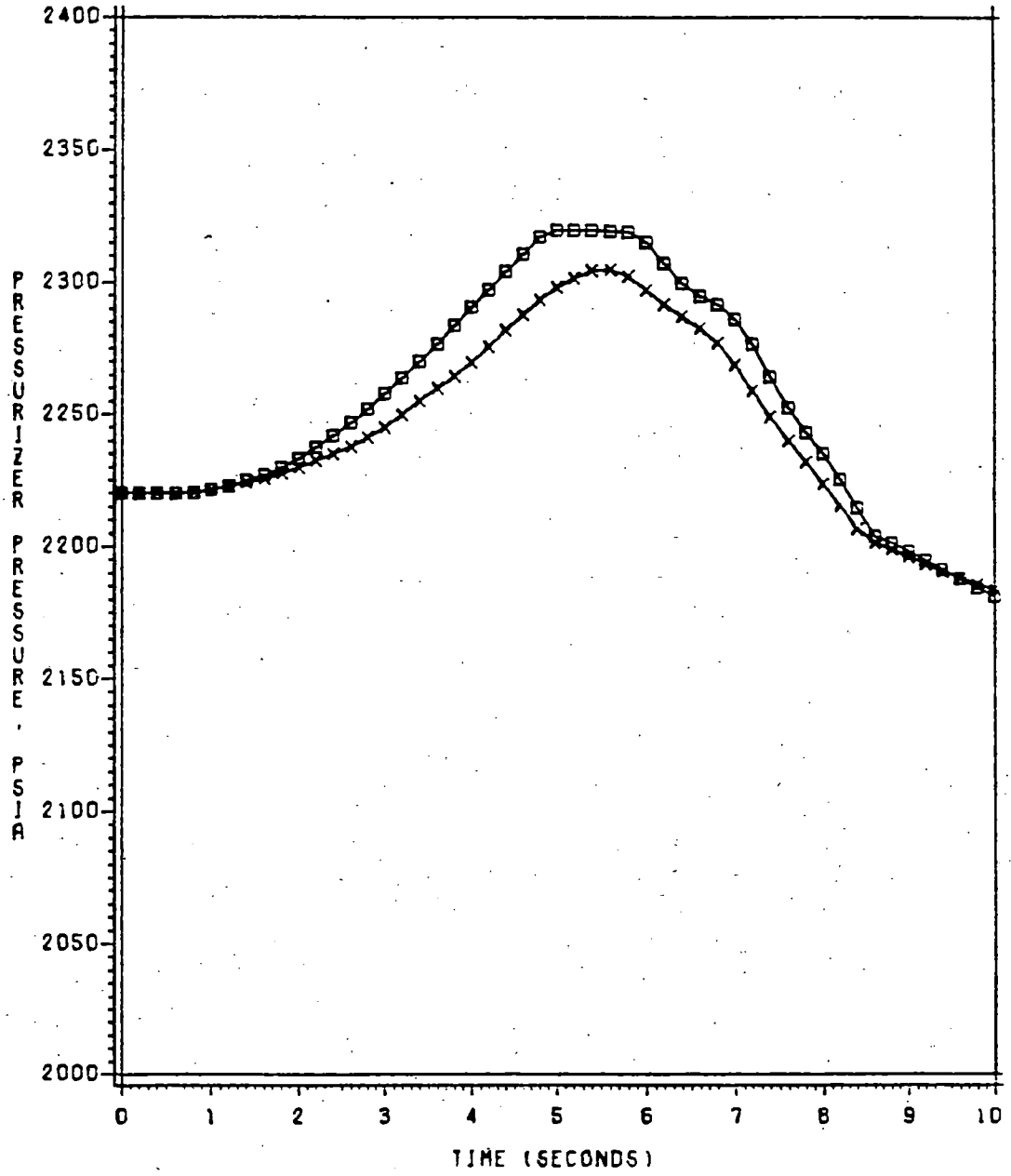


FIGURE 7C
LOSS OF FLOW

PRESSURIZER PRESSURE

RETRAN01 VS RETRAN02

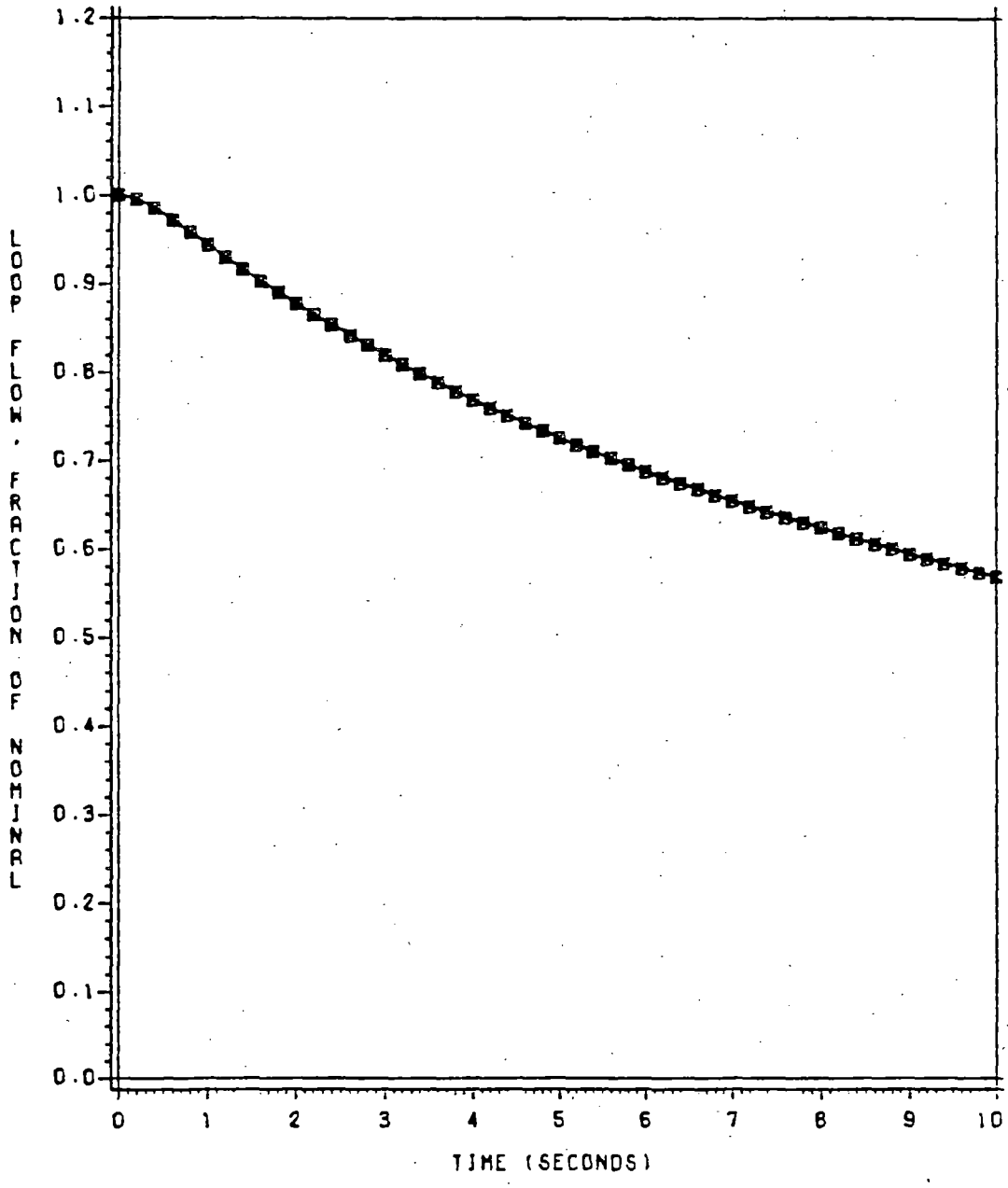


RETRAN01=X
RETRAN02=SQUARE

FIGURE 8C
LOSS OF FLOW

LOOP FLOW

RETRAN01 VS RETRAN02



RETRAN01=X
RETRAN02=SQUARE