- Monticello - Cycle 2 -
Scram Reactivity Considerations, Analysis and Modifications

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Contents

MONTICELLO - CYCLE 2 SCRAM REACTIVITY CONSIDERATIONS, ANALYSIS AND MODIFICATIONS

I INTRODUCTION

Over the past several months, considerable attention has been given to the potential effects of the previously reported changes to the Monticello scram reactivity insertion rate as applied to abnormal operational transient analyses.

An additional factor, the inability of the Target Rock Safety/Relief valves to meet the original design operating specification (delay time) of 0.200 seconds from attainment of setpoint pressure to valve opening has also been evaluated.

The effects apply to the satisfaction of the GE recommended 25 psi margin between the peak pressure resulting from the worst case single failure caused abnormal operational transient (turbine trip with failure of the bypass valves) and the setpoint of the lowest set spring safety valve, i.e., the relief valve sizing transient.

The safety valve sizing event (main steam isolation valve closure with indirect scram) is used to determine satisfaction of ASME pressure vessel code requirements and, while affected by the variables discussed here, does not result in limiting conditions. This event is, however, analyzed here for comparison and completeness.

Efforts have been made (and reported) to determine the magnitude of these effects and the time (cycle 2 core exposure) at which they introduce possible operational restrictions.

Because several variables are involved, many evaluations were made to obtain a solution (or solutions) that was both optimum and conservative from the analytical, operational and practical standpoints, including such factors as shutdown schedules, modification possibilities, plant availability requirements, analytical capability, license limitations and regulatory considerations.

The end result has been the development of a specific short term solution based on plant modifications and operating restrictions for the present cycle and a long term solution for future cycles; the former is reported here.

II SUMMARY

Based on analyses performed at several core exposure values throughout cycle 2 and adoption of the proposed modifications to the relief and safety valves, operation for the entire cycle has been defined. For the interval up to 1640 MWD/T, full power operation was obtained; between 1640 and the early October 1973 outage, a control rod pattern limitation coupled with a power restriction was applied; from the outage (following the RV and SV modifications) to 2680 MWD/T, full power operation is permissible; between 2680 MWD/T and the end of cycle 2 (3635 MWD/T) reactor power must be restricted to 91%.

The sensitivity of the transient effects to changes in the analytical input parameters and analysis under varied assumptions have shown that the operating envelope described adequately ensures operation of the plant within the intended constraints and, given adequate consideration to the conservatisms involved, within desired margins.

III DISCUSSION

A. Background

As reported in the past (Feb 73), development and improvement of analytical methods at General Electric revealed changes to the scram reactivity insertion curve applied to Monticello. Recognition of additional scram reactivity curve degradation was made early last year with subsequent development of the Monticello end of cycle (EOC) curve, designated curve "C." Because the analysis in effect at that time was based on the "Generic 72," (i.e., "B") curve, an evaluation was made to estimate the Cycle 2 exposure at which the "B" curve ceased to adequately described the scram reactivity insertion rate, the effect of the assumption of "C" curve inputs at that time, and what actions might be taken to compensate for any adverse effects.

Attainment of "B" curve conditions was conservatively estimated to occur at 2250 MWD/T in Cycle 2. Beyond that exposure, reactor operation would be restricted, (assuming no changes to the plant) based on the EOC2 "C" curve.

A later refinement to the 2250 MWD/T exposure determination derived from then more current projected plant operation confirmed the conservative nature of the original estimate, the new figure being 2400 MWD/T. As actual operating history accumulated, a more precise figure was calculated in August, 1973, establishing 2680 MWD/T as the exposure at which the curve equivalent to the Generic '72 B curve was attained. At the same time, the EOC2 C curve was recalculated and found to be slightly less effective than previously noted. The 2680 MWD/T and EOC2 C2 curve (designated C2 to differentiate from the earlier C curve) are analytical benchmarks in this report.

A review of earlier generic data and analyses revealed, in early 1973, the possibility of Target Rock Safety/Relief valves being unable to satisfy the design operating specification (delay time) of 0.200 seconds from attainment of setpoint pressure to valve operation. For conservatism, an outer bound delay time of 0.800 seconds was applied to plant analyses where Target Rock valves were installed.

Using this outer bound value, analyses showed that the GE recommended 25 psi margin to the safety valves in the turbine trip without bypass transient could not be maintained to as late a time in the cycle as was previously reported.*

The margin is reduced because the transient pressure relief starts some 600 milliseconds later.

One factor that controls the magnitude of the transient is the starting reactor power; as an interim measure, analyses were performed to determine what power level could be sustained under the new conditions and at what point in time, based on core exposure, the power restraint should be applied to compensate for the increase in the analyzed peak of the pressure transient.

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* The "B" curve originally defined the scram reactivity insertion curve that yielded a transient margin of $\geq$ 25 psi with the RV delay time of 0.200 seconds. Because the actual reactivity curve degrades to the B curve with exposure, the margin correspondingly degrades to $\sim$ 25 psi when the B curve is reached. For exposures less than that at which the "B" curve occurs, (2680 MWD/T) the margin is > 25 psi. The exposure point and shape of the "B" curve does not change; the margin at that point, however, does.

The initial estimations indicated the margin would remain above 25 psi until ~ 2000 MWD/T in Cycle 2. (At the time of this evaluation, the B curve exposure was assumed to be 2400 MWD/T.)

At 2000 MWD/T the reactor power level reduction would have to begin, holding a fixed control rod inventory, until power "coasted down" to 90%. This would adequately compensate for the longer RV delay time. The new, lower power level could then be maintained up to 2400 MWD/T, the cut off point for operation under reviewed analyses based on the B curve. (Between 2000 and 2400 MWD/T, the power level could follow a locus of points with the lowest power point occurring at 2400 MWD/T. However, because these intermediate points have not been reviewed, the end point restriction is applied to the entire interval.)

Beyond 2400 MWD/T, the more limiting "C" reactivity curve (all rods out, end-of-cycle) would have to be applied.

The latest evaluations based on refined input information, revised the 2000 MWD/T figure to 1640 MWD/T and the 2400 MWD/T figure to 2680 MWD/T.

During the course of determining the exposure values above, analyses and evaluations were concurrently made to define what analytical, hardware and Tech Spec changes could be applied to mitigate the change to the analyzed plant conditions.

Two changes were committed for alleviation of the overall effects: 1) Increasing the setpoints of the safety valves to four at 1240 psig from 2 each at 1210 psig and 1220 psig, and 2) modifying the relief valves to ensure a delay time less than 0.400 seconds, a value selected on the basis of actual tests of modified valves where measured delay times for all tests were less than 0.350 seconds. These tests, conducted by General Electric, were performed at a steam test facility utilizing sophisticated equipment and methods in support of a program to improve the response of all Target Rock valves.

Some of the other possible changes considered are listed below:

1. Lowering RV setpoints 10 psi
2. Reducing control rod scram times
3. Applying an operationally oriented rather than a design value multiplier to the scram reactivity curve and void coefficient inputs to the analysis.*
4. Operating Power restrictions

Some of these factors were applied to the analyses performed in support of the proposed changes.

Although these extra analyses are not completely applicable to the existing and proposed plant conditions, they have been useful in establishing the sensitivity of the transient results to variations in assumptions and modification possibilities. Additionally, more accurate relationships among the input assumptions can be derived.

The net effect of the many analyses and evaluations is to increase confidence in the analytical methods and to identify those parameters having a significant effect on transient outcomes.

B. Reanalysis Bases

The transient reanalysis of Monticello, Cycle 2 is based on the latest available data at three specified core exposures for which scram, void and Doppler reactivity characteristics are defined. The specified exposures are:

a) 1640 MWD/T, which corresponds to the projected exposure to which the plant can operate at full power without violating defined pressure margins.
b) 2680 MWD/T, which is the exposure at which the scram reactivity profile is equivalent to the Generic 1972 (B) scram curve.

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* Because of a better understainding of the actual scram curve and void coefficient, the multipliers originally applied (design conservatism factors, DCF) for uncertainty could be somewhat reduced.

c) 3635 MWD/T which is the exposure corresponding to the planned EOC2.

The scram reactivity curves employed in the reanalysis are shown in Figure 1.

The scram curves for 1640 MWD/T and EOC2 represent calculated reactivity profiles for the plant at the specified exposures with consideration of current exposure data. The scram curve at 2680 MWD/T represents a previously defined curve but is equivalent to a calculated reactivity profile at that exposure.

Four operating conditions were considered in this analysis based on a scheduled outage during the cycle to modify the Target Rock relief valves and to change the safety valve setpoints. The outage is assumed to occur at some time between the core exposure of 1640 MWD/T and 2680 MWD/T. The modification of the relief valves will reduce the time delay from 800 milliseconds to 400 milliseconds. The safety valve setp[illegible]s will be raised to 1240 psig. The four operating conditions conside[illegible]orrespond to conditions prevailing during four cycle intervals:

A. BOC to 1640 MWD/T
B. 1640 MWD/T to Outage
C. Outage to 2680 MWD/T
D. 2680 MWD/T to EOC2 (3635 MWD/T)

The conditions assumed for these intervals are tabulated as follows:

TABLE 1

Operating Conditions	(BOC-1640) Cycle Interval A	(1640-outage) Cycle Interval B	(outage 2680) Cycle Interval C	(2680-EOC) Cycle Interval D
Power	100%	90%	100%	97%/91%
SV Set Pt (nominal)	1210 psig	1210 psig	1240 psig	1240 psig
RV Set Pt (nominal)	1070-1080 psig + 1%	1070-1080 psig + 1%	1070-1080 psig + 1% & 1080 psig + 1%	
RV Time Delay	800 ms	800 ms	400 ms	400 ms
CRD	67 PL	67 PL	67 PL	67 PL
Scram Curve	1640 MWD/T	2680 MWD/T "B" Curve	2680 MWD/T "B" Curve	EOC2 "C2" Curve

The scram reactivity profile for Monticello is degraded from BOC to the EOC on the basis that the scram reactivity function is characterized by the amount of reactivity inserted in a specified period of time. The decreasing function results in pressure responses to operational transients which are increasingly more severe. Consequently, the scram curves considered for each cycle interval, except interval B, correspond to the end of that period to ensure a conservative margin for the entire interval. No scram curve is defined for the end of interval B so the next defined curve is used.

Analysis of a plant in the design phase using a mathematical model employing design data must consider uncertainties associated with the model, design data, and design characteristics and features. Consequently, design conservatism factors (DCF) should logically be larger than the conservative factors used after the plant is operating where as-built inputs may be applied. The concept of operating conservatism factors (OCF) was applied in the Monticello reanalyses to gain a better understanding between the design, pre-operational analyses and the more realistic current plant condition analyses.

C. <u>Transients Analyzed</u>

The change of the scram reactivity curve from BOC to EOC and the time delay of the relief valves affects primarily the transients employed as the bases for sizing the relief and safety valves. The design basis for sizing the relief valves is to avoid lifting the safety valves. The transient which defines this basis is the most severe abnormal operational transient, turbine trip with the bypass valves failed. The design basis for safety valve sizing is to avoid violating the vessel pressure code limit of 110% of design vessel pressure, or 1375 psig. The event used to define this is the closure of all main steamline isolation valves (MSIV) with flux scram, assuming direct scram has failed.

The relief valve sizing transient, turbine trip without bypass, is more limiting than the safety valve sizing event. Consequently, power reduction levels are defined on the relief valve sizing basis. Safety valve sizing

events are evaluated in all cases at full power but only for cycle interval B to cover from BOC to the outage and for cycle interval D to cover from the outage to EOC 2. This full power analysis over the entire cycle ensures conservatism and eliminates the need for analysis at the various power plateaus in the four exposure intervals.

Fourteen analyses (Table 2) have been performed, eight using the design conservatism factors and six using operating conservatism factors which establishes the sensitivity of the analyses to both design (DCF) and operating conservatism factors (OCF). Those six analyses for the exposure period up to the outage (3 with DCF and 3 with OCF) were assumed to have RV setpoints at a nominal 1070, 1075, and 1080 psig + 1%, a conservative application of "as set" RV's. (RV's are set 1% below specifications to ensure setting methods account for possible setpoint changes related to environmental conditions and other factors.) For the eight analyses for the period following the outage, five were performed using DCF and three with OCF. Of these eight, two were run using RV setpoints of all at 1080 psig + 1%.

D. Results of Analyses

The pertinent results of the current analysis of the Monticello plant based on the latest data available, including exposure data, is tabulated in Table 2. The relief valve sizing transient for cycle interval B is evaluated at 90% power because that power level had been defined by a previous analysis. Cycle interval D is evaluated for relief valve sizing at power levels corresponding to defined pressure margins with both the operating conservatism factors (OCF) and the design conservatism factors (DCF).

The tabulated data specifies the peak steamline pressure ($\hat{P}_{SL}$) for the relief valve sizing transient of turbine trip without bypass with the margin to the lowest safety valve setpoint noted in parentheses. Peak pressure at the bottom of the vessel ($\hat{P}_V$) is tabulated for the MSIV closure events with the margin to the 1375 psig code limit noted in parentheses. Appropriate figure numbers for the transient plots are shown in brackets [ ].

TABLE 2

MONTICELLO CYCLE 2 DATA

Cycle Interval	Conservatism Factors	Power Level (%) T.T	Power Level (%) MSIV	TT w/o BP Trip Scram $\hat{P}sl$	(psig)	[Fig]	MSIV Flux Scram $\hat{P}v$	(Psig)	[Fig]
A) BOC to 1640 MWD/T	OCF	100		1179	(31)	[7]			
	DCF	100		1193	(17)	[8]			
B) 1640 MWD/T to outage	OCF	90	100	1167	(43)	[9]	1266	(109)	[10]
	DCF	90	100	1182	(28)	[11]	1276	(99)	[5]
C) Outage to 2680 MWD/T	OCF	100		1185	(55)	[12]			
	DCF	100		1208	(32)	[13]			
	DCF	100		1211	(29) *	[3]			
D) 2680 MWD/T to EOC2 (3635 MWD/T)	OCF	97	100	1213	(27)	[14]	1289	(86)	[15]
	DCF	91	100	1212	(28)	[16]	1301	(74)	[6]
	DCF	91		1215	(25) *	[4]			

* 4 RV's @ 1080 psig + 1%; all others with RV's @ 1070, 1075 and 1080 psig + 1%

As shown in table 2, the application of OCF versus DCF yields an analyzed peak pressure difference of ~15 psi; the post outage analyses reveal similar relationships including a 6% power equivalence for the OCF/DCF conditions as well as a 3 psi margin change for a consolidation of all the RV setpoints at 1080 psig + 1%.

Th analyses discussed below are those necessary for operation from the outage to the end of cycle, after the RV and SV changes have been made. Figures 3 through 6 are the transient plots for these analyses. Figures 7 through 16 are the transient plots for the remaining ten analyses and are provided for comparison with those parameters not noted in this report.

Figure 1 shows the scram reactivity curves applied to the various analyses.

Relief Valve Sizing (TT w/o Byp)

Case 1 - Outage to 2680 MWD/T. Figure 3.

Assumptions: NB rated power and flow, design conservatisms (FSAR), SV's set 4 @ 1240, RV's set 4 @ 1080, 67 PL scram time, 2680 MWD/T reactivity curve, RV delay time 0.400 seconds.

A scram signal is initiated at the same time a turbine trip occurs by position switches on the turbine stop valves. This transient causes a rapid pressure increase in the reactor pressure vessel. Primary system relief valves are provided to remove sufficient energy from the reactor to prevent safety valves from lifting. The peak pressure in the steam line at the safety valve location is 1211 psig, which provides an adequate margin of 29 psi to the first safety valve set point. Thus, the adequacy of the four relief valves was confirmed for these conditions. Four relief/safety valves are required to operate to prevent this pressure transient from exceeding the safety valve set point. The rapid pressure rise due to rapid closure (0.10 sec.) of the turbine stop valve without bypass operation causes core voids to collapse and neutron flux reaches 202% of design in 0.89 seconds (Figure 3) before the scram shuts down the reactor. Peak surface heat flux is no greater than 105% at 1.5 seconds (Figure 3) thus adequate thermal margins are maintained.

Case 2 - 2680 MWD/T to EOC2 (3635 MWD/T). Figure 4.

Assumptions: Same as Case 1 except EOC reactivity curve ("C2", 3635 MWD/T) and 91% NB rated power

Sequence of events as in Case 1; pressure peaks at 1215 psig, providing a 25 psi margin. Neutron flux peaks at 257% in .92 seconds, heat flux at 104% in 1.6 seconds. All margins satisfied.

<u>Safety Valve Sizing (MSIV Closure)</u>

The ASME Nuclear Boiler and Pressure Vessel Code requires that each vessel designed to meet Section III be protected from the consequence of pressure and temperature in excess of design conditions. The ASA Code for Pressure Piping also requires overpressure protection. The set points of the safety valves comply with the ASME pressure vessel code taking into account static heads and dynamic losses.

Case 3 - BOC to outage. Figure 5.

Assumptions: NB rated power and flow, design conservatisms (FSAR), SV's set 2 @ 1210, 2 @ 1220, RV's set in 3 groups at 1070, 1075, and 1080 psig + 1%, 67 PL Scram time, 2680 MWD/T reactivity curve, RV delay 0.8 seconds, indirect (high flux) scram.

Both a turbine trip without bypass and closure of all main steam line isolation valves produce severe overpressure transients. Analyses for these two events have shown that the 3 second closure of the isolation valves is slightly more severe for the final plant configuration when direct reactor scram is neglected. This results because the longer steam lines, allowing more volume for steam compression, more than compensates for the faster acting turbine stop valves in the former transient, when compared with MSLIV closure. The latter event is therefore provided here as the basis for determining the adequacy of the safety valves.

Pressure increases follow this reactor isolation until limited by the opening of the safety valves. The peak allowable pressure is 1375 psig (according to ASME Section III, equal to 110 percent of the vessel design pressure of 1250 psig). The Target Rock set points are ≤ 1080 psig and the spring safety valve set points are at 1210 psig (2 valves) and 1220 psig (2 valves). Thus the ASME code specifications that the lowest safety valve be set at or below vessel design pressure, and the highest safety valve be set to open at or below 105 percent of vessel design pressure are satisifed. The four spring valves together have nameplate capacity greater than 35 percent of turbine design flow.

Figure 5 shows the resulting transient assuming the capacity of the 4 relief/safety valves (47% of main steam generation rate) and the 4 safety valves (36.9% of main steam generation rate). An abrupt pressure and power rise occur as soon as the isolation becomes effective. Neutron flux reaches scram at approximately 2.10 seconds initiating reactor shutdown; it peaks at a value of 592%. The assumed safety valve capacity (Target Rock plus spring safety capacities) keeps the peak vessel pressure 99 psi below the peak allowable ASME overpressure of 1375 psig. Therefore, the relief valves plus the spring safety valves provide adequate protection against excessive overpressurization of the nuclear system process barrier with a large margin.

Case 4 - Outage to EOC2 (3635 MWD/T). Figure 6.

Assumptions: ND rated power and flow, design conservatisms (FSAR), SV's set 4 @ 1240, RV's set in 3 groups at 1070, 1075, and 1080 psig + 1%. 67 PL scram time, EOC reactivity curve ("C2", 3635 MWD/T), RV delay 0.4 seconds, indirect (high flux) scram.

Sequence is as in Case 3; pressure peaks at 1301, 74 psi below ASME limit. Neutron flux peaks at 631%. All margins satisfied.

Other cases analyzed are summarized in Tables 1 and 2. Transient plots for all cases are provided in Figures 3 through 16.

IV SUMMARY OF RESULTS

Figure 2 is the power profile for Monticello for Cycle 2.

For the exposure periods and power levels described, the desired margins in the RV sizing transients and SV sizing events have been maintained or exceeded with one exception; in the interval up to 1640 MWD/T the margin could, on the basis of the very conservative design assumptions, be as low as 17 psi, 9 psi below the GE recommeded 25 psi. With the application of operating conservatisms and the sensitivity relationships found in the other analyses, the margin here would be maintained.

While the plant safety is in no way jeopardized by the inability to meet the recommended 25 spi margin, the desire to retain it remains. For this reason, operation will be restricted on this basis.

For that interval in which the margin was analytically inadequate, the judicial application of more realistic, yet still very conservative, assumptions shows that, in fact, the margin was not threatened.

The conclusion may therefore be drawn that Monticello operation throughout cycle has been and will continue to be safe and within the contraints desired.

V TECHNICAL SPECIFICATIONS CHANGES

ITEM	LOCATION	CHANGE	REASON
*Bases Statement for 2.2	Pg. 24 last para. Pg. 25 top of pg.	Change to read as follows: "The normal operating pressure of the reactor coolant system is approximately 1025 psig. The turbine trip from power with failure of the bypass system represents the most severe primary system pressure increase resulting from an abnormal operational transient. The peak pressure in this transient is 1215 psig. In addition, the safety valves are sized on the basis of a closure of all Main Steam Isolation Valves (MSIV Closure) where scram is assumed to be indirect (high flux) rather than from the MSIV position switches. In this transient, assuming rated power, the pressure at the bottom of the vessel is no greater than 1301 psig. Reactor pressure is continuously monitored in the control room during operation on a 1500 psig full-scale pressure recorder.	This change provides the bases for the valve configuration used in this analysis.
*Basis Statement for 2.4	Pg. 26 Para 2, Line 9	Change 1283 psig to 1301 psig	This change reflects the results of this analysis.
Basis Statement for 2.4	Page 26, Para 3 last sentence	Delete entire last sentence	This change eliminates a contradiction with the Specification that RV's be set ≤1080 psig. A ± 1% tolerance is assumed on the basis of ASME codes and need not be listed here.

* This or a similar change was proposed in the submittal to the AEC dated September 13, 1973. This change, were different, supersede all previous changes. Other pending changes are considered effective.

List of Figures

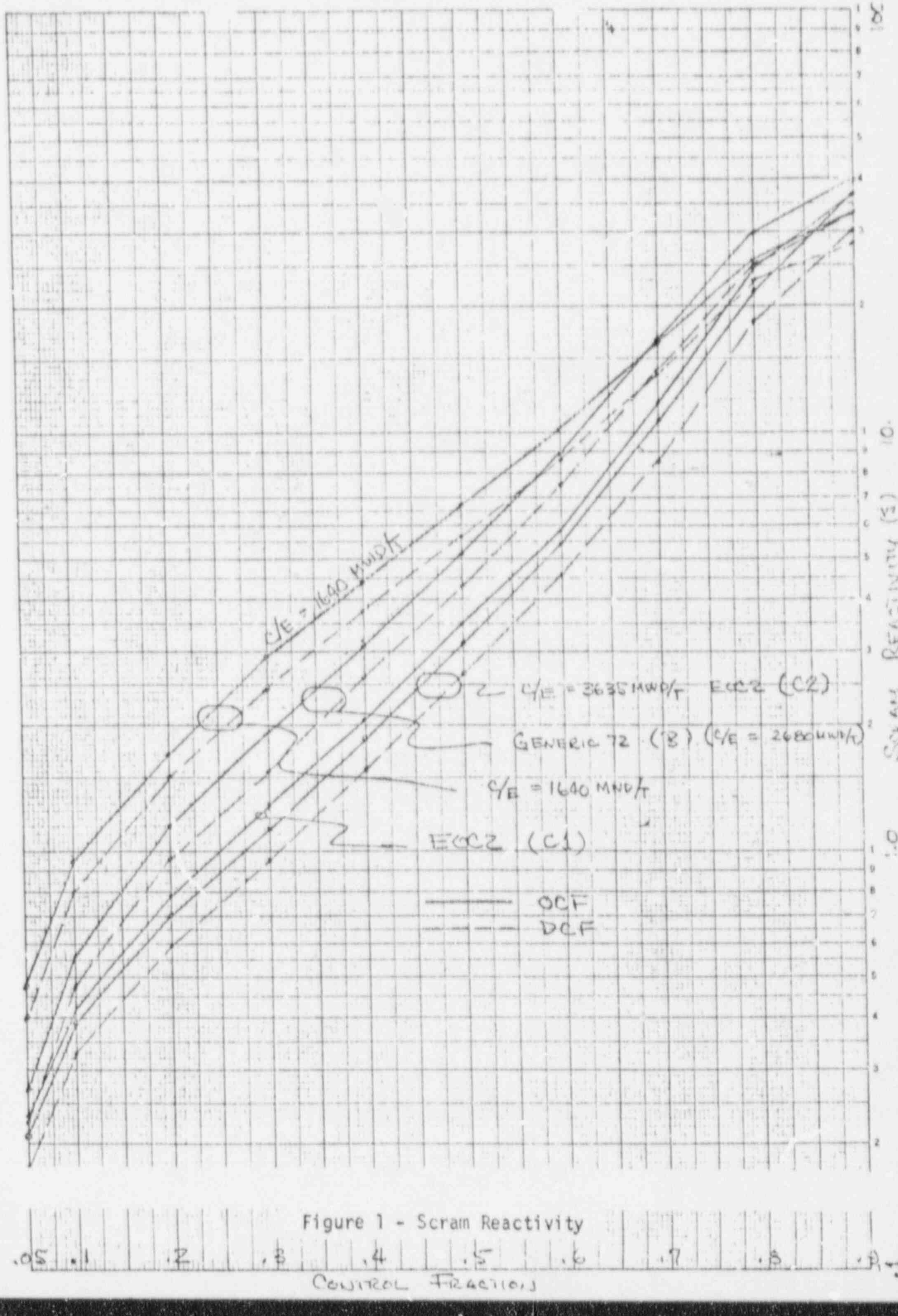
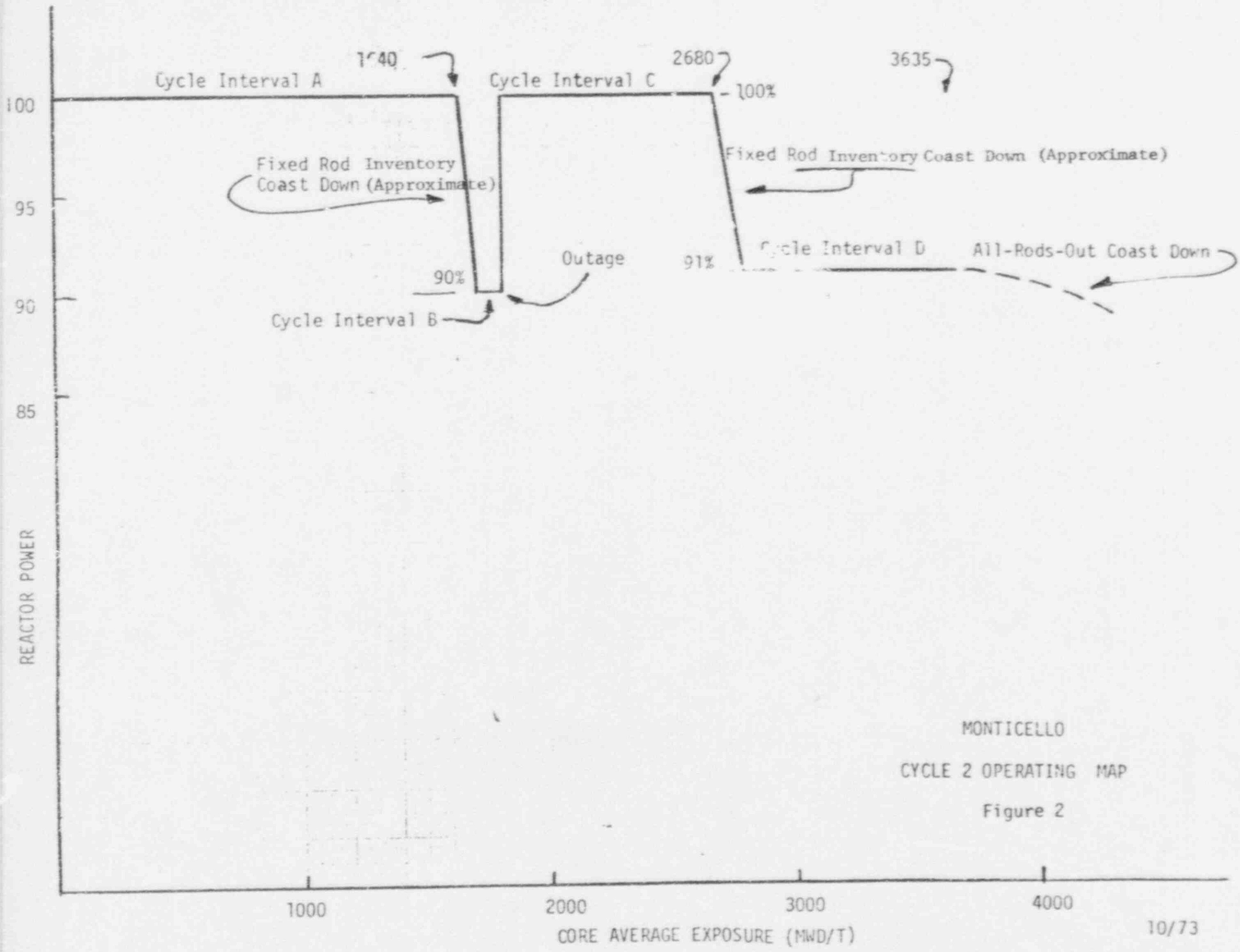


Figure 1 - Scram Reactivity



MONTICELLO

CYCLE 2 OPERATING MAP

Figure 2

10/73

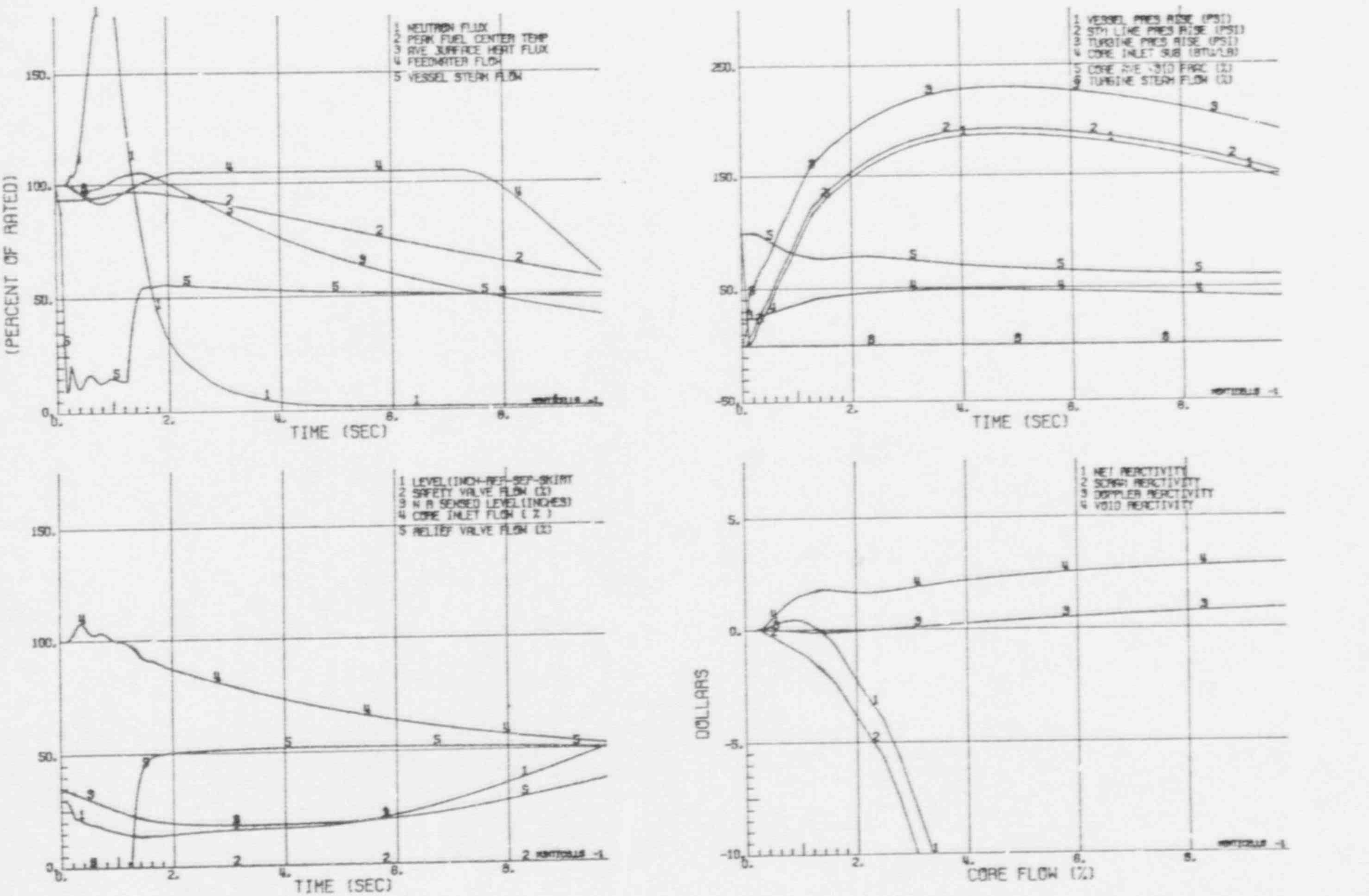


Figure 3 - Case 1 - Outage to 2680 MWD/T, RV Sizing

MONT RLD169 W/O PRT
TT W/O BP.DCF.67A-2/72B. 4RV-47% CAP.0.4 DLY W/2 PUMP TRIP

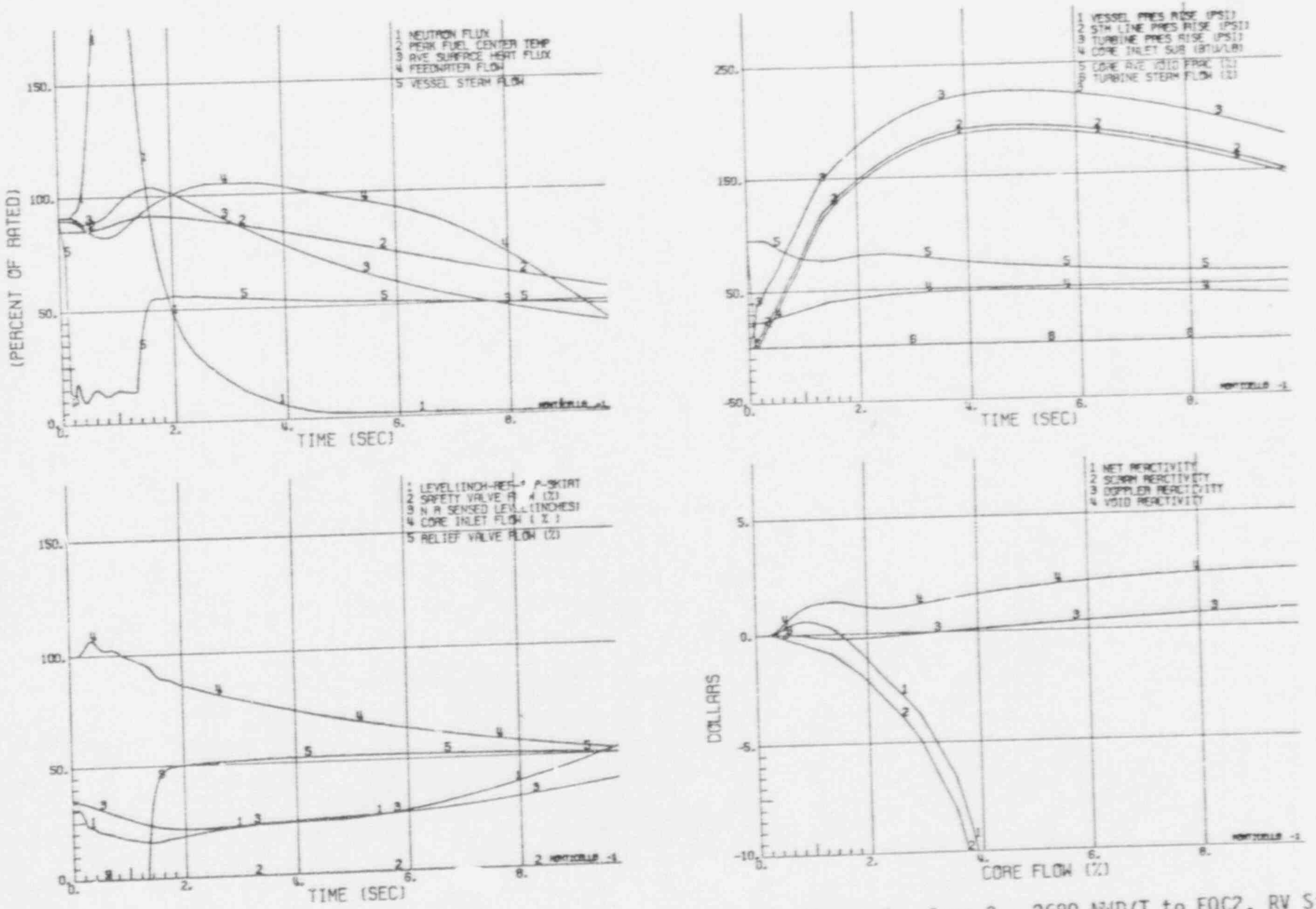


Figure 4 - Case 2 - 2680 MWD/T to EOC2, RV Sizing

MONT RL0170 W/O PAT
TT W/O BP.DCF.67A-8/73-C2.4RV-47% CAP.0.4 DLY.91% PWR W/2 PUMP TRIP

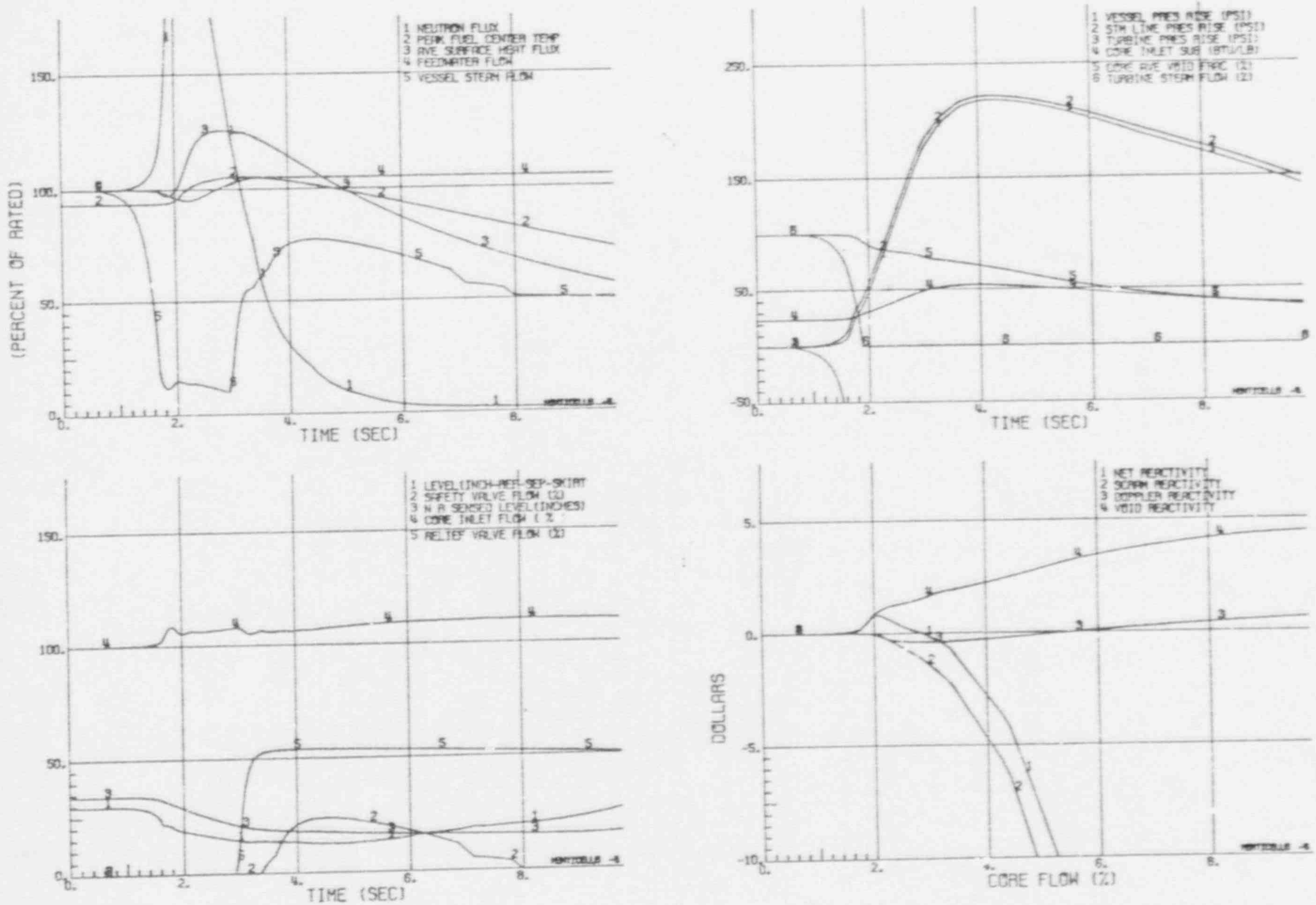


Figure 5 - Case 3 - BOC to Outage, SV Adequacy

MONT RLD166 W/O PRT
MSIV FSCRAM.DCF 67A-2/72B . 36.9%SV.

W/2 PUMP TRIP

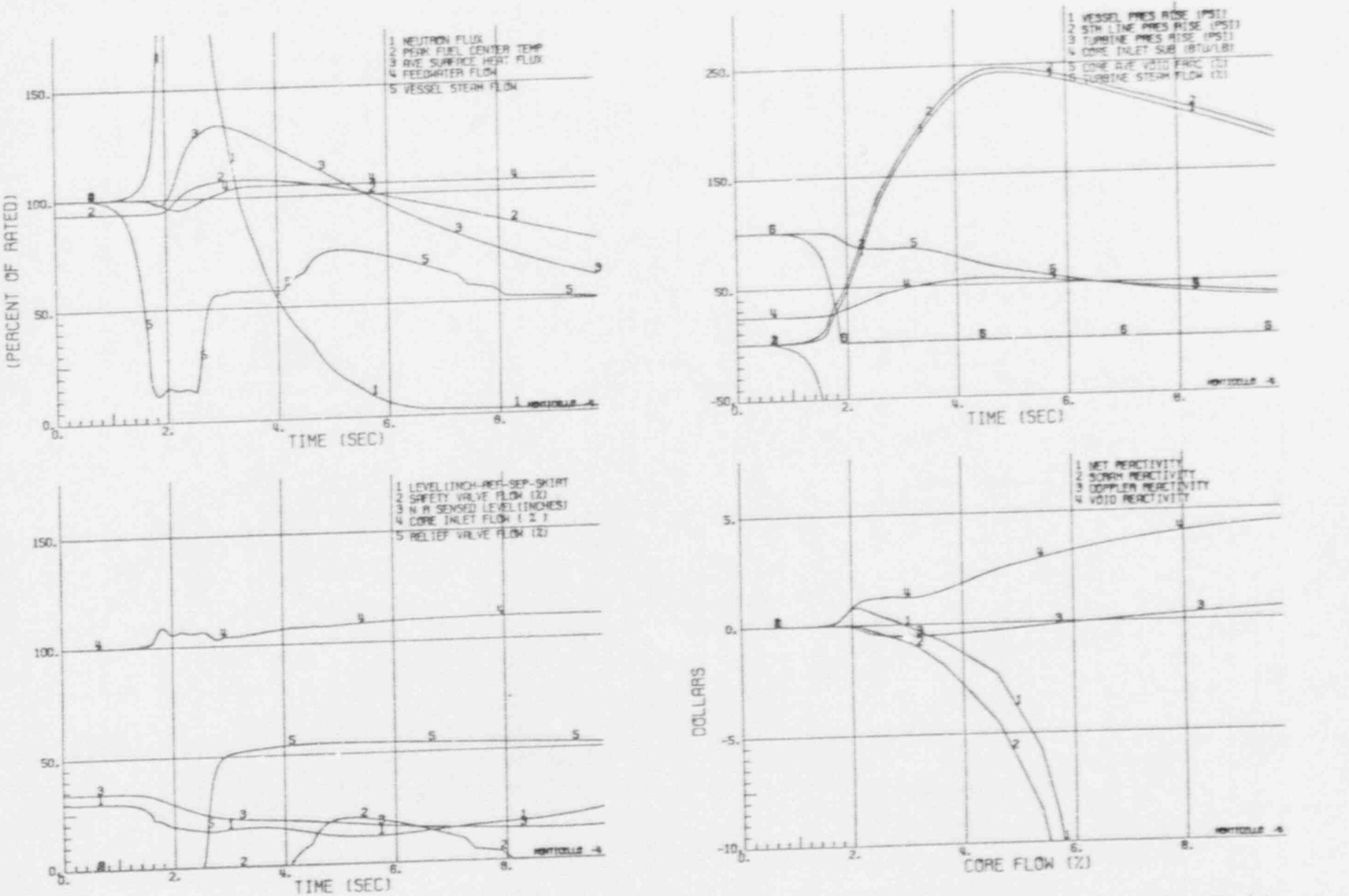


Figure 6 - Case 4 - Outage to EOC2, SV Adequacy

MONT RLD158 W/O PRT
MSIV FSCRAM.DCF 67A-8/73C2M, 36.9%SV.

W/2 PUMP TRIP

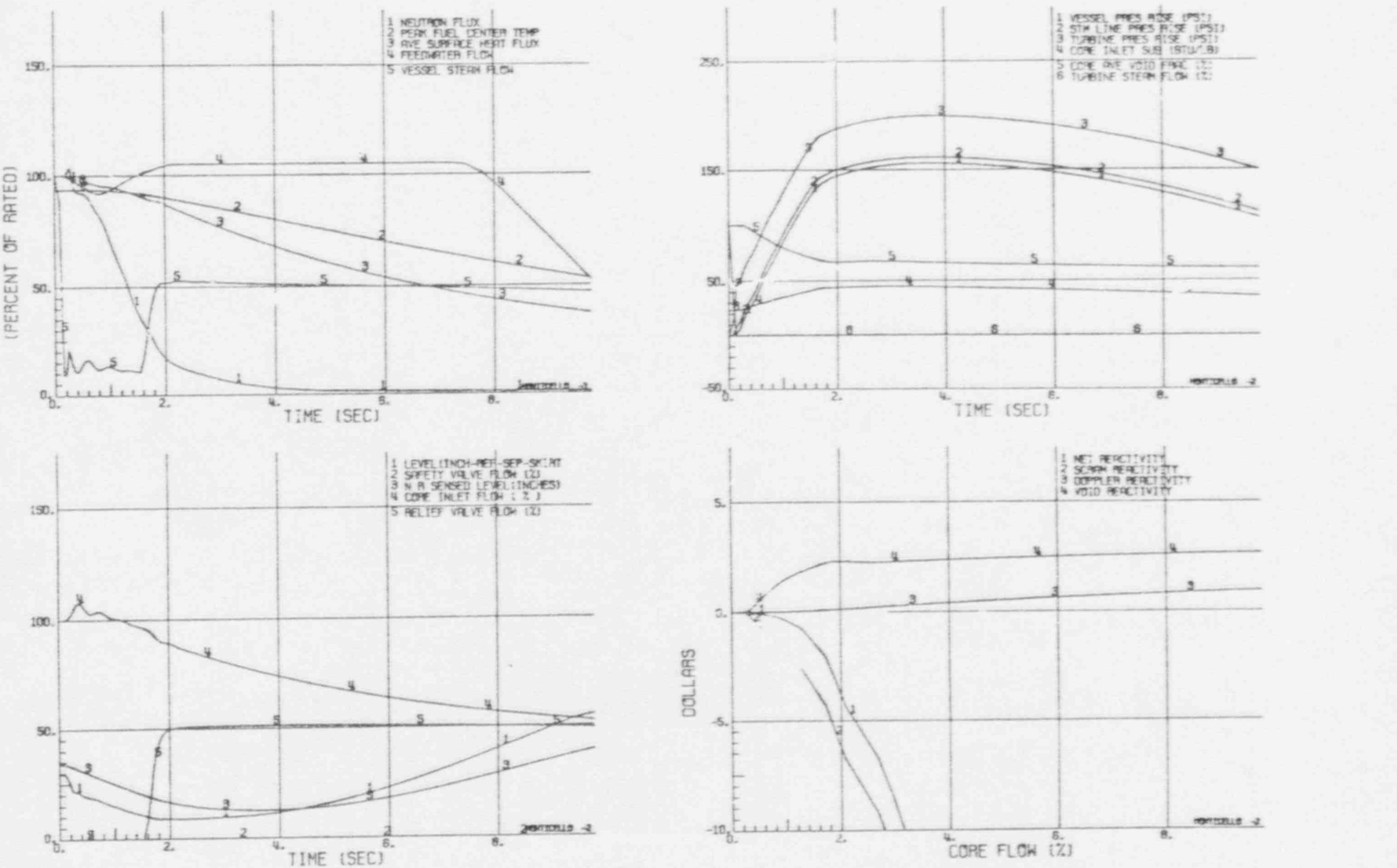


Figure 7 - BOC to 1640 MWD/T, OCF, TT w/o Byp, 100%

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MONT RLD W/O PAT
TT W/O BP, OCF 670-16WOM, 47%BV

W/2 PUMP TRIP

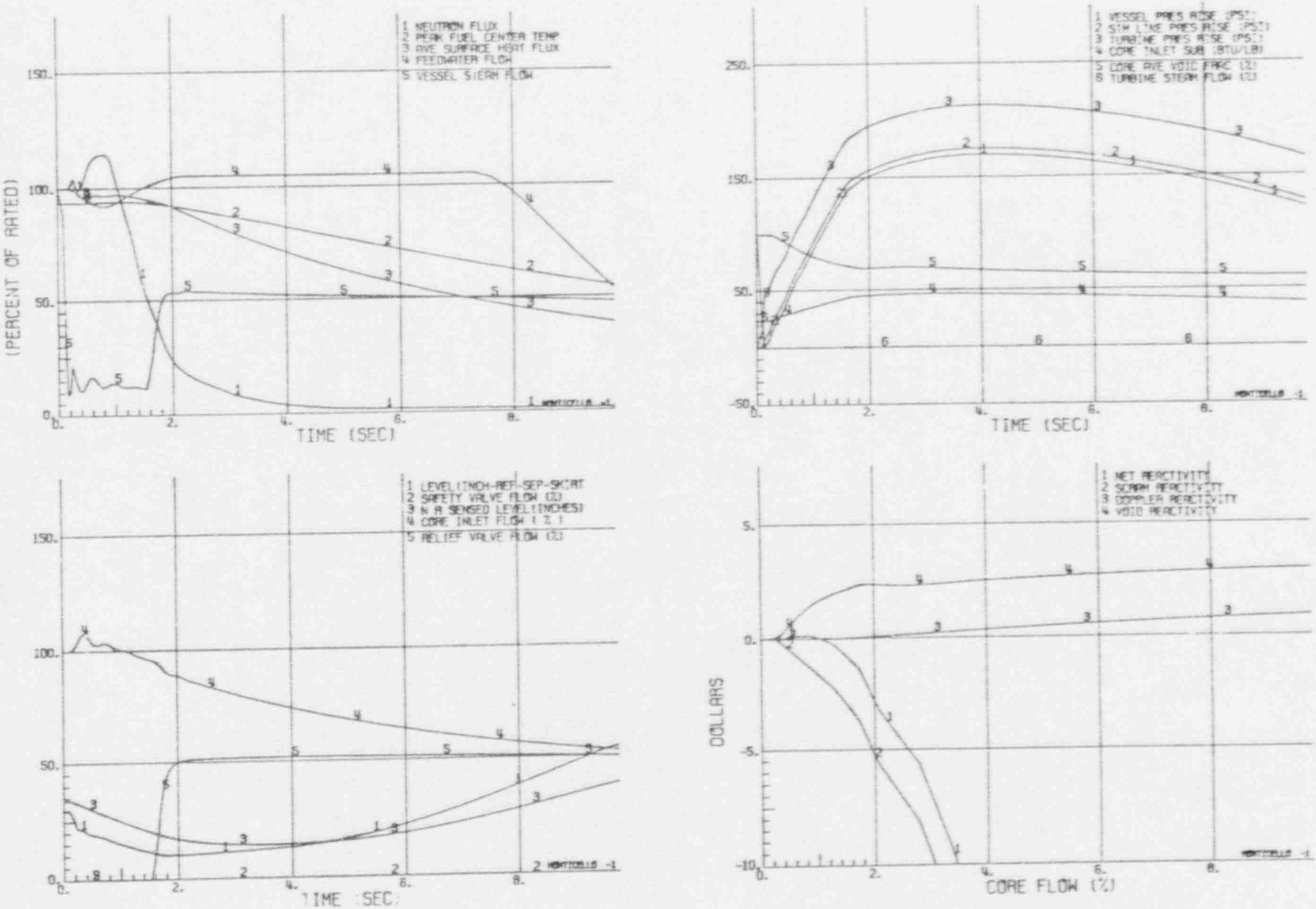

Figure 8 - BOC to 1640 MWD/T, DCF, TT w/o Byp, 100%

MONT RLD W/O PRT
TT W/O BP, DCF 67A-1640M, 47%RV

W/2 PUMP TRIP

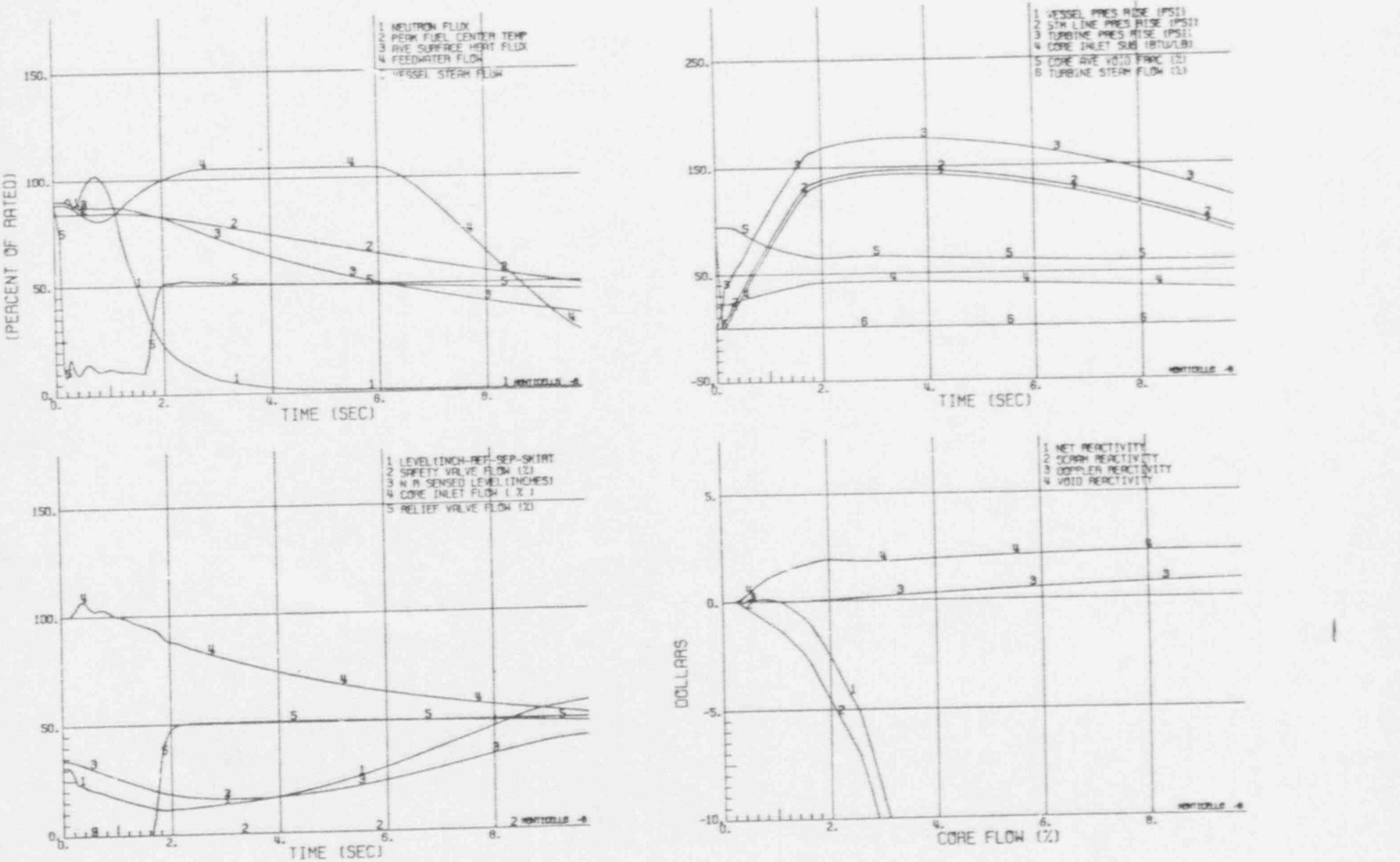

Figure 9 - 1640 MWD/T to Outage, OCF, TT w/o Byp, 90%

MONT RLD W/O PRT
TT W/O BP. OCF 67A-2/72B. 47%RV

W/2 PUMP TRIP

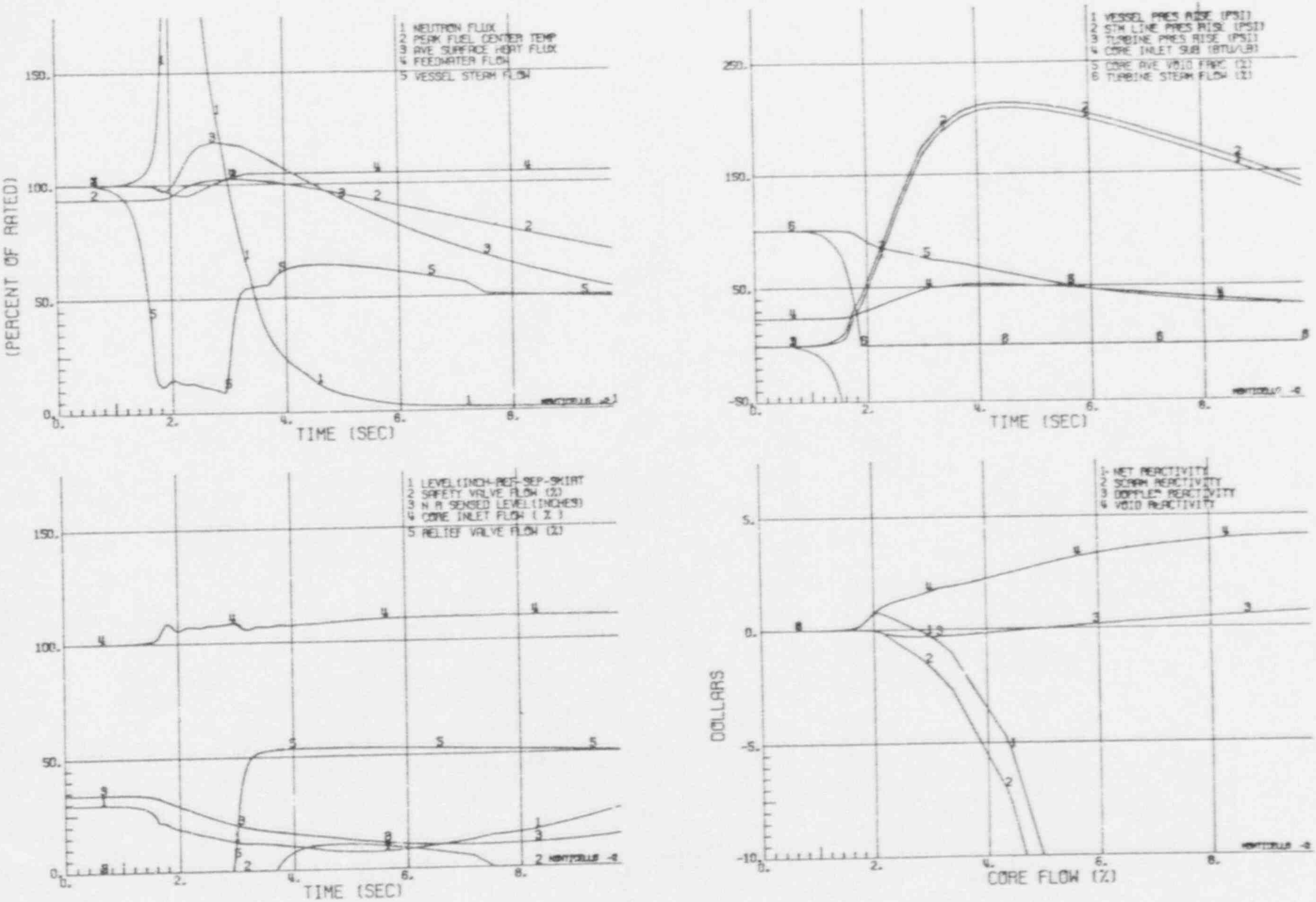

Figure 10 - 1640 MWD/T to Outage, OCF, MSIV, 100%

MONT RLD164 W/O PRT
MSIV FSCRAM.OCF 67A-2/728 . 36.9%SV.

W/2 PUMP TRIP

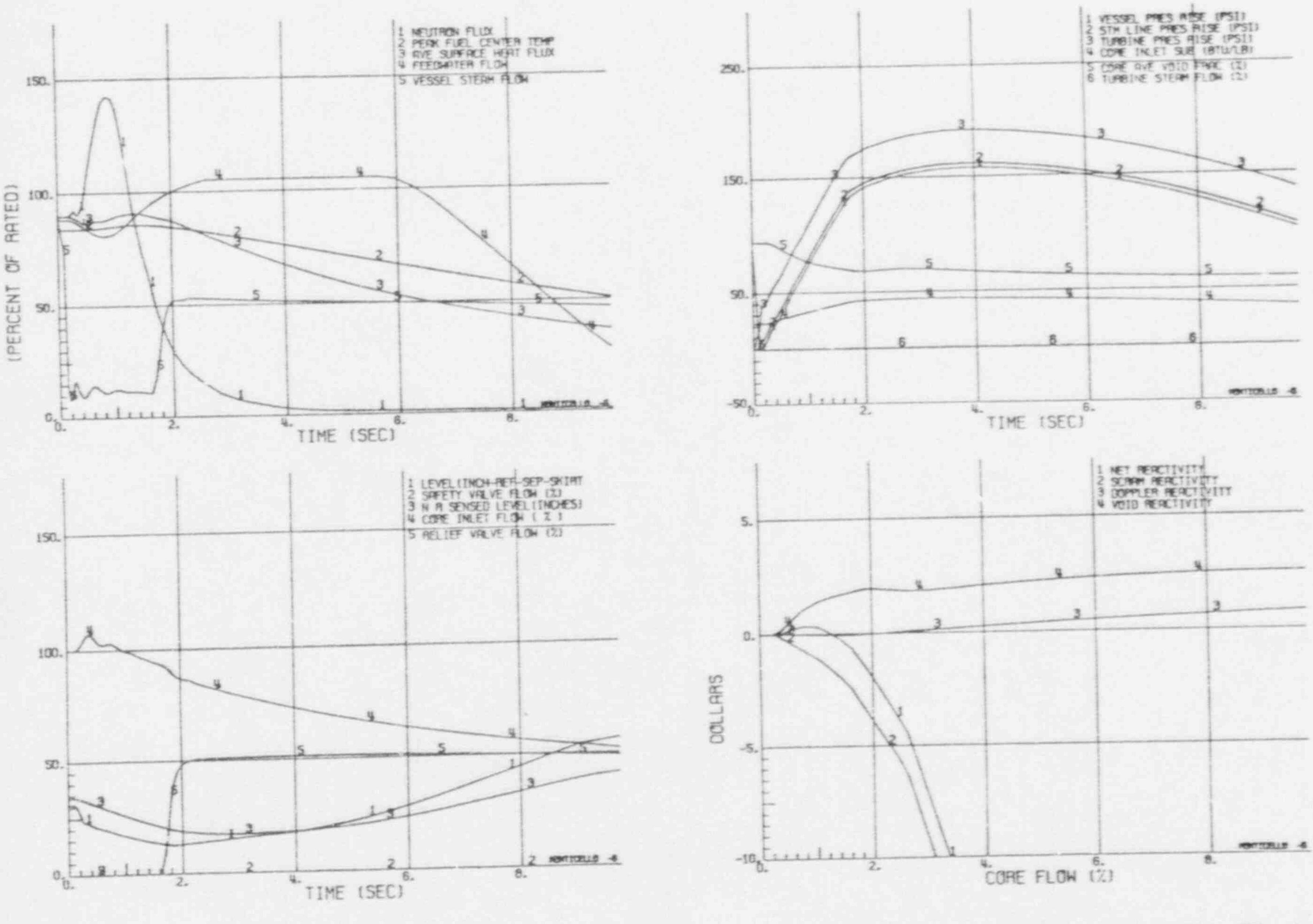

Figure 11 - 1640 MWD/T to Outage, DCF, TT w/o Byp, 90%

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MONT RLD1.3 W/O PRT
TT W/O BP. DCF S7A-2/72B. 47%RV

W/2 PUMP TRIP

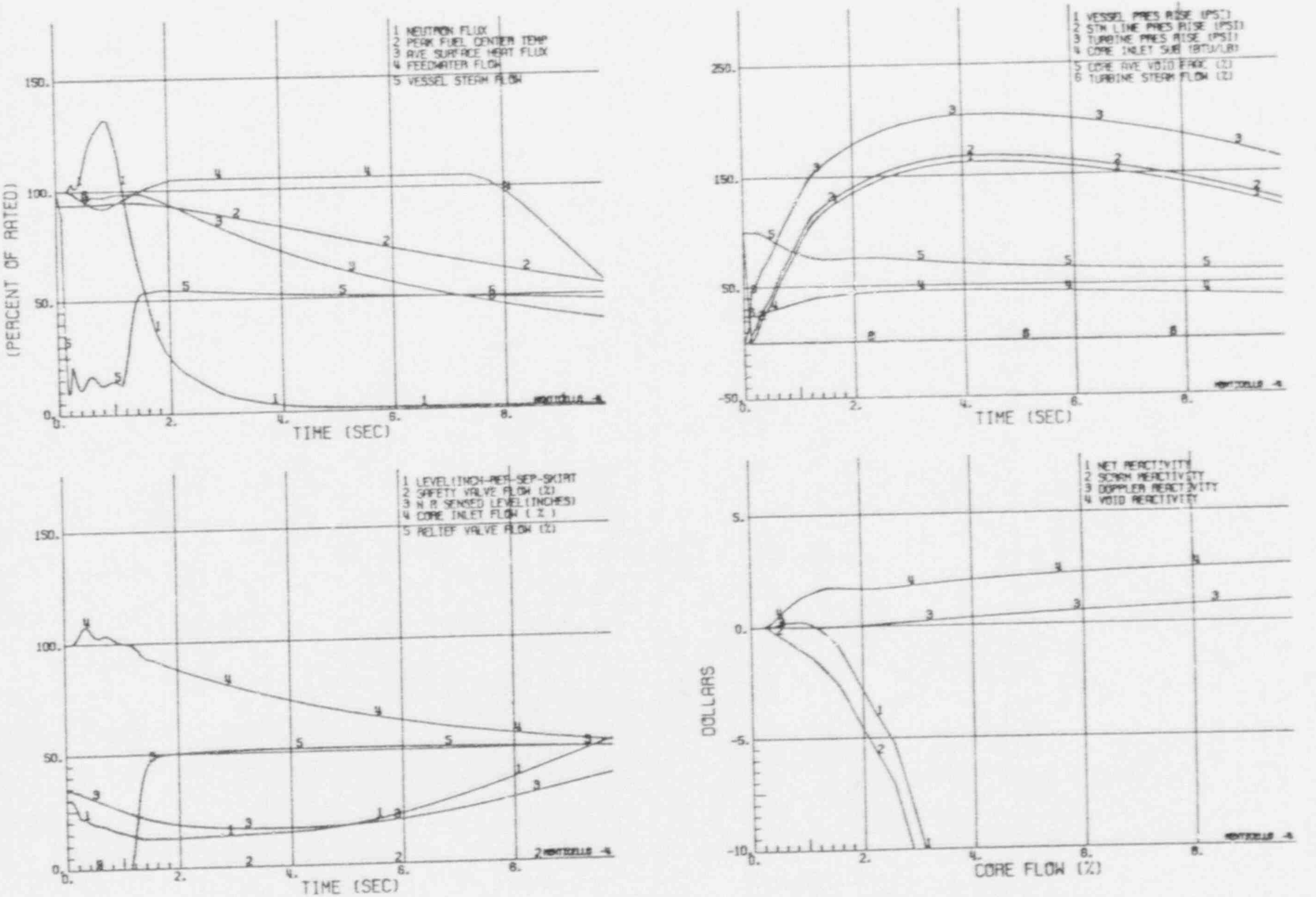

Figure 12 - Outage to 2680 MWD/T, ^CF, TT w/o Byp, 100%

150
MONT RLD W/O PRT
TT W/O BP. OCF 67A-2/72B. 47%RV

W/2 PUMP TRIP

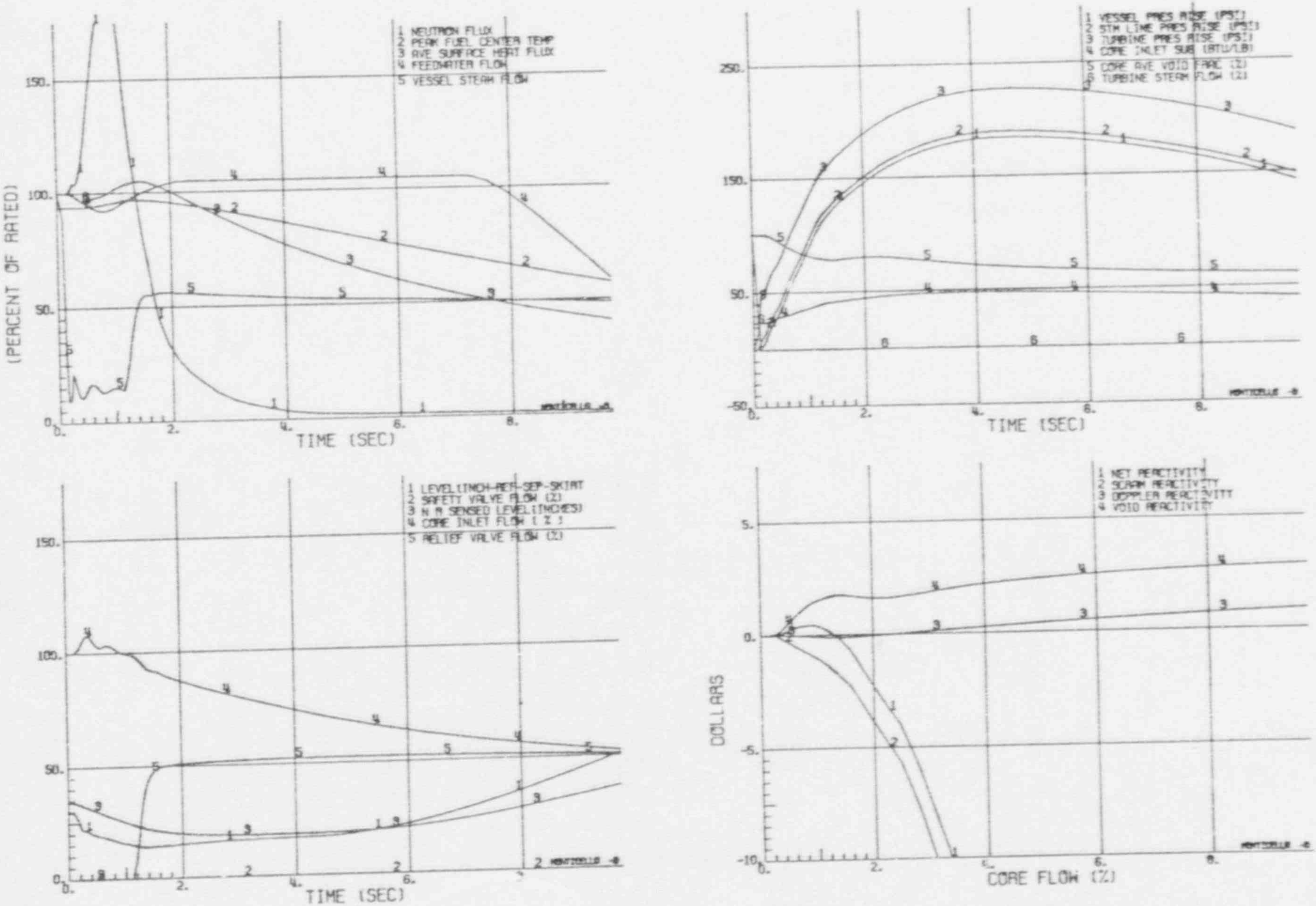

Figure 13 - Outage to 2680MWD/T, DCF, TT w/o Byp. 100%

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MONT RLD[redacted] W/O PRT
TT W/O BP. DCF 6TA-2/72B. 47%RV

W/2 PUMP TRIP

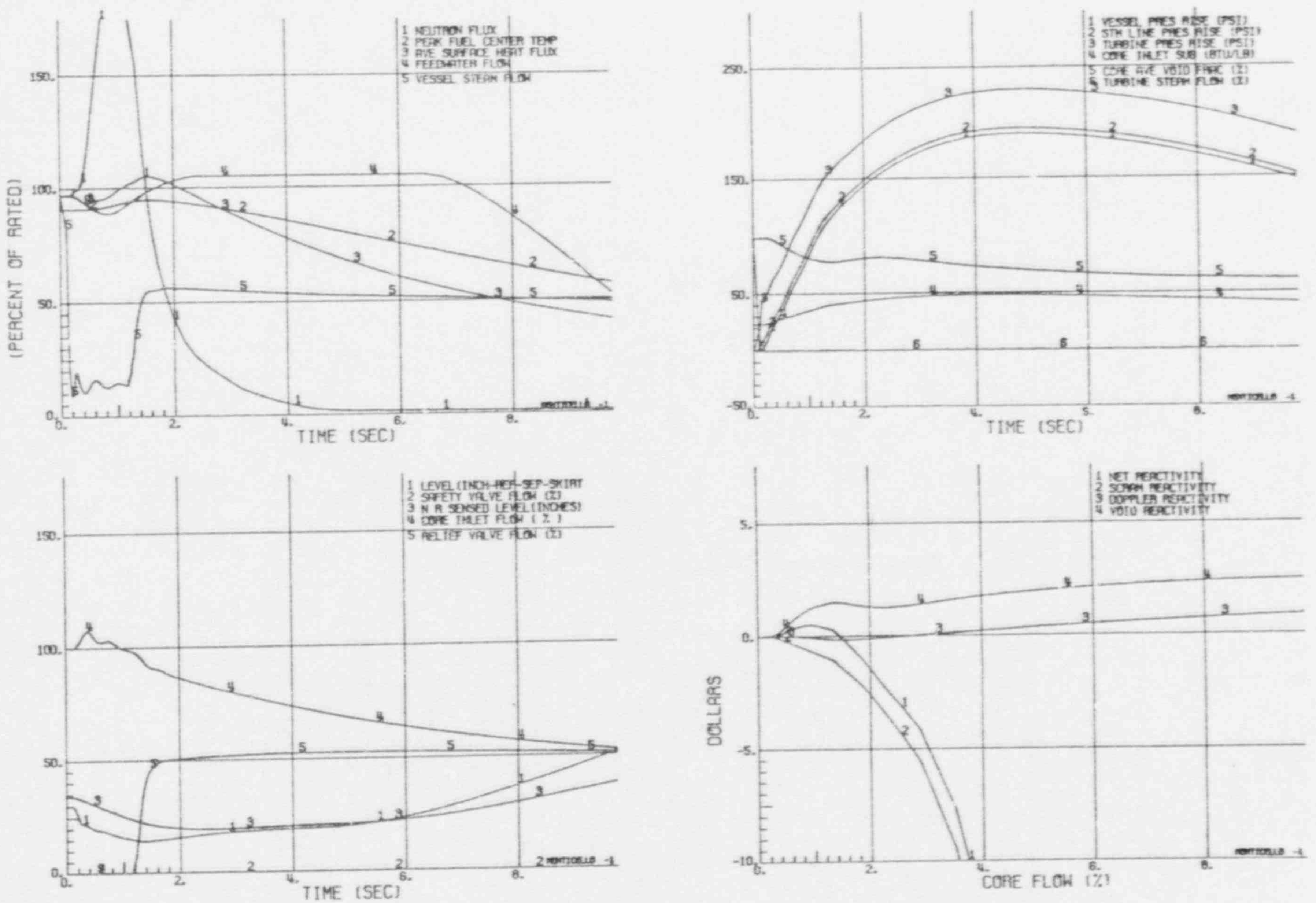

Figure 14 - 2680 MWD/T to EOC2, OCF, TT w/o Byp, 97%

MONT RLD153 W/O PRT
TT W/O BP. OCF 67A-B/73C2M. 47%RV.

W/2 PUMP TRIP

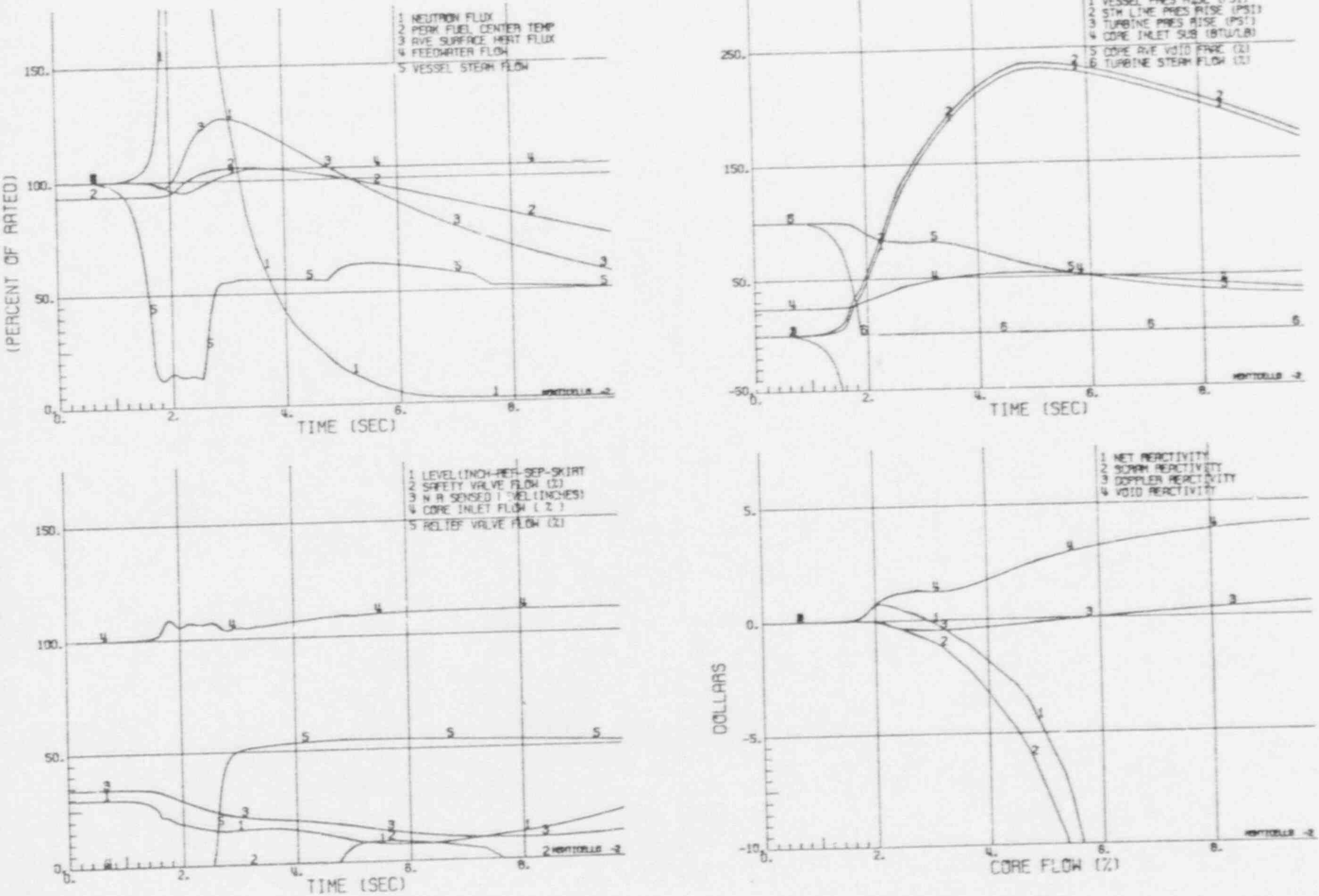

Figure 15 - 2680 MWD/T to EOC2, OCF, MSIV, 100%

MONT RLD156 W/O PRT
MSIV FSCRAM.OCF 67A-8/73C2M. 36.9%SV.

W/2 PUMP TRIP

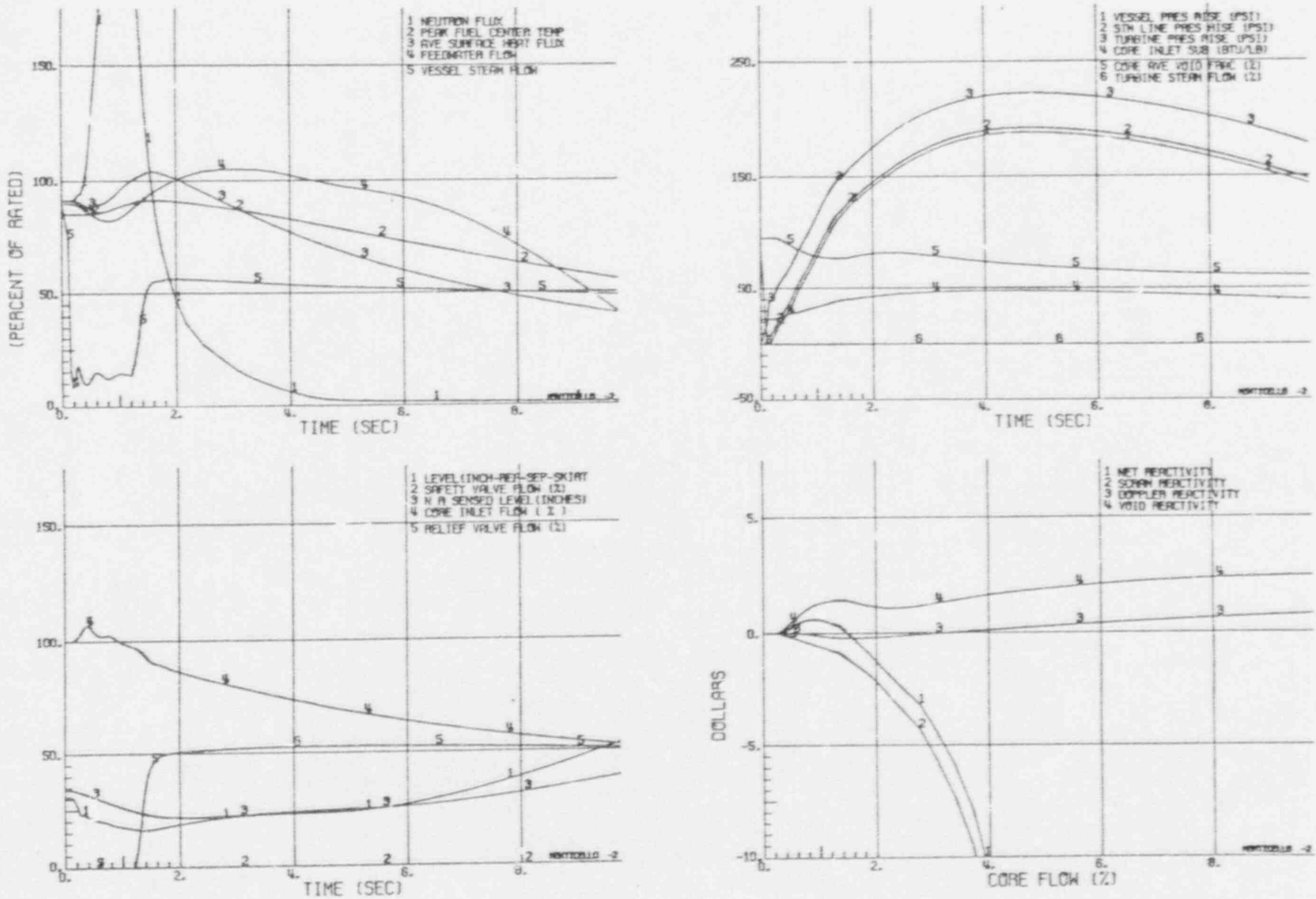

Figure 16 - 2680 MWD/T to EOC2, DCF, TT w/o Byp, 91%

MONT RLD154 W/O PRT
TT W/O BP. DCF 67A-8/73C2M. 47%RV.

W/2 PUMP TRIP