AUXILIARY FEEDWATER FLOW

RATE FOLLOWING A

LOSS OF MAIN

FEEDWATER

(177 FA PLANTS)

AFW FLOW RATE SENSITIVITY STUDY

1.0 PURPOSE

The purpose of this study was to evaluate the system response of a Babcock & Wilcox 177 FA plant to a range of auxiliary feedwater (AFW) flow rates following a loss of feedwater (LOFW) event.

2.0 ANALYSIS PROCEDURE

A. CODE

The computer code used for this analysis is CADDS (see Section 3.2.1.1 of Reference 1). The model discussed in Reference 1, Sections 3.2.1.2, 4.2, 4.3, and 4.4, is used in this study. Volume III of Reference 1 verifies that this analysis is applicable to raised and lowered loop 177 FA plants.

B. ASSUMPTIONS

A survey of B&W 177 FA plants shows that AFW flow rates normally will range from 1500-1700 gpm at full flow conditions. Operation of only one AFW pump would reduce this flow to about 800 gpm. The minimum capacity AFW flow at any of the 177 FA units is a one AFW pump flow of 740 gpm, at a 2568 MWt unit. Under some circumstances, an Oconee unit (2568 MWt) can potentially receive 3500 gpm under full flow conditions.

For whatever flow conditions, proper control will be assumed. That is:

- AFW flow will be controlled on an indicated steam generator level of 30".
- Steam pressure will be controlled at 1025 psig, the reset value following a reactor trip. For saturation conditions in the steam generator, an average primary system temperature of $\sim 550^{o}F$ is used.

Because of this control scheme, the CADDS model will initiate AFW flow when OTSG level is predicted to drop to 30" and flow will

be reduced to balance heat input (decay plus stored) when T_{ave} reached 550°F.

Normal makeup and letdown operations would reduce the severity of the LOFW events analyzed here; however, for conservatism, the analysis models will not include the effects of makeup or letdown.

3.0 RESULTS

A spectrum of AFW flow rates and system initial conditions were evaluated, for both trip on high RC pressure (2300 psig) and for an anticipatory trip at zero seconds. The results are summarized in Table 1. Plots of system pressure, hot leg temperature, and pressurizer level for the extreme cases of 500 gpm and 3500 gpm are provided in Figures 1-3.

In each case analyzed, the system parameters remain within acceptable ranges for a reactor trip. For example, the minimum AFW flow rate case of 500 gpm, with a reactor trip at 2300 psig (trip occurs at 8 seconds) results in a peak RCS hot leg temperature of 574°F, with AFW heat demand balancing the decay- and stored-heat addition at about 3 1/2 minutes. Cooldown then progresses until level control at ~1025 psig is achieved in the steam generators. For the maximum cooling case (3500 gpm AFW), steam generator level control is achieved in about 53 seconds with maximum decay heat assumed, and 39 seconds if no decay heat is assumed.

In no instance does the pressurizer empty or fill, nor is the PORV seen to actuate.

REFERENCES

1. B&W Report to the NRC, May 7, 1979, "Evaluation of Transient Behavior and Small Reactor Coolant System Breaks in the 177 Fuel Assembly Plant".

Table 1

AFW Flow, gpm	Initial Power, %	Rated Power, MWt	Reactor Trip	Decay Heat (ANS)	Time of SG Level Control, sec	PORV Open?	Pzr Fill or Drain?
500	100	2772	0 sec	1.0	655	No	No
500	100	2772	2300 psig	1.0	915	No	No
740	100	2772	0 sec	1.0	265	No	No
740	100	2772	2300 psig	1.0	400	No	No
1000	100	2772	0 sec	1.0	160	No	No
1000	100	2772	2300 psig	1.0	240	No	No
1700	100	2772	0 sec	1.0	90	No	No
1700	100	2772	2300 psig	1.0	115	No	No
3500	100	2772	0 sec	1.0	53	No	No
3500	100	2772	2300 psig	1.0	68	No	No
3500	100	2772	0 sec	0.0	39	No	No
3500	15	2568	0 sec	0.0	48	No	No

FIGURE 1

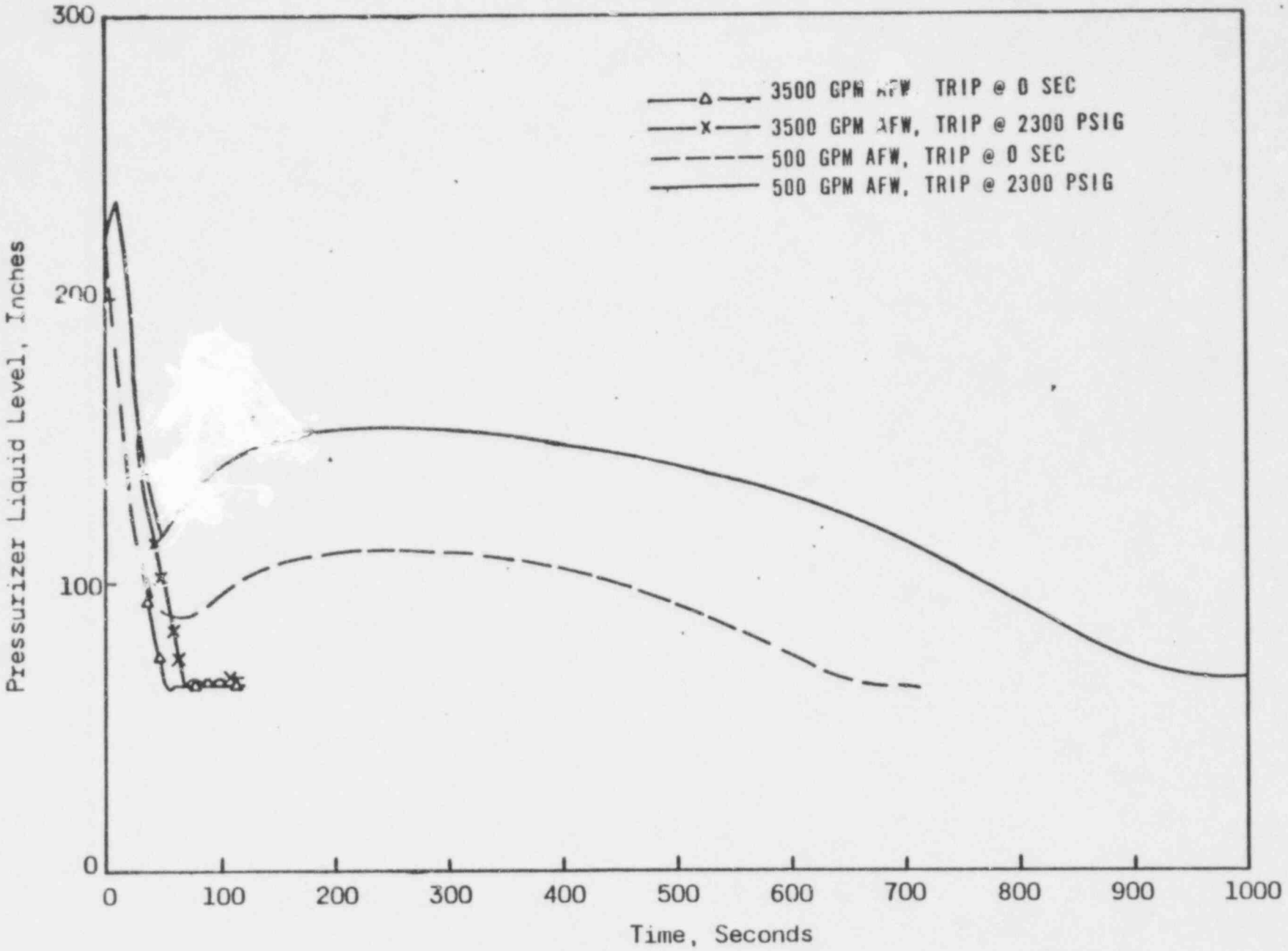
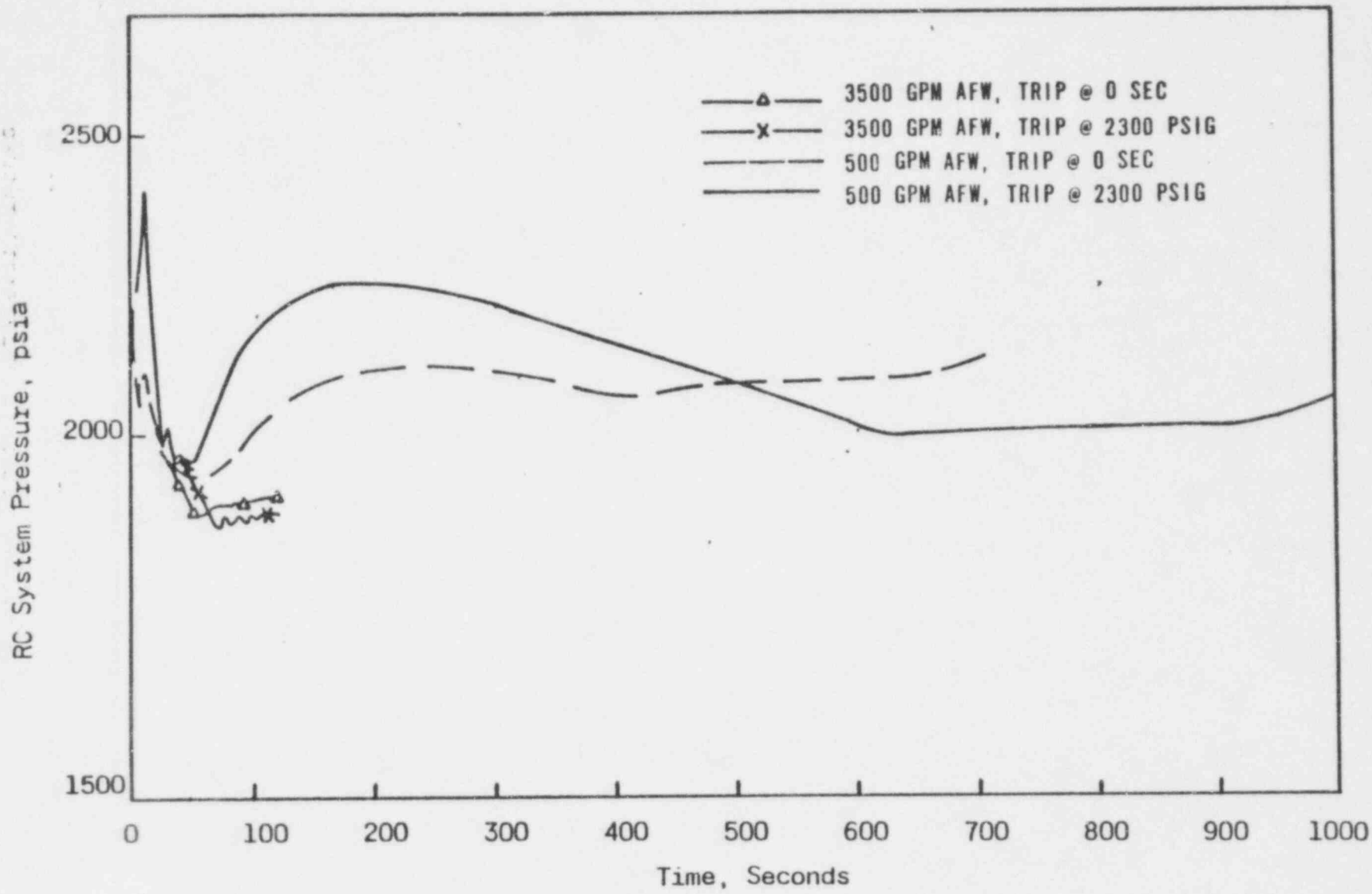
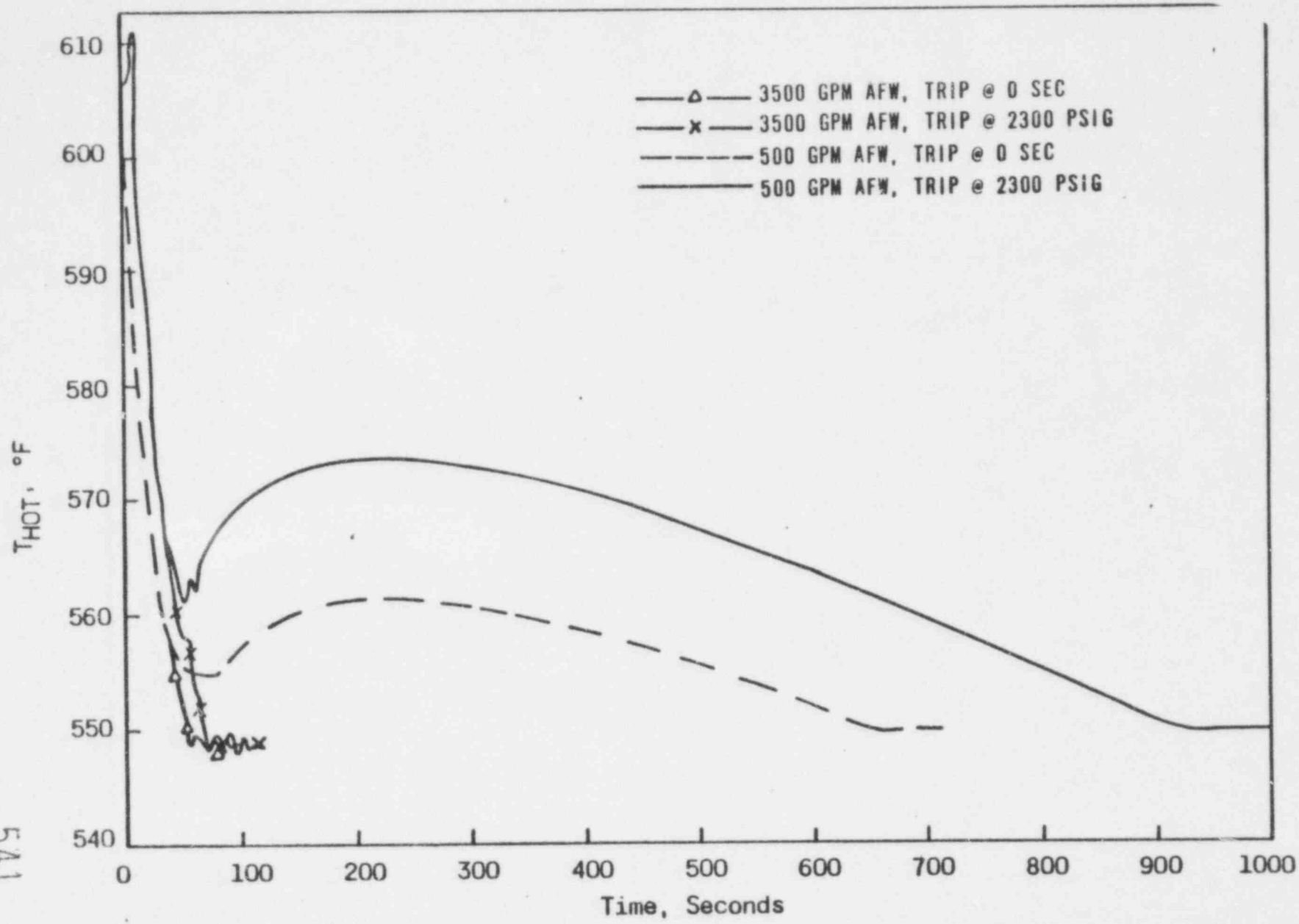


FIGURE 2



547 - 170

FIGURE 3


610
600
590
580
570
560
550
540
T_{HOT}, °F
0
100
200
300
400
500
600
700
800
900
1000
Time, Seconds
3500 GPM AFW, TRIP @ 0 SEC
3500 GPM AFW, TRIP @ 2300 PSIG
500 GPM AFW, TRIP @ 0 SEC
500 GPM AFW, TRIP @ 2300 PSIG