AUXILIARY FEEDWATER SYSTEM PUMP ENDURANCE TEST REPORT

PREPARED FOR

THE UNITED STATES NUCLEAR REGULATORY COMMISSION

BY

POWER PLANT ENGINEERING

JANUARY 12, 1983

ABSTRACT

The purpose of this report is to provide the results of the endurance tests performed on all auxiliary feedwater pumps during the St. Lucie Unit 2 preoperational testing.

Testing was performed in accordance with Preoperational Test Procedure 2-0700095, "Auxiliary Feedwater System Endurance Test". Data of bearing housing and bearing oil temperature vs time and pump room ambient temperature vs time for each auxiliary feedwater pump was recorded and plotted. The pumps performance characteristics were also observed and plotted. The test also examined the pumps to ensure that allowable vibration limits were not exceeded.

The test demonstrated that bearing housing, bearing oil temperature and ambient temperature remained within the design temperature limits. In addition, the test showed that vibration limits were not exceeded and that the pump's performance requirements were maintained.

INTRODUCTION

The Auxiliary Feedwater Pump Endurance Test for the St. Lucie Unit 2 nuclear site was performed between October 8, 1982 and November 7, 1982. This test was performed as a result of a USNRC recommendation. To implement this recommendation, FPL committed to perform this test and provide a copy of the test results.

This report presents the test results in five sections as follows: (1) Description of the test method (2) Results and conclusions demonstrating that temperature design limits were not exceeded for the pump bearing housing/bearing oil (3) Results and conclusions demonstrating that pump room ambient temperature did not exceed environmental qualification temperature limits for safety-related equipment (4) Confirmation that pump vibration limits were not exceeded and (5) Demonstration that pump performance parameters were maintained. At the end of the report, conclusions are presented.

(1) Test Procedure

The test was performed by pumping water thru each pump by either a recirculation loop to the Condensate Storage Tank or by feeding the Steam Generators as required to support Pre-core Hot Functional Testing. The testing lasted a period of at least 48 hours. Figures 1, 2 and 3 show the flow configurations used for pump 2A, 2B and 2C. Each pump was stopped at the end of the 48 hour test and allowed to cool down before it was restarted and run for an additional hour. A summary of the relevant test parameters are listed in Table 1.

Table 1 - Test Condition

PARAMETER	Operating Test Condition	Design Operating Condition
Pump Head (ft H2O)		
2A AFW Pump	3058 - 2960	2660
2B AFW Pump	2991 - 2933	2660
2C AFW Pump	3040	2660
PUMP FLOW (GPM)		
2A AFW Pump	50 - 170*	300
2B AFW Pump	50 - 170*	300
2C AFW Pump	70**	570
PUMP SPEED (RPM)		
2C AFW Pump	3750 - 3850	3750 RPM
Steam Inlet Temperature (^{o}F)		
2C AFW Pump Steam Inlet temperature	$518^{o}F$ - $532^{o}F$	$512^{o}F$ - $544^{o}F$

* Includes 50 GPM recirculation flow
** Includes 70 GPM recirculation flow

(2) Bearing housing/bearing oil temperatures for the AFW pump driver, inboard and outboard bearings were recorded (T_1 - T_4) as a function of time. The results are presented in figures 3 thru 6 and they demonstrate that the pump/driver design temperature limits for these bearings were not exceeded during the tests.

(3) Figures 3 thru 6 also contain the pump room ambient temperatures (T_5) versus time. As can be seen from the recorded results, a steady and acceptable ambient room temperature was maintained throughout the endurance test and environmental qualification temperature limits were not exceeded for safety related equipment.

(4) Pump vibration data was recorded during the endurance tests using a calibrated hand-held vibrometer. The results indicate that AFW pump vibration

did not exceed allowable limits established by plant procedures.

(5) Auxiliary Feedwater Pump performance characteristics (based on assumed recirculation flow) were recorded during the endurance test. The results are presented in figures 7 through 9 and demonstrate acceptable performance.

CONCLUSIONS

This report presents the results of St. Lucie Unit 2 AFW pump 2A, 2B, and 2C endurance tests performed as a result of a USNRC recommendation.

The results demonstrate that the pumps remain within design limits with respect to bearing housing/bearing oil temperature and vibration, that the pump room ambient temperature did not exceed environmental qualification temperature limits for safety-related equipment in the room and that the pumps' performance characteristics were acceptable.

Figure 1

2A PUMP ENDURANCE TEST

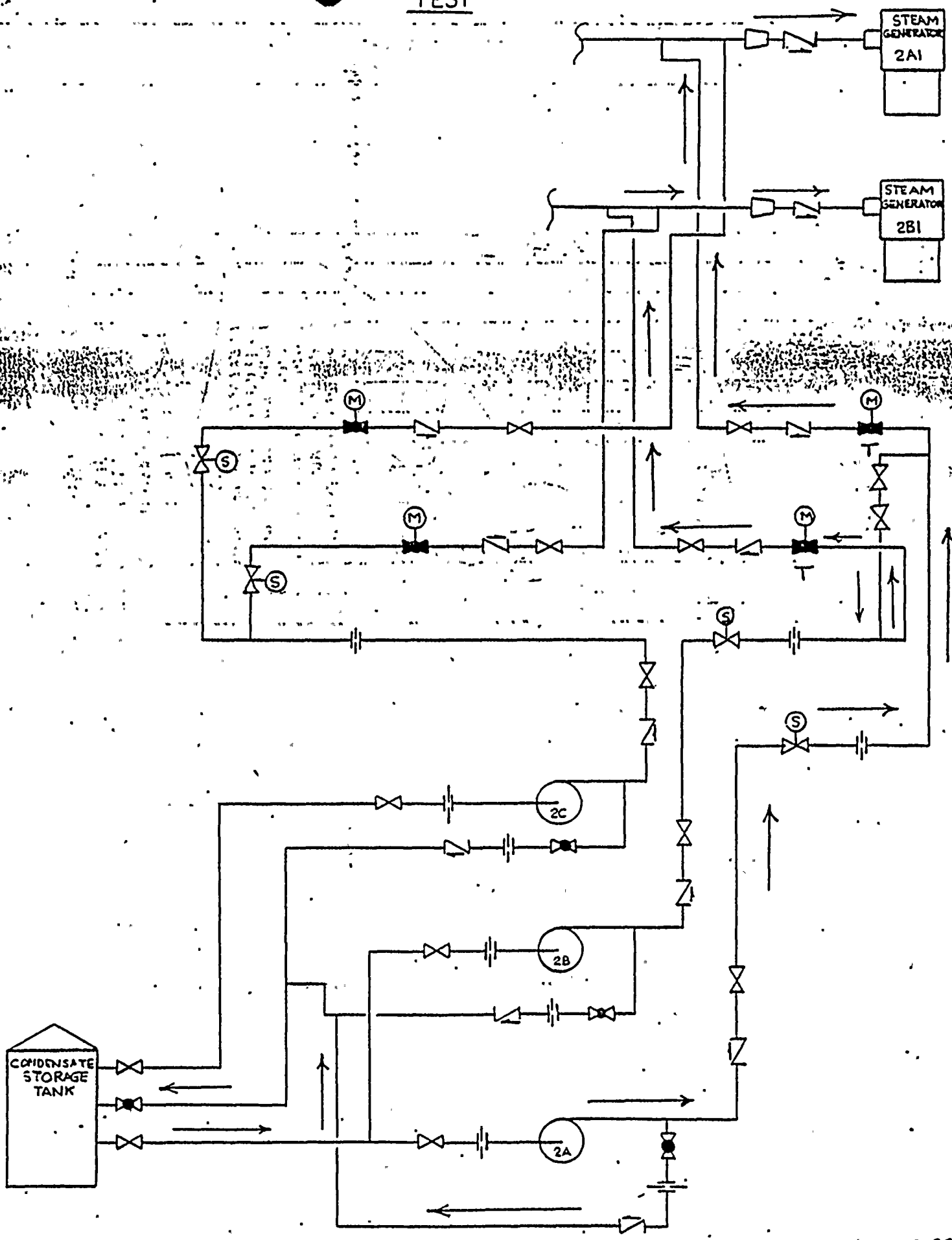

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Figure 2

2B PUMP ENDURANCE TEST

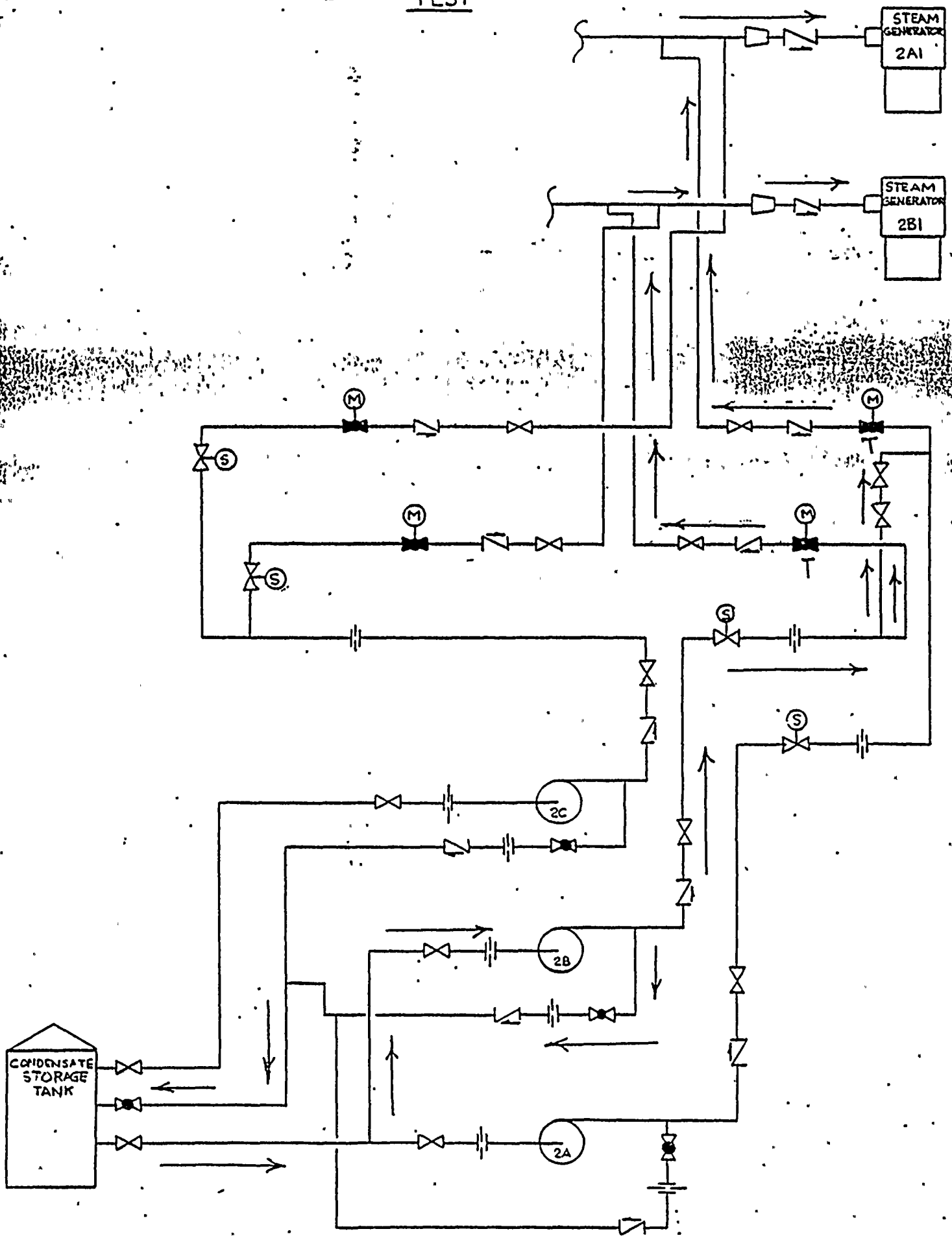

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Figure 3

2C PUMP ENDURANCE TEST

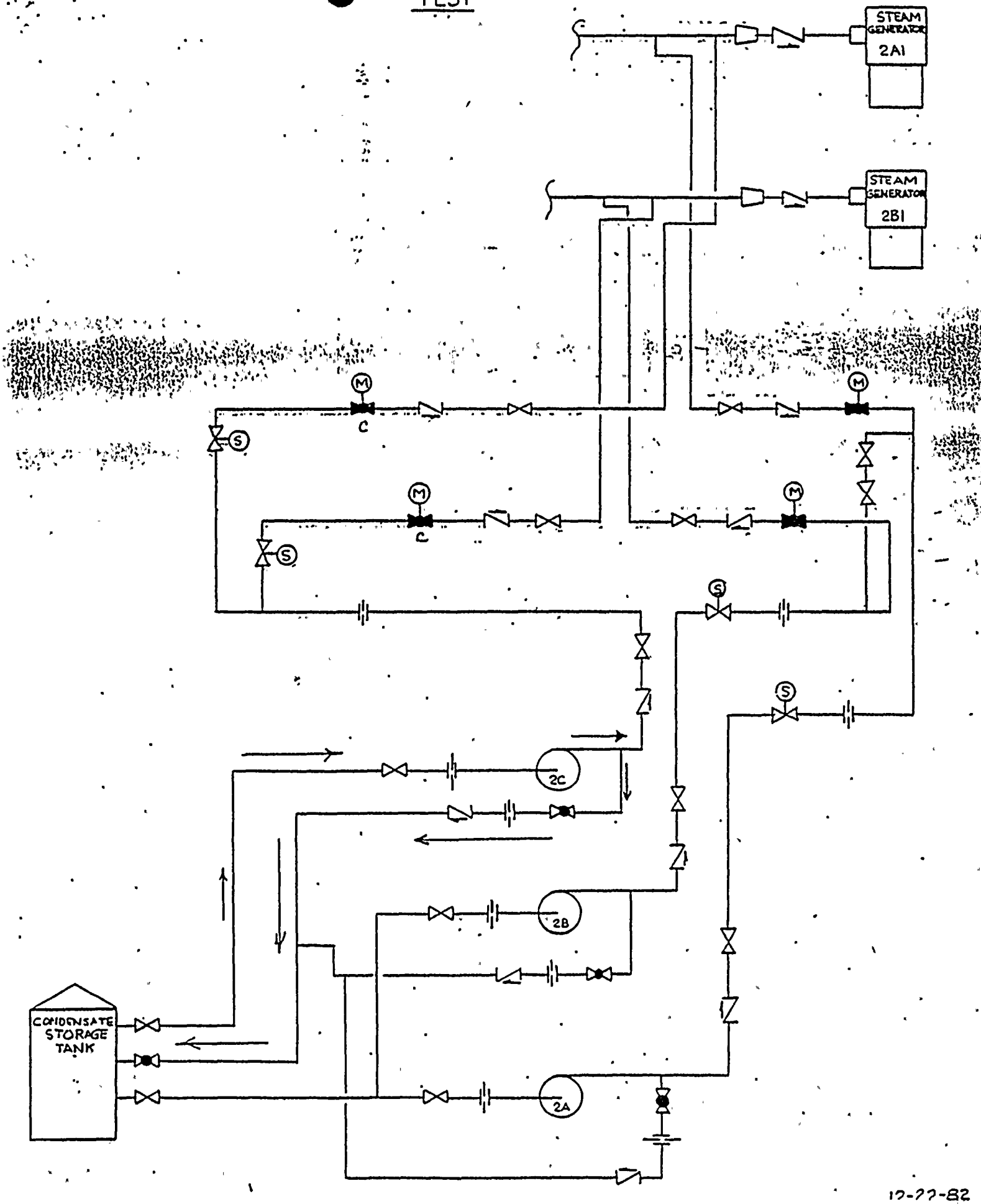

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Figure 4

St Lucie Plant Unit 2
2A Auxiliary Feedwater Pump Endurance Test
Temperatures vs. Time

T_1-T_4 Bearing Temperatures
T_5 Vicinity Ambient Temp.

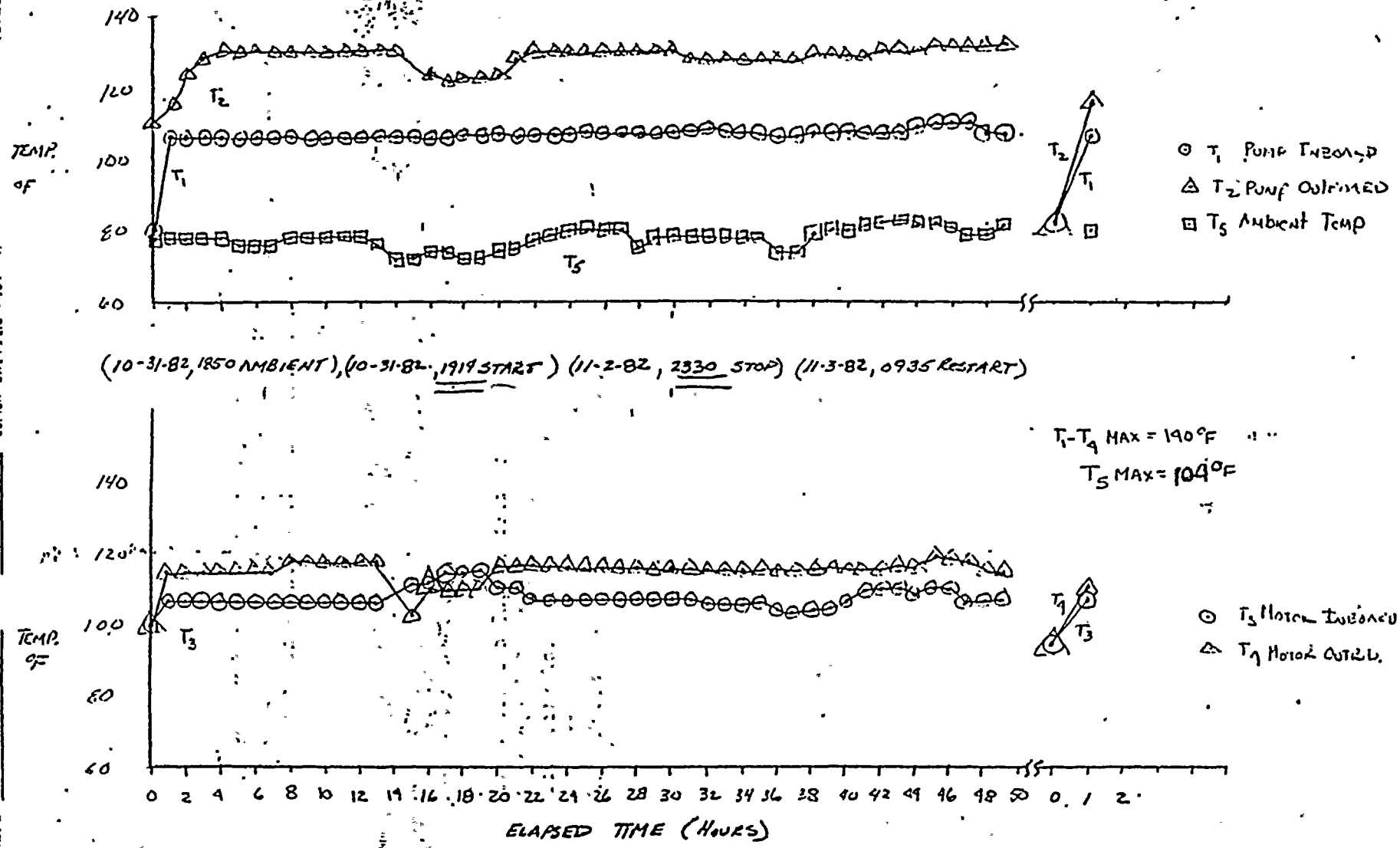

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Figure 5

St Lucie. Plant Unit 2
2B Auxiliary Feedwater Pump Endurance Test
Temperatures. VS Time

T_1-T_4 Bearing Temperatures
T_5 Vicinity Ambient Temperature

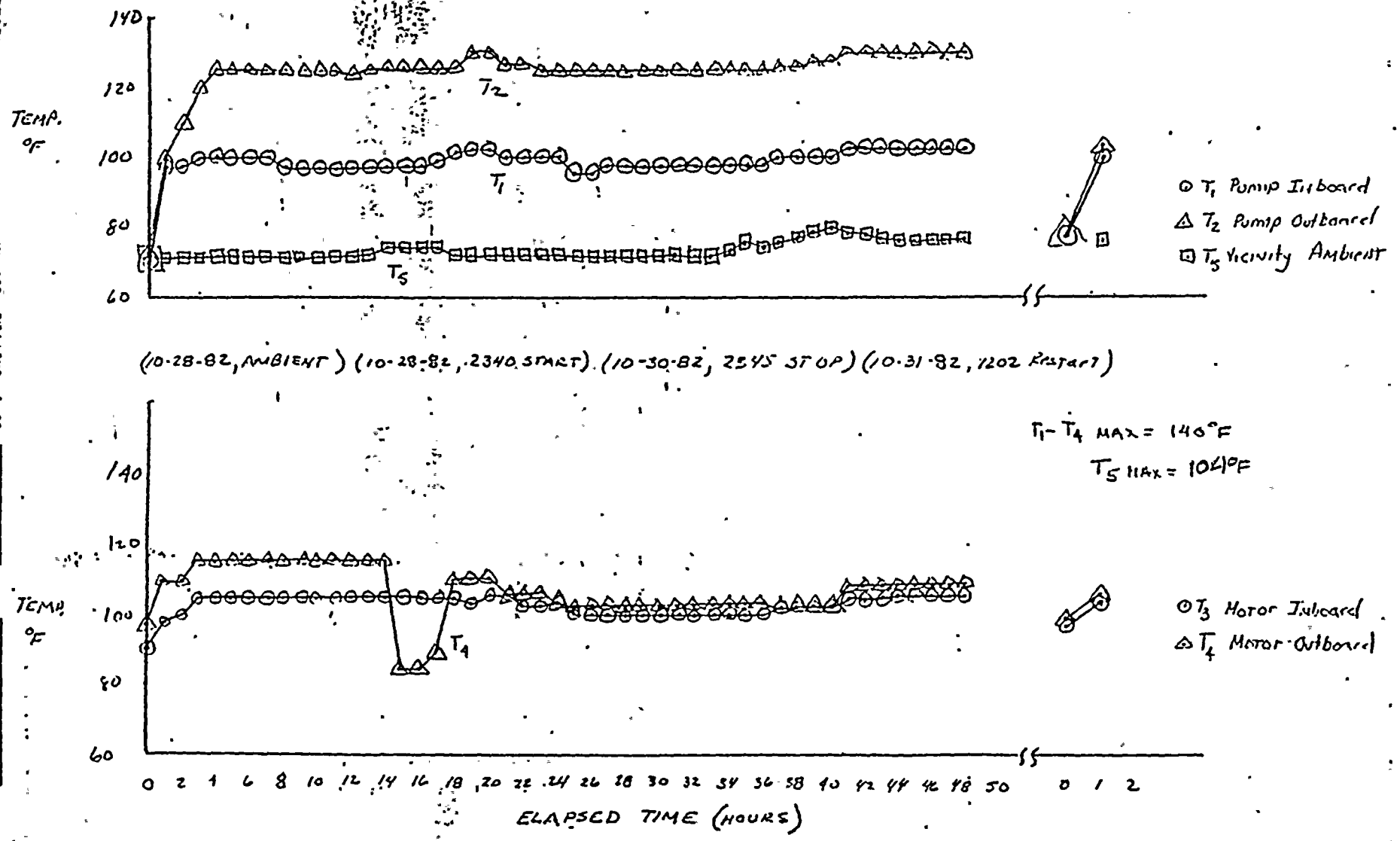

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Figure 6

St Lucie Plant Unit 2
2C Auxiliary Feedwater Pump Endurance Test
Temperatures vs Time

T_1–T_4 Bearing Temperatures
T_5 Vicinity Ambient Temp.

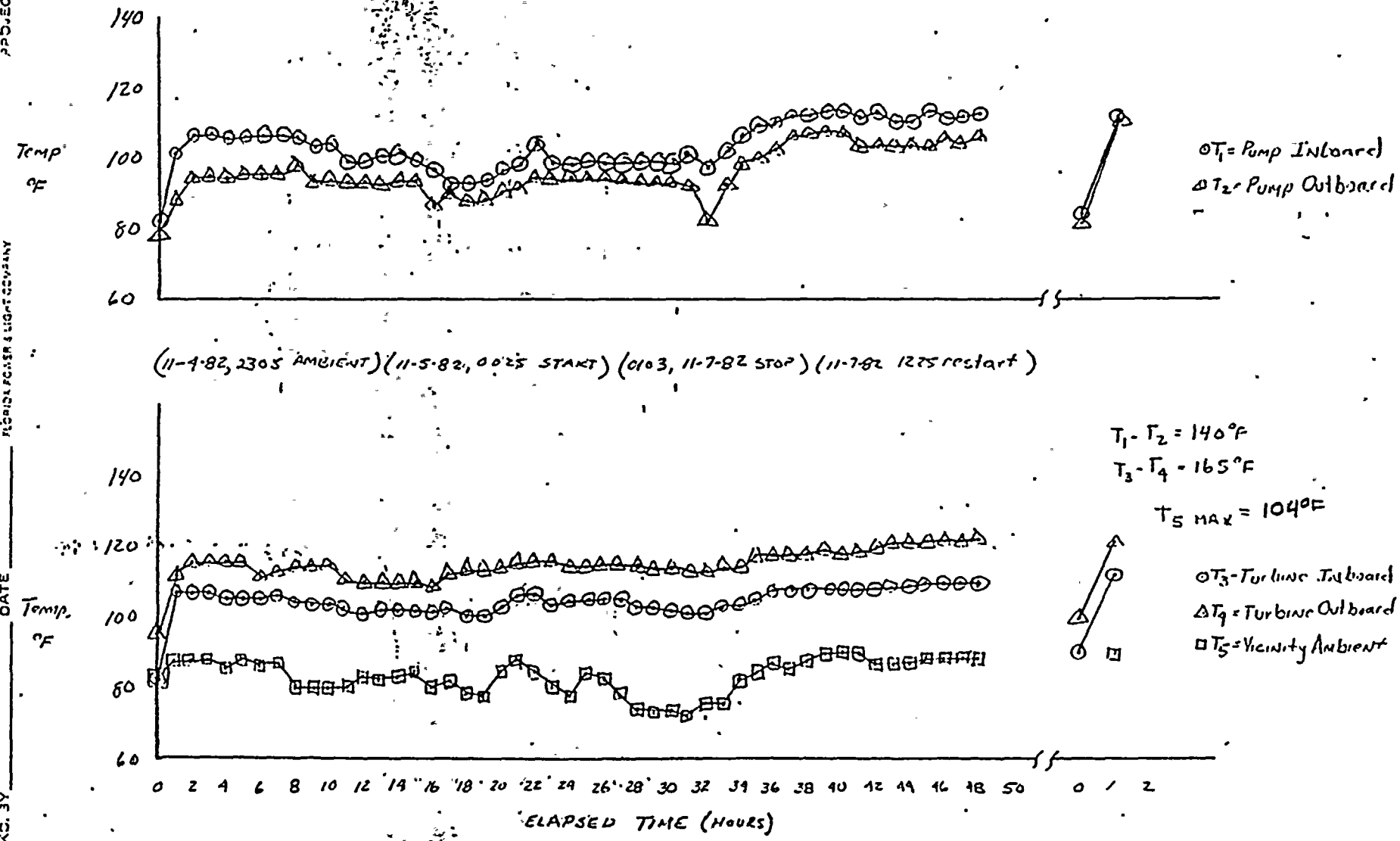

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Figure 7

CUSTOMER EBASCO / FLA. P&L.	DESIGN CONDITIONS	Ingersoll-Rand	CURVE N-753, Rev. 0
PROPOSAL NO. NY-3236-13 ITEM	GPM 300 ① EFF 64		PUMP 2HMTA-10
SPECIAL NOTES MOTOR DRIVEN AUX. FEED MIN FLOW REQ'D 50 GPM	T.H. (FT.) 2660 BHP 315 SG.		Curves are approximate. Pump is guaranteed for one set of conditions. Capacity, head and efficiency guarantees are based on shop test and when pumping clean, cold, fresh water at a temperature of not over 85 degrees and not over 15' suction lift.
	RPM 3570 DRIVER HP MOTOR 350 HP WITH 1.15 S.F.	DRAWN BY RBE DATE 3 MAR 76	

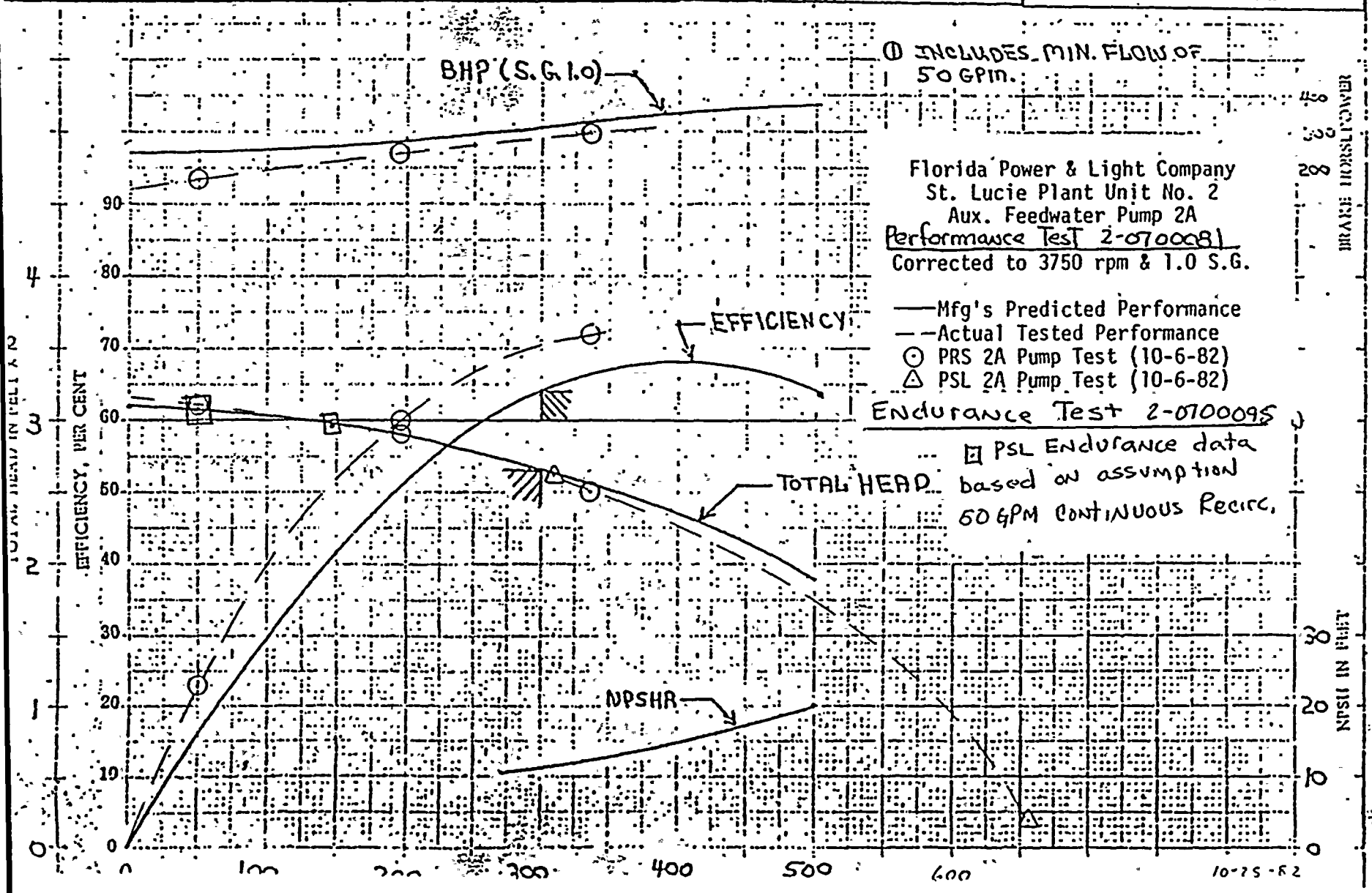


Figure 8

CUSTOMER EBASCO / FLA. P&L.	DESIGN CONDITIONS	Ingersoll-Rand	CURVE N-753, Rev. 0
PROPOSAL NO. NY-3236-13 ITEM	GPM 300 ① EFF 64		PUMP 2HMTA-10
SPECIAL NOTES MOTOR DRIVEN AUX. FEED MIN FLOW REQ'D 50 GPM	T.H. (FT.) 2660 BHP 315 SG. RPM 3570 DRIVER HP MOTOR 350 HP WITH 1.15 S.F.	DRAWN BY RBE DATE 3 MAR 76	Curves are approximate. Pump is guaranteed for one set of conditions. Capacity, head and efficiency guarantees are based on shop test and when pumping clear, cold, fresh water at a temperature of not over 85 degrees and not over 15' suction lift.

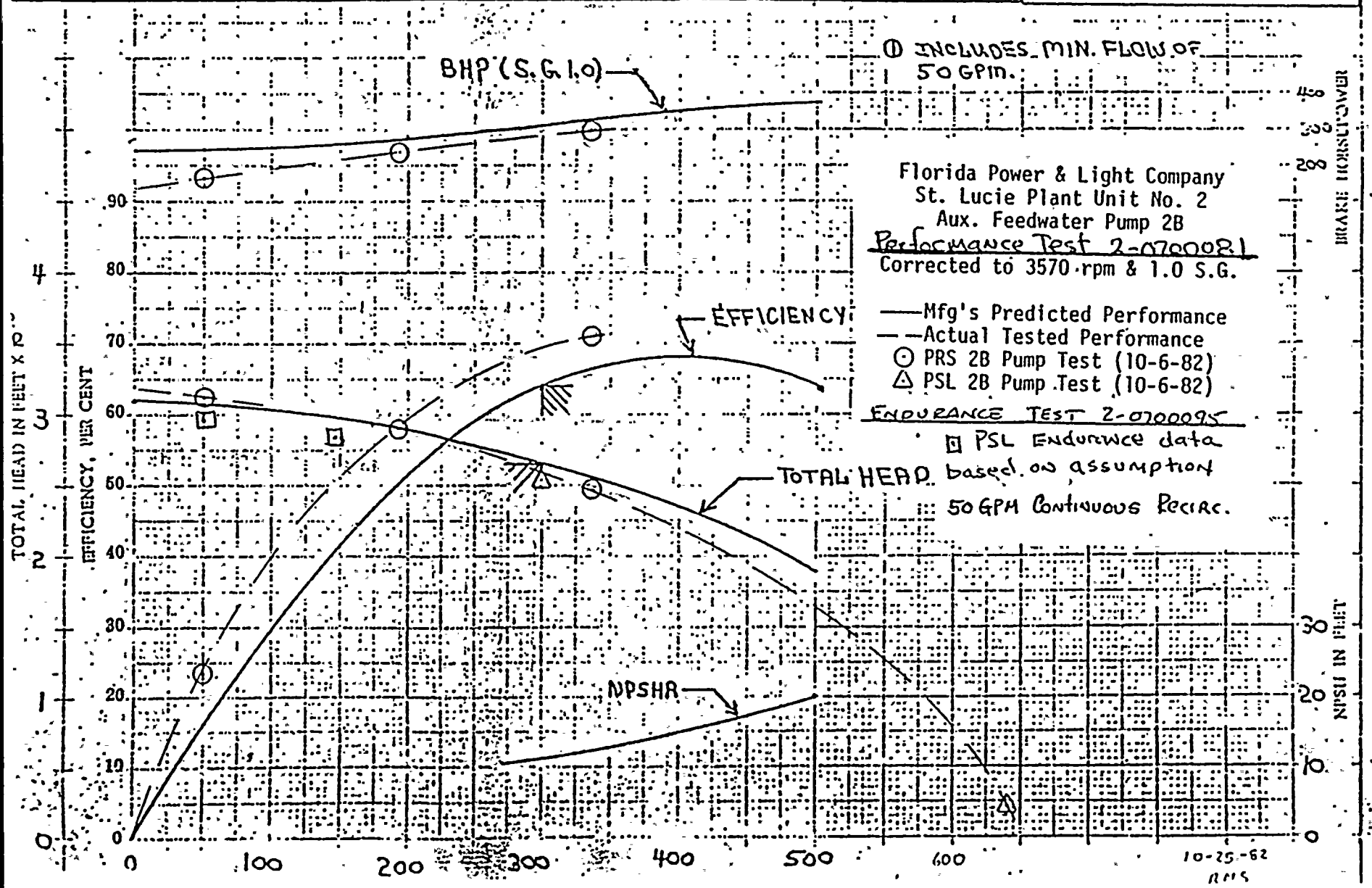
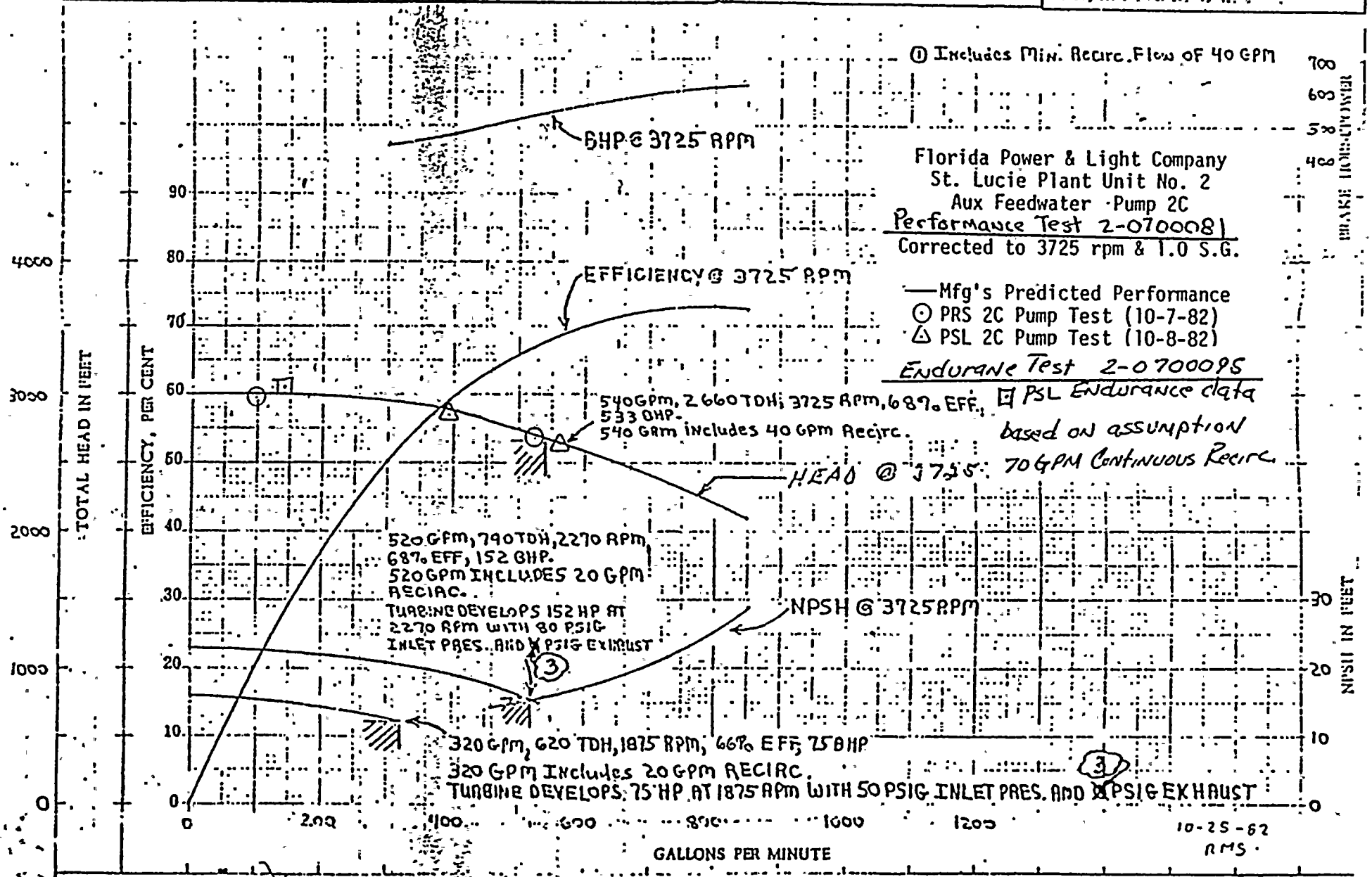


Figure 9

CUSTOMER EBASCO / FLOR. P.&L.	DESIGN CONDITIONS	Ingersoll-Rand	CURVE N-754, Rev. 2
PROPOSAL NO. 031-34285 ITEM	GPM 540 ① EFF 68%		PUMP 4 HMTA-7
SPECIAL NOTES Turbine Driven Aux. Feed Min. Recirc. Flow Reqd - 40 GPM AT DESIGN CONDITIONS	T.H. (FT) 2660 BHP 533 SG. RPM 3725 DRIVER Turbine HP	DRAWN BY RRR CJN DATE 2-6-86	Curves are based on a single impeller tested for one set of conditions. Capacity, head and efficiency are guaranteed for one impeller at speed and specific gravity when handling clean, cold fresh water at a temperature of not over 85 degrees F. not over 15 feet elevation.



CURVE N-754, REV. 2