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ERDA 10MW$_e$ SOLAR PILOT PLANT SUBSYSTEM RESEARCH EXPERIMENTS, STEAM GENERATOR TESTS AT NORTHERN STATES POWER RIVERSIDE STATION

Volume V: Test Number 20

April 19, 1977

Work Performed Under Contract No. EY-76-C-03-1109

Honeywell, Inc.
Energy Resources Center
Minneapolis, Minnesota

U.S. Department of Energy

Solar Energy

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ERDA 10 MWe SOLAR PILOT PLANT
SUBSYSTEM RESEARCH EXPERIMENTS

VOLUME V

STEAM GENERATOR TEST NO. 20

NORTHERN STATES POWER RIVERSIDE STATION

APRIL 19, 1977

ERDA CONTRACT E(04-3)-1109

Honeywell
Energy Resources Center
2600 RIDGWAY PARKWAY,
MINNEAPOLIS, MINNESOTA 55413

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SECTION 1

EXPLANATORY SHEETS

Summary of SRE Steam Generator Testing

TEST NUMBER	DATE 1977	DURATION (HOURS)	OBJECTIVE	PEAK POWER (Mw) IN/OUT*	MANUFACTURER'S OPERATING MANUAL REFERENCE	DIFFICULTIES**
1	3/11	7.25	INITIAL STEAMING		3.0	RECIRCULATION PUMP INSTABILITY
2	3/14	4.95	RELIEF VALVE SETTING		3.0	DAC P-T OUTPUT
3	3/16	9.87	RELIEF VALVE SETTING SATURATION CHECK OF T/C		3.0	480-V CIRCUIT BREAKER TRIPS
4	3/17	4.55	RECIRCULATION VERSUS DRUM LEVEL COOLING WATER INSTRUMENTATION		3.0	- DAC INTERMITTENT - COOLING WATER PLUGGING
5	3/18	12.93	STEADY STATE AT HIGHER POWER TUNE AUTOMATIC CONTROLS		3.0	- ZONE 3 CIRCUIT BREAKER TRIP - ATTEMPERATOR AUTO CONTROL
6	3/19	9.93	TUNE AUTOMATIC CONTROLS		3.0	ZONE 3 CIRCUIT BREAKER TRIP
7	3/21	13.83	TUNE AUTOMATIC CONTROLS		3.0	ZONE 3 CIRCUIT BREAKER TRIP
8	3/22	10.00	CALIBRATE SIMULATOR AND CHECK FULL RANGE OPERATION		3.0	FAILED MANY LAMPS IN ARRAY
9	3/28	7.93	CHECK R/A AFTER RE-LAMPING STEADY STATE CHECKS; AUTO CONTROL TUNING	2.07/1.4	4.0	ZONE 3 TRIP PROBLEM
10	3/29	3.83	DETERMINE CAUSE OF ZONE 3 TRIP; STEADY STATE DATA		4.0	ZONE 3 TRIP; NO STEADY STATE DATA
11	3/30	6.25	CONFIRM CORRECTION OF ZONE 3 TRIP REPAIR; TAKE STEADY STATE DATA	2.07/1.4	4.0	ZONE 3 TRIP PROBLEM
12	3/31	3.04	ZONE 3 TRIP INVESTIGATION; STEADY STATE DATA	3.84/2.76	4.0	ZONE 3 TRIP 18 LAMPS FAILED
13	4/2	2.5	TAKE HEAT BALANCE DATA		4.0	NSP FEEDWATER FAILURE
14	4/4	5.5	CALIBRATE R/A POWER DELIVERY			ZONE 1 CIRCUIT BREAKER FAILED
15	4/7	5.0	R/A POWER DELIVERY CALIBRATION AND INSTALL 420V LIMITING			ZONE 3 POWER CONTROL CIRCUITRY
16	4/11	6.5	REPEAT TESTS 11 AND 12 TO NOTE EFFECT OF BOILER PAINTING	2.07/1.4	4.0	35 LAMPS FAILED

113.86

Summary of SRE Steam Generator Testing -- Concluded

TEST NUMBER	DATE 1977	DURATION (HOURS)	OBJECTIVE	PEAK POWER (Mw) IN/OUT*	MANUFACTURER'S OPERATING MANUAL REFERENCE	DIFFICULTIES**
17	4/13	10.7	TRANSIENT: MAIN STEAM	4.1/3.0	5.1.1	- 100 LAMPS FAILED
			TRANSIENT: RADIANT ARRAY		5.1.3	- DAC RECORDING STOPPED
			TRANSIENT: DRUM SHRINK-SWELL		5.1.4	DURING "SHRINK SWELL"
18	4/15	10.5	TRANSIENT: POWER RAMP		5.1.5	- 154 LAMPS FAILED
			CLOUD OBSTRUCTION		5.1.6	- DAC REMOTE CABINET OUTAGES
			ATTEMPERATOR		5.1.2	
			POWER		5.1.7	
19	4/18	6.7	TRIP: RECIRCULATION PUMP		6.1.2	NONE
			FEEDWATER PUMP		6.1.4	NONE
			RECIRCULATION PUMP STABILITY		---	
			STEADY STATE		---	
			TRANSIENT: POWER STEP INCREASE		---	
20	4/19	10.5	TRIP: HELIOSTAT - 800°F		6.1.1	LOW NSP WATER RESERVES
			TRIP: HELIOSTAT - 700°F		6.1.1	
			TRIP: HELIOSTAT - 595°F		6.1.1	
			TRANSIENT: SHRINK-SWELL (REPEAT)		5.1.4	
			TUNE ATTEMPERATOR CONTROL		---	
21	4/21	29.5	ASYMMETRIC HEAT INPUT	3.8/2.7	7.1.1	20 LAMPS FAILED
	4/22				7.1.2	DAC INTERMITTENT
						LOW NSP WATER SUPPLY
						SCR COOLING WATER PLUGGED
						SIMULATOR ZONE 1
22	4/26	11.75	STEADY STATE AND TRANSIENT		4.0	FAILED 31 LAMPS
			TESTS - WITH AUTOMATIC		5.0	LEAKAGE AT ATTEMPERATOR
			ATTEMPERATION			WATER SUPPLY FLANGE
23	4/28	4.5	MAXIMUM POWER STEADY STATE HEAT BALANCE	5.0/3.85	4.0	FAILED 350 LAMPS

*PEAK POWER ENTRIES ARE FROM THE TEST LOG FOR PERIODS WHEN HEAT BALANCE DATA WERE BEING TAKEN.

**DIFFICULTIES SHOWN DID NOT NECESSARILY PREVENT THE TAKING OF DATA.

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TEST NO. 20

DATE: April 19, 1977

Test Objectives

1. To perform the following trip tests (Refer to Appendix A):
   a) Heliostat trip - decay to 800°F Main Steam Temperature.
   b) Heliostat trip - decay to 700°F Main Steam Temperature.
   c) Heliostat trip - decay to 595°F Main Steam Temperature.
2. To perform the shrink and swell transient with a 225-second delay until automatic control.
3. To tune the attemperator automatic control system.

Description

Testing proceeded without difficulties.

Low Northern States Power Company (NSP) water reserve forced test termination at 2000. At this point, attemperator tuning was not complete, but adequate; i.e., the controls would work through a power transient.

Problems Encountered

Low NSP water reserves.

Code Sheet for Recorder Charts

Recorder Number	Pen or Point Number	Process Variable	Data Source	Scale Range
RCD-1	1, Red	Main Steam Flow	FT-3	0-18,000 lb/hr*
	2, Blue	Drum Inlet Feedwater Flow	FT-1	0-18,000 lb/hr**
	3, Green	Attemperator Spraywater Flow	FT-480	0-2,000 lb/hr**
RCD-4	1, Red	Drum Water Level	LT-211	0-55 Inches†
	2, Blue	Main Steam Pressure	PT-590	0-2,100 psig
	3, Green	Trend Panel PV-1: Water Conductivity	Beckman solu-meter®	0-100 micromhos/cm††
RCD-3	1	Feedwater Temperature (F)	TE-1	0-1,000°F (K)
	2	Attemperator Inlet Temperature (F)	TE-475	0-1,000°F (K)
	3	Attemperator Outlet Temperature (F)	TE-500	0-1,000°F (K)
	4	Main Steam Temperature (F)	TE-591	
	5	Lower 1st Stage Superheater (M)	TE-405	0-1,000°F (K)
	6	Upper 1st Stage Superheater (M)	TE-452	0-1,000°F (K)
	7-10	Recirculation Pump Inlet Water Temperature (F)	TE-301	0-1,000°F (K)
	11	Lower 2nd Stage Superheater (M)	TE-507	0-1,000°F (K)
	12	Upper 2nd Stage Superheater (M)	TE-550	0-1,000°F (K)

*lb/hr. at 955°F, $\rho = 2.06\ lb_m/ft^3$

**lb/hr. at 440°F, $\rho = 52.52\ lb_m/ft^3$

(F): Fluid Temperature

(M): Metal Temperature

†Datum is centerline of lower pipe; transmitter output is for 80°F water; alarm and trips set for 620°F water.

††Specific conductance at 25°C.

Parameter Identification Legend: Operator and Performance Summaries

LABEL	PARAMETER	UNITS	SOURCE (5)
OPERATOR SUMMARY BOILER DRUM			
P-D	Pressure, drum	psig	PT-230
T-D	Temperature, drum	°F	CALC.
L-D	Level, drum	Inches above-55" reference	LT-210
W-FW	Flow, feedwater	Lbs_m/Hour	FT-1
W-BD	Flow, blowdown	Lbs_m/Hour	FT-260
PUMP			
W-B	Flow, boiler recirculation	Lbs_m/Hour	FT-310
T-DC	Temperature, downcomer	°F	TE-300
T-SUB	Temperature, pump suction subcooling	°F	CALC.
T-PC	Temperature, pump coolant	°F	TE-306
SUPERHEATER 1			
TE-	Temperature, thermocouples	°F	TE-420-440; 406-409; 450-454; 455-466
T-S1I	Temperature, steam, superheater inlet	°F	TE-400-402
W-ATT	Flow, attemperator water	Lbs_m/Hour	FT-480
SUPERHEATER 2			
TE-	Temperature, thermocouples	°F	TE-520-540; 506-509; 550-554; 555-566
T-S2O	Temperature, steam, superheater outlet	°F	TT-590
P-S2O	Pressure, steam, superheater outlet	psig	PT-590
W-S2	Flow, superheater	Lbs_m/Hour	FT-3
POWER			
BOILER ABS	Absorbed power, boiler	Kilowatts	CALC.
S.H. #1 ABS	Absorbed power, superheater	Kilowatts	CALC.
S.H. #2 ABS	Absorbed power, superheater	Kilowatts	CALC.
TOTAL INPUT	Net power input (1)	Kilowatts	CALC.
TOTAL ABSORBED	Absorbed power, steam generator	Kilowatts	CALC.
POWER RATIO	$\frac{\text{Total Absorbed}}{\text{Total Input}}$	Dimensionless	

(1) Electrical power to Radiant Array minus cooling water heat absorbed.

(2) Recirculation flow divided by Superheater #1 flow.

(3) Reciprocal of recirculation ratio (N-CR).

(4) Electrical power to Radiant Array minus cooling water heat absorbed.

(5) Sources are cited by transmitter or thermocouple designations as indicated in the P & ID Diagrams, or as calculated (Calc.) by the Data Acquisition System (DAC) (i.e., enthalpies, power). Transmitter and thermocouple raw outputs are modified by the DAC to provide readouts in engineering units.

Parameter Identification Legend: Operator and Performance Summaries--Continued

LABEL	PARAMETER	UNITS	SOURCE (5)
PERFORMANCE SUMMARY BOILER DRUM			
P-D	Pressure, drum	psig	PT-230
T-D	Temperature, drum	°F	CALC.
H-GD	Enthalpy, drum steam	BTU/Lb_m	CALC.
H-FD	Enthalpy, drum water	BTU/Lb_m	CALC.
N-CR	Recirculation ratio (2)	Dimensionless	CALC.
FEEDWATER			
P-FW	Pressure, feedwater	psig	PT-1
T-FW	Temperature, feedwater	°F	TE-19
W-FW	Flow, feedwater	Lb_m/Hour	FT-1
H-FW	Enthalpy, feedwater	BTU/Lb_m	CALC.
FLOW CIRCUITS			
T-DC	Temperature, downcomer	°F	TE-300
T-SUB	Temperature, pump suction subcooling	°F	CALC.
W-B	Flow, boiler recirculation	Lbs_m/Hour	FT-310
W-BC1	Flow, boiler circuit (Transmitter #1)	Lb_m/Hour	FT-350
W-BC2	Flow, boiler circuit (Transmitter #2)	Lb_m/Hour	FT-351
W-BC3	Flow, boiler circuit (Transmitter #3)	Lb_m/Hour	FT-352
X-B	Quality, boiler steam (3)	Dimensionless	CALC.
SUPERHEATERS S.H. Stage 1			
W-SI	Flow, superheater #1	Lb_m/Hour	WS2-WATT
T-S1I	Temperature, steam, superheater inlet	°F	TE-400-402
T=S1O	Temperature, steam, superheater outlet	°F	TE-476
P-S1O	Pressure, steam, superheater outlet	psig	PT-475
H-S1O	Enthalpy, steam, superheater outlet	BTU/Lb_m	CALC.

(1) Electrical power to Radiant Array minus cooling water heat absorbed.

(2) Recirculation flow divided by Superheater #1 flow.

(3) Reciprocal of recirculation ratio (N-CR).

(4) Electrical power to Radiant Array minus cooling water heat absorbed.

(5) Sources are cited by transmitter or thermocouple designations as indicated in the P & ID Diagrams, or as calculated (Calc.) by the Data Acquisition System (DAC) (i.e., enthalpies, power). Transmitter and thermocouple raw outputs are modified by the DAC to provide readouts in engineering units.

Parameter Identification Legend: Operator and Performance Summaries--Concluded

LABEL	PARAMETER	UNITS	SOURCE (5)
ATTEMPERATOR			
P-ATT	Pressure, attemperator water inlet	psig	PT-1
T-ATT	Temperature, attemperator water inlet	°F	TE-480
W-ATT	Flow, attemperator water	Lb_m/Hour	FT-480
H-ATT	Enthalpy, attemperator water	BTU/Lb_m	CALC.
S.H. Stage 2			
W-S2	Flow, superheater #2	Lb_m/Hour	FT-3
T-S2I	Temperature, superheater #2 inlet	°F	TE-500,501
T-S2O	Temperature, steam, superheater outlet	°F	TT 590
P-S2O	Pressure, steam, superheater outlet	°F	PT 590
H-S2O	Enthalpy, steam, superheater outlet	BTU/Lb_m	CALC.
BOILER			
L-D	Level, drum	Inches above-55" reference	LT 210
T-BI	Temperature, boiler inlet	°F	TE-310, 311
H-BI	Enthalpy, boiler inlet	BTU/Lb_m	CALC.
R-BI	Density, boiler inlet	Lb_m/Ft^m	CALC.
R-GD	Density, drum steam	Lb_m/Ft	CALC.
R-FD	Density, drum water	Lb_m/Ft	CALC.
POWER			
Boiler ABS	Absorbed power, boiler	Kilowatts	CALC.
S.H. #1 ABS	Absorbed power, superheater	Kilowatts	CALC.
S.H. #2, ABS	Absorbed power, superheater	Kilowatts	CALC.
Total Input	Net power input (4)		CALC.
Total Absorbed	Absorbed power, steam generator	Kilowatts	CALC.
Power Ratio	Total Absorbed / Total Input	Dimensionless	CALC.

(1) Electrical power to Radiant Array minus cooling water heat absorbed.

(2) Recirculation flow divided by Superheater #1 flow.

(3) Reciprocal of recirculation ratio (N-CR).

(4) Electrical power to Radiant Array minus cooling water heat absorbed.

(5) Sources are cited by transmitter or thermocouple designations as indicated in the P & ID Diagrams, or as calculated (Calc.) by the Data Acquisition System (DAC) (i.e., enthalpies, power). Transmitter and thermocouple raw outputs are modified by the DAC to provide readouts in engineering units.

SRE Steam Generator Thermocouple Identifications/Locations

	AZIMUTH	#1 SUPERHEATER				#2 SUPERHEATER			
SUPERHEATER OUTSIDE* OF TUBES									
ROW 6	345	420	426	432	438	520	526	532	538
ROW 5	30	425	431	437		525	531	537	
ROW 4	120	424	430	436		524	530	536	
ROW 3	210	423	429	435		523	529	535	
ROW 2	240	422	428	434	440	522	528	534	540
ROW 1 (HOT SPOT)	300	421	427	433	439	521	527	533	539
SUPERHEATER INSIDE* OF TUBES AT BEGINNING OF THE HEATED LENGTH									
NEAR ROW 1		406				506			
NEAR ROW 3		407				507			
NEAR ROW 4		408				508			
NEAR ROW 5		409				509			
SUPERHEATER INSIDE* OF TUBES AT BEGINNING OF THE HEATED LENGTH									
NEAR ROW 1		450				550			
NEAR ROW 2		451				551			
NEAR ROW 3		452				552			
NEAR ROW 4		453				553			
NEAR ROW 5		454				554			
SUPERHEATER OUTSIDE* OF TUBES NEAR FLOW EXIT									
	330	455				555			
	300	456				556			
	270	457				557			
	240	458				558			
	210	459				559			
	180	460				560			
	150	461				561			
	120	462				562			
	90	463				563			
	60	464				564			
	30	465				565			
	0	466				566			

SRE Steam Generator Thermocouple Identifications/Locations--Concluded

BOILER	AZIMUTH	LOWER TANGENT** ←							→ NEAR UPPER TANGENT**
ROW 1	~ 10		333		332		331		330
ROW 2	~ 45		337		336		335		334
ROW 3	90		341		340		339		338
ROW 4	~140	349	348	347	346	345	344	343	342
ROW 5	~187½		353		352		351		350
ROW 6	~235	361	360	359	358	357	356	355	354
ROW 7	270	369	368	367	366	365	364	363	362
ROW 8 HOT SPOT (300°)	~295	377	376	375	374	373	372	371	370
ROW 9	~305	385	384	383	382	381	380	379	378
ROW 10	330		389		388		387		386

DRUM

T/C#	
210	DRUM SURFACE: ADJACENT TO FEEDWATER (FW) INLET
211	DRUM SURFACE: FW INLET PLANE AT 270° AZIMUTH
212	DRUM SURFACE: 11" BELOW UPPER TANGENT AT 270° AZIMUTH
213	DRUM SUPPORT: ~240° AZIMUTH
214	DRUM GUSSET 1" FROM DRUM SURFACE: ~240° AZIMUTH
215	DRUM SURFACE 1" FROM T/C #214
216	FW INLET PIPE ~1/2" FROM WELD
217	DRUM SURFACE ~1/2" FROM DOWNCOMER PIPE AT 0° AZIMUTH

* WITH RESPECT TO STEAM GENERATOR CAVITY.

** WITH RESPECT TO VERTICAL SECTION OF BOILER TUBE.

Explanation of Array Flux Map

INCIDENT FLUX SENSOR	LOCATION	
IF 1	4 INCHES ABOVE TOP OF BOTTOM REFLECTOR	THERE IS 15.5 IN. OF VERTICAL SEPARATION BETWEEN ADJACENT SENSORS IF 1 THROUGH IF 10.
IF 10	6 INCHES FROM CEILING	
IF 11	40 INCHES FROM CENTER OF CEILING AT CEILING	
IF 12	20 INCHES FROM CENTER OF CEILING AT CEILING	

IF 1 THROUGH IF 4 ARE IN THE BOILER REGION
IF 5 IS ON THE LINE BETWEEN THE BOILER AND S.H. NO. 1
IF 6 THROUGH IF 7 ARE IN THE S.H. NO. 1 REGION
IF 8 THROUGH IF 10 ARE IN THE S.H. NO. 2 REGION
IF 11 THROUGH IF 12 ARE IN THE CEILING REGION

BOOM POSITION	AZIMUTH	COMMENTS
1	20°	
2	30°	
.	.	
.	.	
.	.	
8	90°	East
.	.	
.	.	
17	180°	South
.	.	
.	.	
26	270°	West
.	.	
.	.	
.	.	
34	350°	
35	360° (0°)	North - not read.
36	10°	Not read.

Each incident flux sensor measures the incident flux over azimuthal positions 1 through 34. Positions 35 and 36 cannot be read due to the design of the flux boom which switches its direction of angular motion before revolving a full 360°.

The boom positions correspond to the center positions of each of the 18 boiler panels and to their intersections.

The unit of flux for each sensor is [hundreds of watts per square meter]

Data Acquisition System Real Time Plot Format

1. PLOT HEADERS
   - NUMBER OF RECORDS - TOTAL VARIABLES PLOTTED (ARGUMENT PLUS FUNCTIONS)
   - ARGUMENT SELECTED - INDEPENDENT VARIABLE - (1 THROUGH 4 IS TIME)
   - FUNCTION NUMBERS - DEPENDENT VARIABLES PLOTTED, NUMBERS SHOWN ON GROUP LIST BELOW
   - SEARCH MODE - SOFTWARE FUNCTION
   - PLOT START TIME - TIME OF DAY IN SECONDS (I.E., 8 AM = 28,800 SEC.)
   - (NO.) POINTS SKIPPED - RECORD SKIP FACTOR (PLOT ONLY Nth POINTS OF ALL DATA TAKEN)
   - POINTS PLOTTED

2. PLOT GROUPING AND IDENTIFIERS

2.1 FLOWS - LBM/HR.	
• 8 - WFW	
• 10 - WS2	
• 17 - WS1	SECTION 4.14 (PAGE 14)
• 9 - WATT (*)	
• 11 - WBD (*)	
2.2 PRESSURES - PSIG	
• 18 - PD	
• 19 - PFW	SECTION 4.15 (PAGE 15)
• 20 - PS10	
• 21 - PS20	
2.3 FLUID TEMPS. DEG. F.	
• 22 - TBI	
• 24 - TFW	
• 26 - TS10	SECTION 4.16 (PAGE 16)
• 27 - TS1I	
• 28 - TS20	
• 29 - TS2I	
2.4 METAL TEMPS. DEG. F.	
• 12 - TE4ØØ	
• 13 - TE4Ø1	
• 14 - TE4Ø2	SECTION 4.17 (PAGE 17)
• 23 - TDC	
• 32 - TAS1	
• 33 - TAS2	
2.5 DRUM LEVEL - INCHES (*)	
• 30 - LD	SECTION 4.18 (PAGE 18)
2.6 RECIRC. FLOW (*)	
• 31 - WB	SECTION 4.19 (PAGE 19)
2.7 POWER LEVELS -	
• 6 - QABS	
• 7 - QIN	SECTION 4.20 (PAGE 20)
• 15 - QB	
• 16 - QS2	

(*) OPTIONAL VARIABLES/PLOTS

Ø = ZERO

Plot Labels and Descriptors

NUMBER	LABEL	DESCRIPTOR	WHERE USED
1-4	time		
5	year		
6	QABS	Total Absorbed Power	A-series, B-series, F-F-series, G1-1
7	QIN	Total Input Power	E1-1, G16-1, G16-2
8	WFW	Feedwater Flow	A1-4, G2-3, E2-1
9	WATT	Attemperator Flow	A1-2, E2-1, G3-1
10	WS2	Steam Flow	A1-1, E2-1, G2-1, B1b-2
11	WBD	Blowdown Flow	A1-3, E2-1
12	TE4ØØ		
13	TE4Ø1	Superheater #1 Inlet Temperature	
14	TE4Ø2		
15	QB	Boiler Absorbed Power	A6-1, F5-1, F6-1, G1-1
16	QS2	Second Stage Superheater Absorbed Power	A6-3, F5-3, F6-3, G1-4
17	WS-1	First Stage Superheater Flow	G2-1
18	PD	Drum Pressure	G4-1
19	PFW	Feedwater Pressure	G4-2
20	PS10	First Stage Superheater Outlet Pressure	A3-2, G5-1
21	PS20	Second Stage Superheater Outlet Pressure	A3-3, G5-2
22	TBI	Boiler Inlet Temperature	A5-2, G6-2
23	TDC	Downcomer Temperature	A5-1, G6-3
24	TFW	Feedwater Temperature	A2-1, G6-4

Plot Labels and Descriptors--Concluded

NUMBER	LABEL	DESCRIPTOR	WHERE USED
25	TATT	Attemperator Supply Temperature	A2-2, G6-5
26	TS1)	First Stage Superheater Outlet Temperature	A2-4, G7-1
27	TS1I	First Stage Superheater Inlet Temperature	
28	TS20	Second Stage Superheater Outlet Temperature	A2-6, G7-3
29	TS2I	Second Stage Superheater Inlet Temperature	A2-5, G7-2
30	LD	Drum Level	G-12
31	WB	Boiler Flow	A4-1, G13-1
32	TAS1	First Stage Superheater Average Metal Temp.	G15-1
33	TAS2	2nd Stage Superheater Average Metal Temp.	G15-2
51	QABS/QIN	Power Ratio	E-1
52	(WFW + WATT) / (WS2 + WBD)	Flow Ratio - Mass Balance	E-2
53	(WS2 + WBD)	Outlet Flows	E-2
54	(TD-TE400)	Drum-to-Superheater Temp. Loss	E-3.3
55	(TD-TE401)	Drum-to-Superheater Temp. Loss	E-3.3
56	(TD-TE402)	Drum-to-Superheater Temp. Loss	E-3.3
57	HS10	Steam Enthalpy, S.H. 1 Outlet	G-8.1
58	HS2I	Steam Enthalpy, S.H. 2 Inlet	G-8.2
59	HS20	Steam Enthalpy, S.H. 2 Outlet	G-8.3
60	H-GD	Drum - Steam Enthalpy	G-9.2
61	H-FD	Drum - Water Enthalpy	G-9.1
62	H-BI	Boiler Inlet Water Enthalpy	G-9.3
63	X-B	Boiler Outlet (Drum) Steam Quality	G-14

Radiant Array Calibration

POWER SETTING%	ZONE 1			ZONE 2			ZONE 3			ZONE 4		
	KW	LAMP VOLTS	CONTROL VOLTS	KW	LAMP VOLTS	CONTROL VOLTS	KW	LAMP VOLTS	CONTROL VOLTS	KW	LAMP VOLTS	CONTROL VOLTS
0												
10	210.5	134.5	0.44	224.4	138.7	0.47	229.5		0.45	230.4		0.45
20	420	209.3	0.89	445.5	217.3	0.97	460.8		0.90	459		0.90
30	633	270	1.34	682.5	284.3	1.47	679.5		1.35	670.5		1.35
40	849	322.7	1.79	922.5	340.3	1.97	909		1.80	900		1.79
50	1065	367.3	2.25	1155	396	2.48	1120.5		2.25	1120.5		2.24
60	1278	420	2.70	1287(2)	420.7	2.76	1350		2.71	1341		2.70
70							1575		3.16	1566		3.15
80							1809		3.60	1800		3.60
90												
100												
KW/Volt (1)	473			464.8			500.9			499		

(1) Based on averages in which 10% values were omitted for Zones 1 and 2; 10% to 20% values were omitted for Zones 3 and 4.

(2) Apparently erroneous

Data Acquisition System Printout Listing

PAGE NUMBER	TITLE
1	Operator Summary
2	Performance Summary
3	Base Data Report -- Metal Temperatures
4	Base Data Report -- Fluid
5	Cooling Water Temperature
6	First Stage Superheater Metal Temperatures
7	Second Stage Superheater Metal Temperatures
8	Boiler Temperature Profile
9	First Stage Superheater Temperature Profile
10	Second Stage Superheater Temperature Profile
11	Warnings and Alarms Report
12	Alarm Conditions
13	Array Flux Map
14	Flows, Plots
15	Pressures, Plots
16	Fluids Temperatures, Plots
17	Metal Temperatures, Plots
18	Drum Level, Plots
19	Recirculation Flow, Plots
20	Power Levels, Plots
21	Enthalpy
22	Ratios

SECTION 2

DATA SHEETS: TEST RUN LOG BOOK PAGES

TEST NO. 20
DEV. NO.
PAGE 1 OF 4

DATE 19 Apr 77

TIME	OPERATOR ACTION	COMMENTS
0900	START Recirc Pump	While Elevating ARRAY INTO Boiler WITH 2% Power on Zones 1 Thru 4
0927	15% Power To Zones 3 & 4	
0932	Open Superheater DRAINS	
0949	Increase Power To Zones 3 & 4 To 20%	
1021	Close BLOWDOWN Close WATER Sample Close CV-1 (Steam) Close Feedwater, CV-2	Bottle-up For Pressure Escalation.
1048	Open CV-10 Open CV-1 To 80%	
1049	Increase Power To 30% To Zones 3 & 4	
1050	Open CV-1 To 75%	
1051	Increase Steam Flow Open CV-1 To 70%	
1052	10% Power To Zones 1 & 2	
1102	40% Power To Zones 3 & 4	
1120	Increase Power as Follows: Zone 1 33% Zone 2 31% Zone 3 42% Zone 4 42%	 1.49 v 1.53 v 1.87 v 1.87 v

90

DATE 19 APR 77

TEST NO. 20
DEV. NO.
PAGE 2 OF 4

TIME	OPERATOR ACTION	COMMENTS
1139	Increase Zone 3 & 4 Power Zone 3 : 44% Zone 4 : 44%	 1.98 V 1.95 V
1200	Trip Simulator	Start Heliostat Trip Tests
1213	PUT F.W. CONTROL VALVES BACK ON MANUAL	VALVES STARTED JACKING OPEN + CLOSED
1240	RELIT ARRAY TO TRIP OUT SETTING	800° MAIN STEAM
1315	Trip Simulator	2nd Heliostat Trip Test.
1325	All controls To MANUAL.	Water Sample is on During These Trip Tests.
1400	Add 3 minutes Phosphate.	
1425	Resume Power. (700°F MAIN STEAM)	Automatic Drum Level Control Manual Control on Steam Pressure, Discharge Pressure
1440 1442	Open Blowdown To 500 PPH Close Blowdown	 Automatic Drum Level Doesn't Perform Right In a Transient with Blowdown
1512 1516	DAC Summary Trip Simulator	
1521	Sample Line Shutoff	
1529	Controls To Manual	

TEST NO. 20
DEV. NO.
PAGE 3 OF 4

DATE 8 APR 77

TIME	OPERATOR ACTION	COMMENTS
1703	Resume Power Drum Level on Auto Steam & Discharge on Manual	595°F Steam Temp.
1724	Add Attemperation Manually	To Control Outlet Steam Temperature.
1726	Close Attemperator	Allow unit To Stabilize For a Repeat of the Shrink & Swell Transient Test.
1759	Steam Valve (CV-1) in Manual Feedwater Valve (CV-2) in Manual Reduce Power To 80% Zone 1 26.4% Zone 2 24.8% Zone 3 35.2% Zone 4 35.2%	 1.20 v 1.22 v 1.58 v 1.55 v
1803	Switched To Automatic Feedwater Control after 225 seconds	(Water Sample and Blowdown are off)
1820	Feedwater Valve in Manual Increase Power 25% To: Zone 1 33% Zone 2 31% Zone 3 44% Zone 4 44%	 1.50 v 1.53 v 1.98 v 1.95 v
1824	Feedwater Valve in Automatic after 225 seconds.	
1827	Open Attemperator	To Limit Outlet Steam Temperature.

92

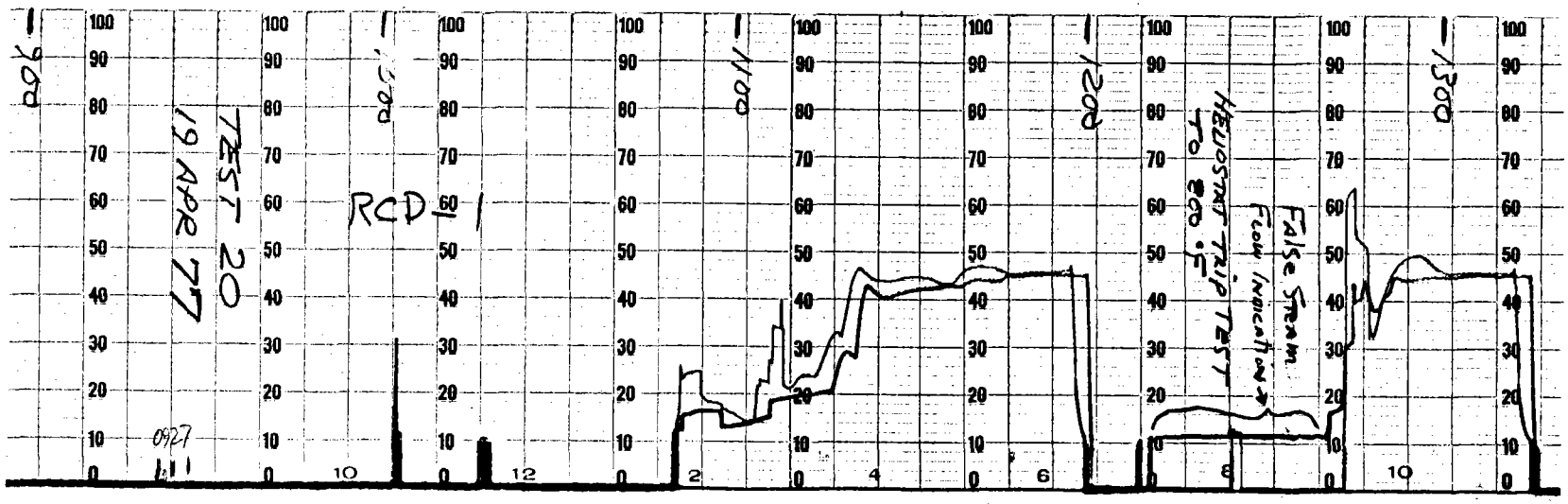
DATE 19 APR 77

TEST NO. 20
DEV. NO.
PAGE 4 OF 4

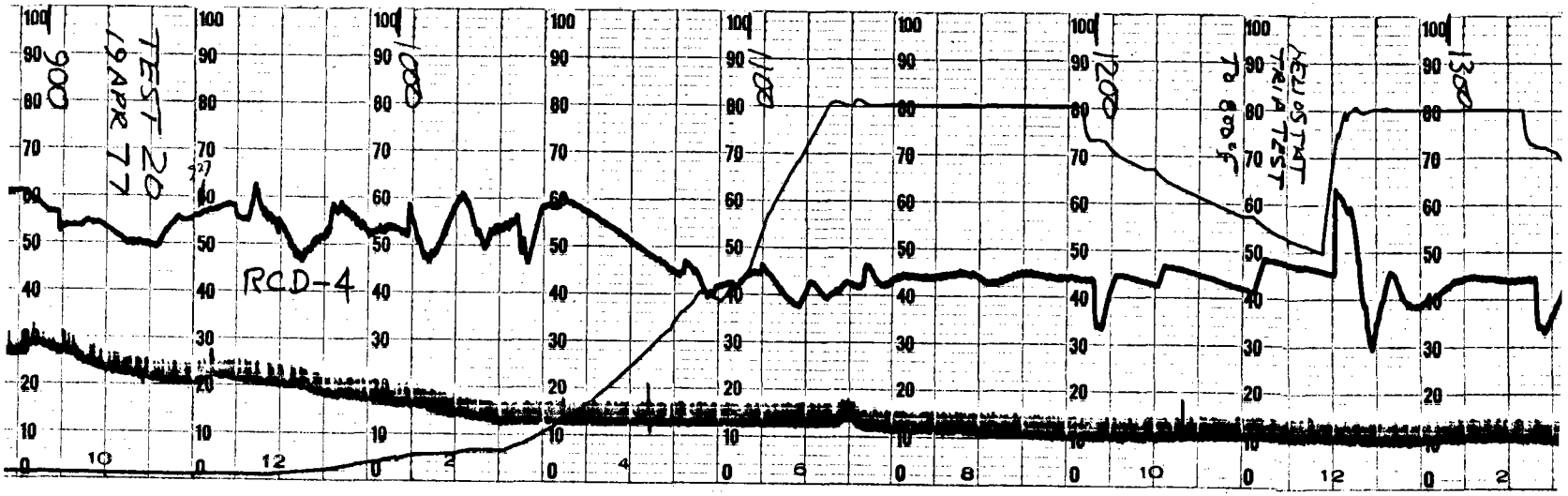
TIME	OPERATOR ACTION	COMMENTS
1830	Close Attemperator	
1834	Steam Valve on Automatic	
1841	Opened Attemperator on Manual To 30% Flow on RCD-1	Begin Attemperator Tuning
1900	Open CV-485 To Cause 36% Attemp Flow.	Move Equalibrium Temp down away From Point 6 on 12 Point Recorder.
1905	Opened Water Sample	
1910	Opened Blowdown To 500PPH	
1917	Put Attemperator on Automatic	Steam Temperature Stabilized at 881 °F
1926	Close Blowdown	Conserve Water
1932	Increase Zone 1 & 2 Power To 40%	Check Attemp. Control in a Transient
1955	Unpower Array CV-485 in Manual and Closed CV-15 in Manual and Opened To 20% CV-1 opened To 80%	Attemperator Automatic Control Worked. (It could be Tuned Better if we had More Time) Bring Unit Down
2052	Close Valve 22 & CV-10	
2125	Unpower Recirc Pump Normal Shutdown	

SECTION 3

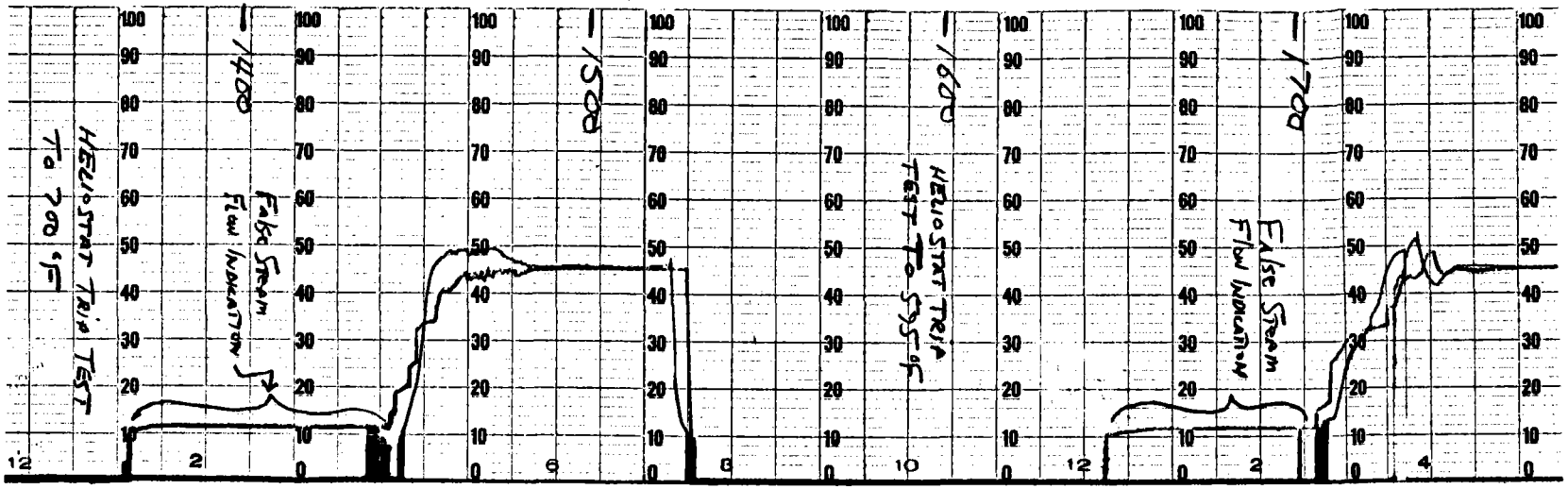
DATA SHEETS: RECORDER CHARTS


TEST 20
19 APR 77
RCD-1
HELIOSTAT TRIP TEST
TO 800 °F
FALSE STEAM
FLOW INDICATION

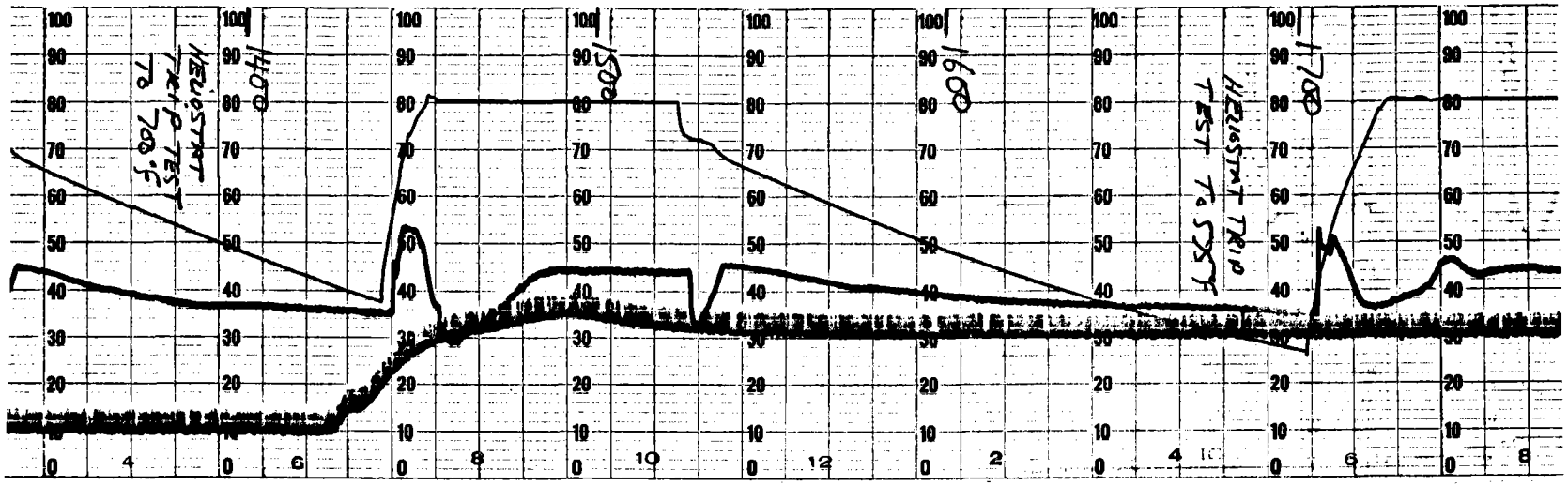
RCD-1


TEST 20
19 APR 77
RCD-4
HELIOSTAT TRIP TEST
TO 800 °F

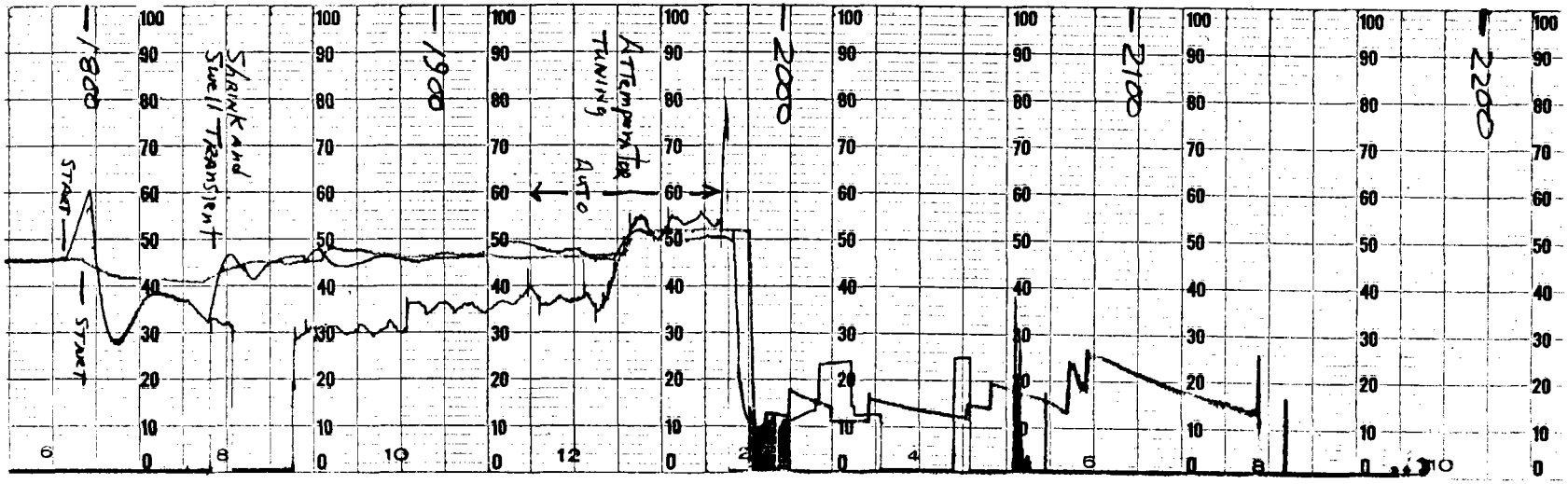
RCD-4


HELIOSTAT TRIP TEST TO 700 °F
False Steam Flow Indication
HELIOSTAT TRIP TEST TO 550 °F
False Steam Flow Indication
1400
1500
1600
1700

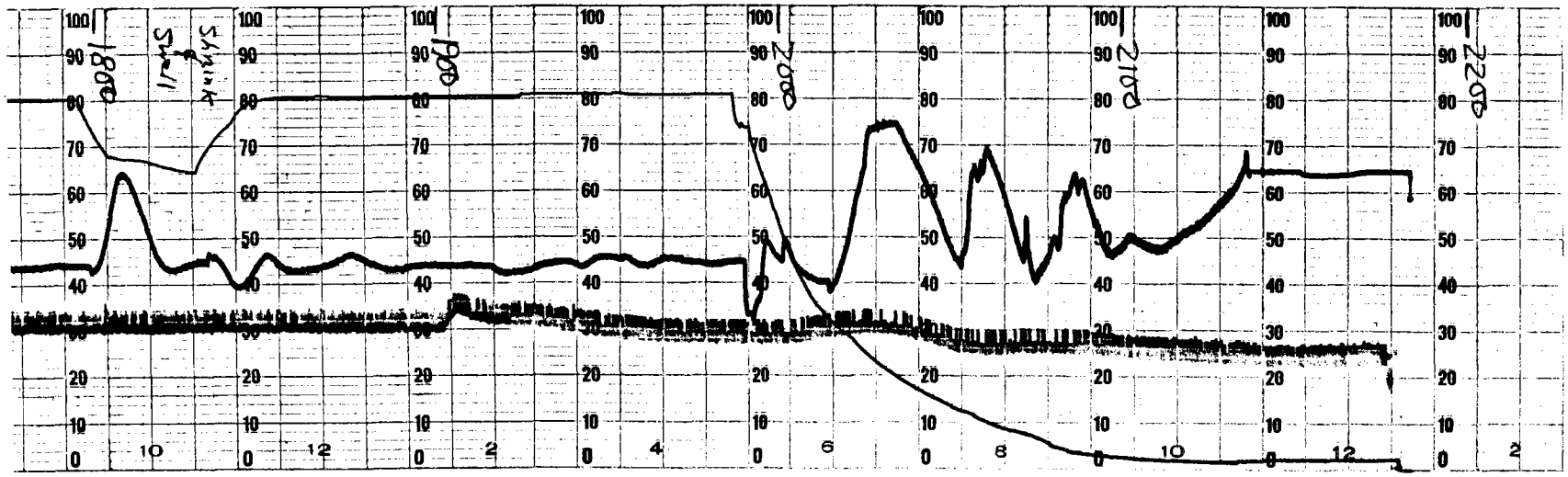
RCD-1


HELIOSTAT TRIP TEST TO 700 °F
HELIOSTAT TRIP TEST TO 550 °F
1400
1500
1600
1700

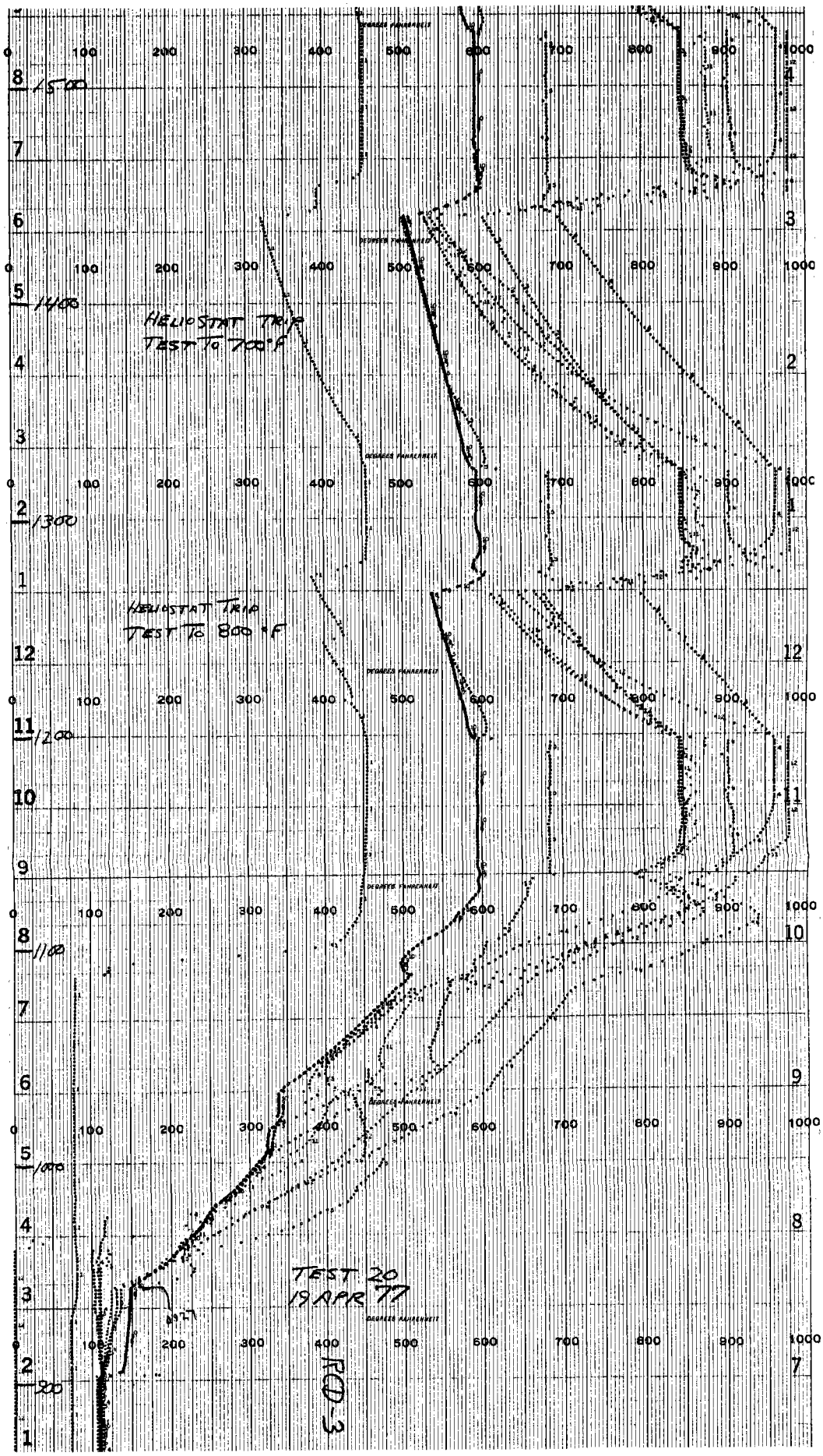
RCD-4


START
START
SHRINK AND SWELL TRANSIENT
ATTEMPT TO TUNING
AUTO
1800
1900
2000
2100
2200

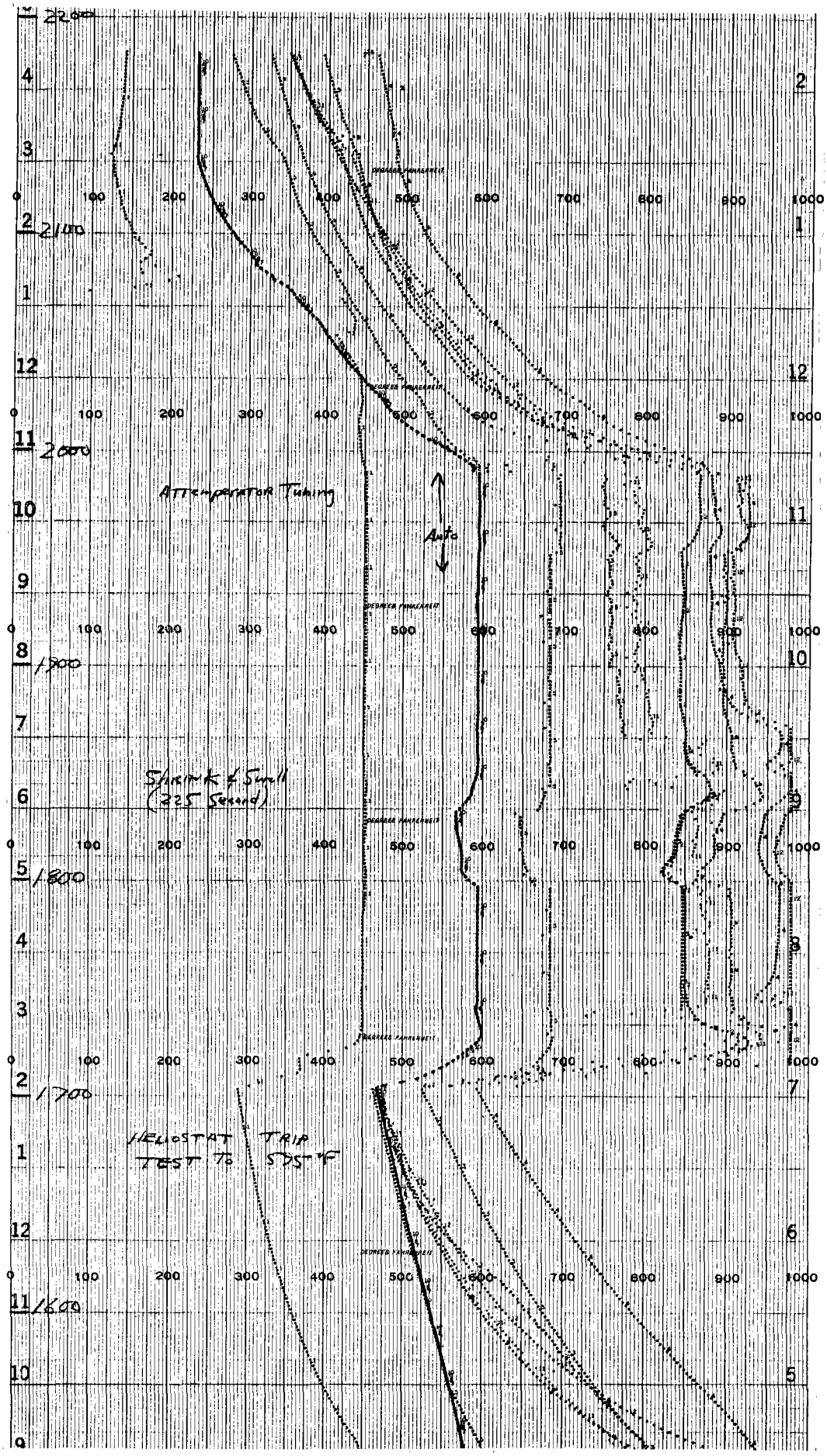
RCD-1


SHRINK & SWELL
1800
1900
2000
2100
2200

RCD-4


DEGREES FAHRENHEIT
0 100 200 300 400 500 600 700 800 900 1000
1500
1400
1300
1200
1100
1000
900
HELIOSTAT TRIP
TEST TO 700°F
HELIOSTAT TRIP
TEST TO 800°F
TEST 20
19 APR 77
RCD-3

RCD-3


2200
2100
2000
1900
1800
1700
1600
Attemperator Tuning
Auto
Shock & Swell
(225 Second)
Heliostat Trip
Test To 525°F
DEGREES FAHRENHEIT
0
100
200
300
400
500
600
700
800
900
1000

RCD-3

SECTION 4

DATA SHEETS: DATA ACQUISITION SYSTEM TABULATION AND PLOT PRINTOUTS

PAGE 1

OPERATOR SUMMARY

```
*****************************************************************************
OPERATOR SUMMARY                                        1977  109  15  11    20
----------------                                      ------------------------

BOILER
------

DRUM                                   PUMP
P-D     1622                           W-B    87240
T-D      607                           T-DC     600
L-D       32                           T-SUB     -7
W-FW    7111                           T-PC      67
W-BD       0

SUPERHEATER 1                          SUPERHEATER 2
--------------                         --------------
INLET METAL       OUTLET METAL         INLET METAL       OUTLET METAL
TE405   681       TE450   149          TE505   150       TE550   991
TE406   664       TE451   149          TE506   150       TE551   149
TE407   693       TE452   907          TE507   881       TE552   966
TE408   669       TE453   150          TE508   150       TE553   666
TE409   674       TE454   918          TE509   896       TE554   412

T-S1I   608                            T-S20   963
                                       P-S20  1578
W-ATT    60                            W-S2   7072

POWER
-----
BOILER ABS. KW      1467    NET INPUT KW          2700
S.H. *1 ABS. KW      478    TOTAL ABSORBED KW     2118
S.H. *2 ABS. KW      173    POWER RATIO           .7846
*****************************************************************************
```

```
*****************************************************************************
OPERATOR SUMMARY                                          1977  109  17  58    20
----------------                                         ------------------------

BOILER
------
DRUM                                   PUMP
P-D     1622                           W-B    86770
T-D      607                           T-DC     599
L-D       32                           T-SUB     -8
W-FW    7063                           T-PC      67
W-BD       0

SUPERHEATER 1                          SUPERHEATER 2
--------------                         --------------
INLET METAL       OUTLET METAL         INLET METAL       OUTLET METAL
TE405   680       TE450   149          TE505   150       TE550   992
TE406   664       TE451   149          TE506   150       TE551   149
TE407   693       TE452   907          TE507   881       TE552   970
TE408   671       TE453   150          TE508   150       TE553   824
TE409   678       TE454   805          TE509   895       TE554   390

T-S1I   609                            T-S20   964
                                       P-S20  1570
W-ATT     0                            W-S2   7105

POWER
-----
BOILER ABS. KW      1502     NET INPUT KW          2658
S.H. *1 ABS. KW      485     TOTAL ABSORBED KW     2139
S.H. *2 ABS. KW      152     POWER RATIO          .8051
*****************************************************************************
```

PAGE 2

PERFORMANCE SUMMARY

```
*****************************************************************************
PERFORMANCE SUMMARY                                   1977  109  15  11    20
--------------------                                  ----------------------
BOILER                    SUPERHEATERS                BOILER
------                    ------------                ------
DRUM                      S.H. STAGE 1                L-D       32
P-D      1622             W-S1     7012               T-BI     598
T-D       607             T-S1I     608               H-BI     632
H-GD     1157             T-S10     851               R-BI  39.439
H-FD      627             P-S10    1602               R-GD  4.0665
N-CR   1.2442             H-S10    1392               R-FD  41.751
FEEDWATER                 ATTEMPERATOR
P-FW     1883             P-ATT    1883
T-FW      458             T-ATT      76
W-FW     7111             W-ATT      60
H-FW      439             H-ATT      36

FLOW CIRCUITS             S.H. STAGE 2                ARRAY - KW
T-DC      600             W-S2     7072               ZONE 1   709
T-SUB      -7             T-S2I     049               ZONE 2   713
W-B     87240                                        ZONE 3   989
W-BC1   10100             T S20     963               ZONE 4   970
W-BC2    9821             P-S20    1578
W-BC3    9622             H-S20    1464               TOTAL   3391
X-B    15.973

POWER
-----
BOILER ABS. KW      1460    NET INPUT KW          2668
S.H. *1 ABS. KW      477    TOTAL ABSORBED KW     2110
S.H. *2 ABS. KW      172    POWER RATIO          .7911
*****************************************************************************
```

```
*****************************************************************************
PERFORMANCE SUMMARY                                      1977  109  17  59    20
--------------------                                     ----------------------
BOILER                    SUPERHEATERS                   BOILER
------                    ------------                   ------
DRUM                      S.H. STAGE 1                   L-D        32
P-D      1622             W-S1     7094                  T-BI      598
T-D       607             T-S1I     608                  H-BI      628
H-GD     1157             T-S1O     851                  R-BI   39.783
H-FD      627             P-S1O    1602                  R-GD   4.0665
N-CR   1.2298             H-S1O    1392                  R-FD   41.751
FEEDWATER                 ATTEMPERATOR
P-FW     1883             P-ATT    1883
T-FW      459             T-ATT     236
W-FW     7063             W-ATT       0
H-FW      440             H-ATT     206

FLOW CIRCUITS             S.H. STAGE 2                   ARRAY - KW
T-DC      598             W-S2     7094                  ZONE 1    709
T-SUB      -9             T-S2I     849                  ZONE 2    711
W-B     87240                                           ZONE 3    989
W-BC1    9962             T S2O     963                  ZONE 4    970
W-BC2    9878             P-S2O    1578
W-BC3    9651             H-S2O    1464                  TOTAL    3379
X-B    16.123

POWER
-----
BOILER ABS. KW      1498     NET INPUT KW          2686
S.H. *1 ABS. KW      484     TOTAL ABSORBED KW     2133
S.H. *2 ABS. KW      149     POWER RATIO          .7939
*****************************************************************************
```

PAGE 3

BASE DATA REPORT -- METAL TEMPERATURES

BASE DATA REPORT - METAL TEMPERATURES 1977 109 15 11 20

TE 210-217	591	599	610	237	543	596	454	599		
TE 330-339	638	560	640	636	638	647	640	640	635	638
TE 340-349	642	638	640	640	640	640	641	640	637	608
TE 350-359	637	642	643	636	635	637	640	639	639	639
TE 360-369	637	611	638	639	639	641	641	641	637	622
TE 370-379	150	639	642	643	641	640	631	624	636	637
TE 380-389	638	639	637	637	637	622	637	639	639	635
TE 405-409	688	664	693	669	683					
TE 450-459	149	149	907	150	925	862	839	263	844	854
TE 460-466	150	863	178	857	854	850	852			
TE 420-429	628	620	631	636	932	674	682	691	702	713
TE 430-439	733	753	767	773	785	795	812	827	892	842
TE 440	842									
TE 505-509	150	150	880	150	896					
TE 550-554	988	149	966	651	408					
TE 555-560	963	965	149	970	966	963				
TE 561-566	968	966	973	970	812	965				
TE 520-529	384	857	866	870	883	150	898	904	904	910
TE 530-539	921	927	932	944	940	945	951	959	962	563
TE 540	149									
TE 470-471	833	835		TE 570-571		937	961			
TE 601-606	794	646	520	823	801	784				
TE 607-612	591	582	572	940	930	922				

BASE DATA REPORT - METAL TEMPERATURES 1977 109 17 59 20

TE 210-217	591	600	610	236	542	596	454	600		
TE 330-339	637	579	640	636	637	645	640	640	633	636
TE 340-349	640	636	640	640	640	640	641	640	637	607
TE 350-359	637	642	643	636	635	637	639	639	638	639
TE 360-369	637	611	638	639	638	641	641	640	637	622
TE 370-379	150	641	643	644	642	639	631	624	637	639
TE 380-389	641	641	639	638	638	622	638	641	642	637
TE 405-409	688	664	693	667	679					
TE 450-459	149	149	907	150	806	862	839	271	845	855
TE 460-466	150	863	146	859	854	850	852			
TE 420-429	629	619	631	637	1074	674	682	692	702	712
TE 430-439	734	753	767	772	784	795	812	826	910	636
TE 440	636									
TE 505-509	150	150	851	150	896					
TE 550-554	993	149	970	816	392					
TE 555-560	963	966	149	971	967	965				
TE 561-566	970	968	974	970	807	965				
TE 520-529	589	861	866	871	884	150	898	905	905	912
TE 530-539	922	927	932	759	942	947	953	959	963	563
TE 540	149									
TE 470-471	834	836		TE 570-571		937	962			
TE 601-606	794	646	520	823	803	786				
TE 607-612	591	580	571	940	930	923				

PAGE 4

BASE DATA REPORT -- FLUID

****

BASE DATA REPORT - FLUID 1977 109 15 11 20

TEMPERATURES - FLUID

TE 19	458
TE 260	503
TE 300	598
TE 301	598
TE 306	67
TE 310	599
TE 311	598
TE 400	609
TE 401	609
TE 402	608
TE 476	851
TE 480	76
TE 501	849
TT 590	962

LEVELS

LT 210	32
LT 211	33

PRESSURES

PT 1	1883
PT 2	1581
PT 3	97
PT 230	1622
PT 475	1601
PT 590	1578

FLOWS

FT 1	7111
FT 3	7053
FT 260	0
FT 310	87620
FT 350	9980
FT 351	9840
FT 352	9583
FT 480	60
FT 13	130950
PUMP JACKET	68

****

BASE DATA REPORT - FLUID 1977 109 17 59 20

TEMPERATURES - FLUID

TE 19	459
TE 260	203
TE 300	599
TE 301	598
TE 306	67
TE 310	598
TE 311	598
TE 400	609
TE 401	609
TE 402	609
TE 476	851
TE 480	236
TE 501	849
TT 590	964

LEVELS

LT 210	32
LT 211	33

PRESSURES

PT 1	1883
PT 2	1581
PT 3	98
PT 230	1622
PT 475	1601
PT 590	1581

FLOWS

FT 1	7108
FT 3	7091
FT 260	0
FT 310	87240
FT 350	9378
FT 351	9850
FT 352	9535
FT 480	0
FT 13	132810
PUMP JACKET	70

PAGE 5

COOLING WATER TEMPERATURE

```
*****************************************************************************
COOLING WATER TEMPERATURES                                  1977  109  15  11    20
--------------------------                                  ------------------------

INLET TEMPERATURE      TE  26    65

OUTLET TEMPERATURES
RECIRCULATION PUMP     TT 306    67
PUMP JACKET            TE 613    68

FLUX BOOM              TT  16   100

POWER CONTROLLERS      TT  23    68

ARRAY POINTS
    FACET 12         FACET 3         FACET 6         FACET 9
BUSBAR COOLERS
TE 700   100   TE 701   106   TE 702   103   TE 703   106

REFLECTOR COOLERS
TE 704    79   TE 705    82   TE 706    97   TE 707    97

UPPER SKIRT    LOWER SKIRT    AMBIENT AIR
TE 708   72    TE 709   74    TE 710  116

ARRAY & FLUX BOOM OUTLET   TE  24    84

*****************************************************************************
```

****

COOLING WATER TEMPERATURES 1977 109 17 59 20

INLET TEMPERATURE TE 26 65

OUTLET TEMPERATURES
RECIRCULATION PUMP TT 306 67
PUMP JACKET TE 613 68

FLUX BOOM TT 16 100

POWER CONTROLLERS TT 23 68

ARRAY POINTS

	FACET 12		FACET 3		FACET 6		FACET 9
BUSBAR COOLERS							
TE 700	96	TE 701	99	TE 702	99	TE 703	102
REFLECTOR COOLERS							
TE 704	81	TE 705	85	TE 706	97	TE 707	97

UPPER SKIRT		LOWER SKIRT		AMBIENT AIR	
TE 708	74	TE 709	81	TE 710	118

ARRAY & FLUX BOOM OUTLET TE 24 84

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PAGE 6

FIRST STAGE SUPERHEATER METAL TEMPERATURES

```
*****************************************************************************
FIRST STAGE SUPERHEATER METAL TEMPERATURES        1977  109  15  11    20
------------------------------------------        -------------------------

TUBE OUTLET METAL TEMPERATURES
TUBE NUMBER     2      5      4     11      8
ANGLE REF-N   300    210    240     30    120
              149    907    149    925    150

TUBE INLET METAL TEMPERATURES
TUBE NUMBER     6      9      4      3     12
ANGLE REF-N   300    210      0     30    120
              664    693    688    683    669

TUBE-TO-TUBE OUTLET TEMPERATURES
TUBE NUMBER     1      2      3      4      5      6
              839    263    844    854    150    863
TUBE NUMBER     7      8      9     10     11     12
              178    857    854    850    852    862

HEADER TEMPERATURES
METAL    862    835     FLUID    851

DRUM TEMPERATURES
GUSSET PLATE   DRUM        596    STEAM LEVEL      610
               BRACKET     543    WATER LEVEL      591
               BASE        237    DRUM AT FEED     599
                                  FEED LINE        454
                                  DOWNCOMER        599

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*****************************************************************************
FIRST STAGE SUPERHEATER METAL TEMPERATURES          1977  109  17  59    20
------------------------------------------          ------------------------

TUBE OUTLET METAL TEMPERATURES
TUBE NUMBER     2      5      4     11      8
ANGLE REF-N   300    210    240     30    120
              149    906    149    801    150

TUBE INLET METAL TEMPERATURES
TUBE NUMBER     6      9      4      3     12
ANGLE REF-N   300    210      0     30    120
              664    693    688    686    668

TUBE-TO-TUBE OUTLET TEMPERATURES
TUBE NUMBER     1      2      3      4      5      6
              839    272    845    854    150    862
TUBE NUMBER     7      8      9     10     11     12
              146    858    854    849    852    862

HEADER TEMPERATURES
METAL    862    836      FLUID     851

DRUM TEMPERATURES
GUSSET PLATE    DRUM        596    STEAM LEVEL      610
                BRACKET     541    WATER LEVEL      591
                BASE        237    DRUM AT FEED     599
                                   FEED LINE        454
                                   DOWNCOMER        599

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SECOND STAGE SUPERHEATER METAL TEMPERATURES

```
*****************************************************************************
SECOND STAGE SUPERHEATER METAL TEMPERATURES        1977  109  15  11    20
-------------------------------------------------   ------------------------

TUBE OUTLET METAL TEMPERATURES
TUBE NUMBER     2      5      4      11      8
ANGLE REF-N   300    210    240      30    120
              980    966    149     408    651

TUBE INLET METAL TEMPERATURES
TUBE NUMBER     6      9      4       3     12
ANGLE REF-H   300    210      0      30    120
              150    880    150     896    150

TUBE-TO-TUBE OUTLET TEMPERATURES
TUBE NUMBER     1      2      3       4      5      6
              966    149    970     966    963    970
TUBE NUMBER     7      8      9      10     11     12
              966    973    970     800    964    937

HEADER TEMPERATURES
METAL     963    961      FLUID    962

LUG TEMPERATURES        HEADER DISTANCE (INCHES)
                         .875    2.125    3.375
BOILER OUTLET SUPRT      794      646      521
S.H.1  OUTLET SUPRT      823      801      784
S.H.2 SNUBBER PLATE      591      582      572
S.H.2 SNUBBER BRAKT      940      930      922

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SECOND STAGE SUPERHEATER METAL TEMPERATURES        1977  109  17  59    20
-------------------------------------------        ------------------------

TUBE OUTLET METAL TEMPERATURES
TUBE NUMBER     2      5      4     11      9
ANGLE REF-N   300    210    240     30    120
              992    970    149    393    822

TUBE INLET METAL TEMPERATURES
TUBE NUMBER     6      9      4      3     12
ANGLE REF-N   300    210      0     30    120
              150    880    150    896    150

TUBE-TO-TUBE OUTLET TEMPERATURES
TUBE NUMBER     1      2      3      4      5      6
              966    149    971    968    964    970
TUBE NUMBER     7      8      9     10     11     12
              968    974    970    809    965    963

HEADER TEMPERATURES
METAL    963    962      FLUID    964

LUG TEMPERATURES          HEADER DISTANCE (INCHES)
                           .875    2.125    3.375
BOILER OUTLET SUPRT         794      646      521
S.H.1  OUTLET SUPRT         823      803      786
S.H.2 SNUBBER PLATE         591      580      571
S.H.2 SNUBBER BRAKT         941      930      923

*****************************************************************************
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BOILER TEMPERATURE PROFILE

BOILER TEMPERATURE PROFILE 1977 109 15 12 20

DRUM T-SAT 607

LEVEL	COLUMN 1	2	3	4	5	6	7	8	9	10
8	637	637	636	640	638	635	637	150	637	638
66.0	T-81	T-82	T-83	T-84	T-85	T-86	T-87	T-88	T-89	T-810
7				640		636	639	639	639	
57.2				T-74		T-76	T-77	T-78	T-79	
6	553	647	638	640	643	638	637	642	639	641
48.5	T-61	T-62	T-63	T-64	T-65	T-66	T-67	T-68	T-69	T-610
5				640		639	639	643	640	
38.8				T-54		T-56	T-57	T-58	T-59	
4	640	640	641	641	643	638	641	641	638	641
29.0	T-41	T-42	T-43	T-44	T-45	T-46	T-47	T-48	T-49	T-410
3				640		639	639	639	637	
19.2				T-34		T-36	T-37	T-38	T-39	
2	636	640	638	637	636	636	636	631	637	636
9.50	T-21	T-22	T-23	T-24	T-25	T-26	T-27	T-28	T-29	T-210
1				608		611	622	624	622	
-.2				T-14		T-16	T-17	T-18	T-19	

BOILER TEMPERATURE PROFILE 1977 109 17 59 20

DRUM T-SAT 607

LEVEL	COLUMN 1	2	3	4	5	6	7	8	9	10
8	637	638	635	638	637	635	638	150	637	639
66.0	T-81	T-82	T-83	T-84	T-85	T-86	T-87	T-88	T-89	T-810
7				638		636	639	640	639	
57.2				T-74		T-76	T-77	T-78	T-79	
6	582	645	638	639	643	640	638	642	639	641
48.5	T-61	T-62	T-63	T-64	T-65	T-66	T-67	T-68	T-69	T-610
5				638		639	641	643	641	
38.8				T-54		T-56	T-57	T-58	T-59	
4	640	640	642	639	642	638	641	641	638	641
29.0	T-41	T-42	T-43	T-44	T-45	T-46	T-47	T-48	T-49	T-410
3				638		639	641	641	638	
19.2				T-34		T-36	T-37	T-38	T-39	
2	636	640	638	636	636	637	637	632	638	637
9.50	T-21	T-22	T-23	T-24	T-25	T-26	T-27	T-28	T-29	T-210
1				607		611	622	624	622	
-.2				T-14		T-16	T-17	T-18	T-19	

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FIRST STAGE SUPERHEATER TEMPERATURE PROFILE

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FIRST STAGE SUPERHEATER TEMPERATURE PROFILE 1977 109 15 12 20

TUBE * 4

INLET	TS11	TE400	609
		TE401	609
		TE402	609
OUTLET	TS10	TE476	851
	LEG	TE459	854

TURN	COLUMN 6	1	2	3	4	5
	345	300	255	210	120	30
4	892	843	843			
	T-46	T-41	T-42			
3	768	773	783	795	812	828
	T-36	T-31	T-32	T-33	T-34	T-35
2	682	691	702	713	733	753
	T-26	T-21	T-22	T-23	T-24	T-25
1	629	619	630	636	932	674
	T-16	T-11	T-12	T-13	T-14	T-15

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FIRST STAGE SUPERHEATER TEMPERATURE PROFILE 1977 109 17 59 20

TUBE * 4

INLET	TS1I	TE400	609
		TE401	609
		TE402	609
OUTLET	TS10	TE476	851
	LEG	TE459	854

TURN	COLUMN					
	6	1	2	3	4	5
	345	300	255	210	120	30
4	909	647	647			
	T-46	T-41	T-42			
3	767	773	785	795	812	828
	T-36	T-31	T-32	T-33	T-34	T-35
2	682	692	702	713	733	753
	T-26	T-21	T-22	T-23	T-24	T-25
1	628	619	631	637	1074	674
	T-16	T-11	T-12	T-13	T-14	T-15

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SECOND STAGE SUPERHEATER TEMPERATURE PROFILE

SECOND STAGE SUPERHEATER TEMPERATURE PROFILE 1977 109 15 12 20

TUBE * 4

INLET	TS2I	TE501	849
OUTLET	TS20	TT590	962
	LEG	TE559	966

TURN	COLUMN 6	1	2	3	4	5
	345	300	255	210	120	30
4	962	563	149			
	T-46	T-41	T-42			
3	932	944	941	946	951	959
	T-36	T-31	T-32	T-33	T-34	T-35
2	898	904	904	910	921	927
	T-26	T-21	T-22	T-23	T-24	T-25
1	384	857	866	870	883	150
	T-16	T-11	T-12	T-13	T-14	T-15

SECOND STAGE SUPERHEATER TEMPERATURE PROFILE 1977 109 17 59 20

TUBE * 4

INLET	TS2I	TE501	849
OUTLET	TS2O	TT590	964
	LEG	TE559	968

TURN	COLUMN 6	1	2	3	4	5
	345	300	255	210	120	30
4	963	563	149			
	T-46	T-41	T-42			
3	932	758	943	947	952	959
	T-36	T-31	T-32	T-33	T-34	T-35
2	898	905	905	912	921	927
	T-26	T-21	T-22	T-23	T-24	T-25
1	594	860	866	871	883	150
	T-16	T-11	T-12	T-13	T-14	T-15

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WARNINGS AND ALARMS REPORT

PAGE 12

ALARM CONDITIONS

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ALARM CONDITIONS	YEAR	DAY	HR	MIN	SEC	TEST
	1977	109	12	48	11	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
35	DT215	61	60	1	HI

****

****

ALARM CONDITIONS	YEAR	DAY	HR	MIN	SEC	TEST
	1977	109	12	51	31	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
35	DT215	60	60	1	HI

****

****

ALARM CONDITIONS	YEAR	DAY	HR	MIN	SEC	TEST
	1977	109	12	53	11	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
35	DT215	60	60	1	HI

****

****

ALARM CONDITIONS

YEAR	DAY	HR	MIN	SEC	TEST
1977	109	12	53	51	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
35	DT215	60	60	1	HI

****

****

ALARM CONDITIONS

YEAR	DAY	HR	MIN	SEC	TEST
1977	109	12	55	11	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
35	DT215	60	60	1	HI

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****

ALARM CONDITIONS

YEAR	DAY	HR	MIN	SEC	TEST
1977	109	18	28	24	20

ALARM NUMBER	INPUT DEVICE	CURRENT VALUE	ALARM VALUE	CURRENT COUNT	HI-LO
9	TT590	982	980	1	HI

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ARRAY FLUX MAP

ARRAY FLUX MAP

YEAR	DAY	HR	MIN	TEST
1977	109	15	12	20

TOTAL BOILER INCIDENT FLUX 214
TOTAL S.H.#1 INCIDENT FLUX 81
TOTAL S.H.#2 INCIDENT FLUX 40
TOTAL SRE INCIDENT FLUX 330

ARRAY INPUT POWER
SECTION # 1 711
SECTION # 2 711
SECTION # 3 989
SECTION # 4 973

TOTAL INPUT POWER 3380

BOOM	IF 1	IF 2	IF 3	IF 4	IF 5	IF 6	IF 7	IF 8	IF 9	IF10	IF11	IF12
1	1121	1277	1374	1244	1158	838	657	489	429	340	217	241
2	1140	1301	1408	1265	1166	853	676	489	446	324	232	245
3	1140	1301	1391	1240	1149	828	661	489	412	312	254	245
4	1197	1367	1453	1294	1183	864	661	504	425	328	235	258
5	1209	1359	1449	1277	1166	849	650	485	412	328	239	245
6	1232	1384	1458	1290	1183	849	657	481	421	312	228	254
7	1239	1392	1474	1324	1191	864	661	504	421	312	243	245
8	1205	1355	1433	1282	1166	835	661	485	421	328	232	279
9	1220	1359	1445	1290	1174	860	654	489	425	320	224	271
10	1216	1367	1458	1298	1208	849	661	493	438	332	247	237
11	1186	1334	1408	1252	1158	838	654	500	421	328	247	250
12	1209	1359	1449	1290	1178	864	665	497	421	328	224	258
13	1209	1359	1449	1298	1187	860	676	500	438	336	232	250
14	1190	1334	1399	1257	1153	835	654	504	425	320	232	258
15	1213	1351	1437	1277	1174	853	661	500	429	348	224	237
16	1201	1338	1395	1261	1158	842	654	489	412	328	239	245
17	1175	1310	1391	1227	1141	838	631	489	421	320	235	266
18	1205	1343	1424	1248	1153	828	646	485	429	340	228	254
19	1186	1322	1408	1236	1128	813	642	473	425	320	232	250
20	1178	1310	1391	1215	1116	806	635	481	412	312	217	245
21	186	1318	1416	1240	1133	813	638	481	421	328	235	245
22	1190	1326	1424	1248	1137	813	638	489	412	320	243	271
23	1163	1293	1391	1215	1120	799	631	473	412	328	239	245
24	1178	1310	1387	1223	1120	806	638	477	412	312	228	245
25	1178	1306	1408	1248	1124	813	646	485	429	328	228	254
26	1148	1285	1374	1210	1108	795	627	489	412	324	232	254
27	1171	1310	1391	1248	1158	835	646	489	412	328	247	258
28	1163	1301	1399	1227	1133	813	638	500	429	328	247	245
29	1144	1273	1353	1215	1116	806	627	481	412	328	224	262
30	1163	1301	1383	1248	1141	828	646	493	438	324	224	254
31	1129	1277	1358	1223	1120	820	650	489	412	320	247	245
32	1106	1260	1341	1202	1120	820	646	481	421	344	235	245
33	1087	1277	1383	1248	1149	835	654	504	429	336	228	279
34	1072	1244	1349	1210	1124	813	638	499	429	328	232	258

ARRAY FLUX MAP

YEAR	DAY	HR	MIN	TEST
1977	109	17	59	20

TOTAL BOILER INCIDENT FLUX 214
TOTAL S.H.#1 INCIDENT FLUX 81
TOTAL S.H.#2 INCIDENT FLUX 41
TOTAL SRE INCIDENT FLUX 330

ARRAY INPUT POWER
SECTION # 1 709
SECTION # 2 711
SECTION # 3 989
SECTION # 4 970

TOTAL INPUT POWER 3380

BOOM	IF 1	IF 2	IF 3	IF 4	IF 5	IF 6	IF 7	IF 8	IF 9	IF10	IF11	IF12
1	1125	1281	1399	1282	1153	835	661	504	438	336	224	245
2	1140	1306	1399	1265	1158	842	657	481	421	320	247	241
3	1148	1306	1408	1244	1158	824	642	481	429	328	250	254
4	1197	1359	1453	1290	1183	853	661	512	421	336	232	245
5	1194	1351	1424	1265	1158	835	650	477	425	320	235	245
6	1201	1351	1433	1282	1158	842	646	512	412	308	224	254
7	1220	1376	1458	1307	1191	849	665	497	438	328	247	245
8	1190	1334	1416	1248	1158	831	650	489	404	344	262	262
9	1201	1351	1428	1282	1178	842	654	481	412	344	247	245
10	1205	1359	1441	1294	1187	856	669	500	425	344	228	254
11	1178	1334	1416	1257	1162	835	646	481	421	340	243	254
12	1201	1351	1428	1282	1162	849	665	489	412	328	254	279
13	1209	1367	1449	1294	1191	856	661	497	446	336	235	245
14	1190	1334	1408	1252	1158	846	657	489	421	312	247	279
15	1205	1355	1433	1282	1183	846	665	489	425	360	235	254
16	1209	1343	1441	1277	1187	856	661	508	438	328	224	245
17	1186	1322	1399	1248	1162	838	661	497	412	344	232	254
18	1163	1310	1391	1240	1128	820	638	473	421	308	217	245
19	1186	1322	1416	1265	1149	842	646	493	425	340	262	237
20	1148	1293	1370	1223	1116	799	627	469	412	328	247	245
21	1156	1293	1366	1215	1108	806	631	481	404	324	228	254
22	1171	1301	1391	1231	1120	806	638	477	425	320	239	275
23	1148	1281	1366	1210	1108	799	627	473	425	328	235	245
24	1182	1306	1399	1223	1124	810	638	477	412	316	235	250
25	1156	1277	1370	1198	1108	799	623	473	404	324	247	254
26	1152	1293	1370	1206	1108	810	616	473	417	320	232	254
27	1171	1310	1399	1248	1133	817	646	489	438	328	228	245
28	1163	1293	1383	1231	1124	813	646	489	417	328	247	237
29	1156	1285	1370	1210	1115	802	642	481	421	328	243	254
30	1175	1301	1399	1240	1145	820	646	489	425	328	228	245
31	1140	1277	1366	1231	1120	806	638	497	425	336	232	254
32	1118	1264	1374	1215	1124	813	650	493	429	328	232	237
33	1091	1277	1399	1244	1158	838	654	504	429	328	247	241
34	1083	1260	1366	1244	1153	828	661	489	438	328	247	258

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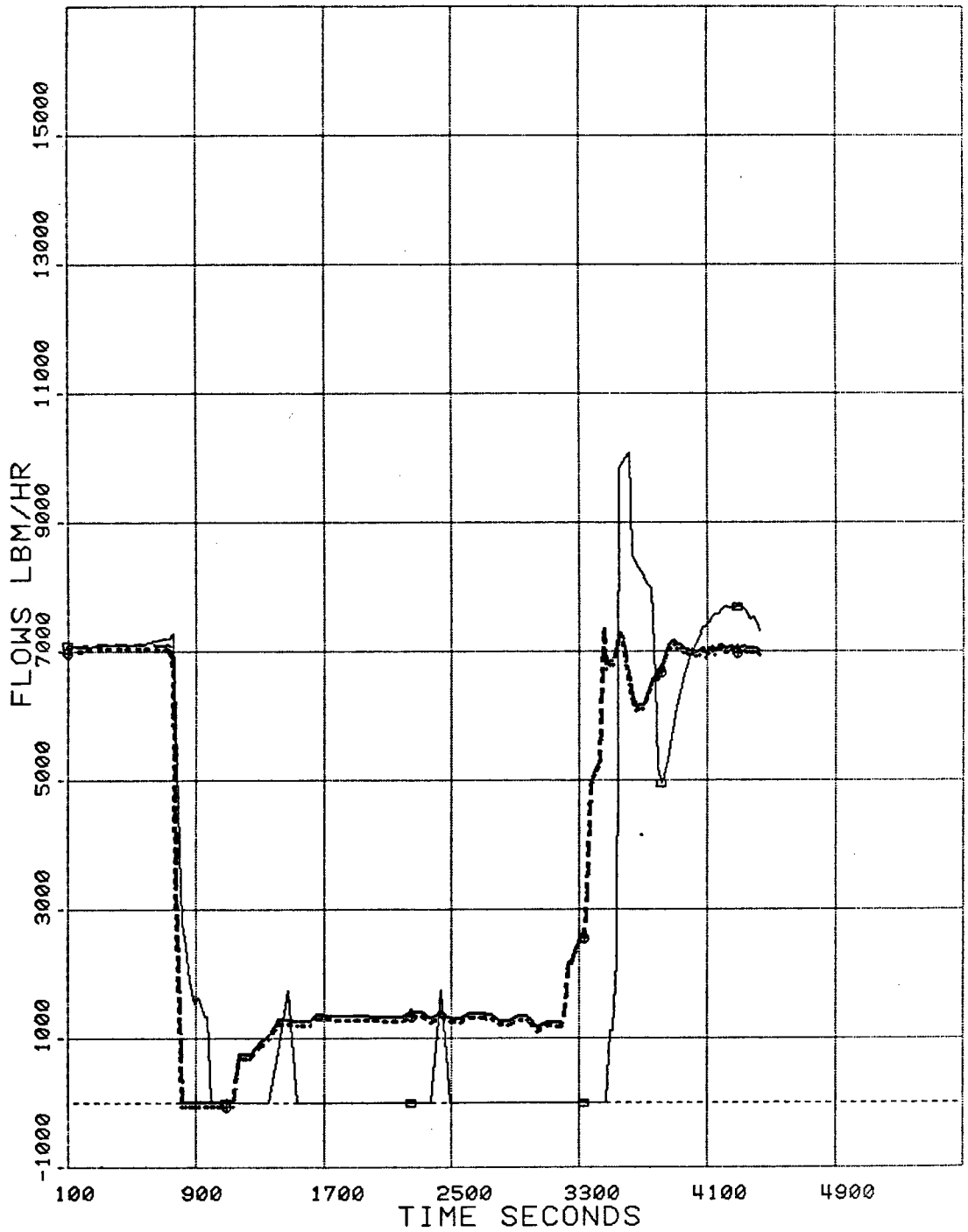
FLOWS, PLOTS

```
SEARCH START
DAY #109 1977  TIME 11:48
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 8 OPEN BOX

SECOND FUNCTION #10 TRIANGLE

THIRD  FUNCTION #17 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   42480.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


FLOWS LBM/HR
15000
13000
11000
9000
7000
5000
3000
1000
-1000
100
900
1700
2500
3300
4100
4900
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 11:48
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

PLOT START TIME = 42480.0

EACH 1TH POINT IS PLOTTED

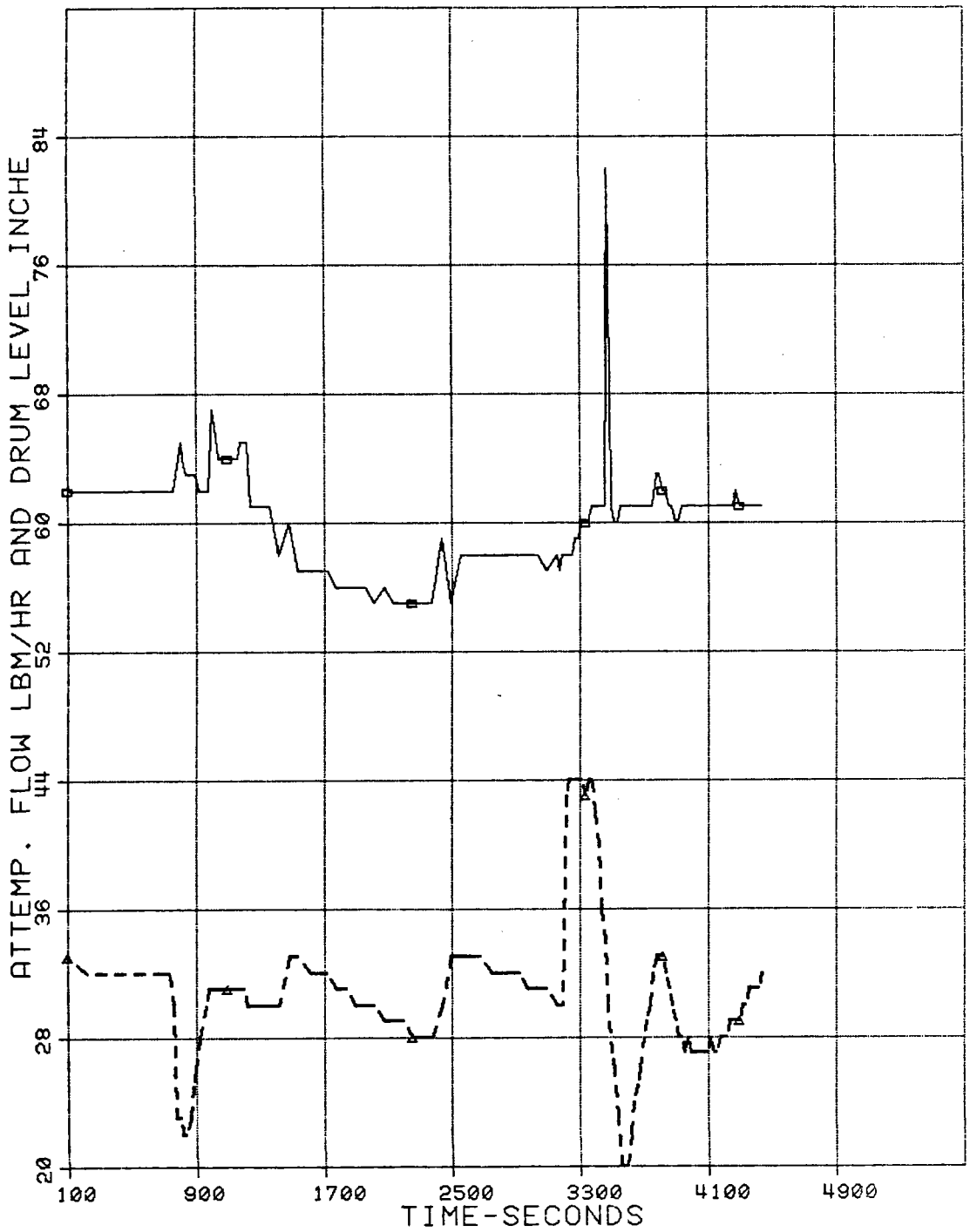
LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

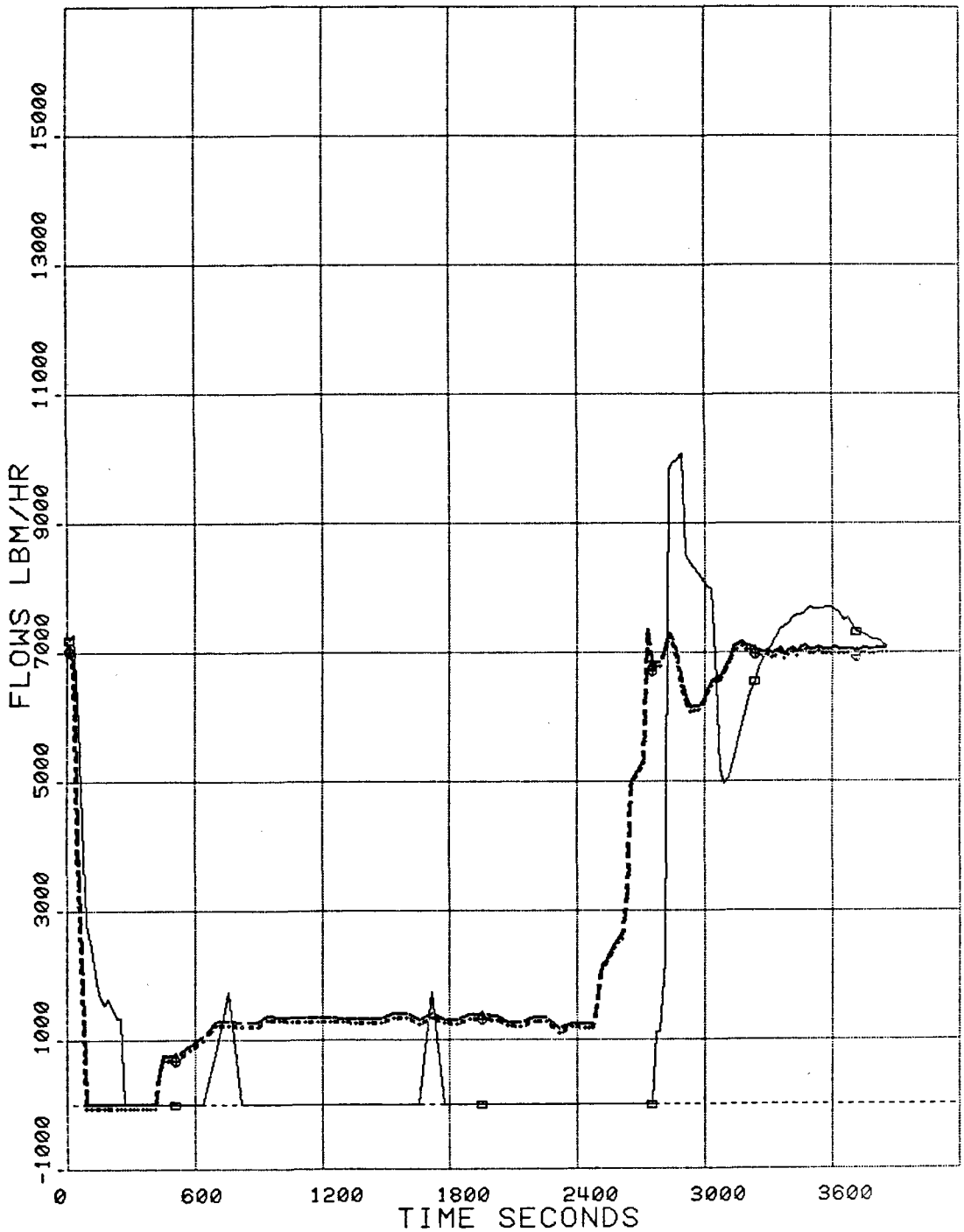
14 –

18 –

Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
20
28
36
44
52
60
68
76
84
100
900
1700
2500
3300
4100
4900
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 8 OPEN BOX

SECOND FUNCTION #10 TRIANGLE

THIRD  FUNCTION #17 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


FLOWS LBM/HR
15000
13000
11000
9000
7000
5000
3000
1000
-1000
0
600
1200
1800
2400
3000
3600
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 12: 0
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

PLOT START TIME = 43200.0

EACH 1TH POINT IS PLOTTED

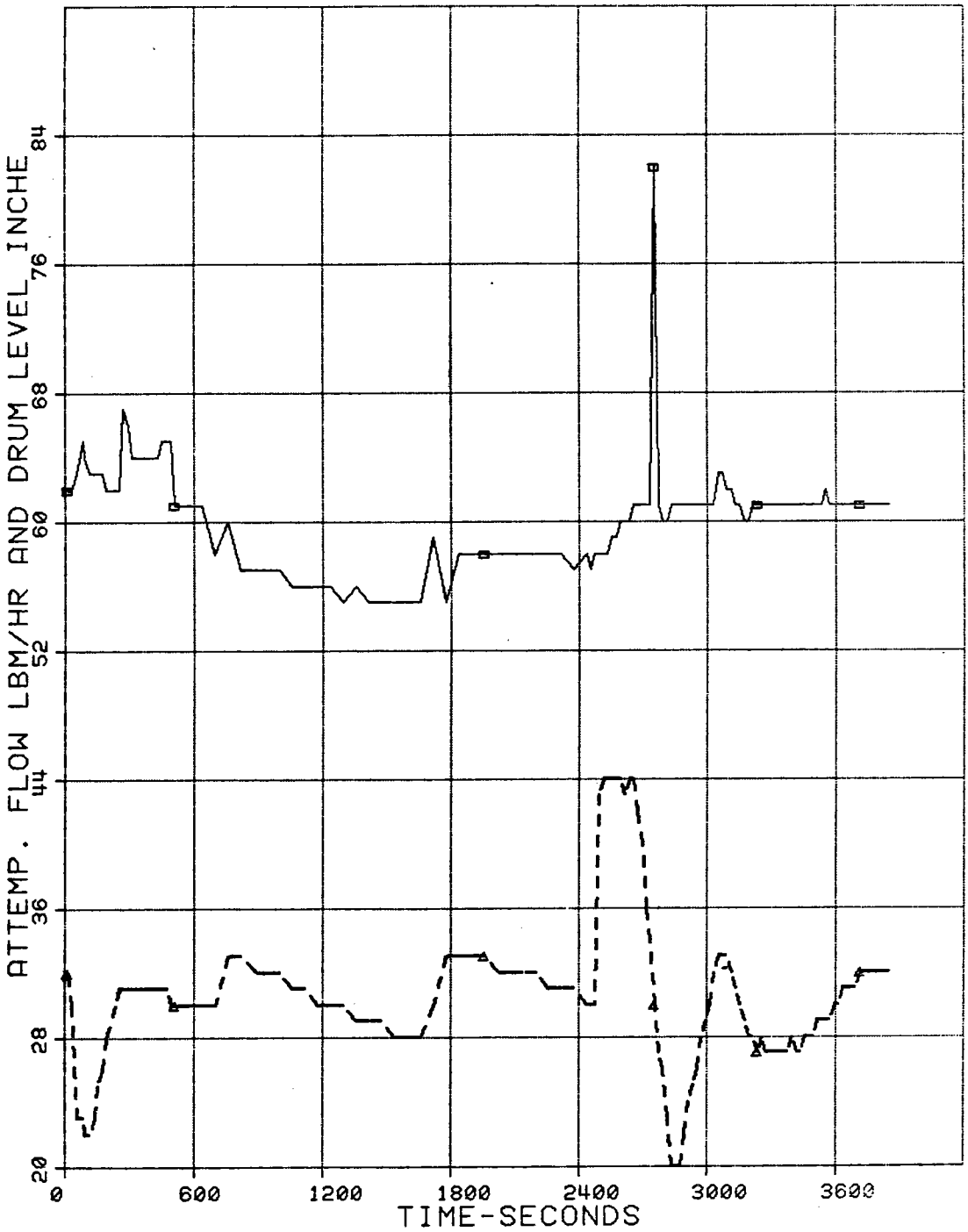
LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

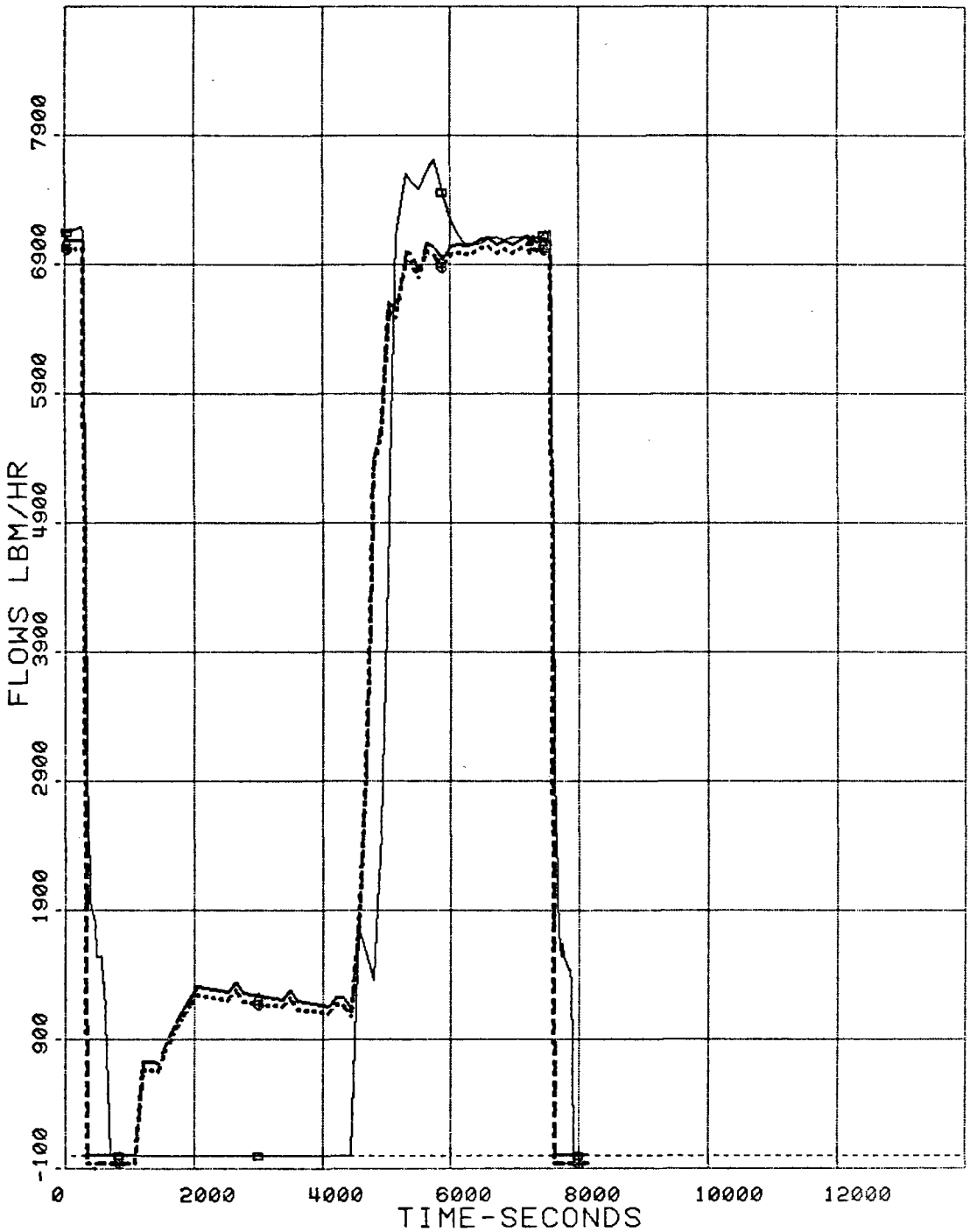
14-

18-

Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
20
28
36
44
52
60
68
76
84
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 8 OPEN BOX

SECOND FUNCTION #10 TRIANGLE

THIRD  FUNCTION #17 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLOWS LBM/HR
7900
6900
5900
4900
3900
2900
1900
900
-100
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

SEARCH START
DAY #109 1977 TIME 13:11
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

PLOT START TIME = 47460.0

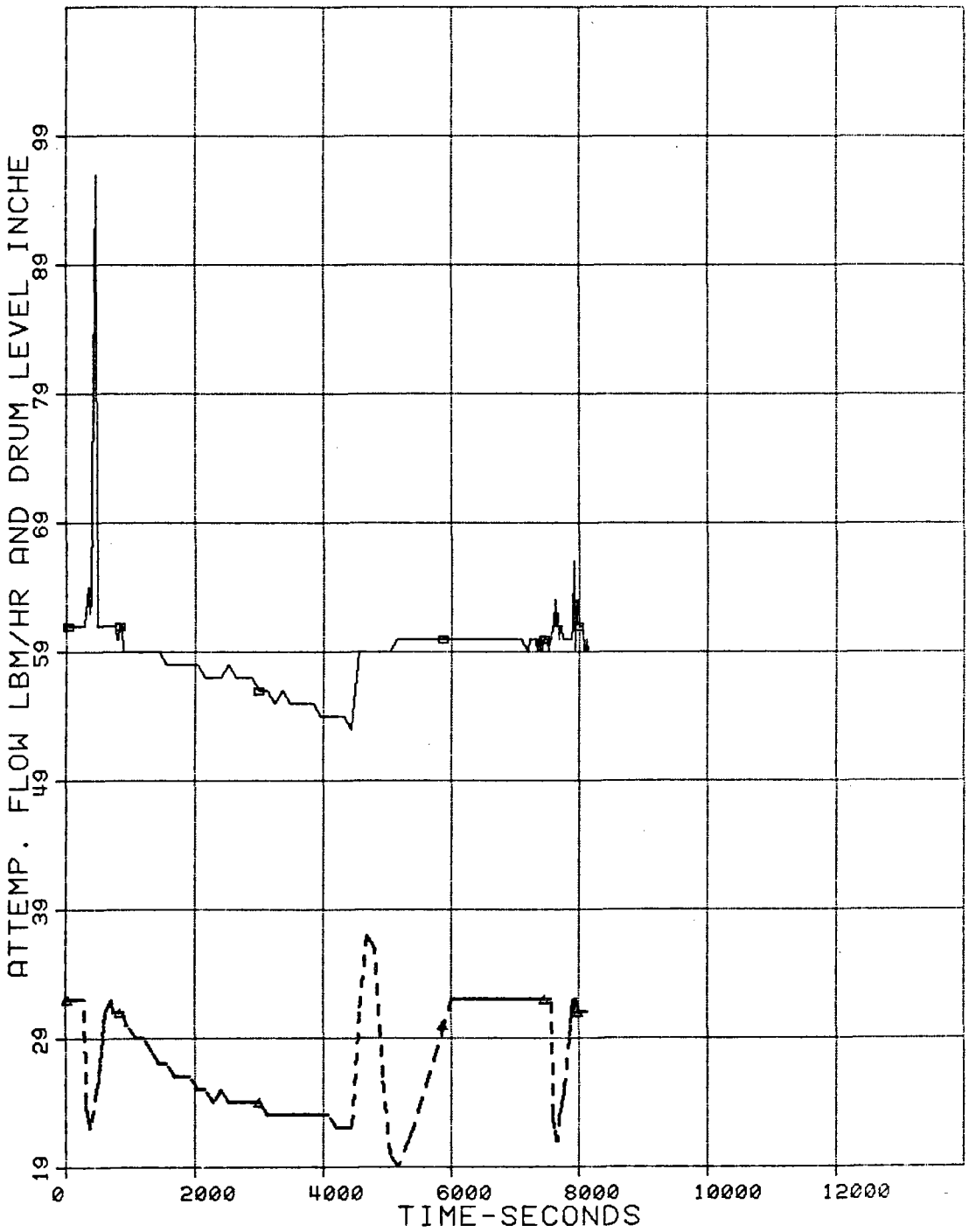
EACH 1TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

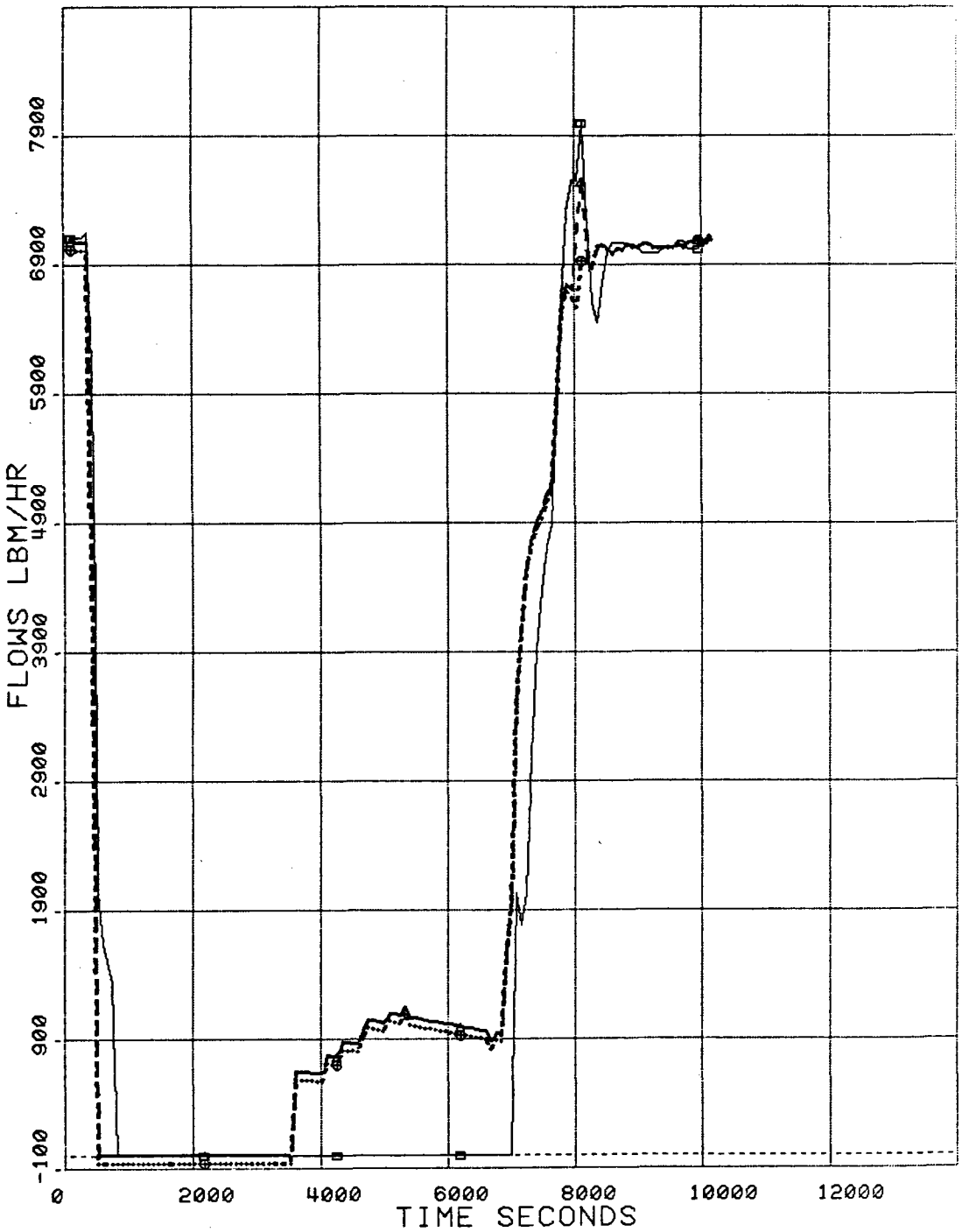
Test No. 20

14-
18-

Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
99
89
79
69
59
49
39
29
19
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 8 OPEN BOX

SECOND FUNCTION #10 TRIANGLE

THIRD  FUNCTION #17 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLOWS LBM/HR
7900
6900
5900
4900
3900
2900
1900
900
-100
0
2000
4000
6000
8000
10000
12000
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 15:10
NUMBER OF RECORDS = 2

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SEARCH MODE 2

PLOT START TIME = 54600.0

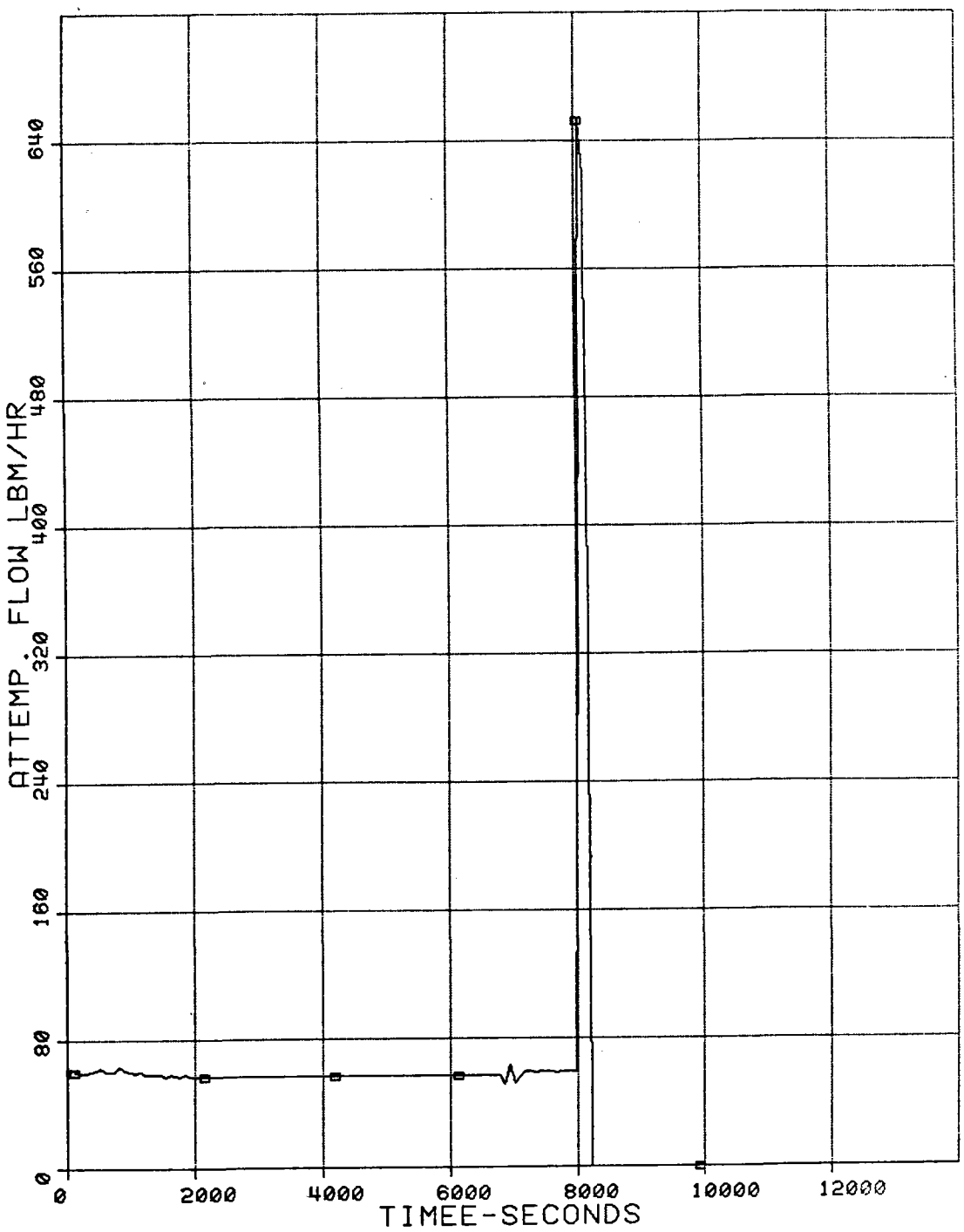
EACH 4TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

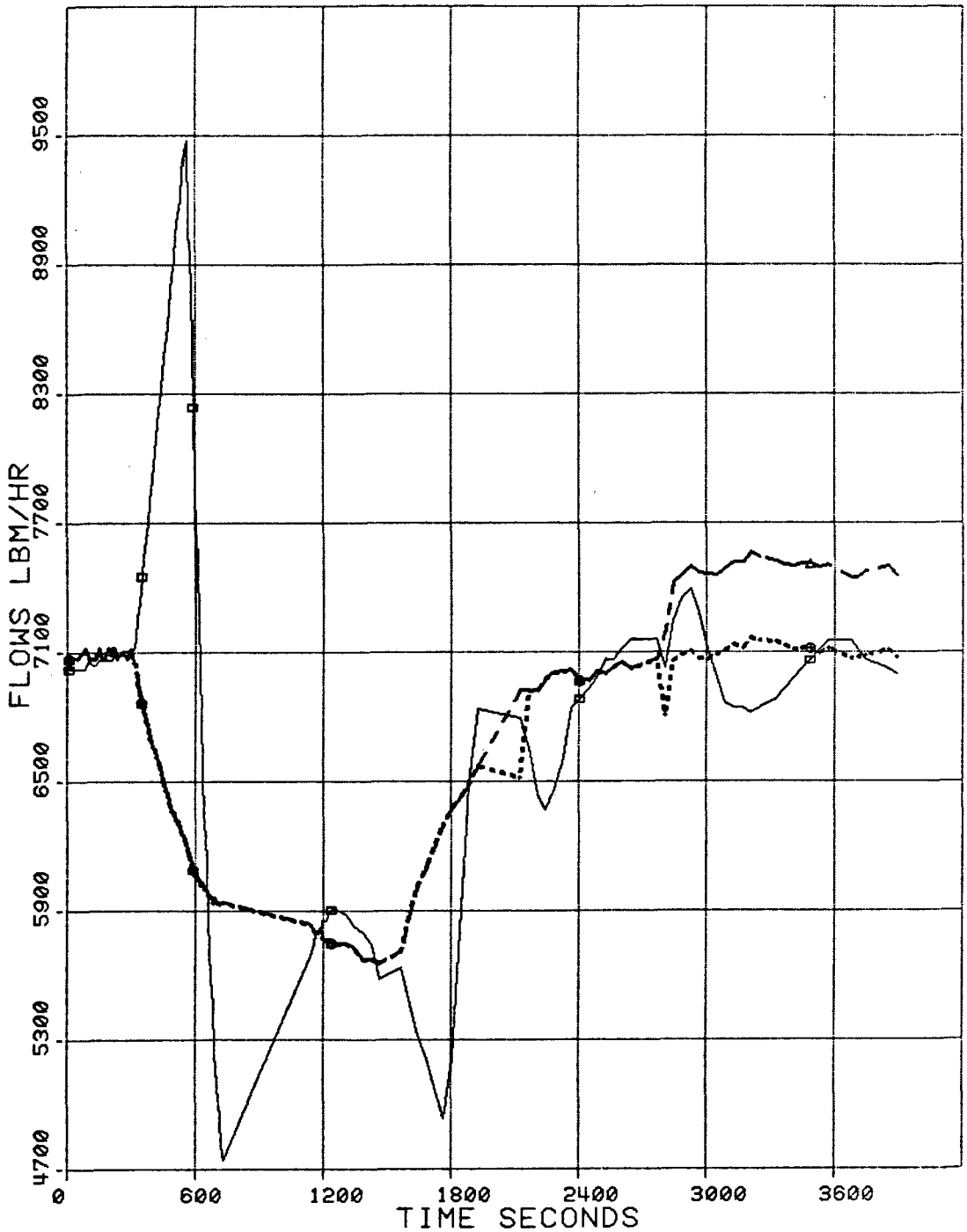
Test No. 20

14-

Replot 4/25/77


ATTEMP. FLOW LBM/HR
0
80
160
240
320
400
480
560
640
0
2000
4000
6000
8000
10000
12000
TIMEE-SECONDS

```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 8 OPEN BOX

SECOND FUNCTION #10 TRIANGLE

THIRD  FUNCTION #17 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLOWS LBM/HR
9500
8900
8300
7700
7100
6500
5900
5300
4700
0
600
1200
1800
2400
3000
3600
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 17:55
NUMBER OF RECORDS = 2

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SEARCH MODE 2

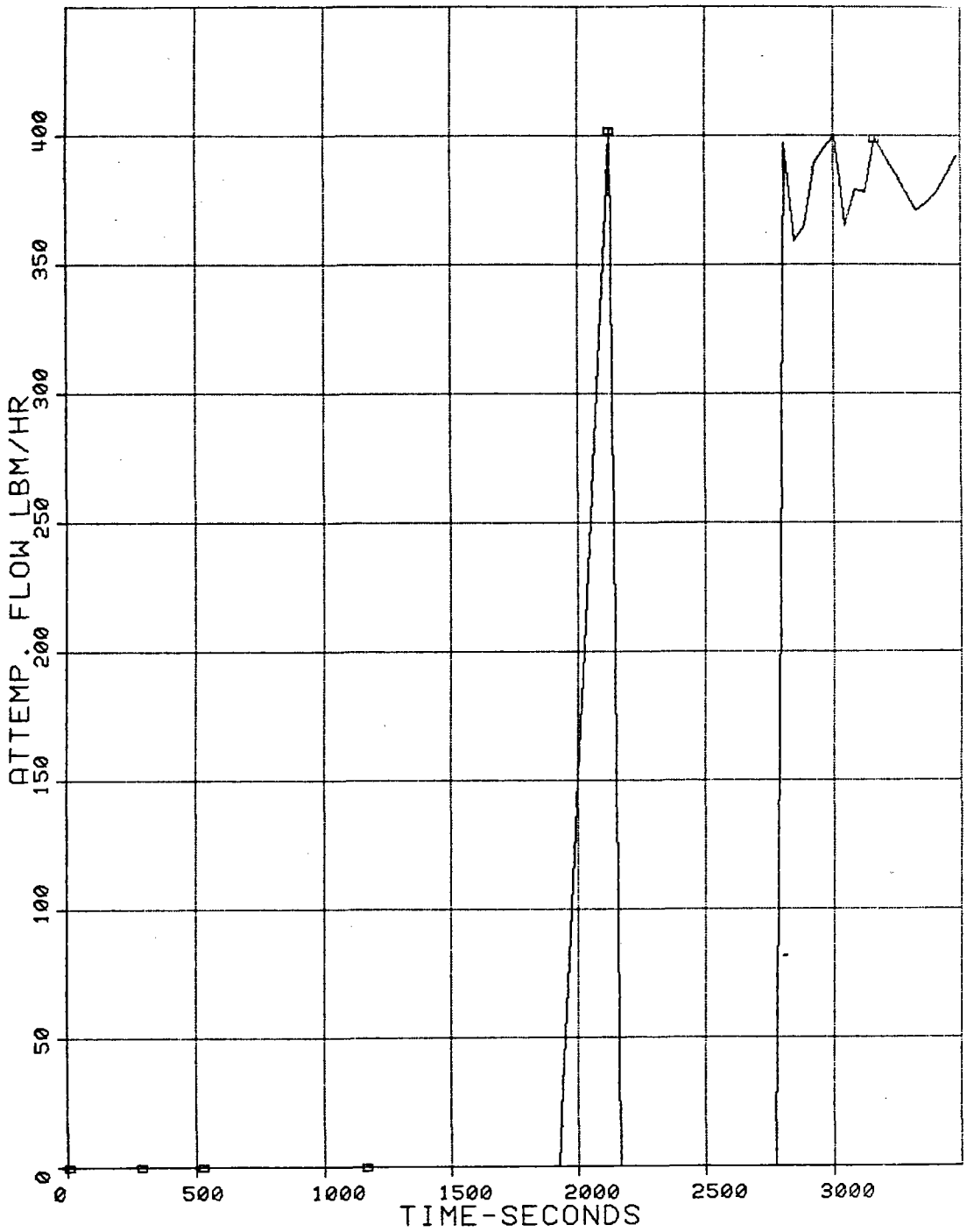
PLOT START TIME = 64500.0

EACH 2TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

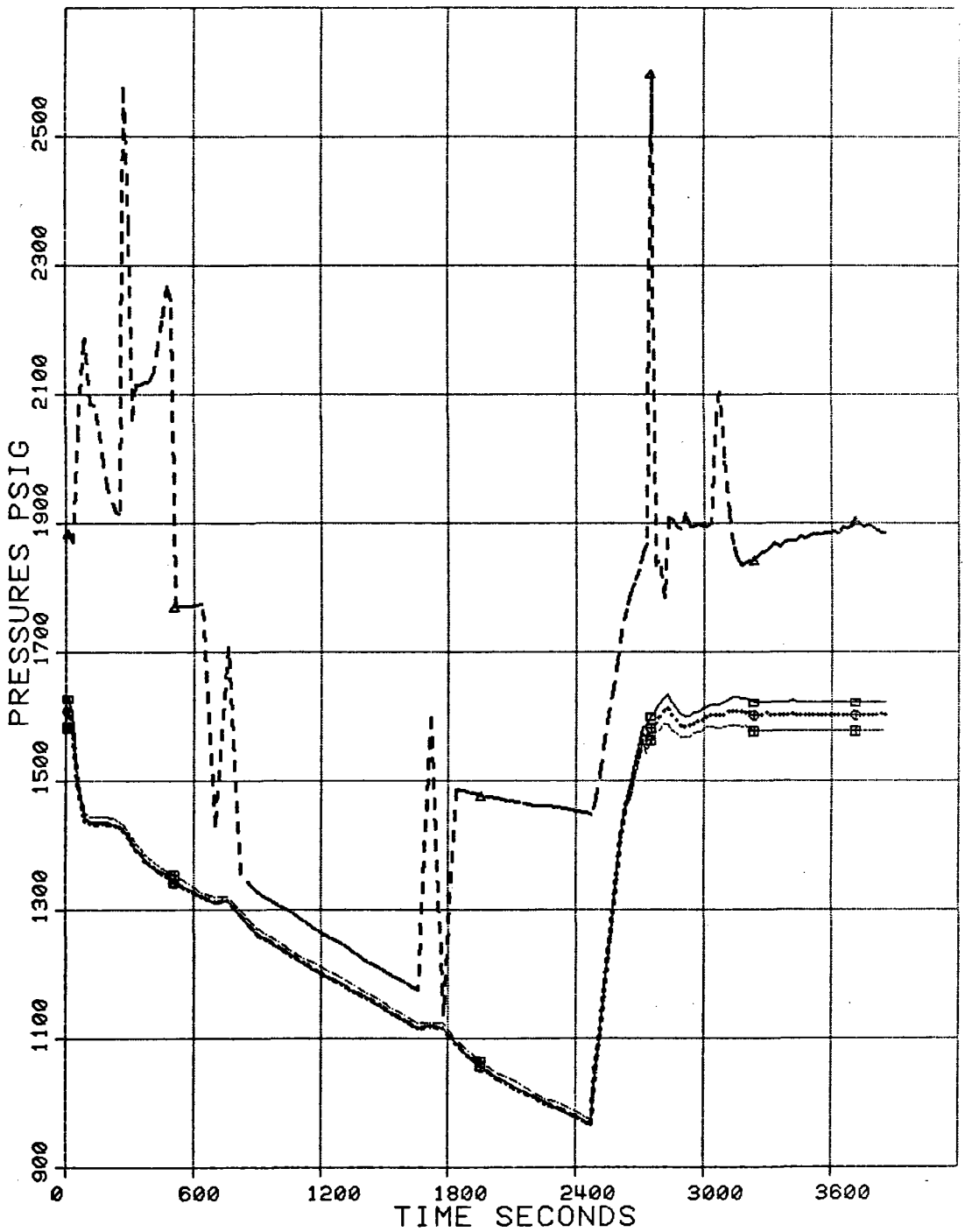
Replot 4/25/77 14-


ATTEMP. FLOW LBM/HR
0
50
100
150
200
250
300
350
400
0
500
1000
1500
2000
2500
3000
TIME-SECONDS

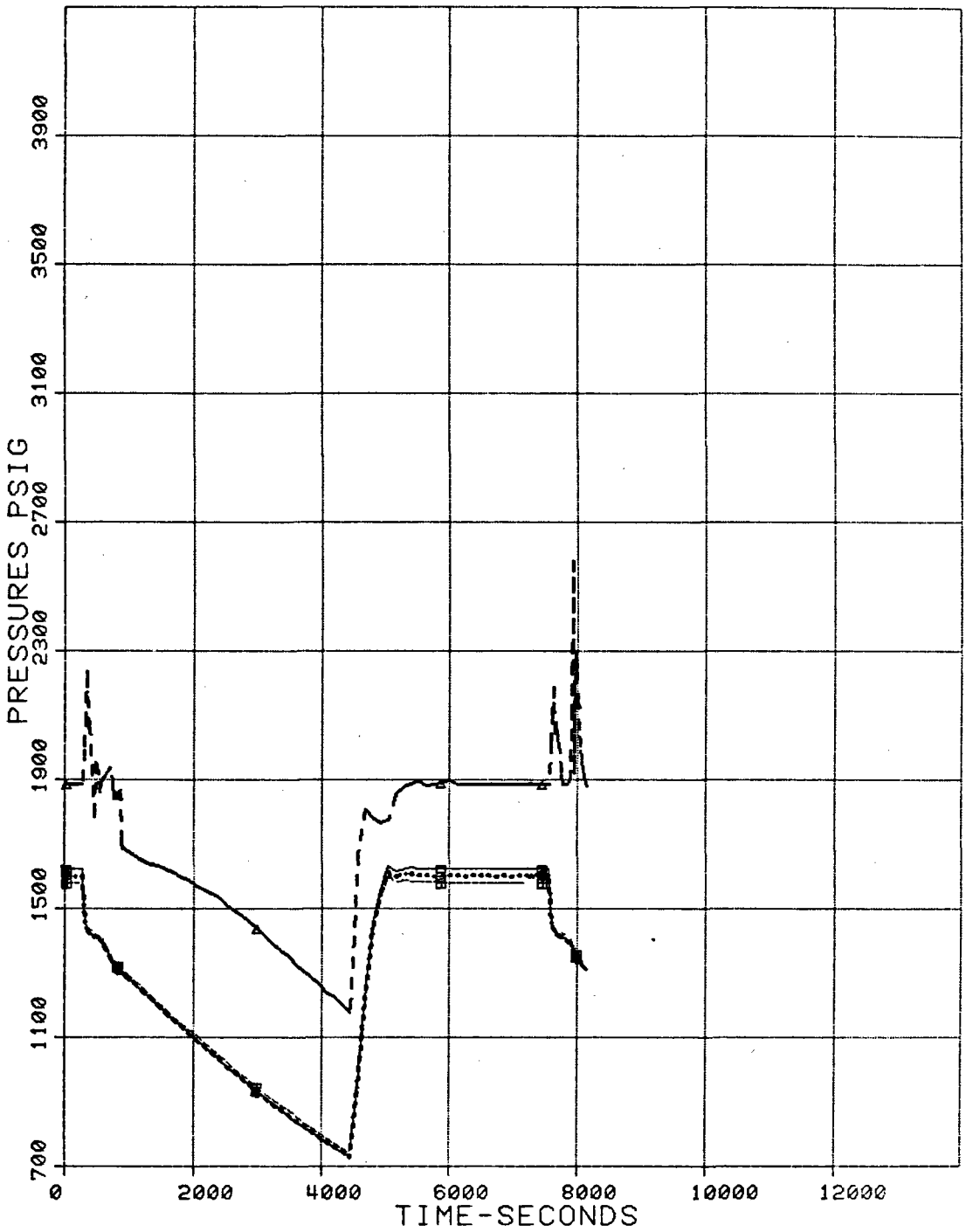
PAGE 15

PRESSURES, PLOTS

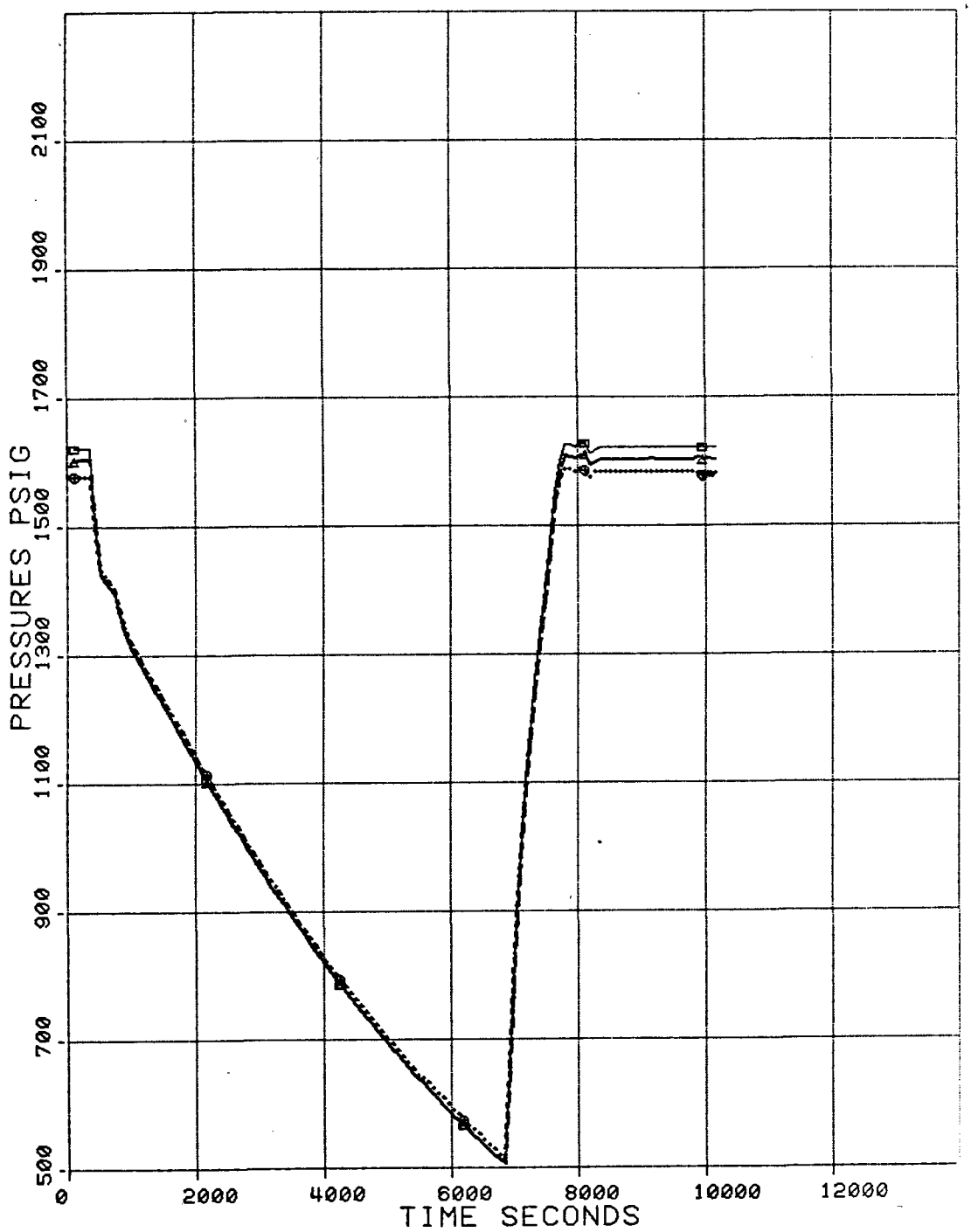
```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION #18 OPEN BOX

SECOND FUNCTION #19 TRIANGLE

THIRD  FUNCTION #20 CROSS-CIRCLE

FOURTH FUNCTION #21 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


PRESSURES PSIG
2500
2300
2100
1900
1700
1500
1300
1100
900
0
600
1200
1800
2400
3000
3600
TIME SECONDS

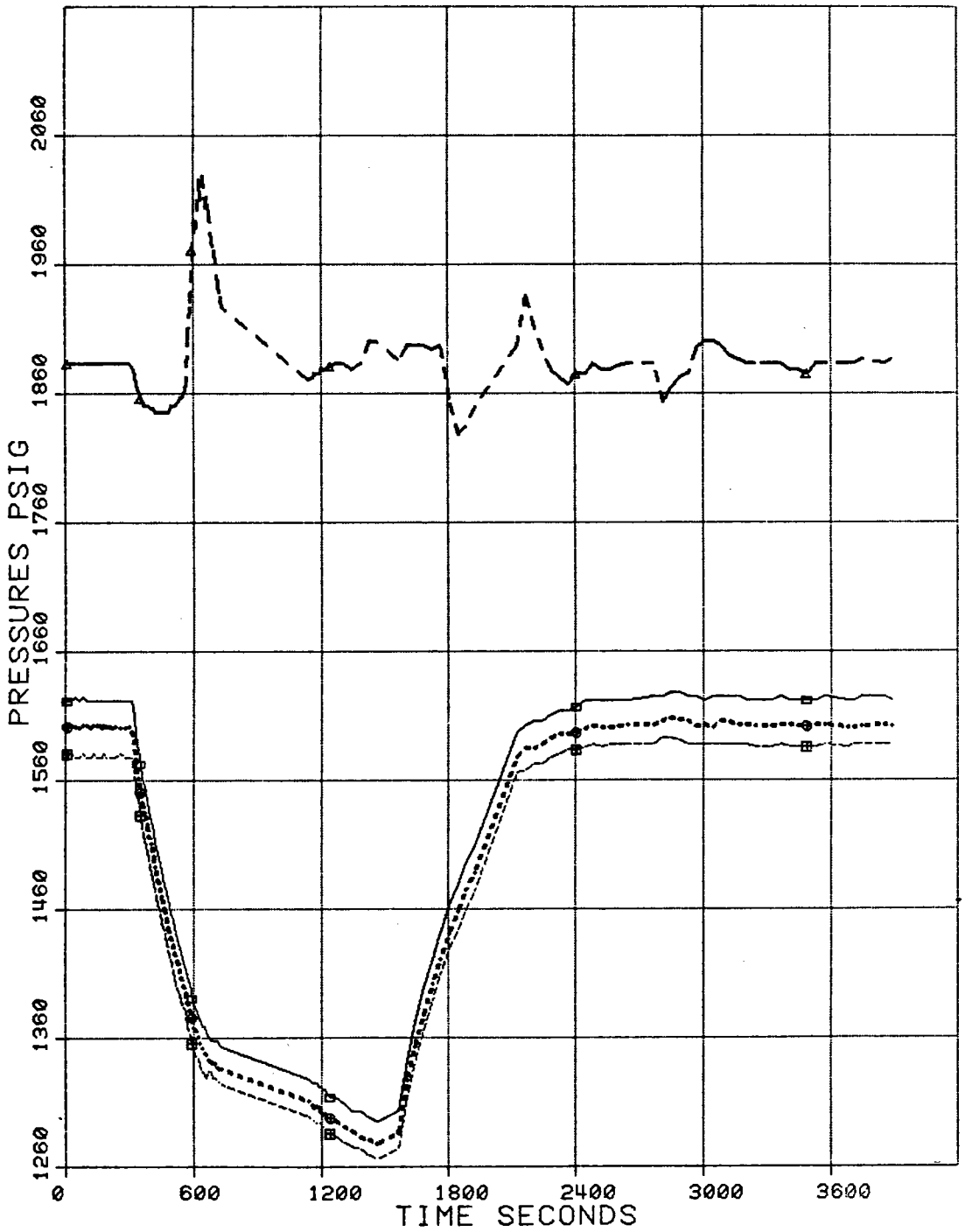
```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION #18 OPEN BOX

SECOND FUNCTION #19 TRIANGLE

THIRD  FUNCTION #20 CROSS-CIRCLE

FOURTH FUNCTION #21 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


PRESSURES PSIG
3900
3500
3100
2700
2300
1900
1500
1100
700
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   4

ARGUMENT SELECTED :   1

FIRST  FUNCTION #18 OPEN BOX

SECOND FUNCTION #20 TRIANGLE

THIRD  FUNCTION #21 CROSS-CIRCLE

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


PRESSURES PSIG
500
700
900
1100
1300
1500
1700
1900
2100
0
2000
4000
6000
8000
10000
12000
TIME SECONDS

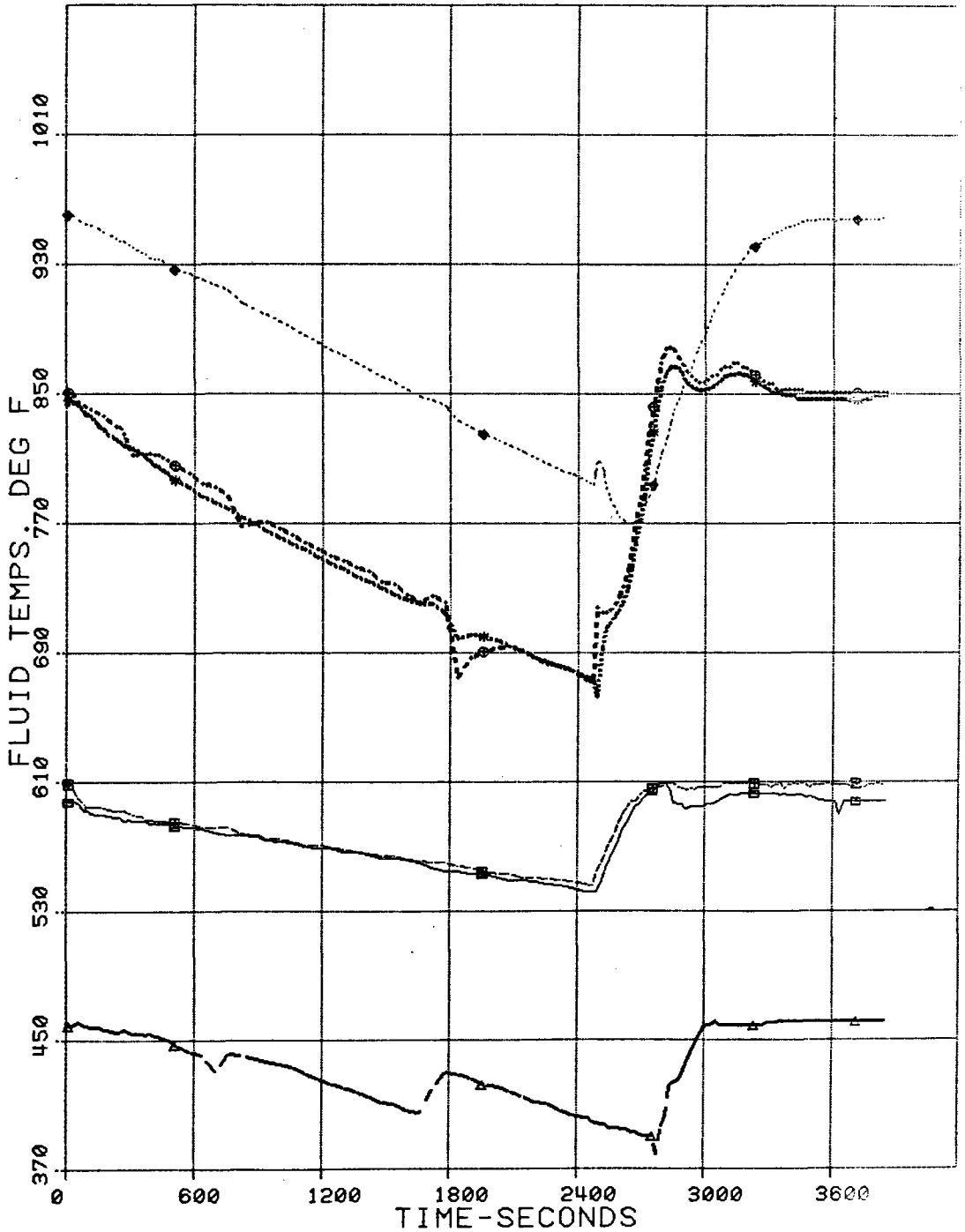
```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION #18 OPEN BOX

SECOND FUNCTION #19 TRIANGLE

THIRD  FUNCTION #20 CROSS-CIRCLE

FOURTH FUNCTION #21 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


PRESSURES PSIG
2060
1960
1860
1760
1660
1560
1460
1360
1260
0
600
1200
1800
2400
3000
3600
TIME SECONDS

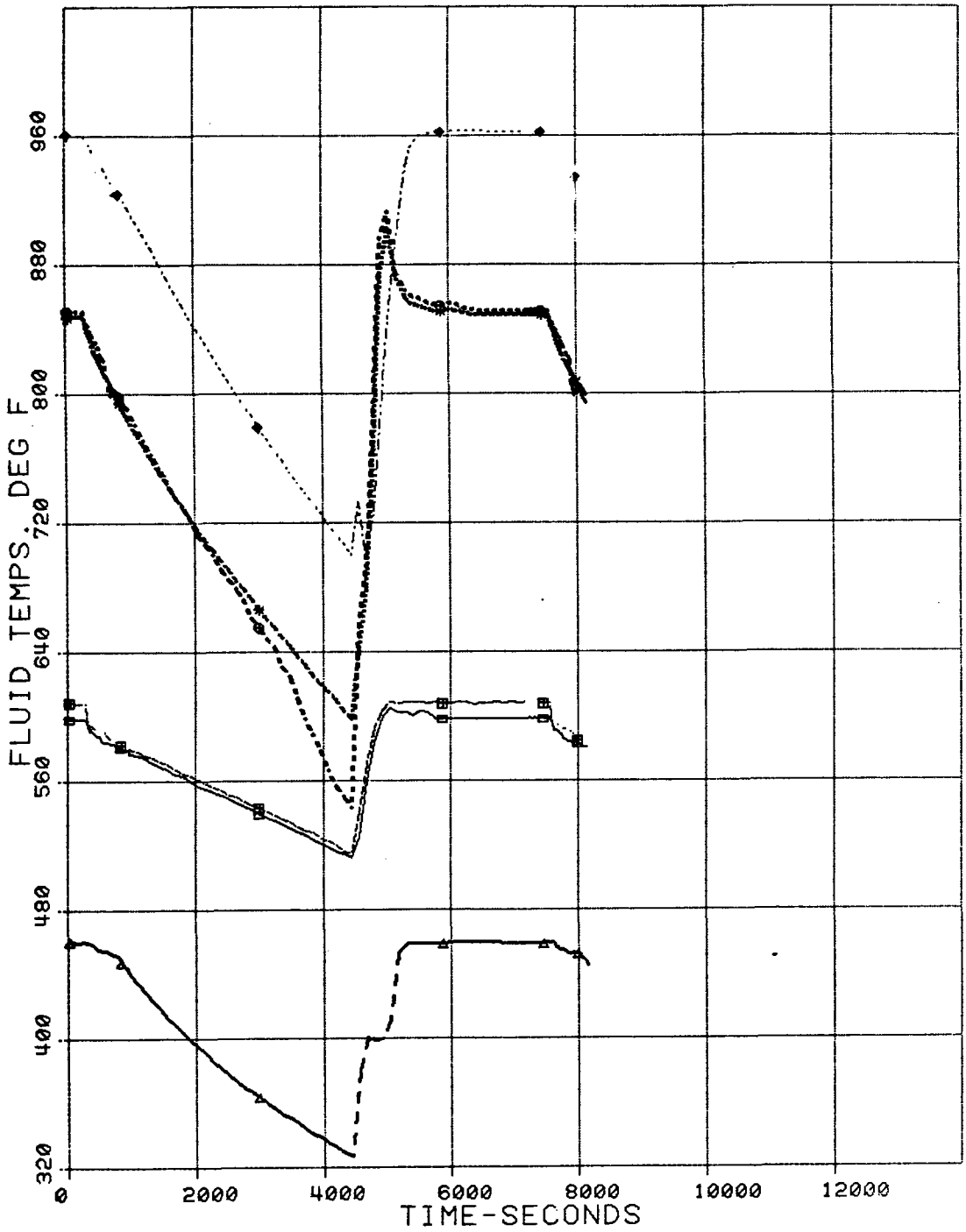
PAGE 16

FLUIDS TEMPERATURES, PLOTS

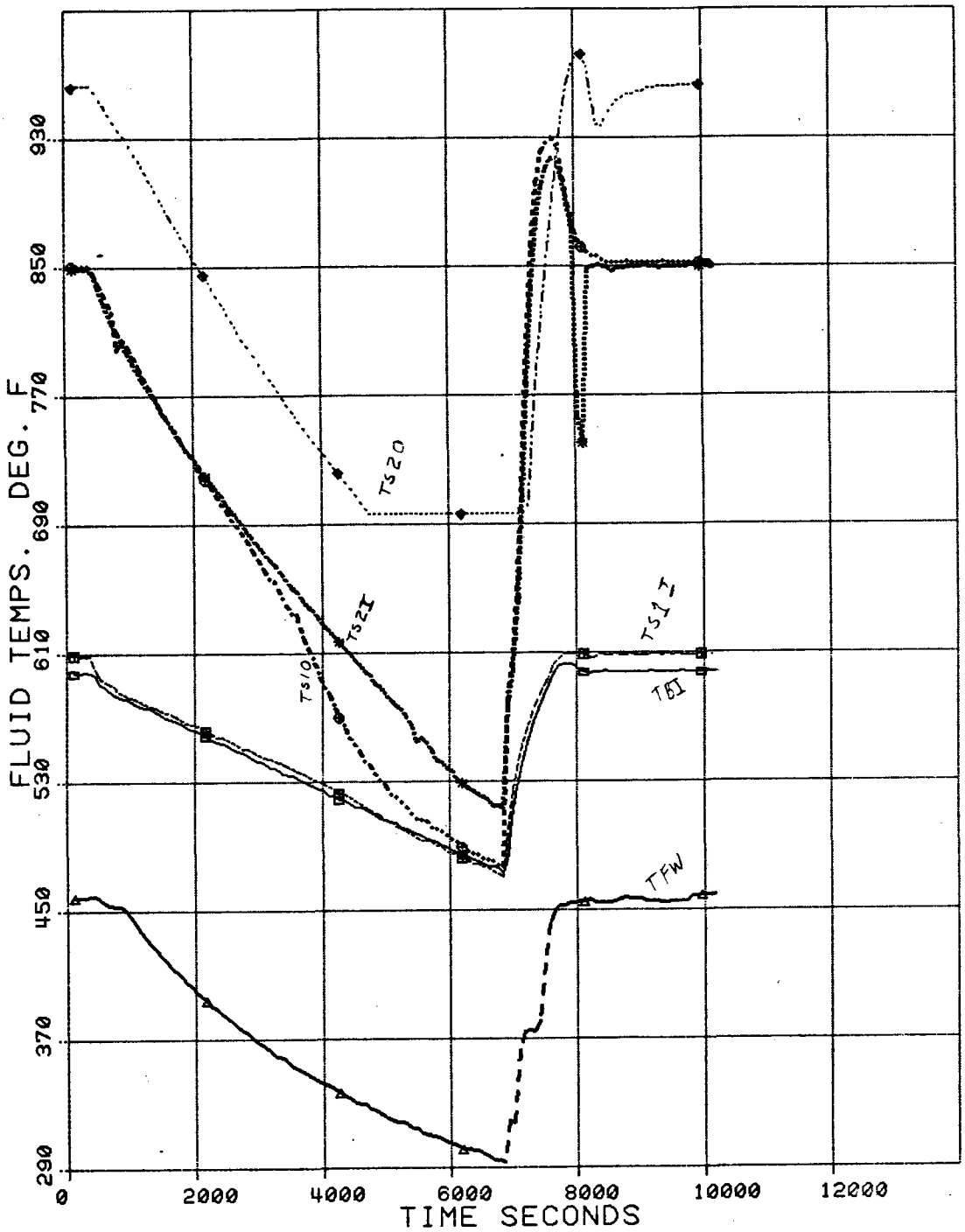
```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #22 OPEN BOX

SECOND FUNCTION #24 TRIANGLE

THIRD  FUNCTION #26 CROSS-CIRCLE

FOURTH FUNCTION #27 CROSS-BOX

FIFTH  FUNCTION #28 CROSS-DIAMOND

SIXTH  FUNCTION #29 ASTERISK

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS    64 POINTS PER FUNCTION
```


FLUID TEMPS, DEG F
1010
930
850
770
690
610
530
450
370
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

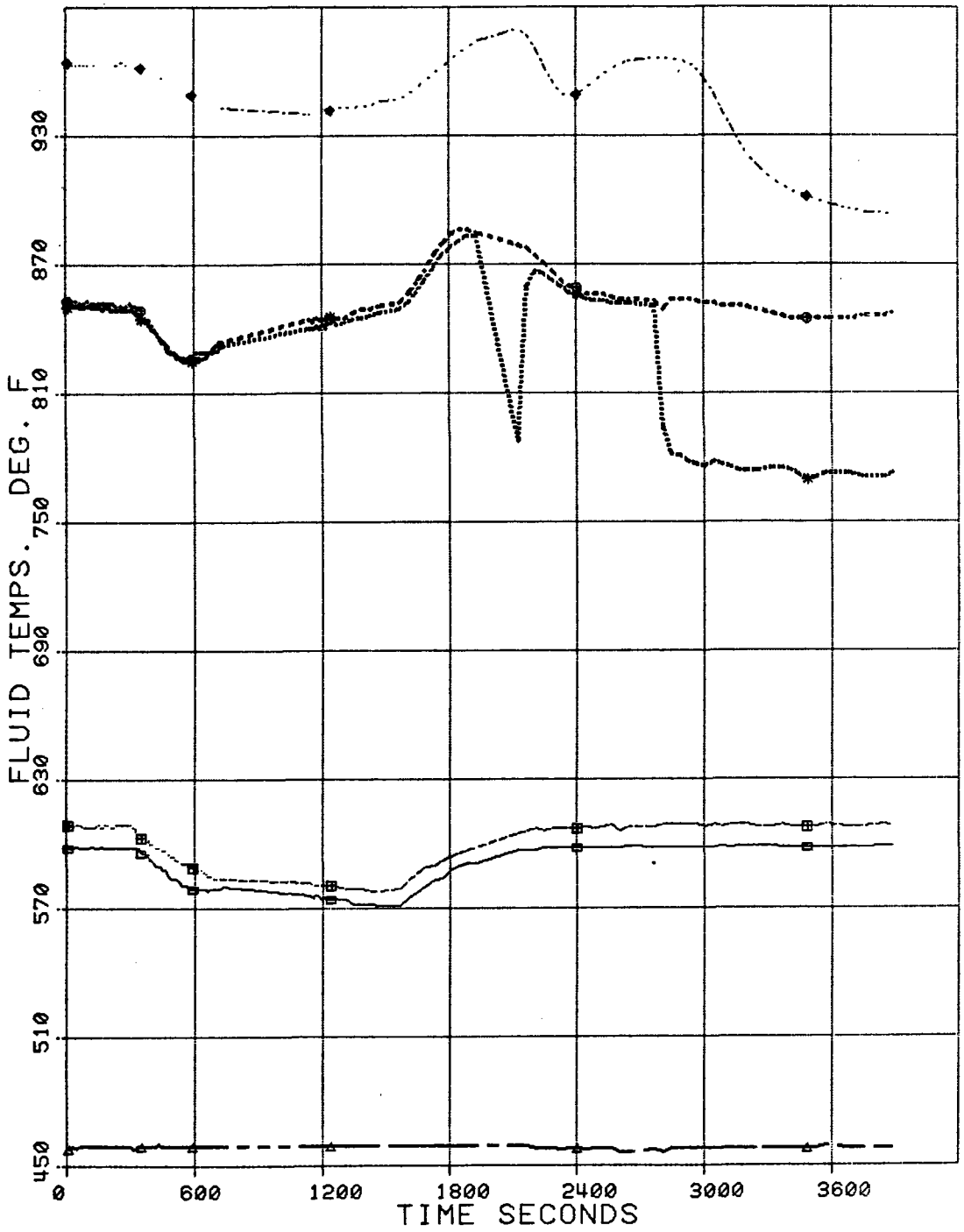
```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #22 OPEN BOX

SECOND FUNCTION #24 TRIANGLE

THIRD  FUNCTION #26 CROSS-CIRCLE

FOURTH FUNCTION #27 CROSS-BOX

FIFTH  FUNCTION #28 CROSS-DIAMOND

SIXTH  FUNCTION #29 ASTERISK

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLUID TEMPS, DEG F
960
880
800
720
640
560
480
400
320
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #22 OPEN BOX

SECOND FUNCTION #24 TRIANGLE

THIRD  FUNCTION #26 CROSS-CIRCLE

FOURTH FUNCTION #27 CROSS-BOX

FIFTH  FUNCTION #28 CROSS-DIAMOND

SIXTH  FUNCTION #29 ASTERISK

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLUID TEMPS. DEG. F
930
850
770
690
610
530
450
370
290
0
2000
4000
6000
8000
10000
12000
TIME SECONDS
TS20
TS2I
TS10
TS1I
TBI
TFW

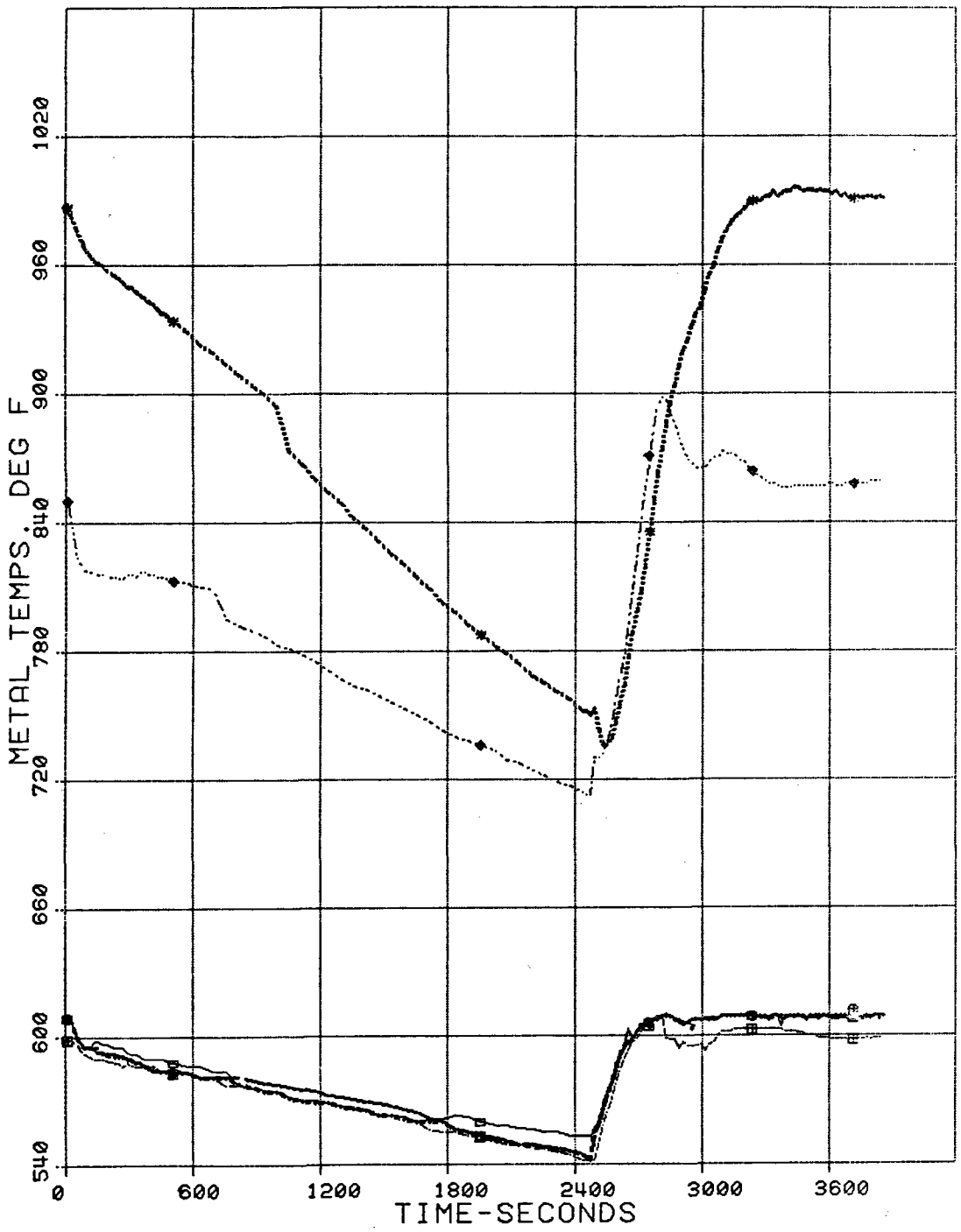
```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #22 OPEN BOX

SECOND FUNCTION #24 TRIANGLE

THIRD  FUNCTION #26 CROSS-CIRCLE

FOURTH FUNCTION #27 CROSS-BOX

FIFTH  FUNCTION #28 CROSS-DIAMOND

SIXTH  FUNCTION #29 ASTERISK

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


FLUID TEMPS. DEG. F
930
870
810
750
690
630
570
510
450
0
600
1200
1800
2400
3000
3600
TIME SECONDS

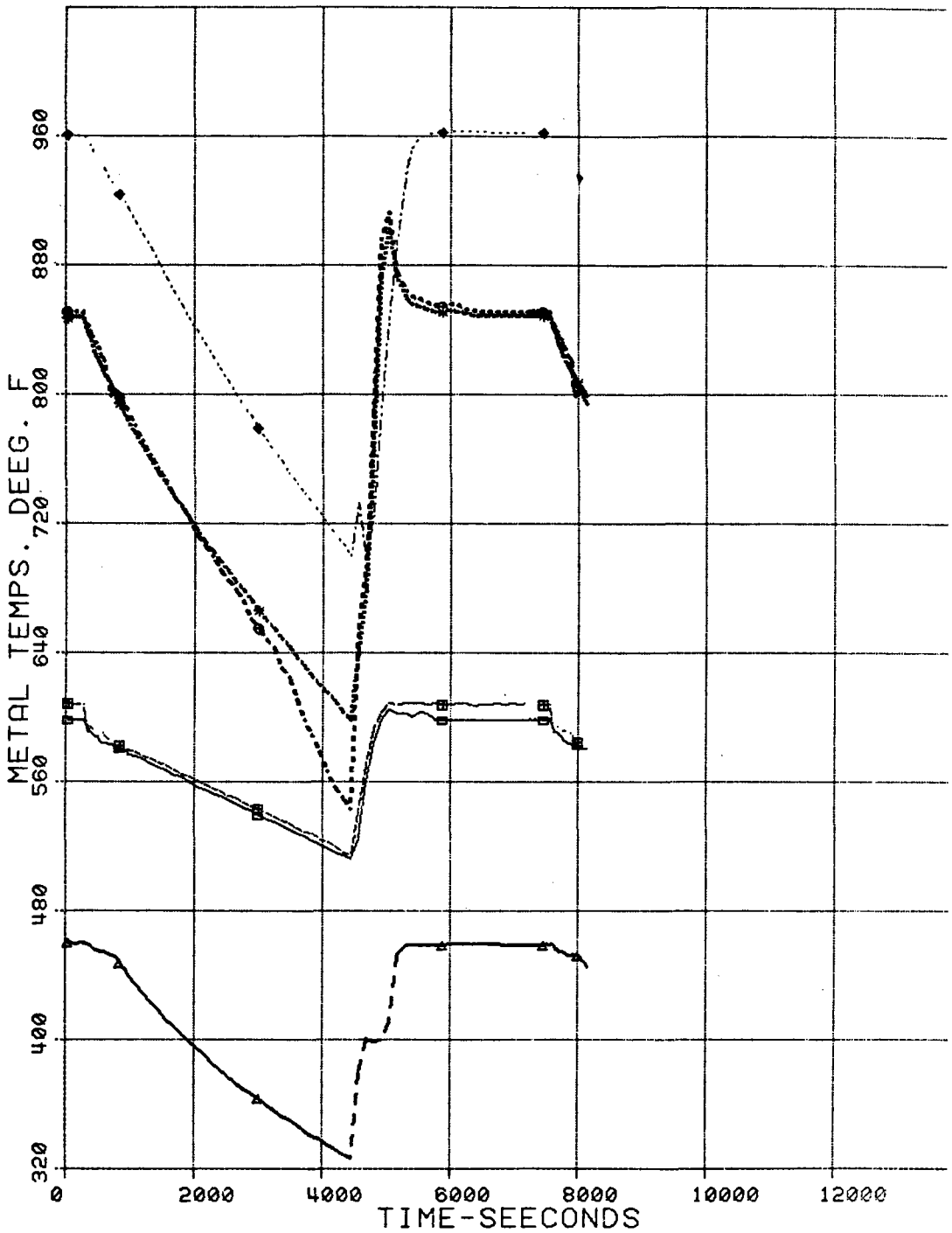
PAGE 17

METAL TEMPERATURES, PLOTS

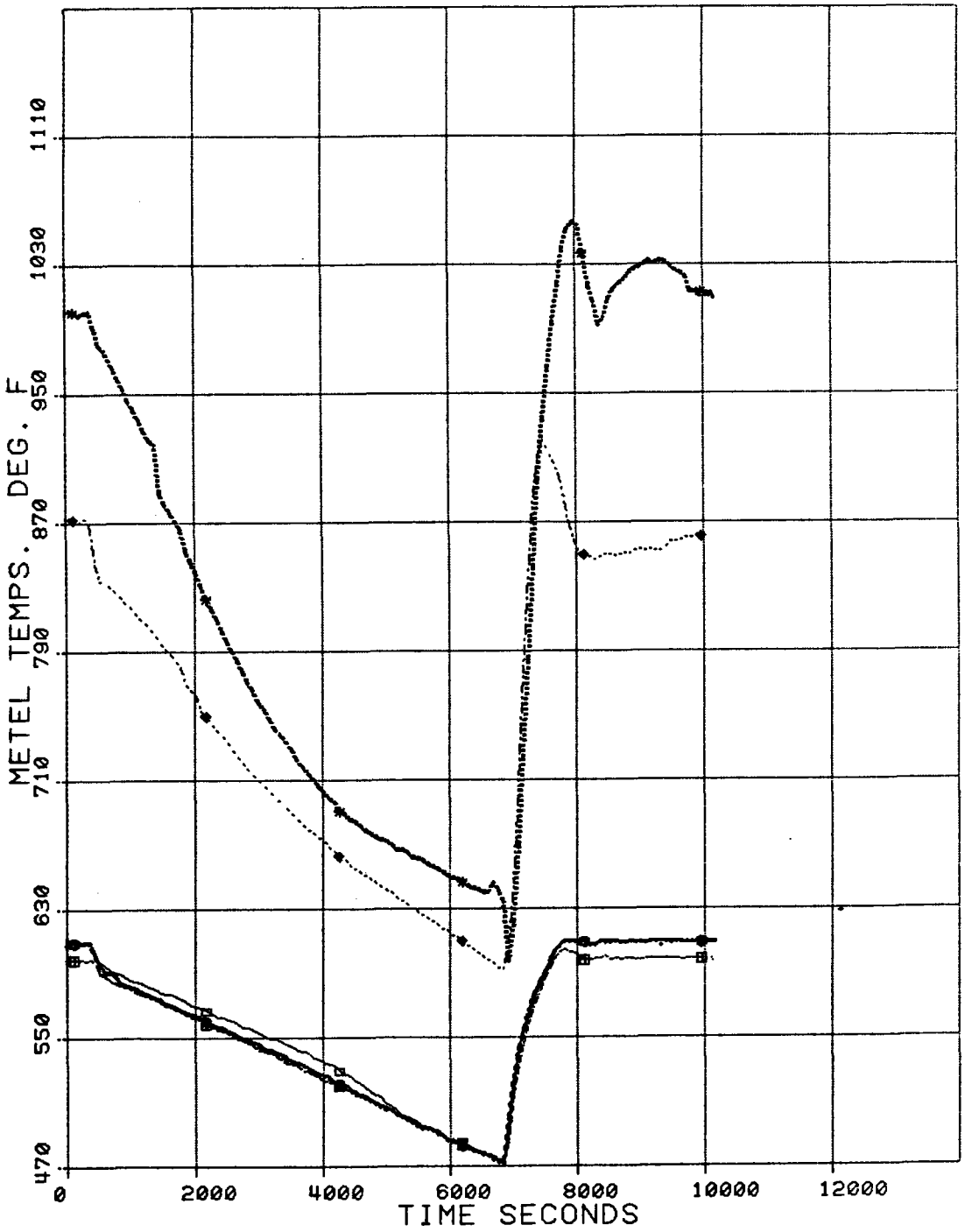
```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #12 OPEN BOX

SECOND FUNCTION #13 TRIANGLE

THIRD  FUNCTION #14 CROSS-CIRCLE

FOURTH FUNCTION #23 CROSS-BOX

FIFTH  FUNCTION #32 CROSS-DIAMOND

SIXTH  FUNCTION #33 ASTERISK

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


METAL TEMPS. DEG F
1020
960
900
840
780
720
660
600
540
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

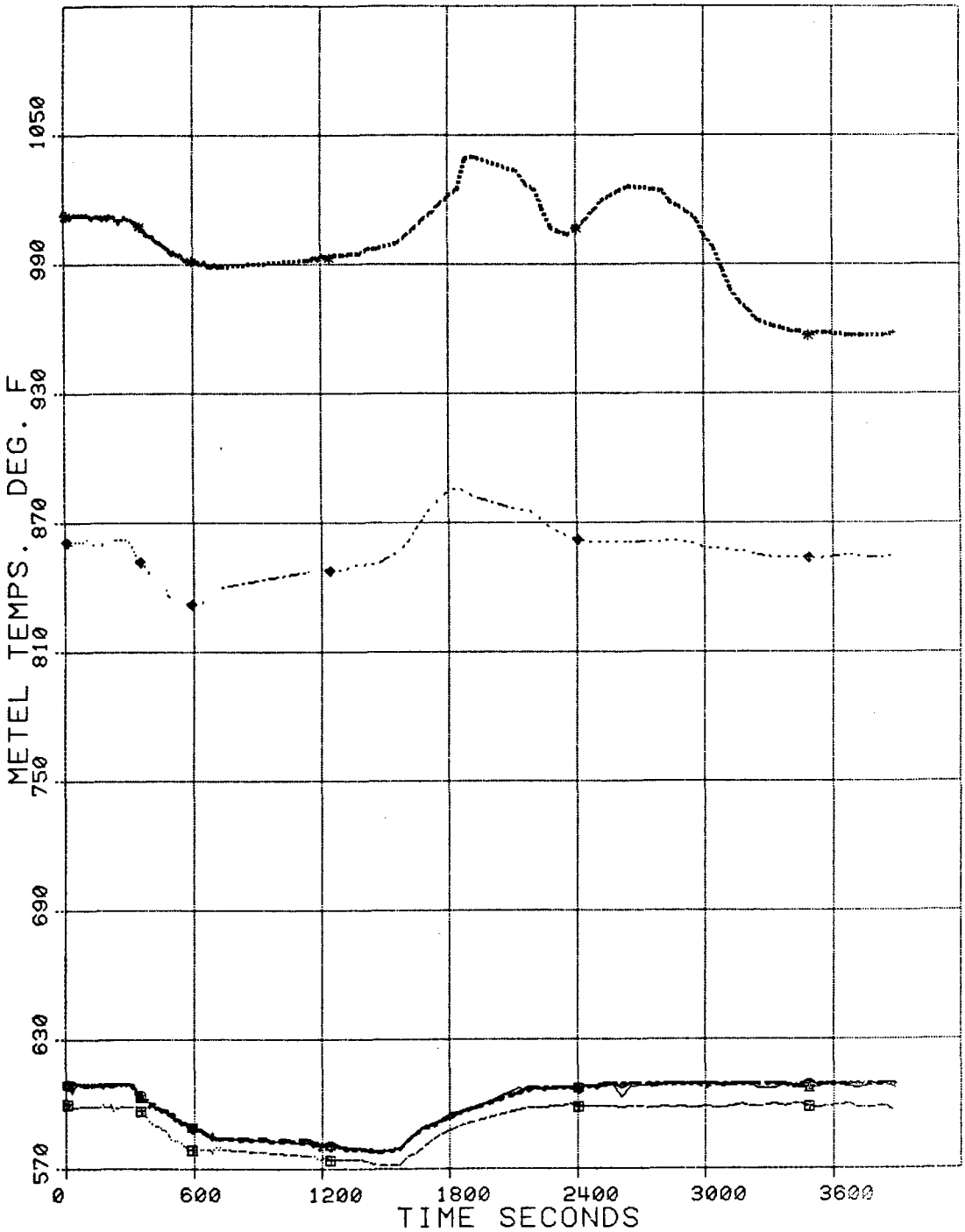
```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #12 OPEN BOX

SECOND FUNCTION #13 TRIANGLE

THIRD  FUNCTION #14 CROSS-CIRCLE

FOURTH FUNCTION #23 CROSS-BOX

FIFTH  FUNCTION #32 CROSS-DIAMOND

SIXTH  FUNCTION #33 ASTERISK

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED
```


METAL TEMPS. DEEG. F
960
880
800
720
640
560
480
400
320
0
2000
4000
6000
8000
10000
12000
TIME-SEECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #12 OPEN BOX

SECOND FUNCTION #13 TRIANGLE

THIRD  FUNCTION #14 CROSS-CIRCLE

FOURTH FUNCTION #23 CROSS-BOX

FIFTH  FUNCTION #32 CROSS-DIAMOND

SIXTH  FUNCTION #33 ASTERISK

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


METEL TEMPS. DEG. F
1110
1030
950
870
790
710
630
550
470
0
2000
4000
6000
8000
10000
12000
TIME SECONDS

```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   7

ARGUMENT SELECTED :   1

FIRST  FUNCTION #12 OPEN BOX

SECOND FUNCTION #13 TRIANGLE

THIRD  FUNCTION #14 CROSS-CIRCLE

FOURTH FUNCTION #23 CROSS-BOX

FIFTH  FUNCTION #32 CROSS-DIAMOND

SIXTH  FUNCTION #33 ASTERISK

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


METEL TEMPS. DEG. F
1050
990
930
870
810
750
690
630
570
0
600
1200
1800
2400
3000
3600
TIME SECONDS

PAGE 18

DRUM LEVEL, PLOTS

SEARCH START
DAY #109 1977 TIME 11:48
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

PLOT START TIME = 42460.0

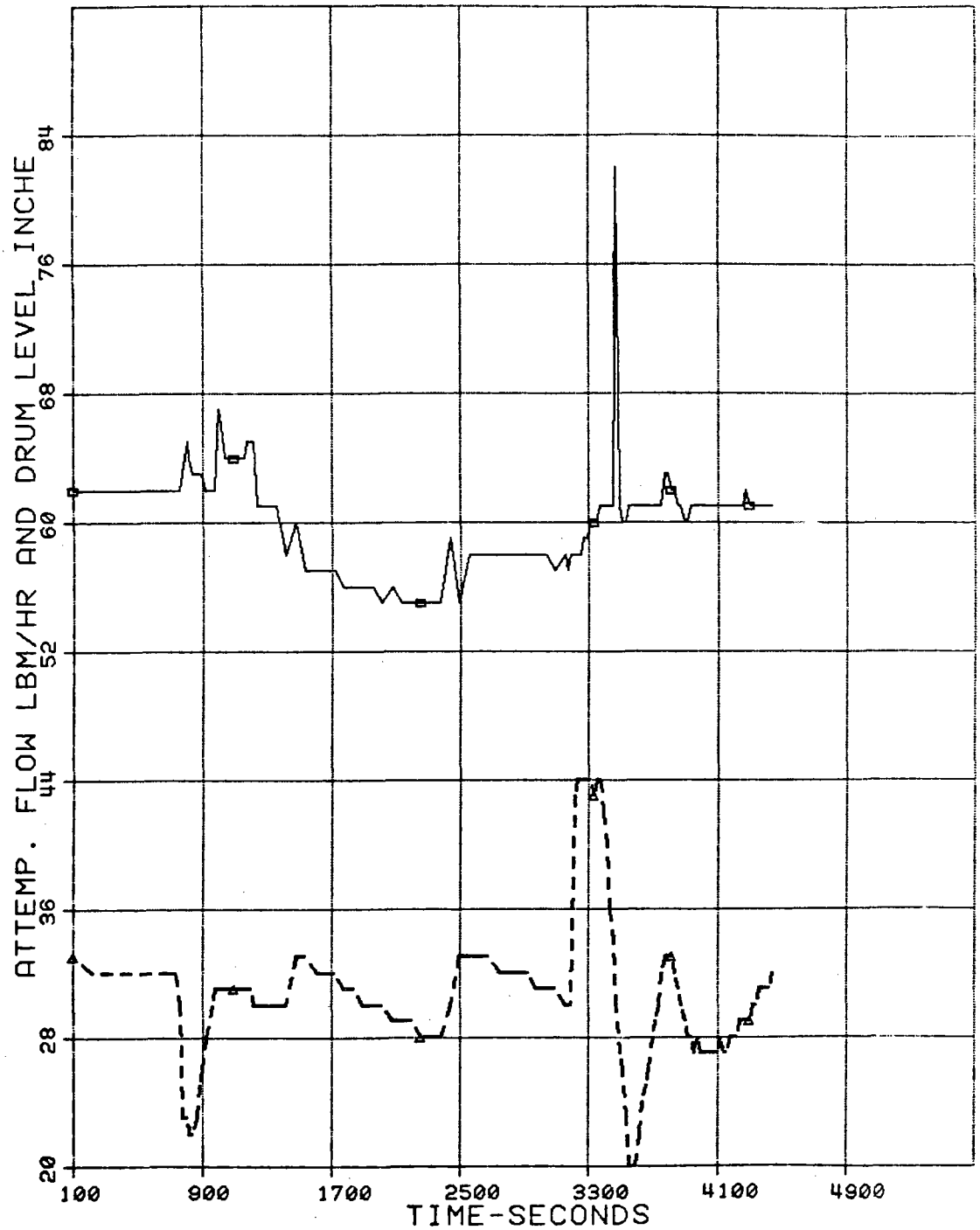
EACH 1TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

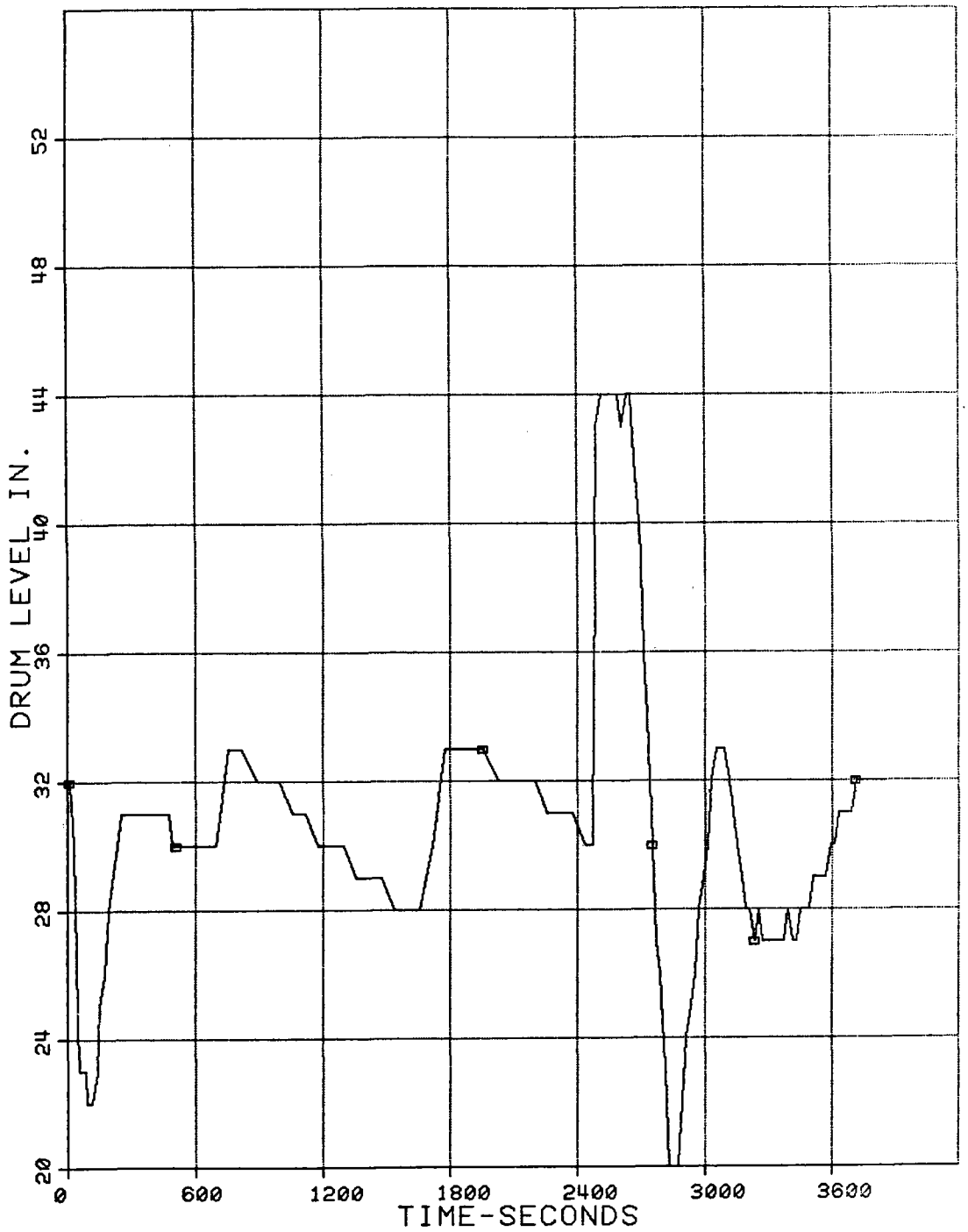
Test No. 20

14 –
18 –

Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
84
76
68
60
52
44
36
28
20
100
900
1700
2500
3300
4100
4900
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   2

ARGUMENT SELECTED :   1

FIRST  FUNCTION #30 OPEN BOX

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


DRUM LEVEL IN.
52
48
44
40
36
32
28
24
20
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

SEARCH START
DAY #109 1977 TIME 12: 0
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

PLOT START TIME = 43200.0

EACH 1TH POINT IS PLOTTED

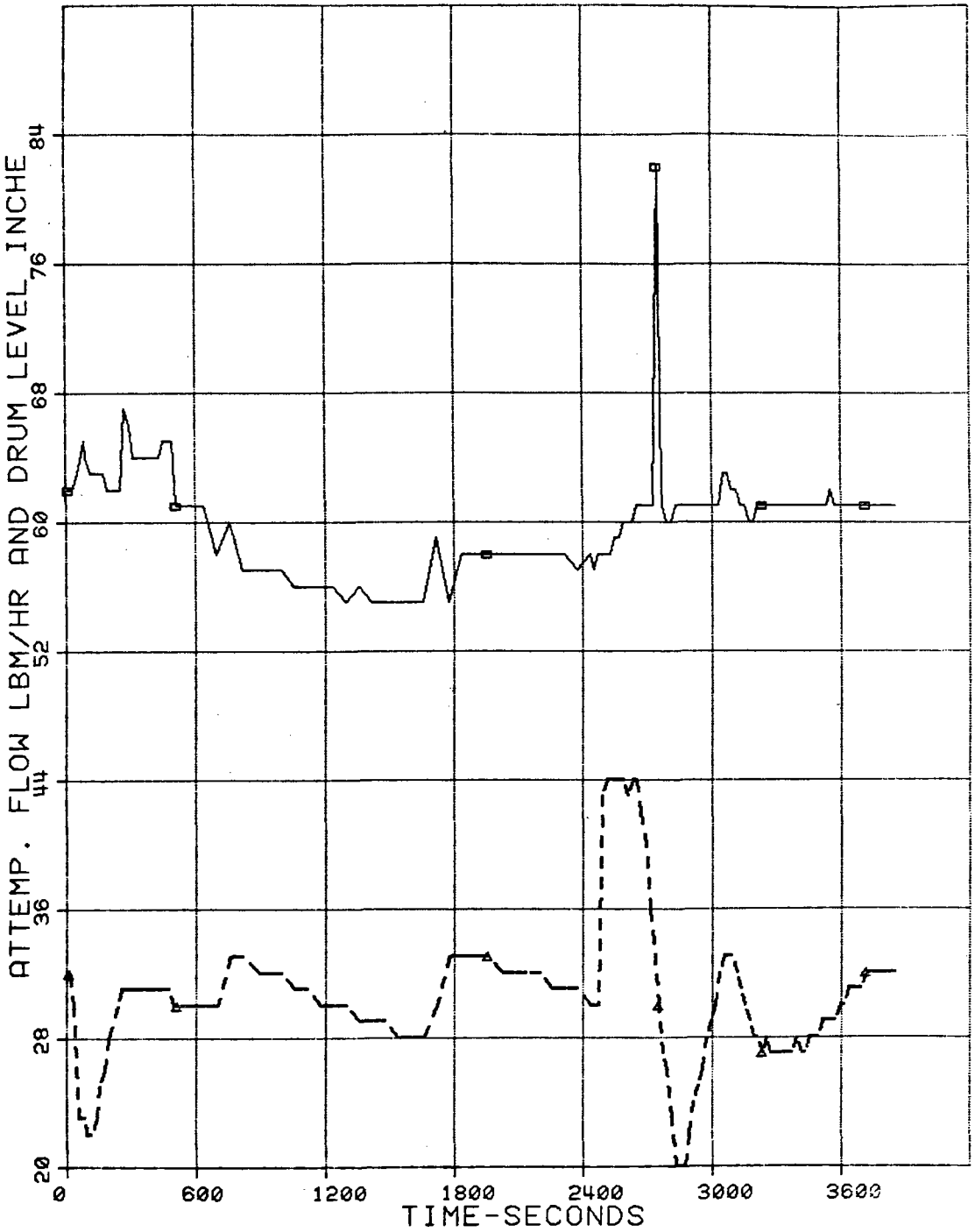
LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

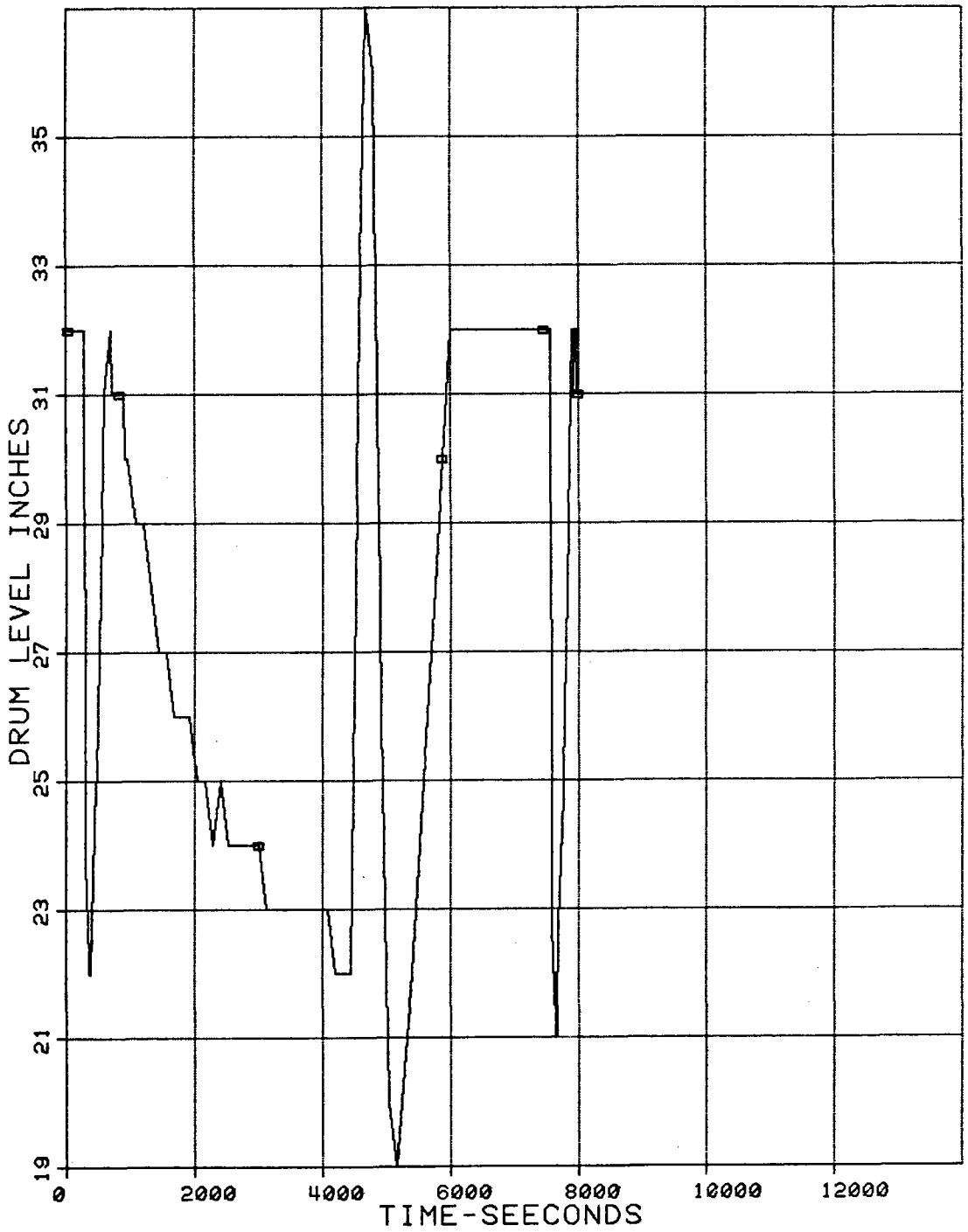
14-

18-

Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
20
28
36
44
52
60
68
76
84
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   2

ARGUMENT SELECTED :   1

FIRST  FUNCTION #30 OPEN BOX

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED


SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED


LINE PLOT HAS  128 POINTS PER FUNCTION
```


DRUM LEVEL INCHES
19
21
23
25
27
29
31
33
35
0
2000
4000
6000
8000
10000
12000
TIME-SEECONDS

SEARCH START
DAY #109 1977 TIME 13:11
NUMBER OF RECORDS = 3

ARGUMENT SELECTED : 1

FIRST FUNCTION # 9 OPEN BOX

SECOND FUNCTION #30 TRIANGLE

SEARCH MODE 2

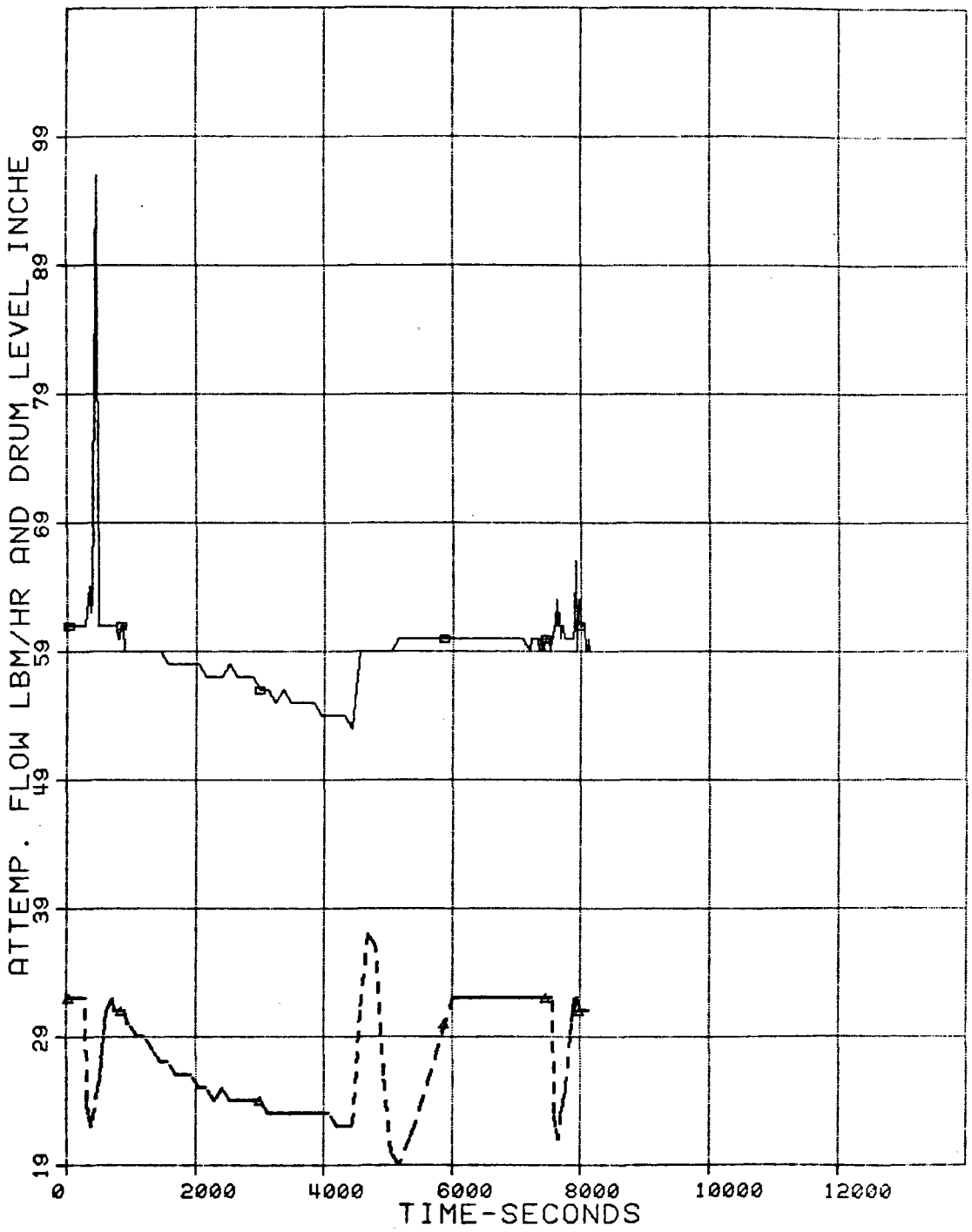
PLOT START TIME = 47460.0

EACH 1TH POINT IS PLOTTED

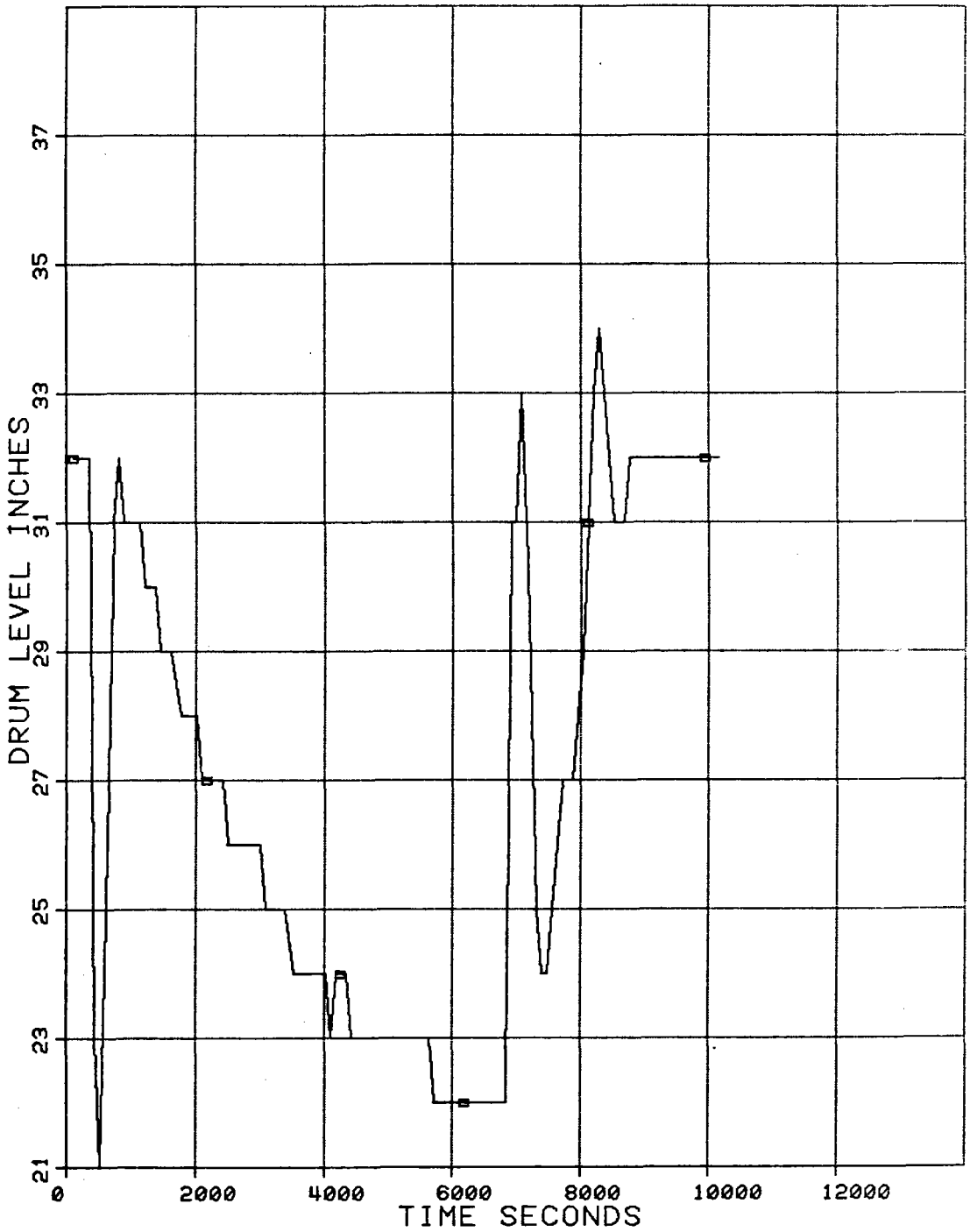
LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

14-
18-
Replot 4/25/77


ATTEMP. FLOW LBM/HR AND DRUM LEVEL INCHE
99
89
79
69
59
49
39
29
19
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   2

ARGUMENT SELECTED :   1

FIRST  FUNCTION #30 OPEN BOX

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


DRUM LEVEL INCHES
37
35
33
31
29
27
25
23
21
0
2000
4000
6000
8000
10000
12000
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 15:10
NUMBER OF RECORDS = 2

ARGUMENT SELECTED : 1

FIRST FUNCTION #30 OPEN BOX

SEARCH MODE 2

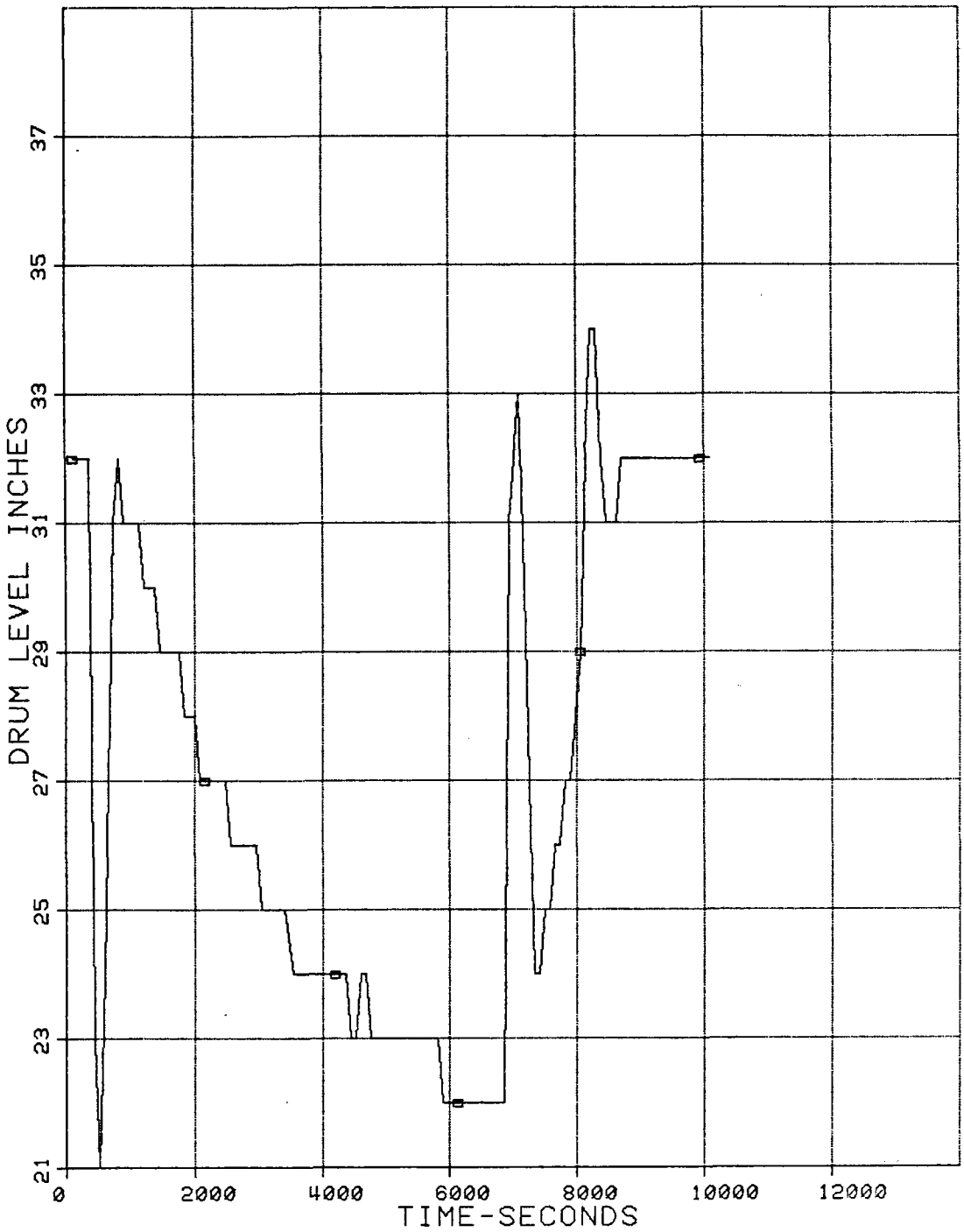
PLOT START TIME = 54600.0

EACH 4TH POINT IS PLOTTED

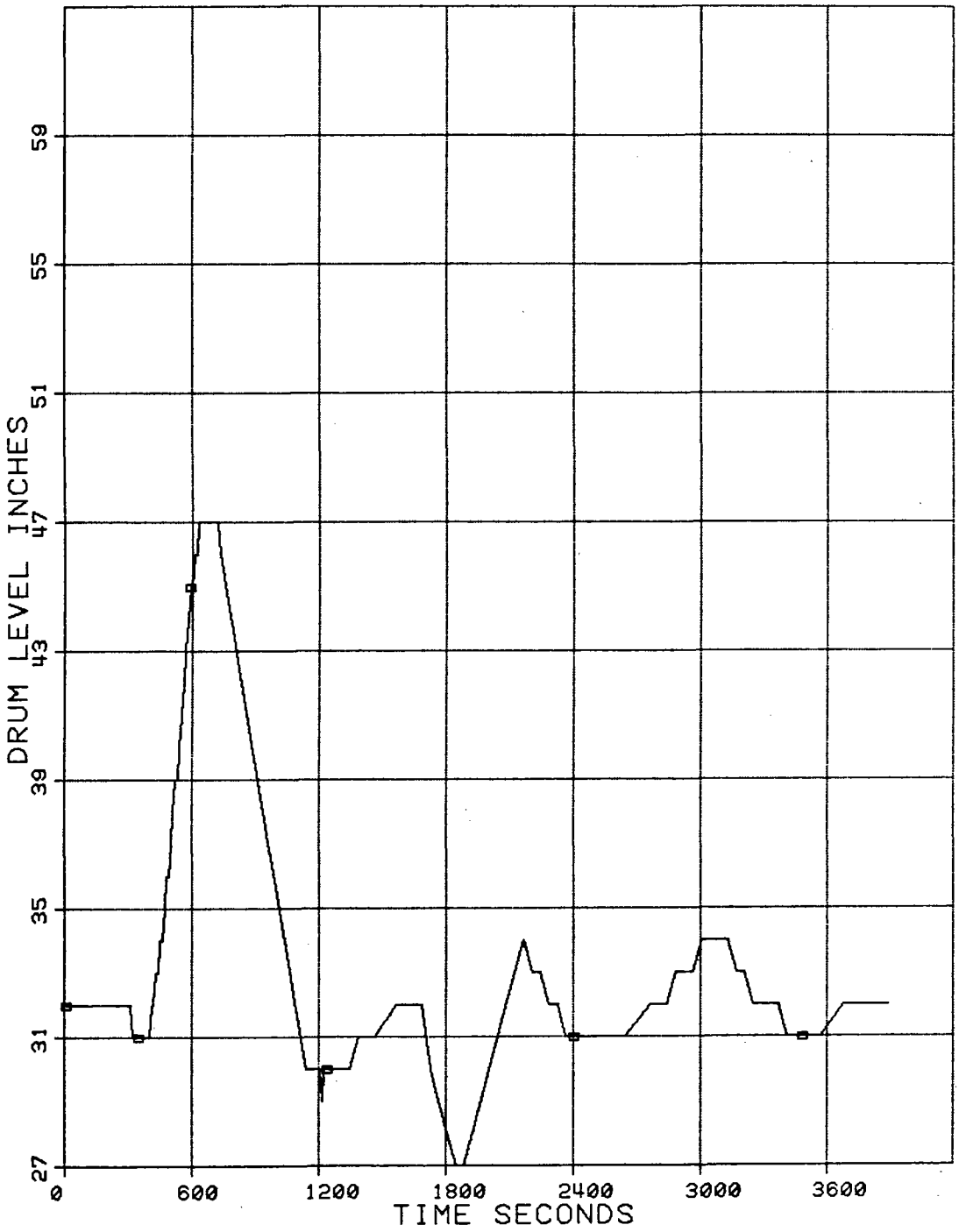
LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

18-
Replot 4/25/77


DRUM LEVEL INCHES
37
35
33
31
29
27
25
23
21
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   2

ARGUMENT SELECTED :   1

FIRST  FUNCTION #30 OPEN BOX

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


DRUM LEVEL INCHES
59
55
51
47
43
39
35
31
27
0
600
1200
1800
2400
3000
3600
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 17:55
NUMBER OF RECORDS = 2

ARGUMENT SELECTED : 1

FIRST FUNCTION #30 OPEN BOX

SEARCH MODE 2

PLOT START TIME = 64500.0

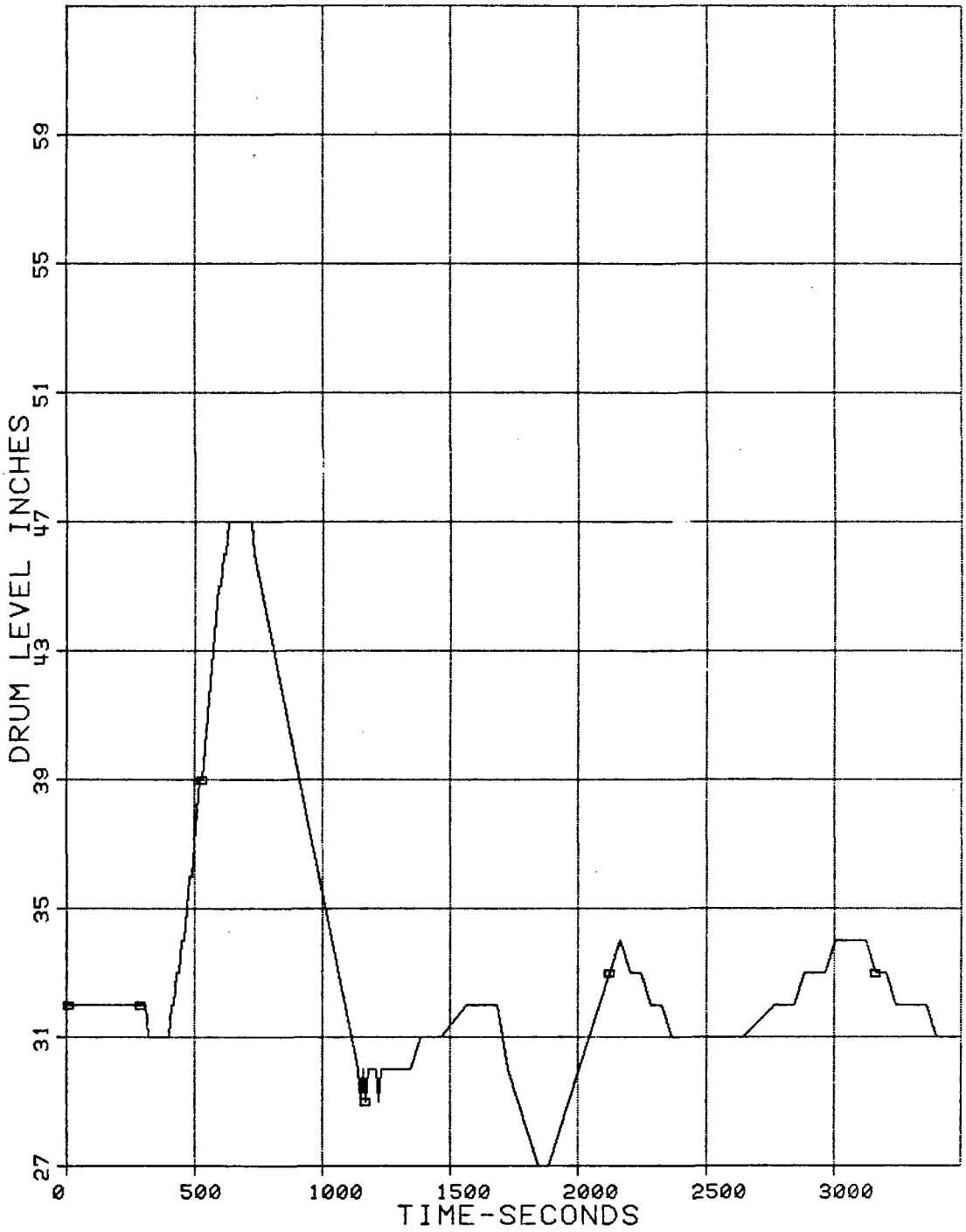
EACH 2TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

Replot 4/25/77

18—


DRUM LEVEL INCHES
59
55
51
47
43
39
35
31
27
0
500
1000
1500
2000
2500
3000
TIME-SECONDS

PAGE 19

RECIRCULATION FLOW, PLOTS

PAGE 20

POWER LEVELS, PLOTS

SEARCH START
DAY #109 1977 TIME 11:48
NUMBER OF RECORDS = 5

ARGUMENT SELECTED : 1

FIRST FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME = 42480.0

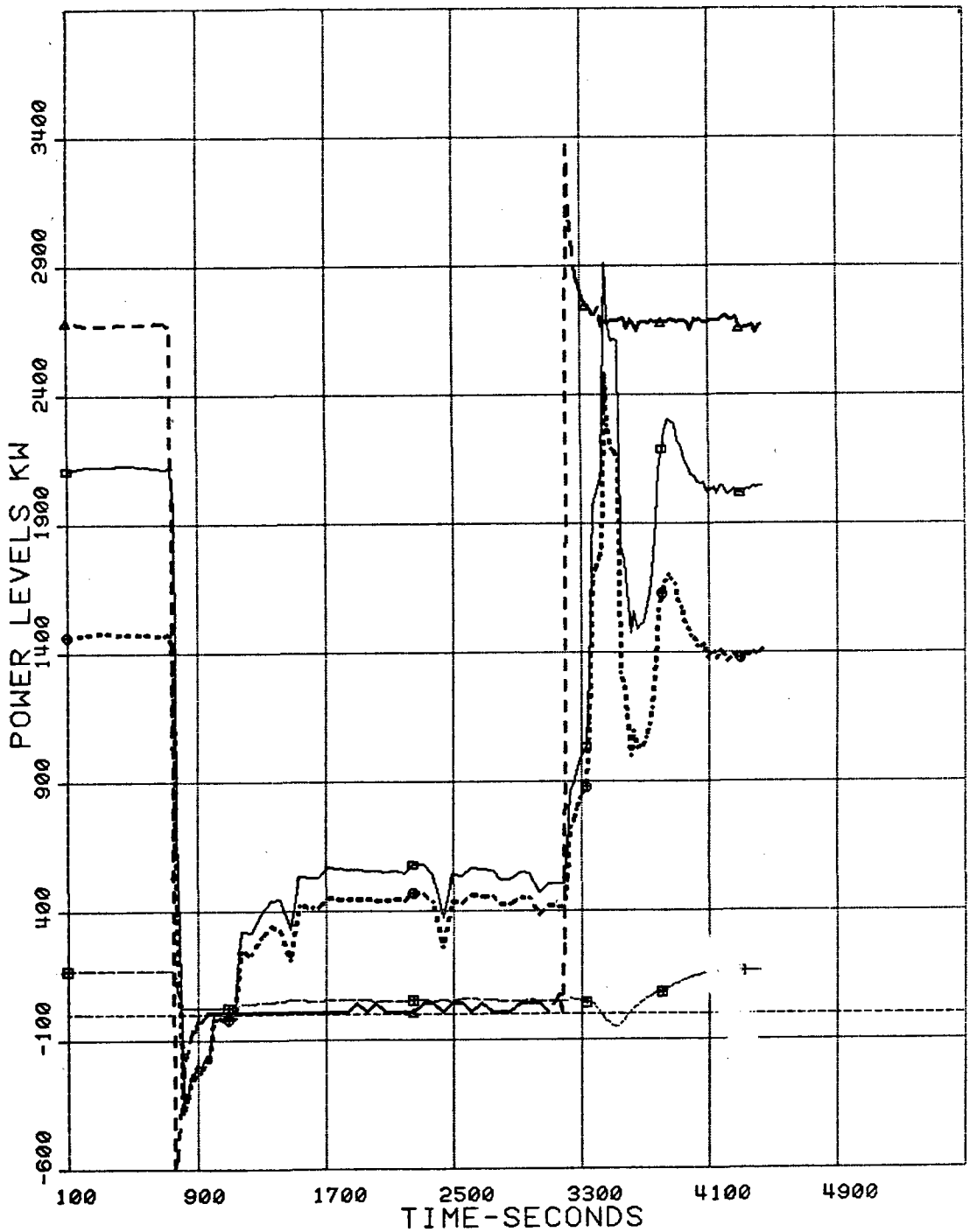
EACH 1TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

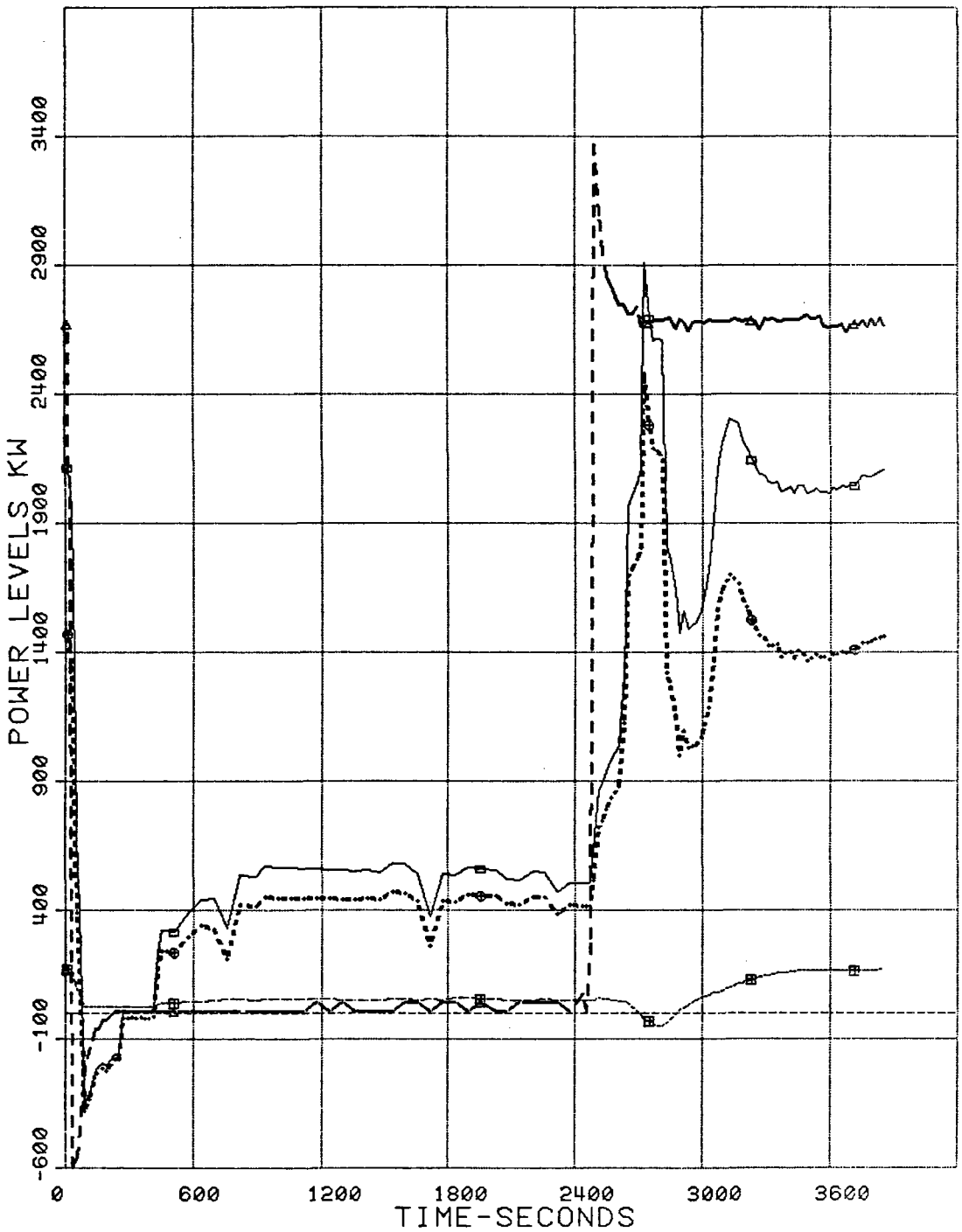
Test No. 20

20-

Replot 4/25/77


POWER LEVELS KW
3400
2900
2400
1900
1400
900
400
-100
-600
100
900
1700
2500
3300
4100
4900
TIME-SECONDS

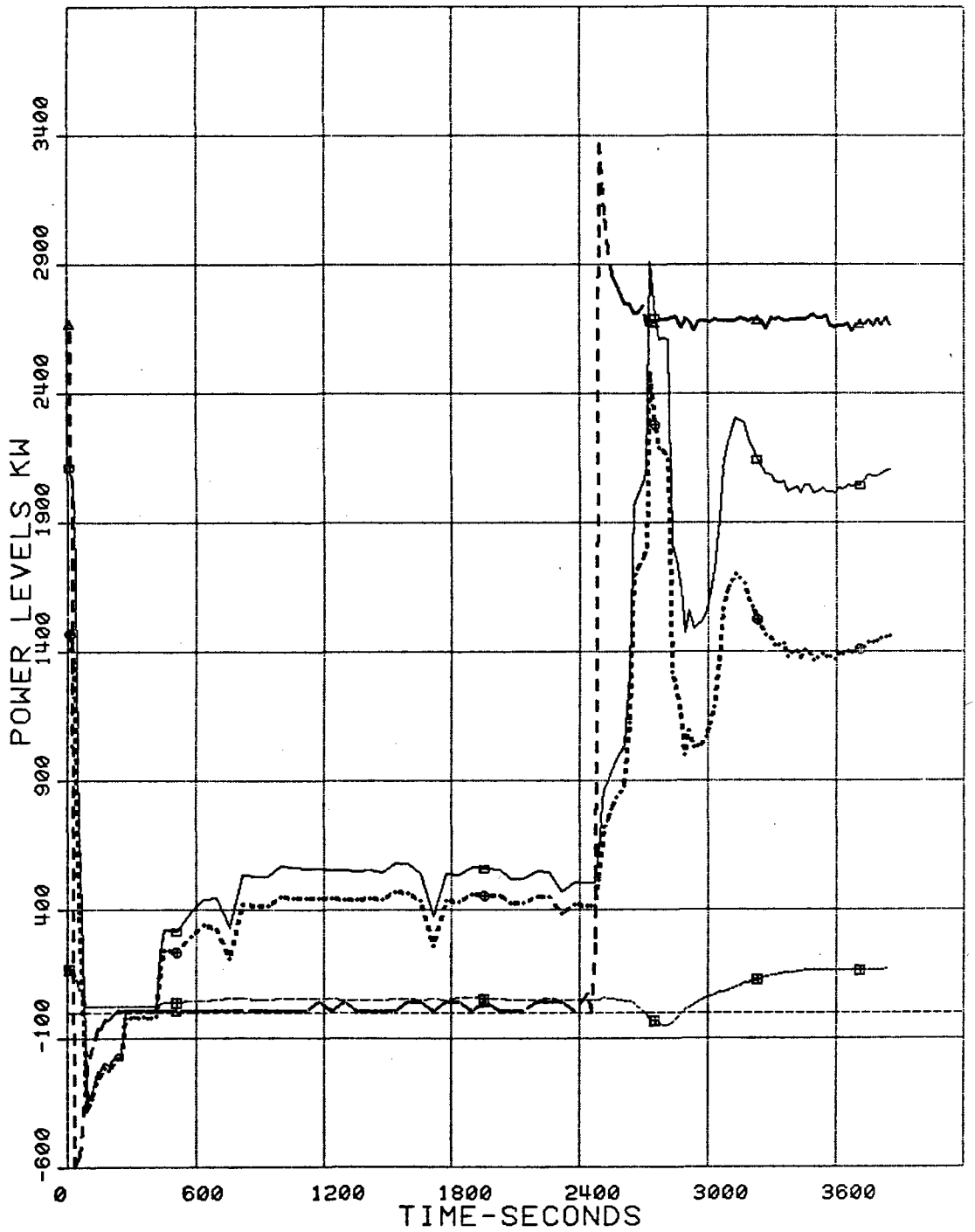
```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS       128 POINTS PER FUNCTION
SCATTER PLOT HAS   64 POINTS PER FUNCTION
```


POWER LEVELS KW
3400
2900
2400
1900
1400
900
400
-100
-600
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

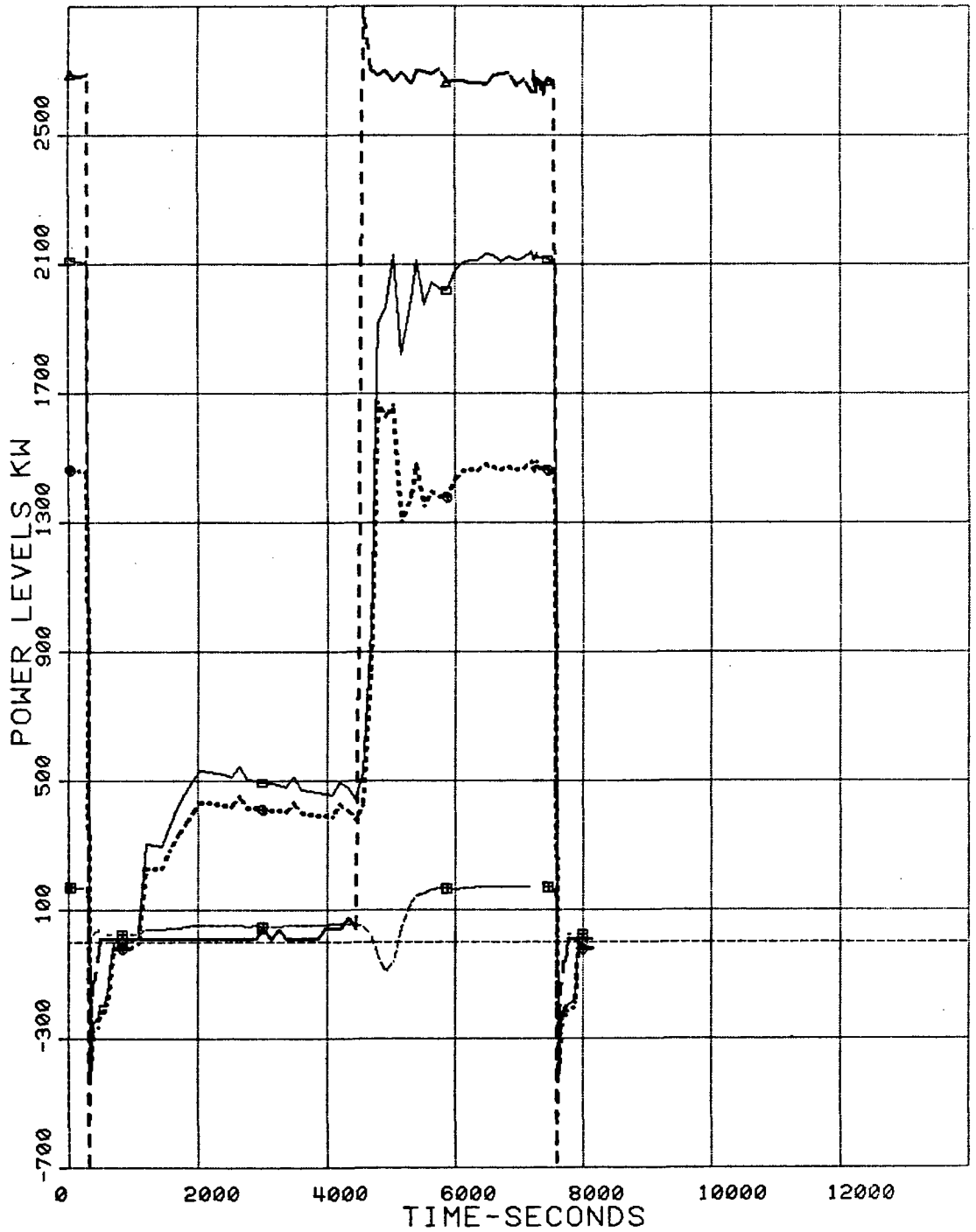
```
SEARCH START
DAY #109 1977  TIME 12: 0
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   43200.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```

Test No. 20

20 — Replot 4/25/77


POWER LEVELS KW
3400
2900
2400
1900
1400
900
400
-100
-600
0
600
1200
1800
2400
3000
3600
TIME-SECONDS

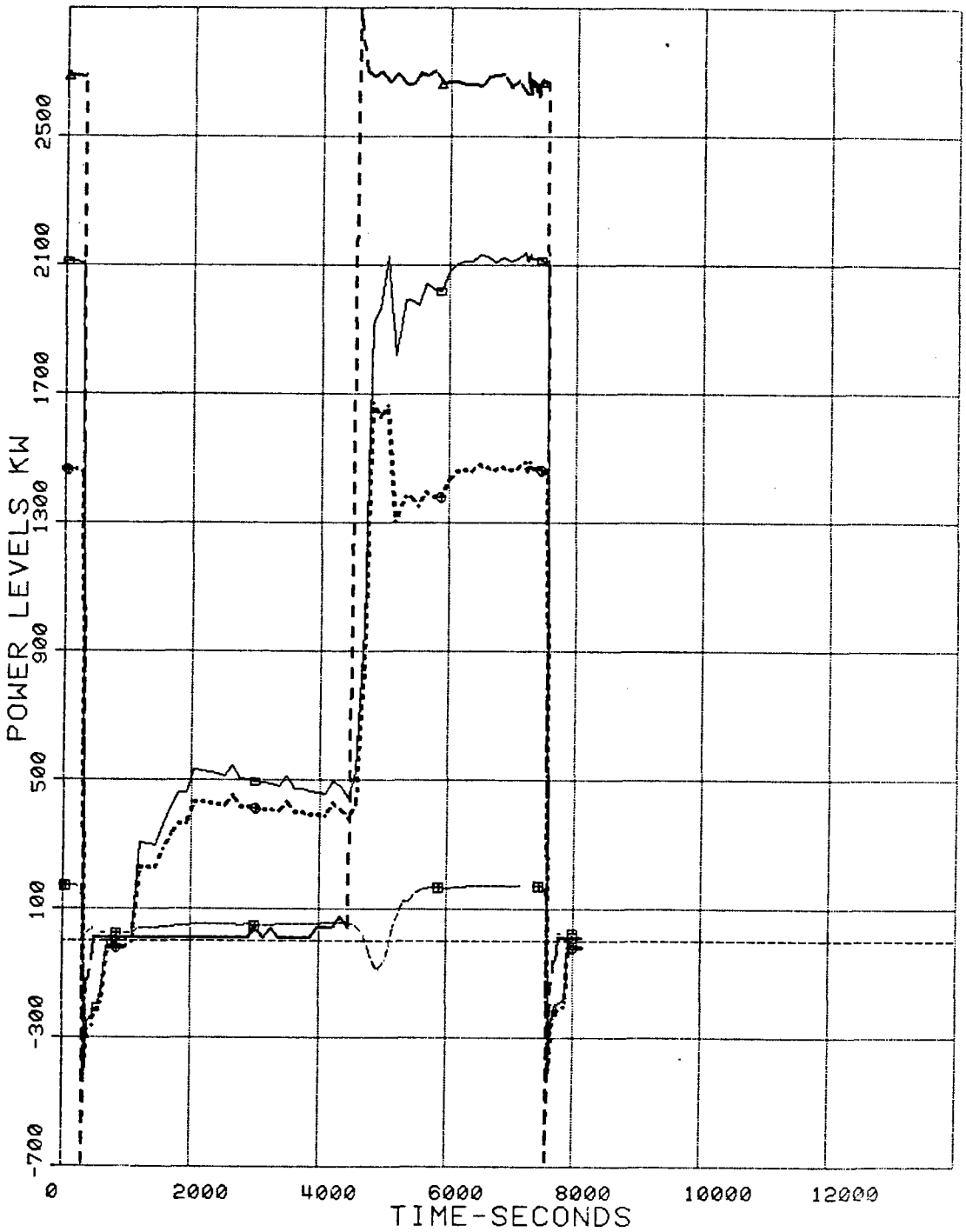
```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


POWER LEVELS KW
2500
2100
1700
1300
900
500
100
-300
-700
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

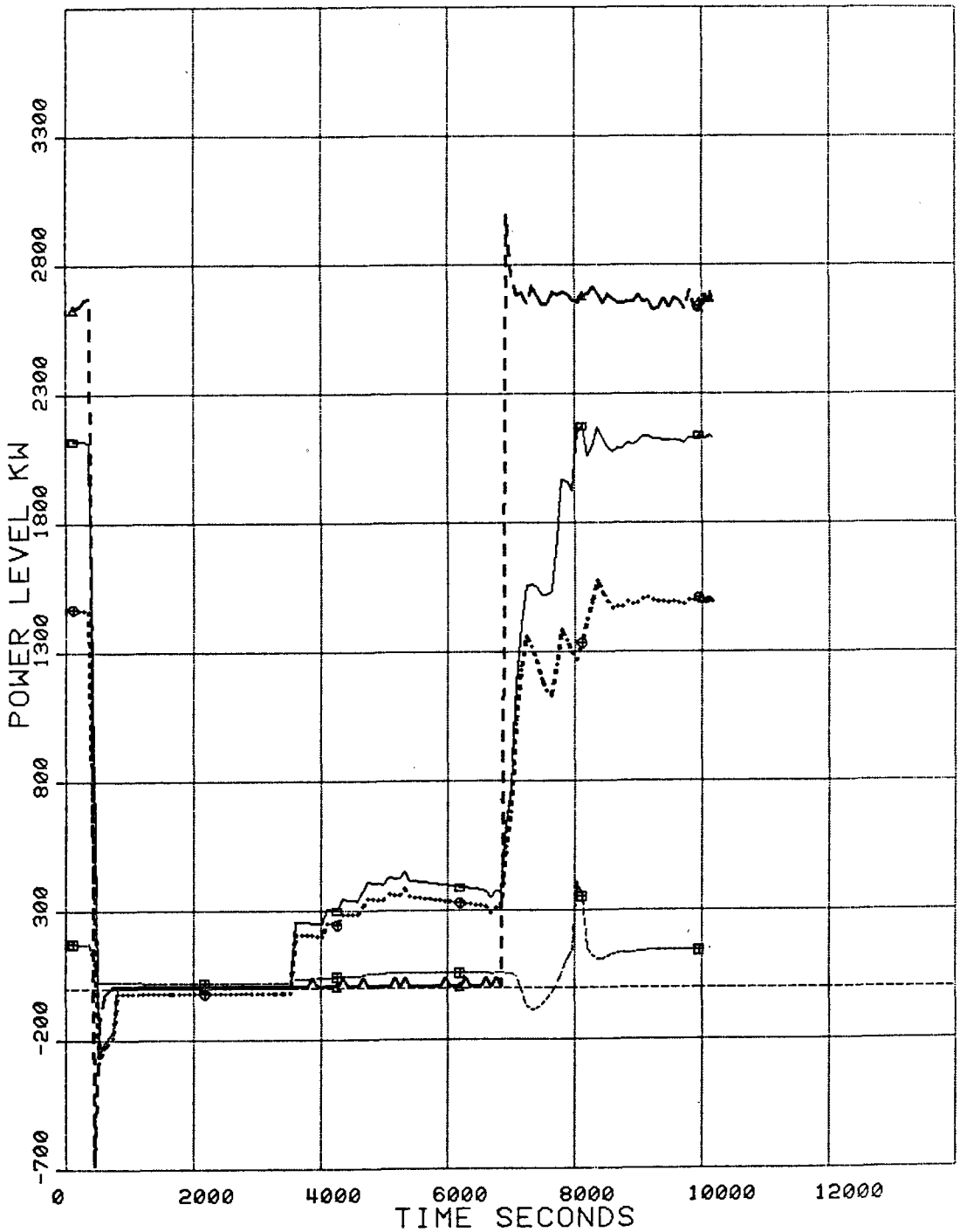
```
SEARCH START
DAY #109 1977  TIME 13:11
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   47460.0

EACH    1TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```

Test No. 20

20-
Replot 4/25/77


POWER LEVELS KW
2500
2100
1700
1300
900
500
100
-300
-700
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 15:10
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   54600.0

EACH    4TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


POWER LEVEL KW
3300
2800
2300
1800
1300
800
300
-200
-700
0
2000
4000
6000
8000
10000
12000
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 15:10
NUMBER OF RECORDS = 5

ARGUMENT SELECTED : 1

FIRST FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME = 54600.0

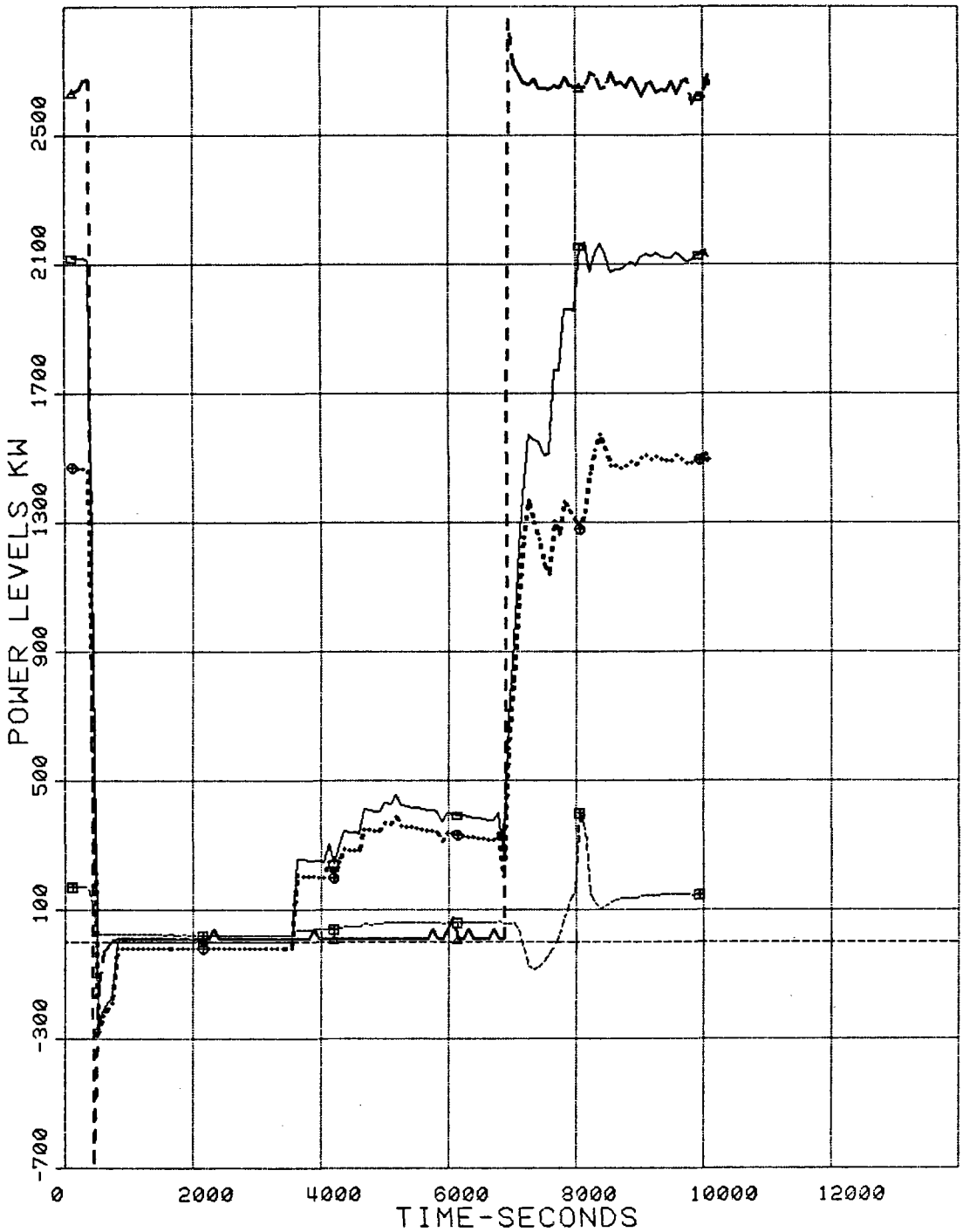
EACH 4TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

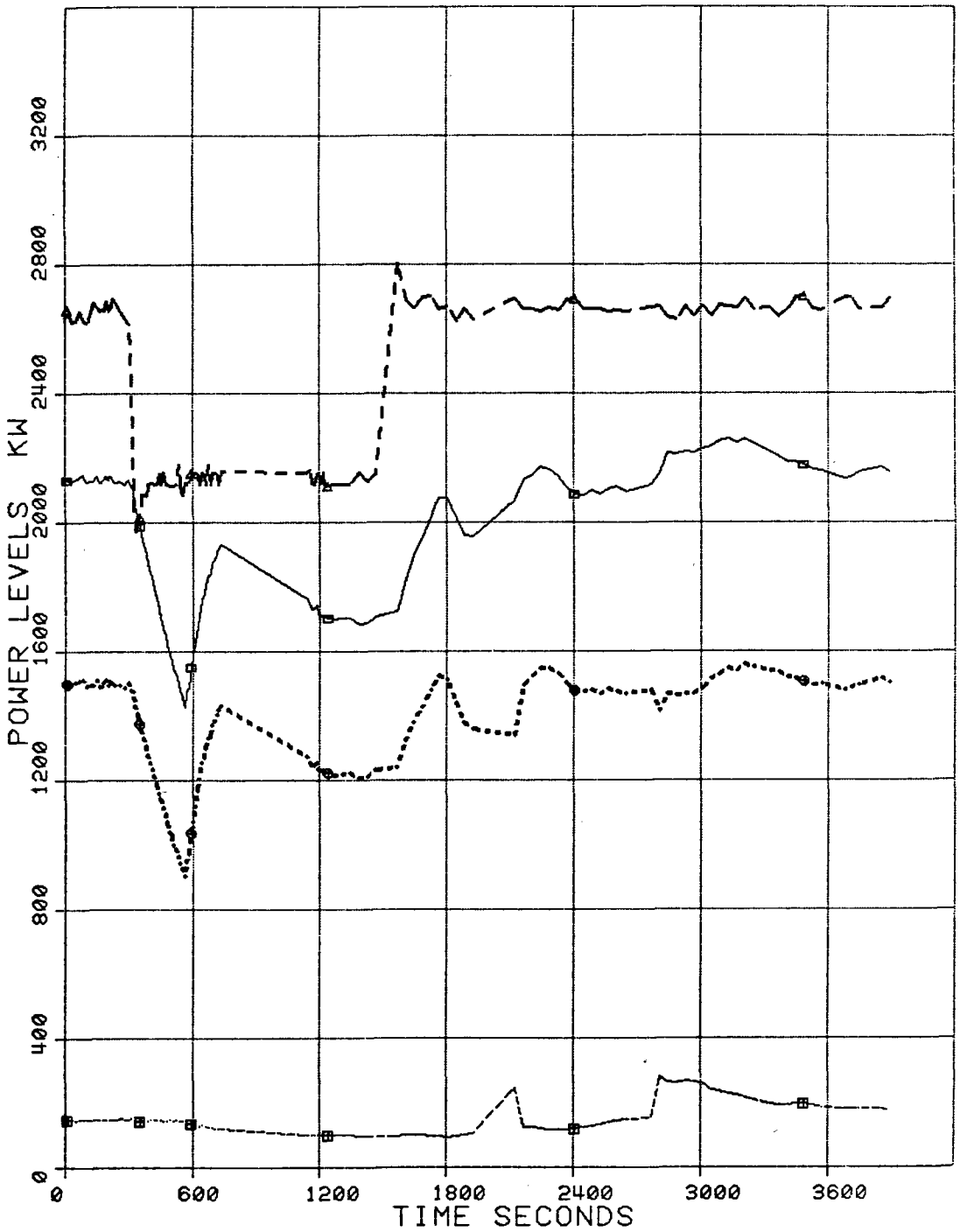
Test No. 20

20—

Replot 4/25/77


POWER LEVELS KW
2500
2100
1700
1300
900
500
100
-300
-700
0
2000
4000
6000
8000
10000
12000
TIME-SECONDS

```
SEARCH START
DAY #109 1977  TIME 17:55
NUMBER OF RECORDS =   5

ARGUMENT SELECTED :   1

FIRST  FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD  FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME =   64500.0

EACH    2TH POINT IS PLOTTED

SEARCH MODE 2

PLOT START TIME =     128.0

EACH   64TH POINT IS PLOTTED

LINE PLOT HAS  128 POINTS PER FUNCTION
```


POWER LEVELS KW
0
400
800
1200
1600
2000
2400
2800
3200
0
600
1200
1800
2400
3000
3600
TIME SECONDS

SEARCH START
DAY #109 1977 TIME 17:55
NUMBER OF RECORDS = 5

ARGUMENT SELECTED : 1

FIRST FUNCTION # 6 OPEN BOX

SECOND FUNCTION # 7 TRIANGLE

THIRD FUNCTION #15 CROSS-CIRCLE

FOURTH FUNCTION #16 CROSS-BOX

SEARCH MODE 2

PLOT START TIME = 64500.0

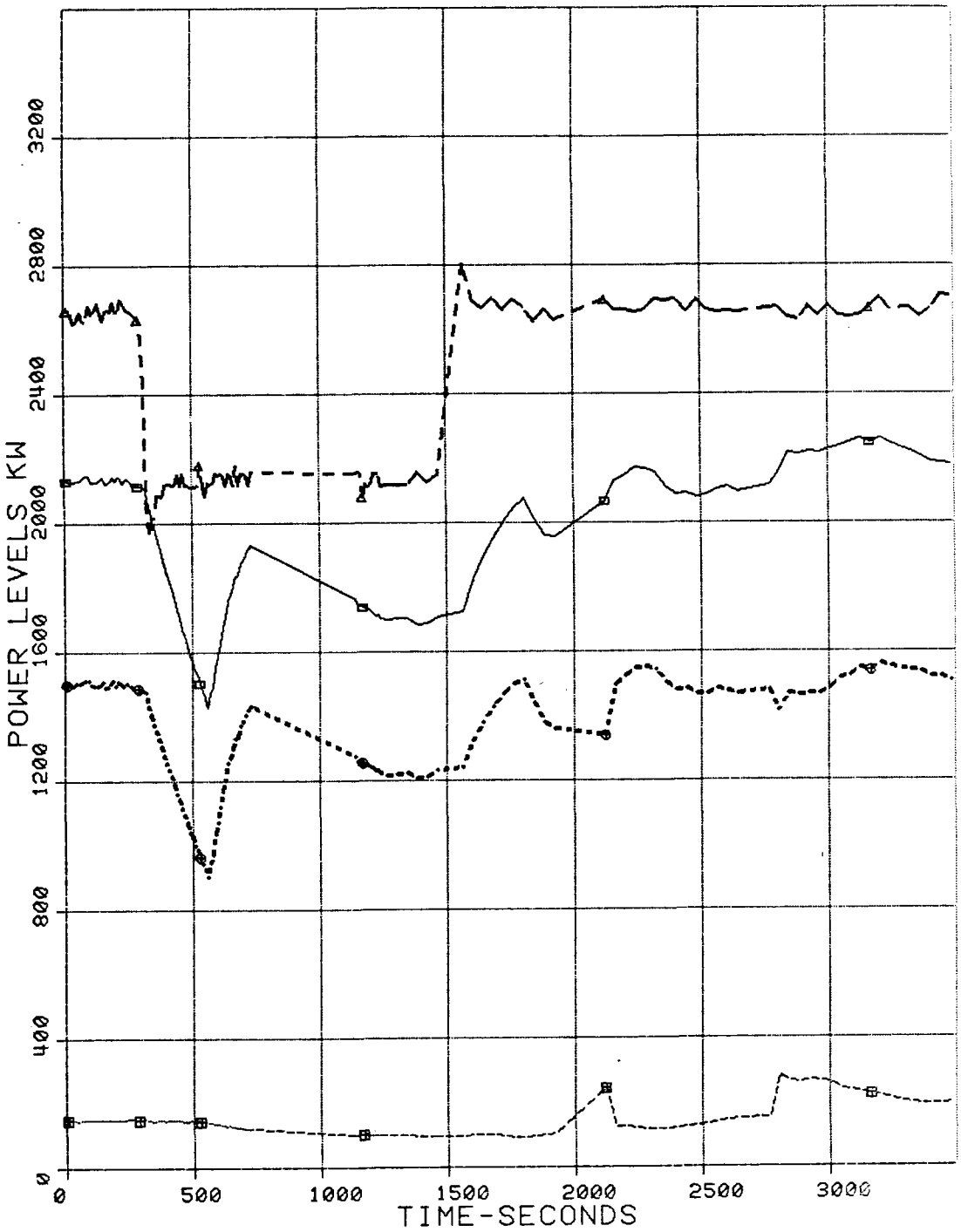
EACH 2TH POINT IS PLOTTED

LINE PLOT HAS 128 POINTS PER FUNCTION

Test No. 20

20—

Replot 4/25/77


POWER LEVELS KW
0
400
800
1200
1600
2000
2400
2800
3200
0
500
1000
1500
2000
2500
3000
TIME-SECONDS

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ENTHALPY

PAGE 22

RATIOS