INTERIM REPORT

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INTERIM REPORT

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APRIL 25, 1979

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LOFT TEST SUPPORT BRANCH DATA ABSTRACT REPORT-
LOFT FUEL ROD THERMOCOUPLE CALIBRATION TEST, ROD RRF-A-8879

C. W. Solbrig
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IDAHO NATIONAL ENGINEERING LABORATORY

DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE UNDER CONTRACT DE-AC07-76IDO1570

EG&G Idaho, Inc.

LOFT TECHNICAL REPORT
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LOFT TEST SUPPORT BRANCH DATA ABSTRACT REPORT, LOFT FUEL ROD THERMOCOUPLE CALIBRATION TEST, ROD RRF-A-8879	LTR-141-99
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DISPOSITION OF RECOMMENDATIONS

No disposition required.

LOFT EXPERIMENTAL SUPPORT BRANCH

DATA ABSTRACT REPORT

LOFT FUEL ROD THERMOCOUPLE CALIBRATION TEST

ROD-RRF-A-8879

by

C. W. Solbrig
E. L. Tolman
H. S. Selcho

Revision 0

Issue Date: September, 1978

The following people have been involved in either the experimental operations or the data analysis and confirm that the information presented is correct and complete to the best of their knowledge.

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LOFT EXPERIMENTAL SUPPORT BRANCH

DATA ABSTRACT REPORT

LOFT FUEL ROD THERMOCOUPLE CALIBRATION TEST

ROD RRF-A-8879

1.0 SUMMARY

This report presents the comparison between LOFT type thermocouples (surface mounted) and embedded thermocouples placed in comparable locations on a stainless steel clad electrically heated rod. The experiments performed on this rod simulated a hot leg break loss-of-coolant accident (LOCA) with the rods at a medium steady state power level. The maximum steady state linear heat generation rate (MLHGR) at steady state was 10 kW/ft and thus these experiments are representative of average operating power levels in PWR's. The purpose of the test was to determine the difference in temperature measured by the two types of thermocouples and from this to infer how well the LOFT thermocouple measures the surface temperature of a nuclear rod. If a difference was observed, then it was expected that the data would provide enough information to develop a technique for predicting the surface temperature from the LOFT type surface mounted thermocouple.

This was the third rod tested in the stainless steel clad series. The next test series will utilize zirconium clad high power density rods which are currently under development.

2.0 TEST DESCRIPTION

The heater rod RRF-A-8879 had the following characteristics:

Stainless Steel Clad
Boron Nitride Insulator
Coil Heater Wire
Heated Length: 5.5 ft
Total Power: 34.4 kW
Axial Peaking Factor: 1.6
MLHGR: 10 kW/ft
MLHGR Location: 26 in. from bottom

Figure 1a is a diagram of the heater rod installed in the test vessel and shows the thermocouple locations. Figure 1b shows the axial power profile in the rod. Figure 2a shows the method of embedded thermocouple installation and Figure 2b shows the method of LOFT thermocouple installation.

A schematic of the Blowdown Facility in which the heater rod was tested is shown in Figure 3. The heater rod was installed in heater section 2. All of the tests conducted were small blowdowns. The small blowdowns were performed by first heating the system to a nominal temperature of 540°F and pressurizing it to a nominal pressure of 2250 psi. The test heater rods were set at the desired steady state value during heat up and the three auxiliary heater rods in the three inch test section were used to control the amount of heat to the system. To initiate a small blowdown, valves FCV-2, FCV-3, CV-7, FCV-10, and CV-9 were closed to isolate the majority of the system. The blowdown valve, CV-12, was then opened to initiate the blowdown.

Table 1 presents the approximate power time profile for each of the eleven tests in this report. The steady state power was nominally 34.4 kW. The remainder of the power-time profile was adjusted

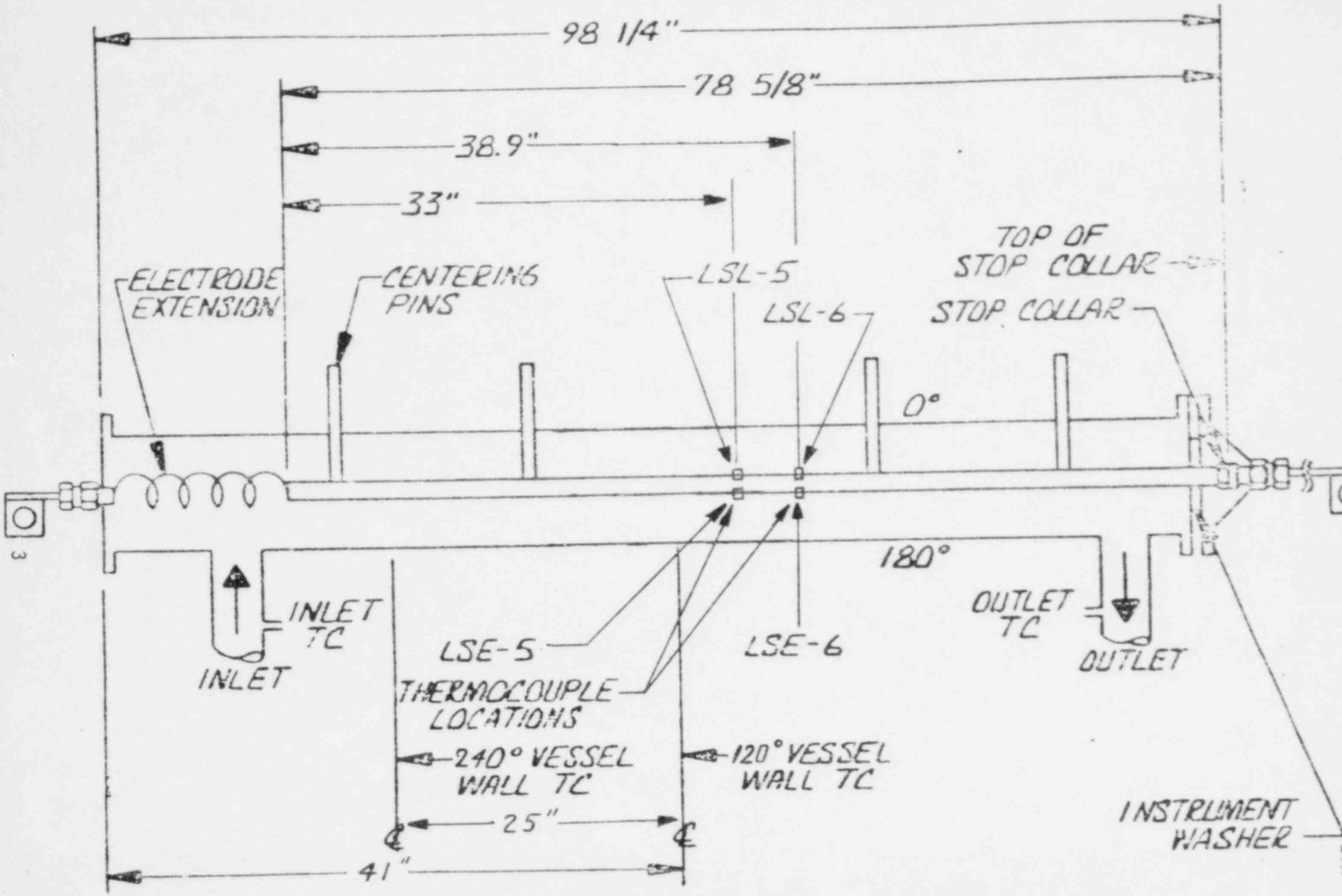


Figure 1a. Diagram of the Heater Rod Installed in the Test Vessel, Showing the Location of the Thermocouples.

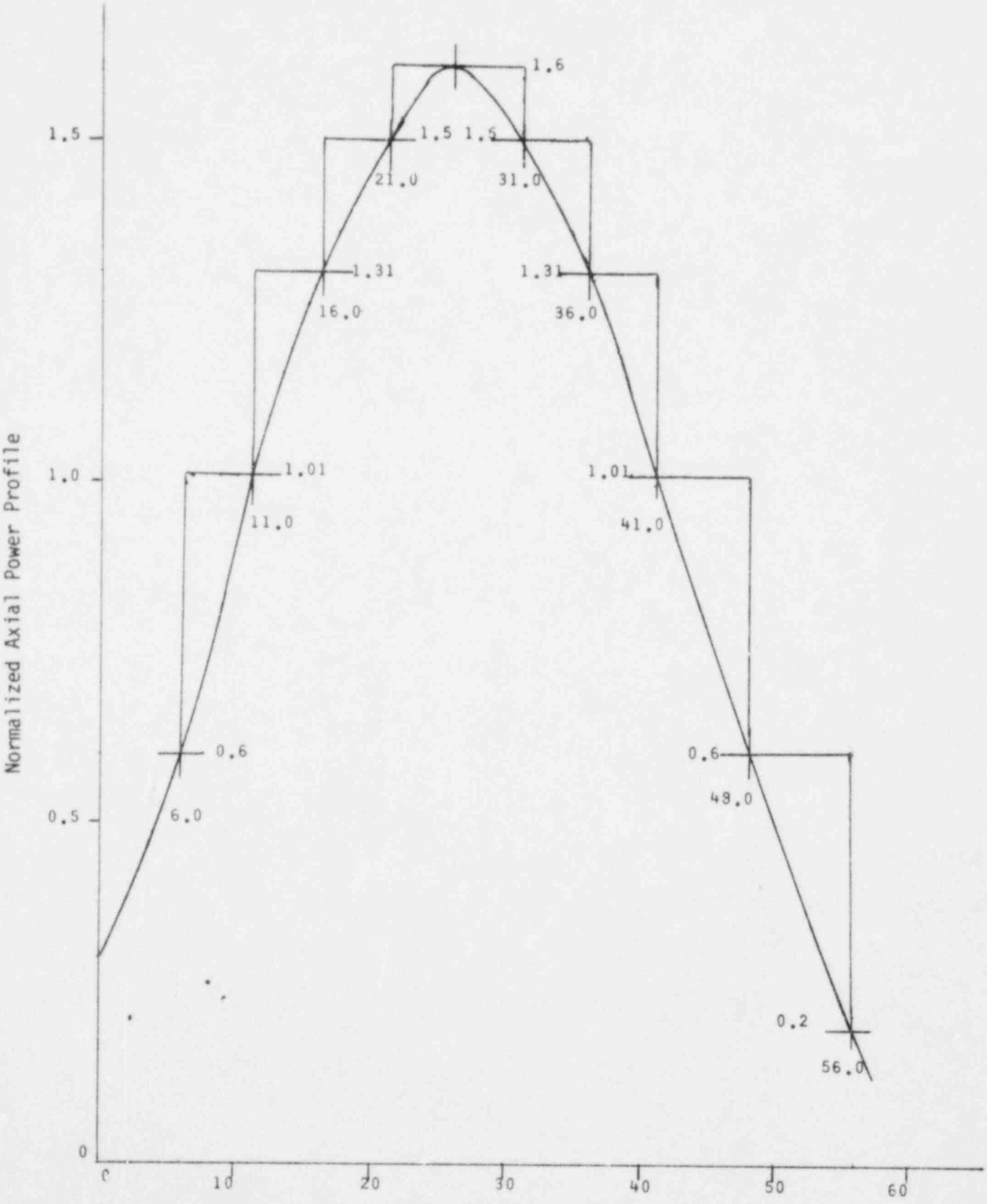


Figure 1b. Normalized Axial Power Profile of Heater Rod 8879

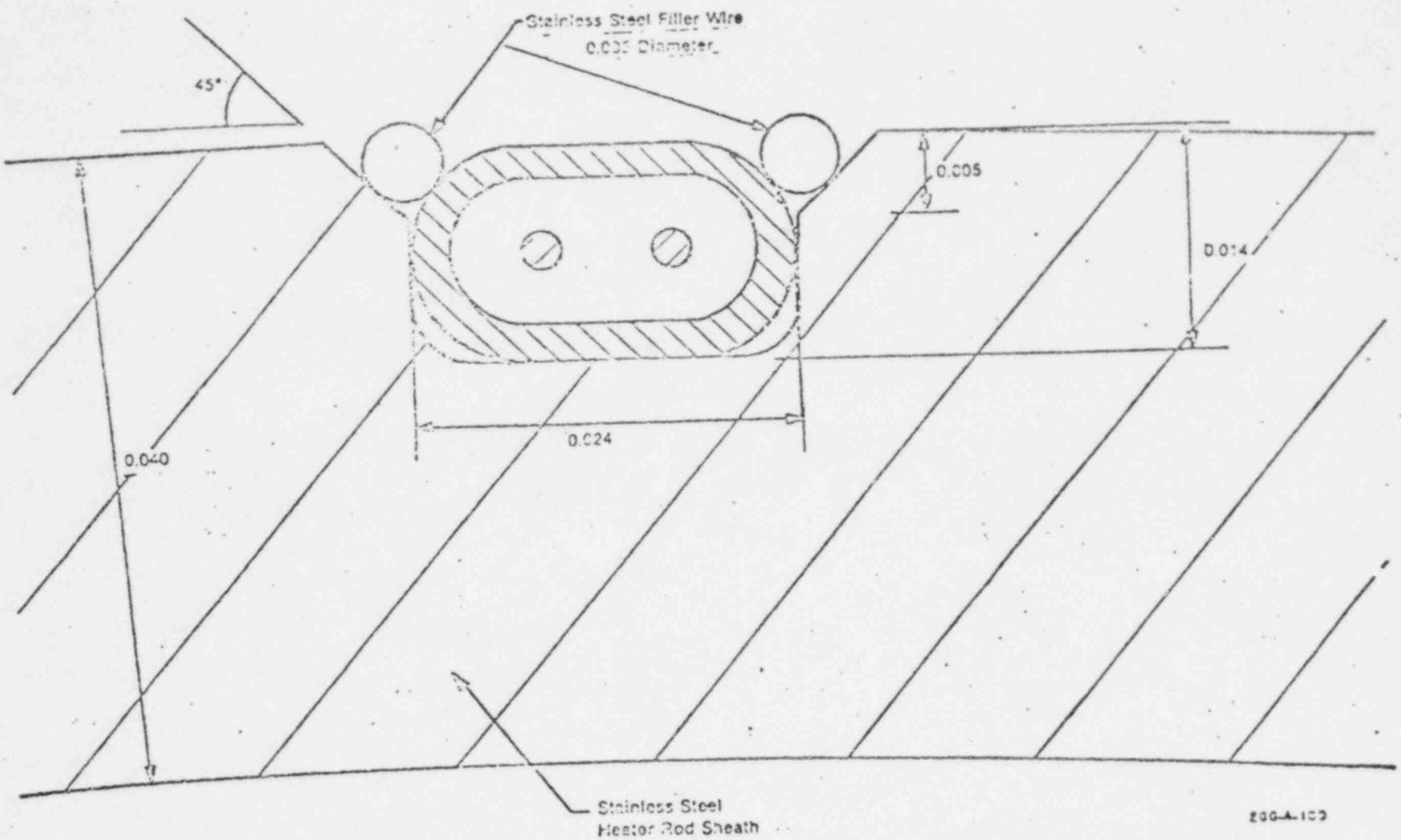


Fig. 2a. Diagram of cross section of embedded thermocouple installation on heater rod, showing geometry used for addition of weld filler wire.

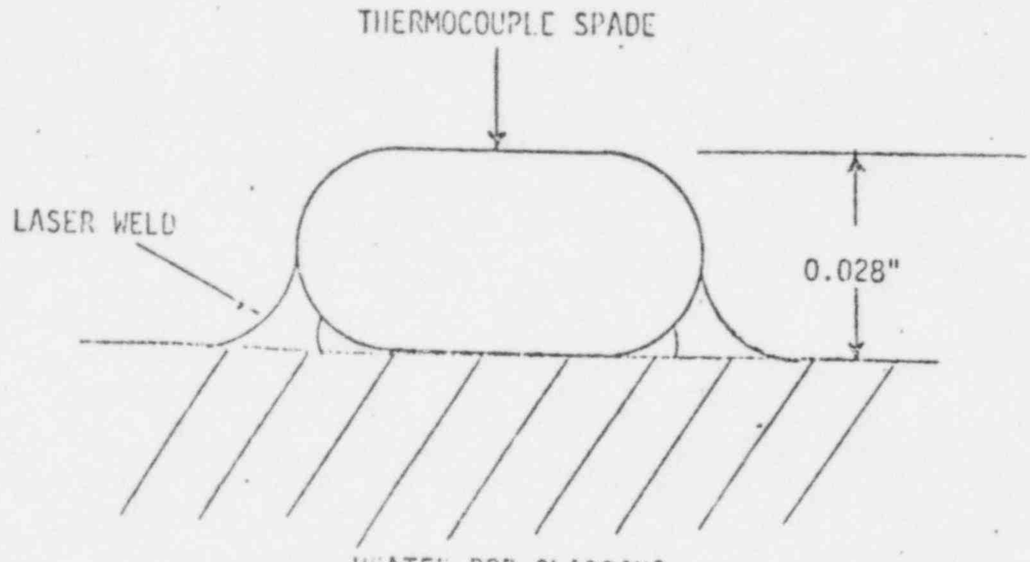


Figure 2b. Diagram of Cross Section of LOFT Thermocouple Installation on Heater Rod

FE	Turbine meter
PDE	Differential pressure detector
PE	Pressure element
TE	Temperature element
FCV	Flow control valve
CV	Control valve
SV	Solenoid valve
Construction material is 304/316 stainless steel	

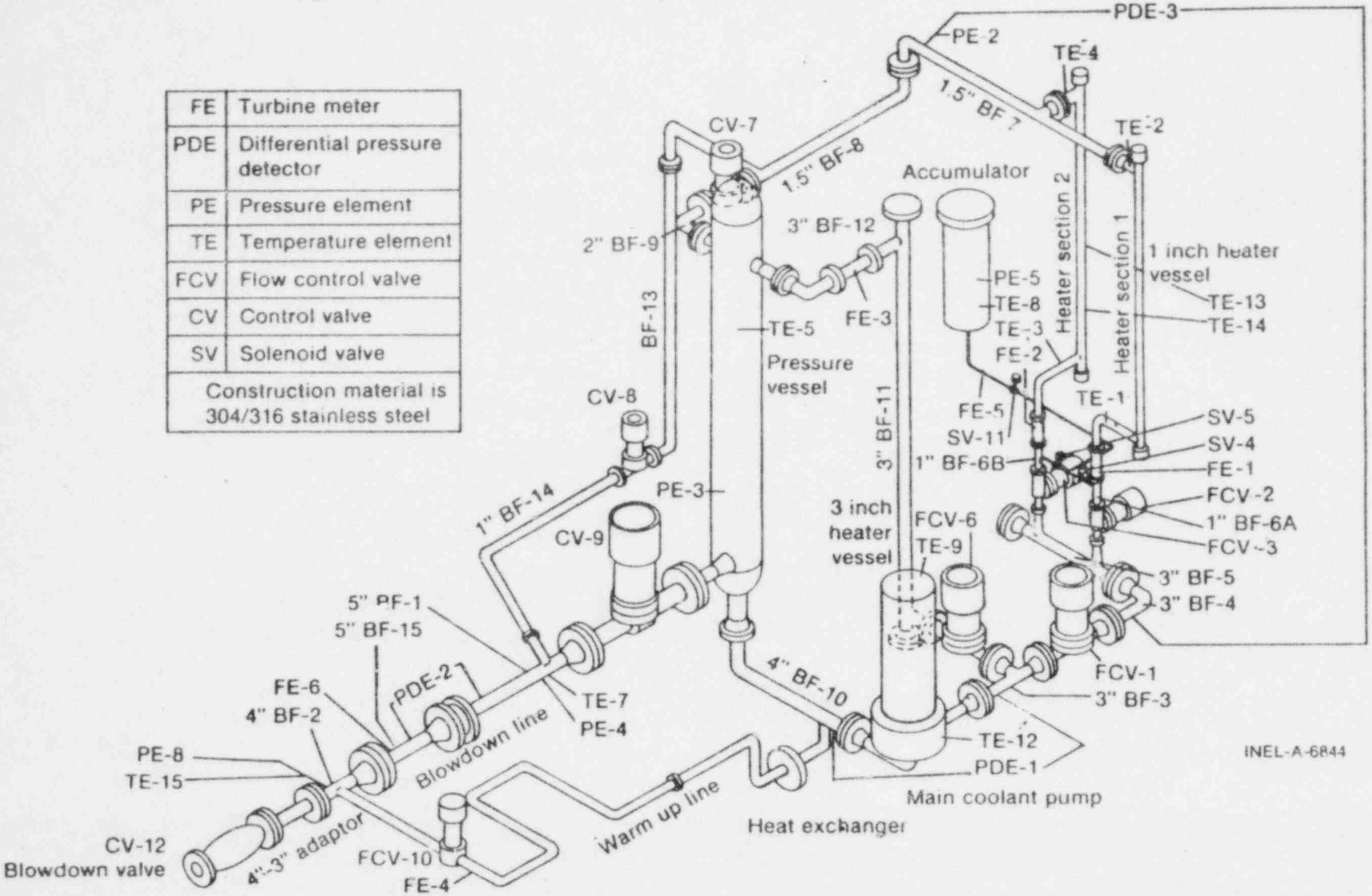


Figure 3. Blowdown Facility Schematic

TABLE 1

HEATER ROD RRF-A-8879 MEASURED POWER (kW)

Run No.	Blowdown I.D.	Power Level 1 (Steady State Power)	Power Level 2 (After Adjustment 1)	Power Level 3 (After Adjustment 2)	Power Level 4 (After Adjustment 3)
			BD + 2 sec	at 300 psi	
1	6	33.70 kW	6.66 KW	6.66 KW	at 1450°F 2.79 kW
2	1	36.58 kW	4.35 kW	10.34 kW	at 1450°F 3.18 kW
3	2	36.04 kW	1.96 kW	6.98 kW	at 1450°F 0.95 kW
4	5	36.89 kW	6.26 kW	9.76 kW	at 1450°F 3.06 kW
5	8	35.01 kW	7.90 kW	7.90 KW	at 1450°F 2.76 kW
6	9	36.73 kW	8.23 kW	8.23 KW	at 1200°F 4.87 kW
7	3	35.75 kW	5.14 kW	9.90 kW	at 1200°F 3.12 kW
8	4	35.79 kW	6.38 kW	10.37 kW	at 1200°F 3.30 kW
9	7B	34.55 kW	7.27 kW	7.27 KW	at 1200°F 3.42 kW
10	7C	35.98 kW	7.90 kW	7.90 KW	at 1200°F 3.07 kW
11	10	35.54 kW	10.62 kW	10.62 KW	at 1600°F 5.21 kW

to simulate the surface temperature history of a nuclear rod undergoing a LOCA. The details of the power time profile for each test are presented in the experimental results section. The power was adjusted by hand and thus some time was required to go from one power level to another. The experiments were performed in a different order than the blowdown I.D. The order in which the experiments were performed is indicated by the Run number in Table 1. Run number is used in the remainder of this report.

Comparisons with RELAP4 calculations indicate that the valves which are intended to seal off the inlet to the single heater rod test sections, FCV-2 and FCV-3, leak after closure. Thus, the fluid flowing past the heater rods is believed to have had a much higher liquid content than a corresponding Loss-of-Coolant Experiment. To compensate for this effect and the difference in initial stored energy, the heater rod required a much higher power level prior to the reflood portion of the transient than would occur in a LOFT test. If this excess power had not been applied, the rods would not have achieved the desired temperature just prior to the reflooding and quench.

3.0 EXPERIMENTAL RESULTS

Data were recorded at all of the measurement locations shown in Figures 1 and 3. The data recorded in this report include only those essential to evaluate the agreement between the two different types of thermocouples. The data plots presented are tabulated in Table 2. Table 2 lists the quality of the data used in this report. Note that the embedded thermocouple at the upper location (LSE6) did not function properly in the last three transients (blowdowns 7B, 7C, and 10). The missing data plots are due to failed instruments or recording.

The data are presented in Figures 4 through 14. Each data set presents (1) the thermocouple comparison 33 inches from the rod bottom (LSL5 and LSE5), (2) the thermocouple comparison 38.9 inches from the bottom (LSL6 and LSE6), (3) the power history for the rod, (4) the coolant thermocouple reading at 33 and 38.9 inches from the bottom of the rod, and (5) pressure just above the heater rod housings (PE-2). All eleven blowdowns were performed on July 14, 1977. A summary of operators comments is presented in Appendix A.

The temperature plots were corrected by the equation

$$T = T_i + \alpha - \sqrt{\beta}\ P$$

where T = corrected temperature

T_i = indicated temperature

α = offset due to signal conditioning bias

β = a coefficient which corrects for small current leakage through the thermocouples

P = power of the rod in kW

The power correction is small. It was evaluated by turning off the power at steady state and noting the instantaneous drop in the thermocouple output. This calibration was done at two power levels. The values of the coefficients for each thermocouple are:

T.C. ID	α	β
LSE 5	0	8
LSE 6	0	17
LSE 5	0	12
LSE 6	0	0

The flow rate through the heater rod test section is not available because the flow rate through the inlet turbine (FE-2 in Figure 3) after the inlet valve was closed was below the minimum measureable by the turbine. There was no turbine on the heater section outlet nor were gamma densitometers available at the inlet or the outlet.

The recorded values of volts and amps also contained signal conditioning bias. The values of these parameters have been corrected by assuming that the volts and amps were measured accurately by panel meter readings at steady state and the final power was zero. The resulting corrections are:

$$V_c - 1.02\ V_i + 12 \text{ volts}$$

$$A_c = .95\ A_i - 318 \text{ amps}$$

where V_c = corrected volts

A_c = corrected amps

V_i = recorded volts

A_i = recorded amps

The total test rod power was calculated by multiplying values of heater voltage and current. The gain was checked by comparing the values recorded after the power to the rod was shut off. The difference between the power off values and the steady state value showed that the recorded voltage and amperage did not have to be corrected.

Thermocouple comparisons can be made at both the 33 inch and 38.9 inch locations because both the embedded and LOFT thermocouple functioned during all experiments, except for the upper embedded thermocouple (LSE6) in Runs 9, 10, and 11.

TABLE 2

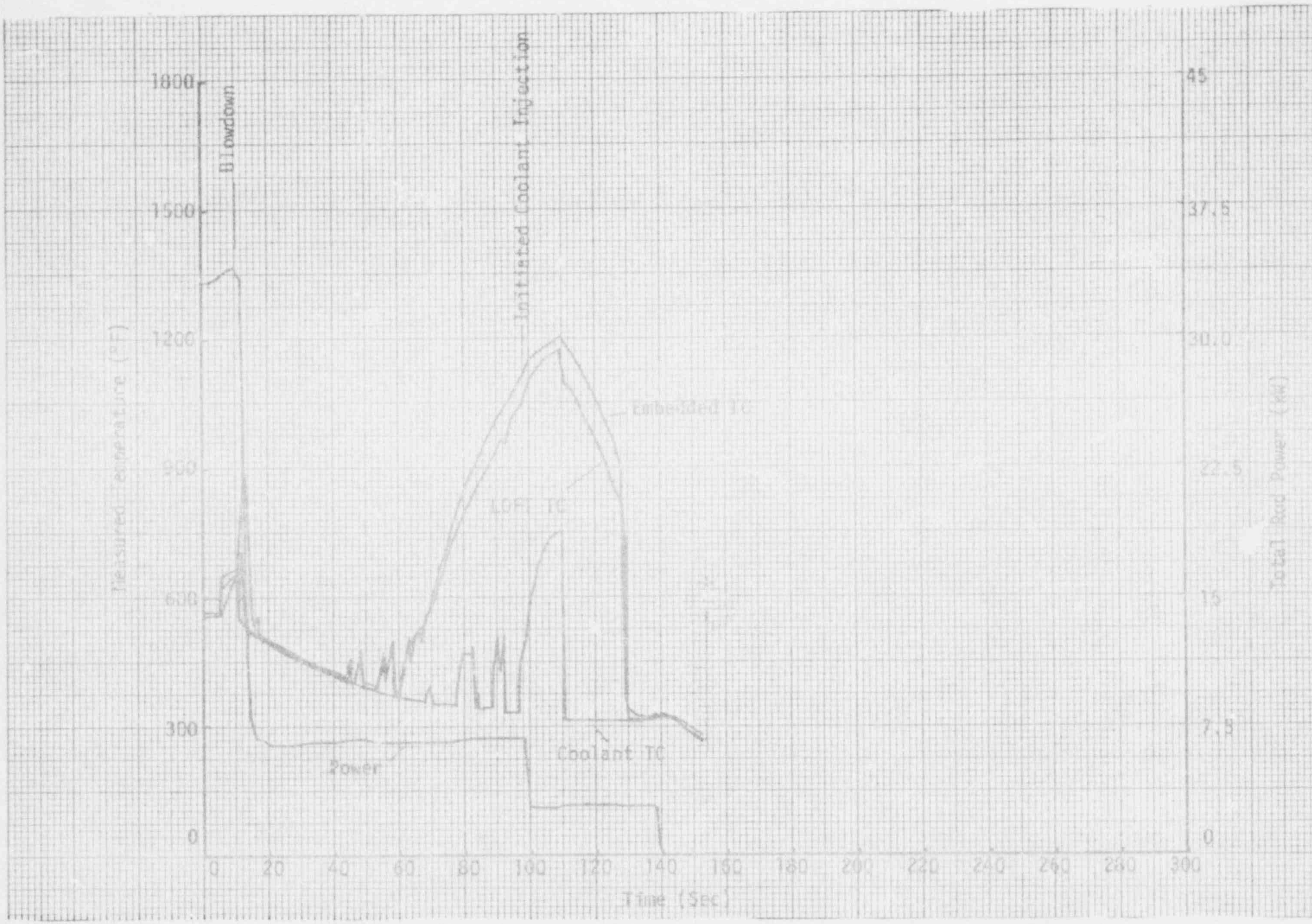
PLOTS OF ROD 8879 WITH GOOD DATA

Run No.	Blowdown I.D.	LOFT T.C. 33" LSL5	Embedded T.C. 33" LSE5	LOFT T.C. 38.9" LSL6	Embedded T.C. 38.9" LSE6	Coolant T.C. 33" LSC5	Coolant T.C. 38.9" LSC6	Power To Rod Volts	Power To Rod Amps	Pressure at Heater Outlet (PE-2)
1	6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	7B	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
10	7C	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
11	10	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

LSE6 output bad on runs 9, 10, 11

No operator comments during Run 8 but during Run 9 operator commented "stopped blowdown - test heater tripped electrically; cause unknown".

Then Run 9 was redone and the same problem occurred. Run 9 was tried a third time with LSE6 disconnected. Operator suspected bad TC LSE6.



4a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 1

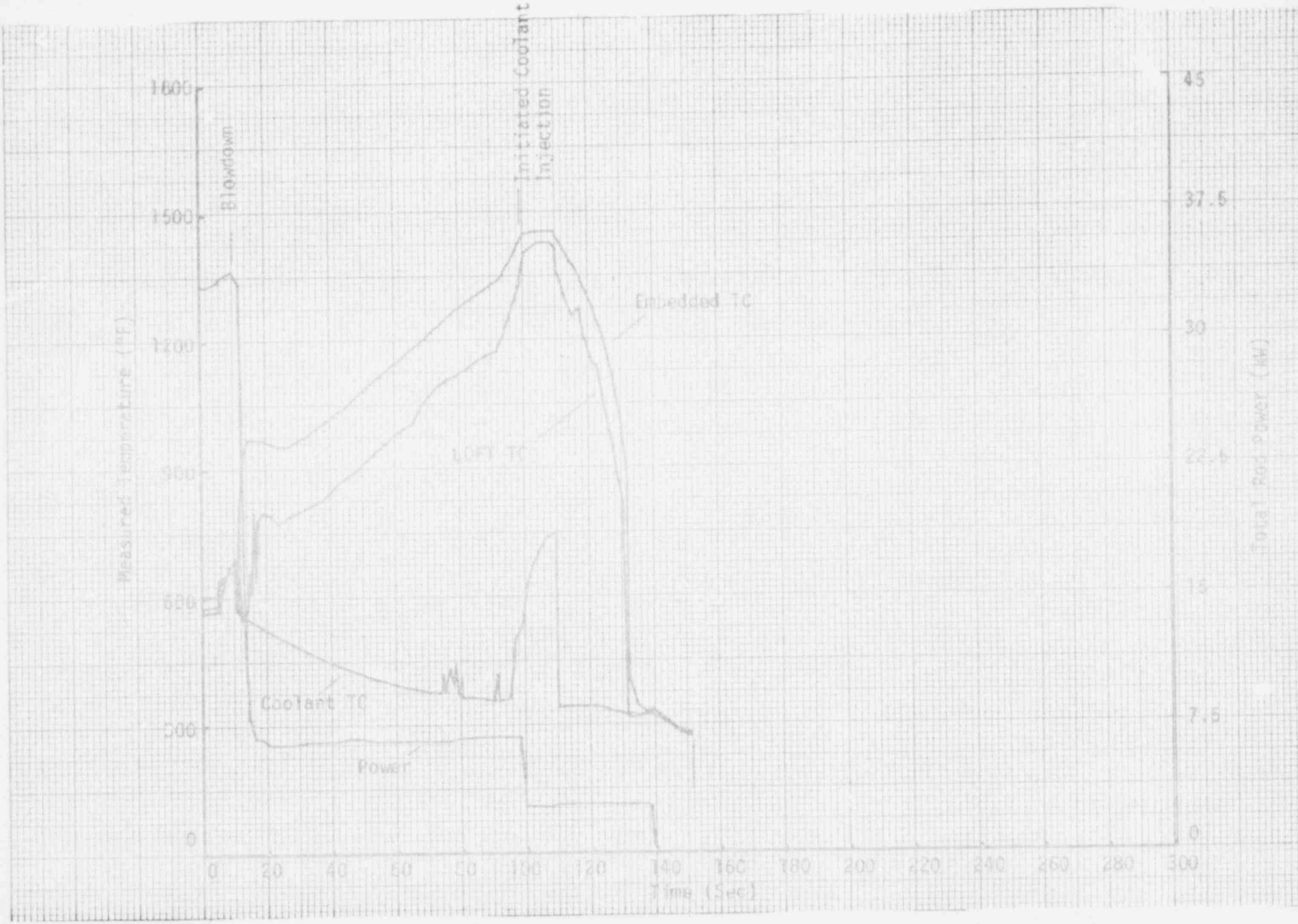


Figure 4b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 1

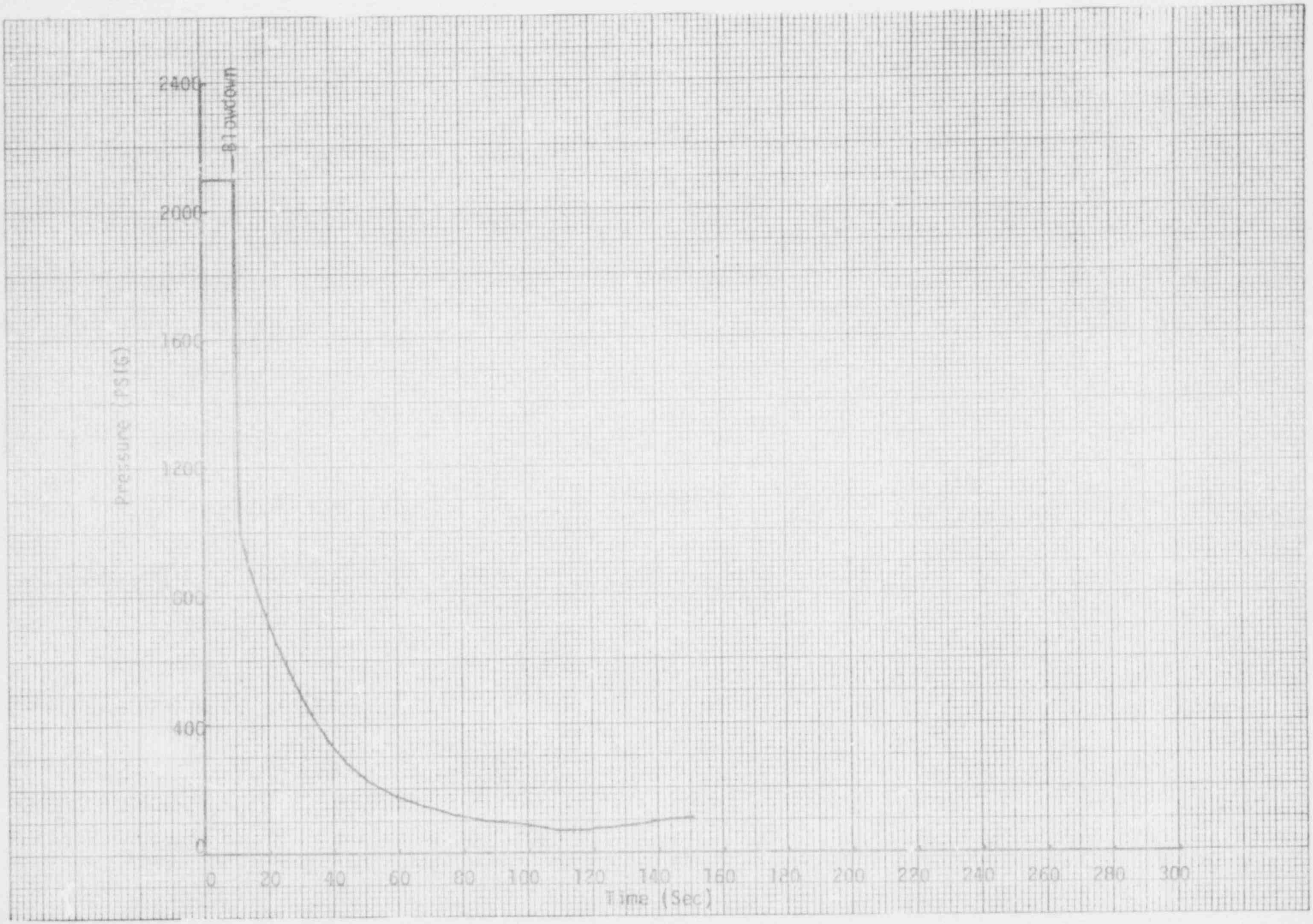


Figure 4c. System Pressure During Run 1

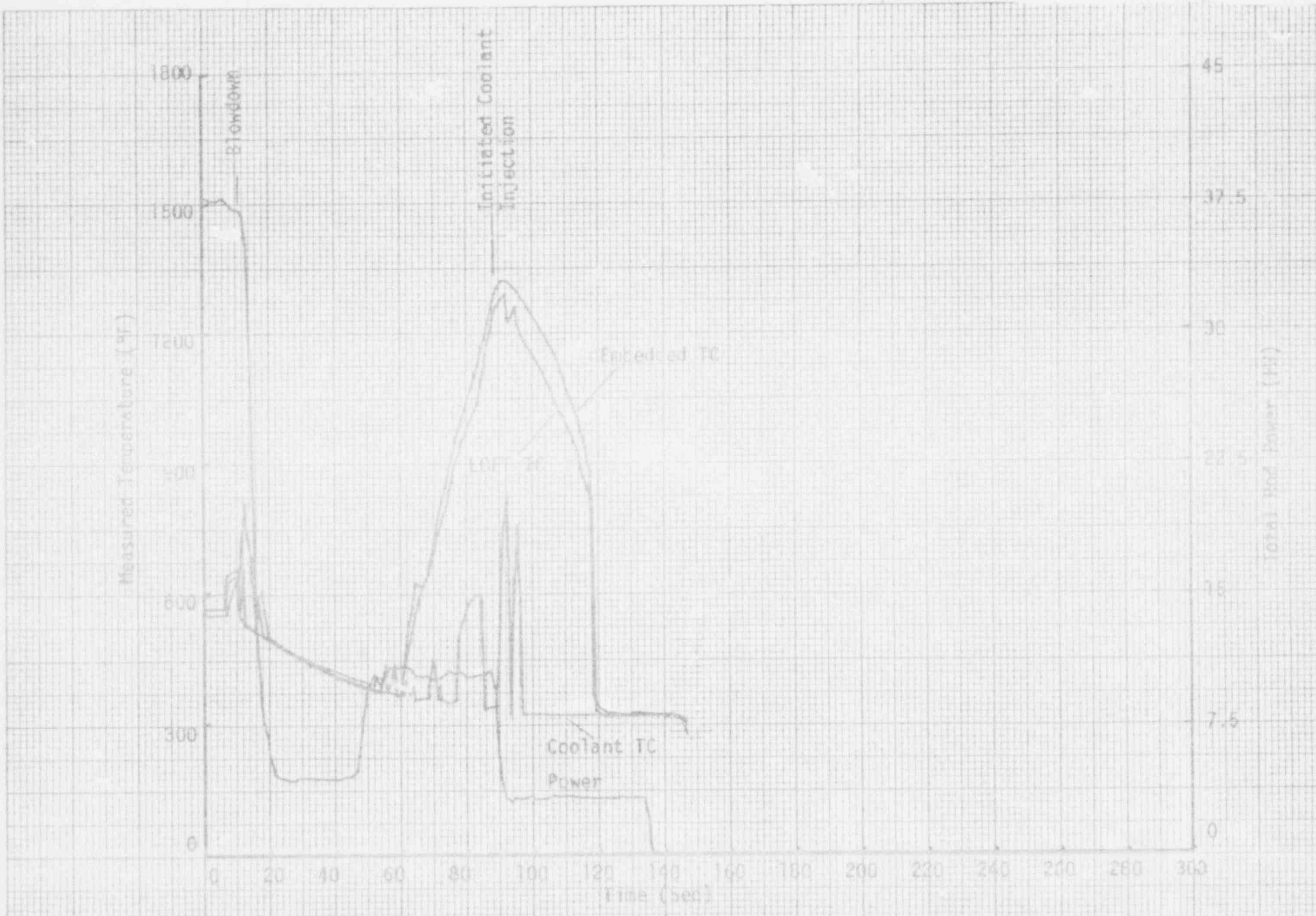


Figure 5a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 2

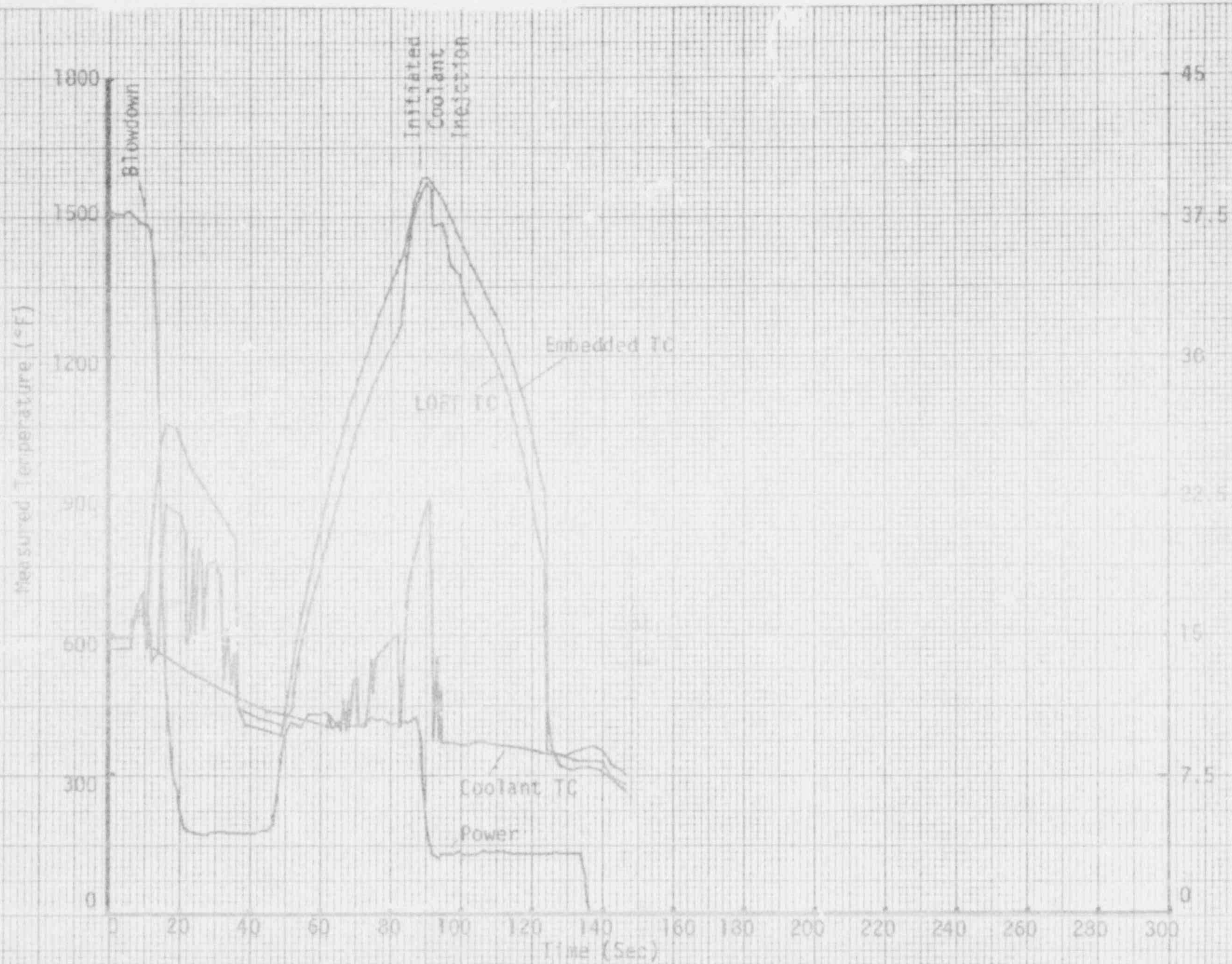


Figure 5b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 2

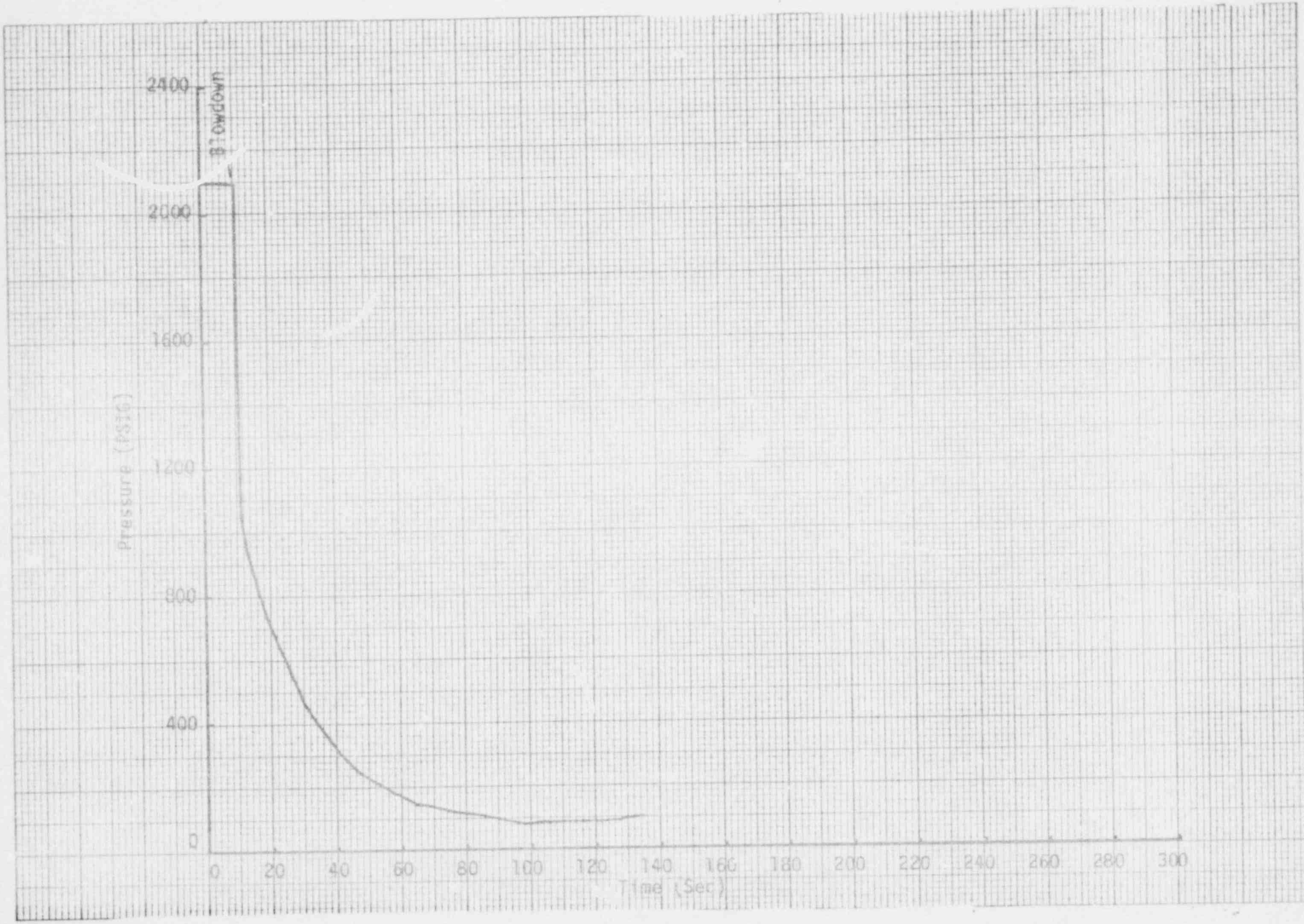


Figure 5c. System Pressure During Run 2

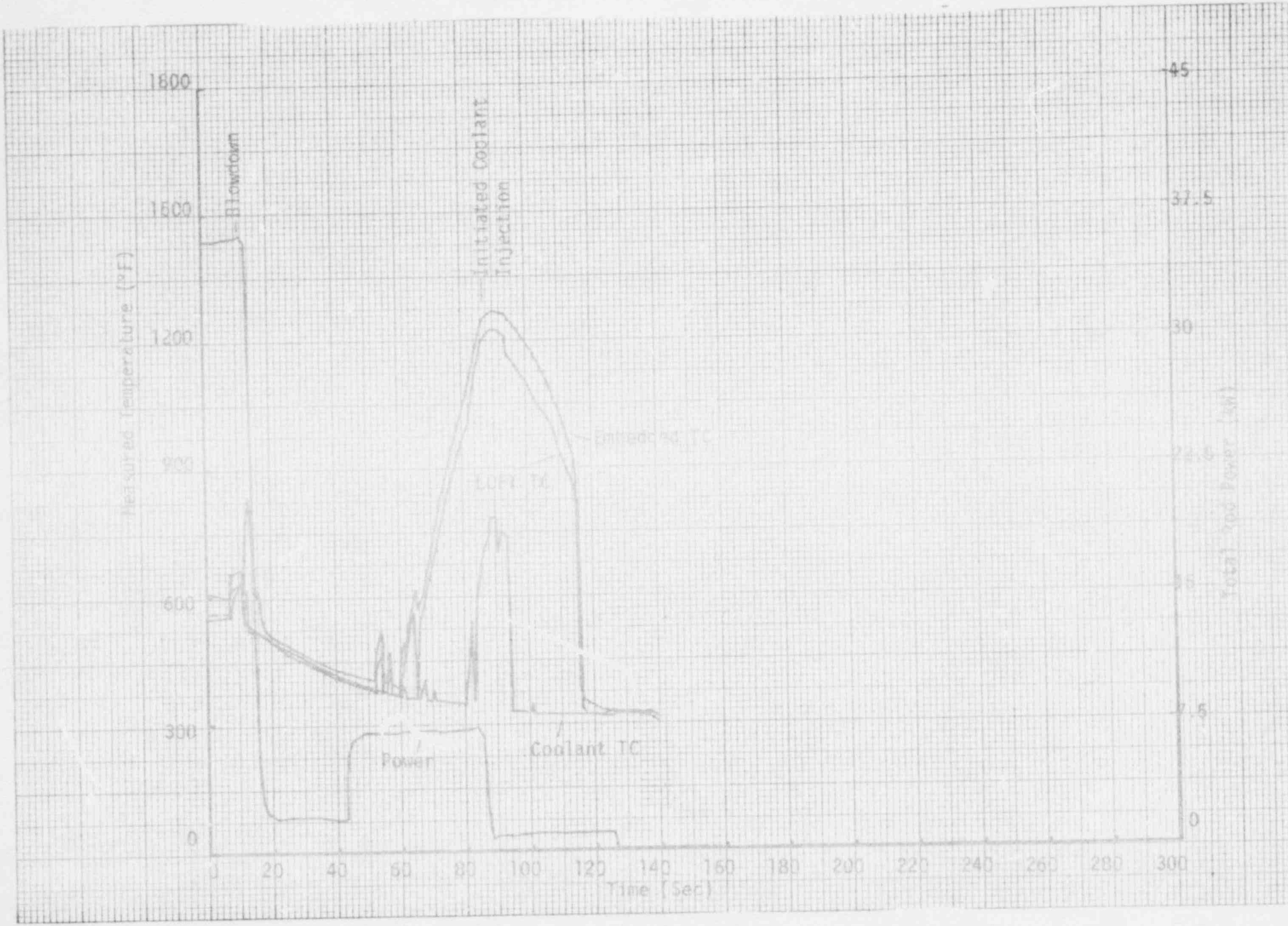


Figure 6a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 3

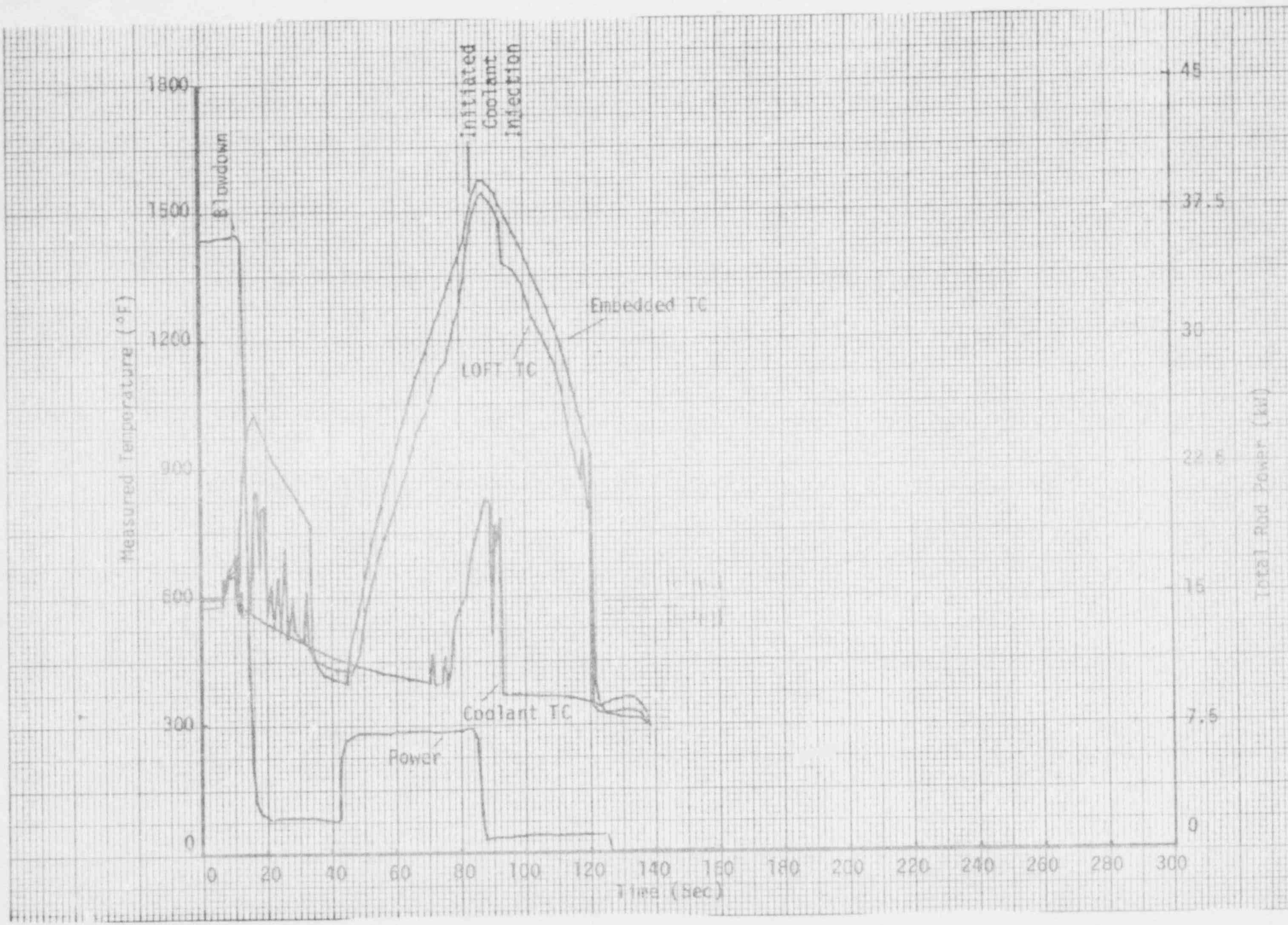


Figure 6b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 3

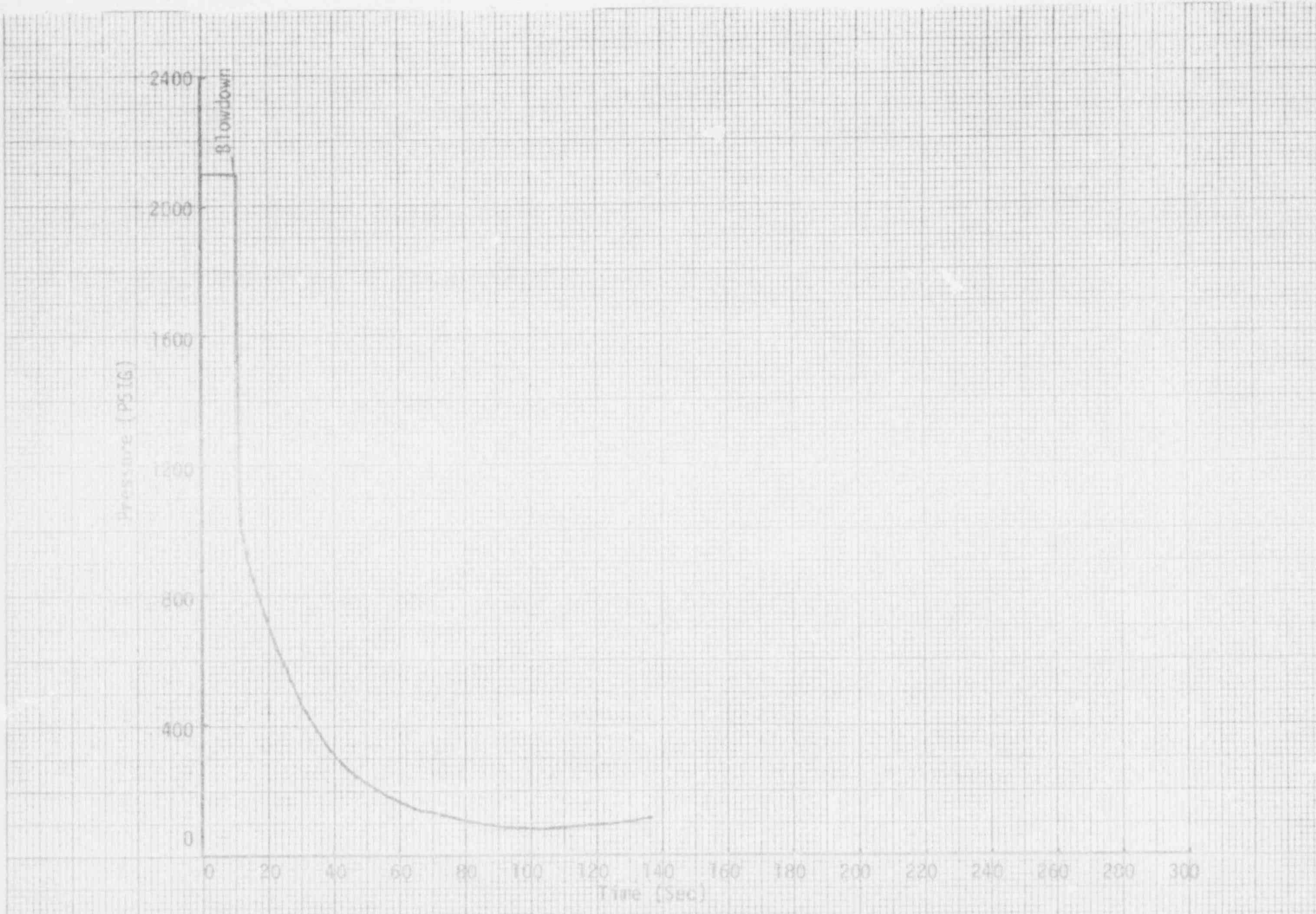


Figure 6c. System Pressure During Run 3

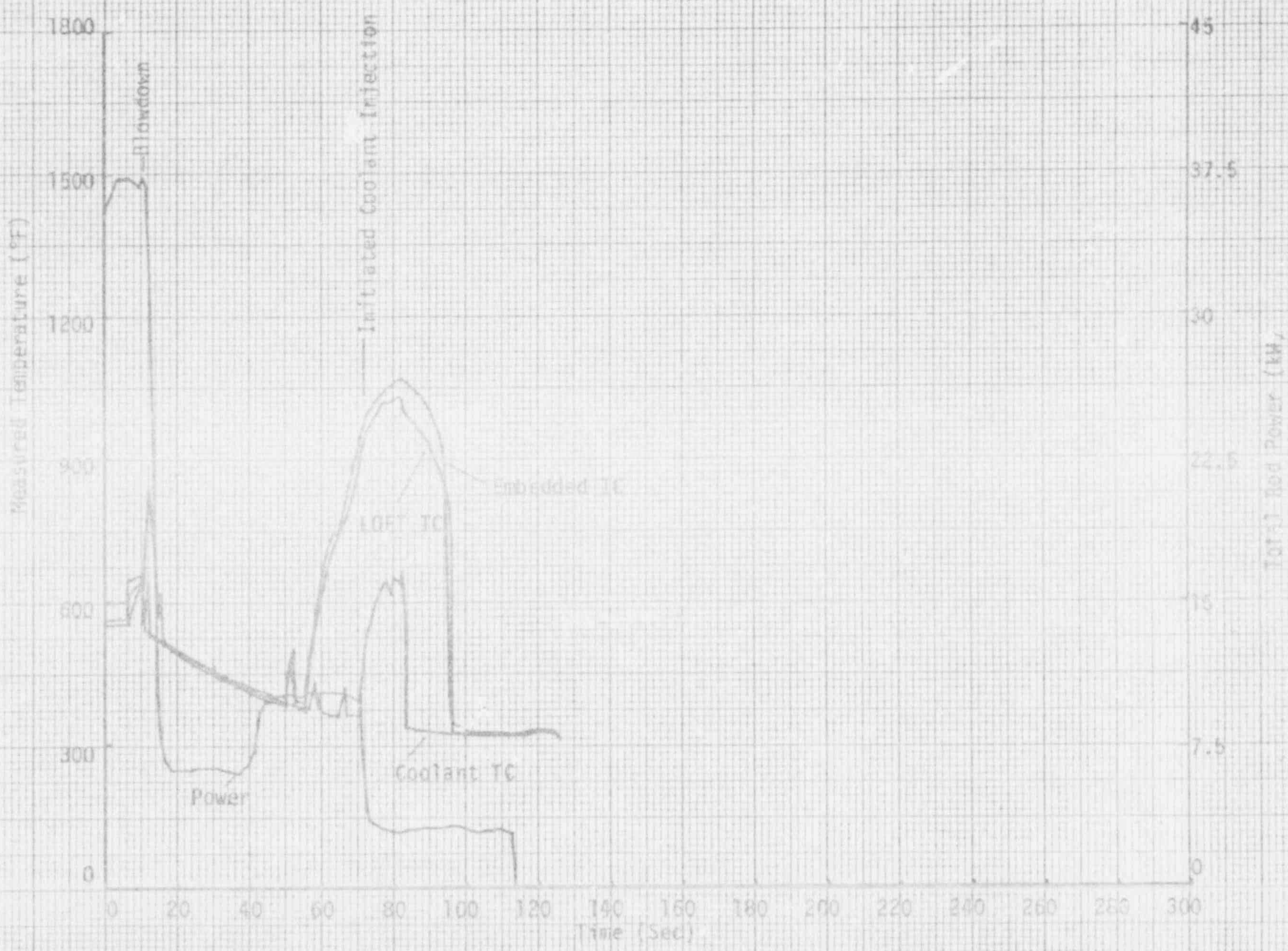


Figure 7a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 4

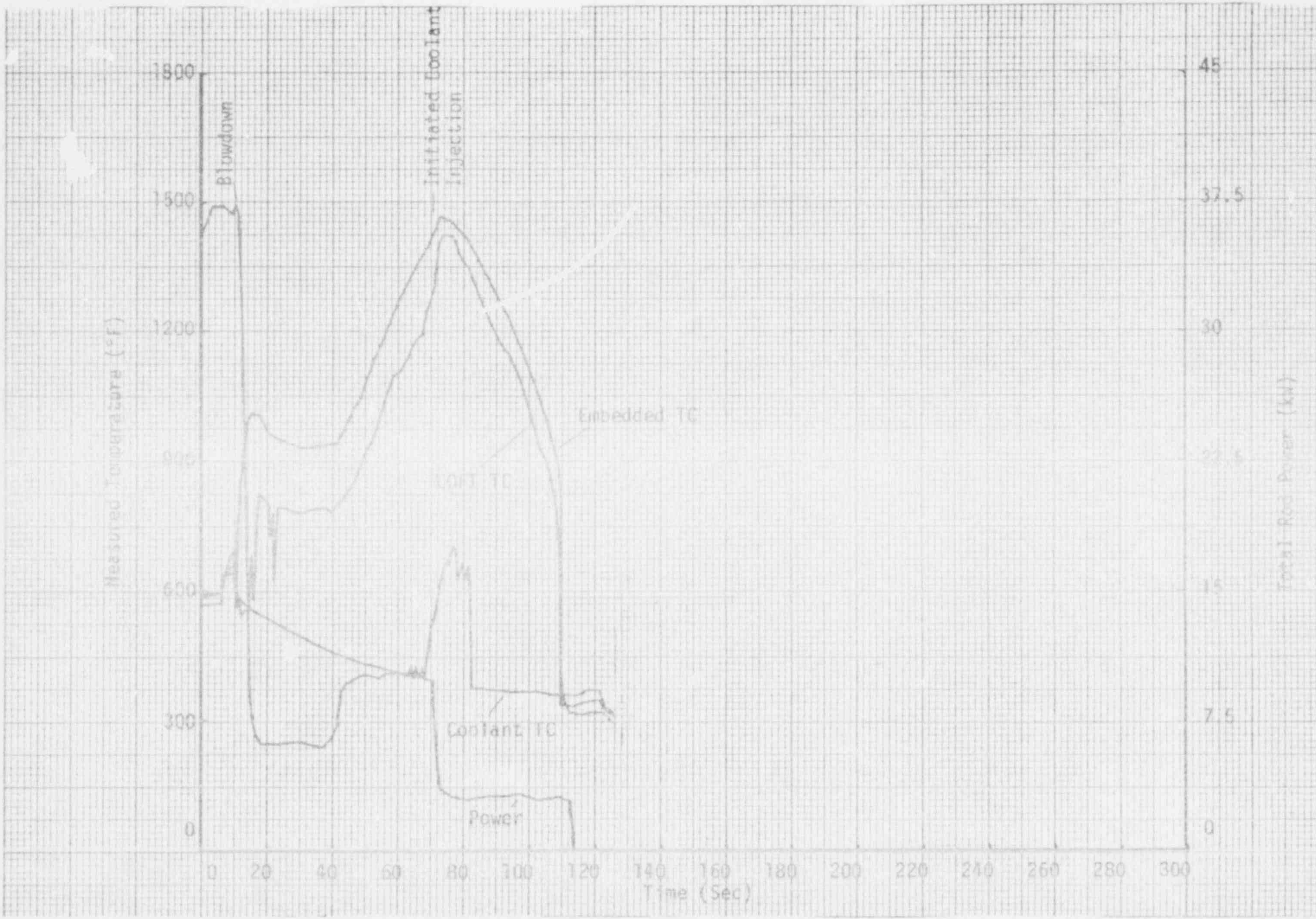


Figure 7b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 4

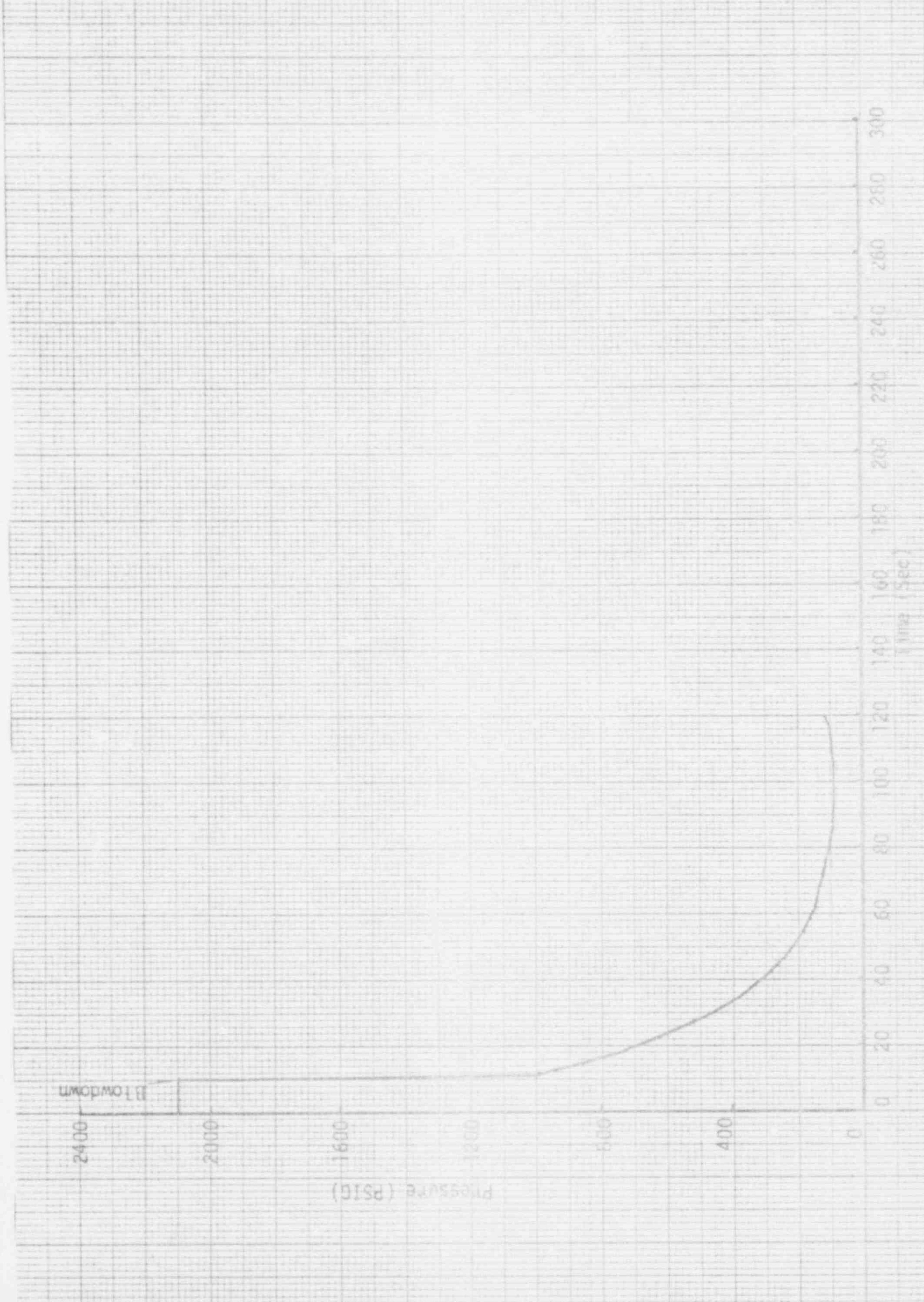


Figure 7c. System Pressure During Run 4

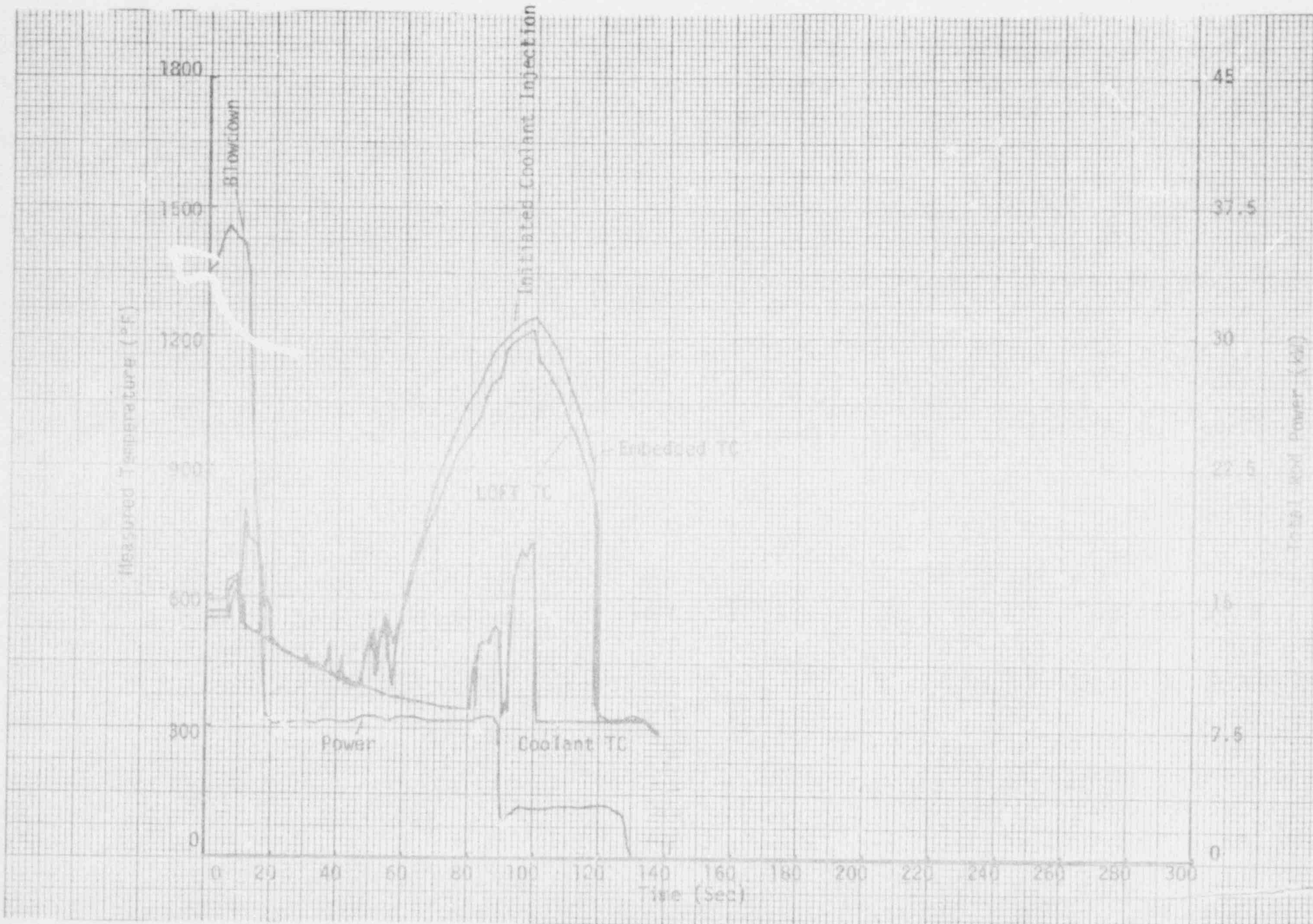


Figure 8a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 5

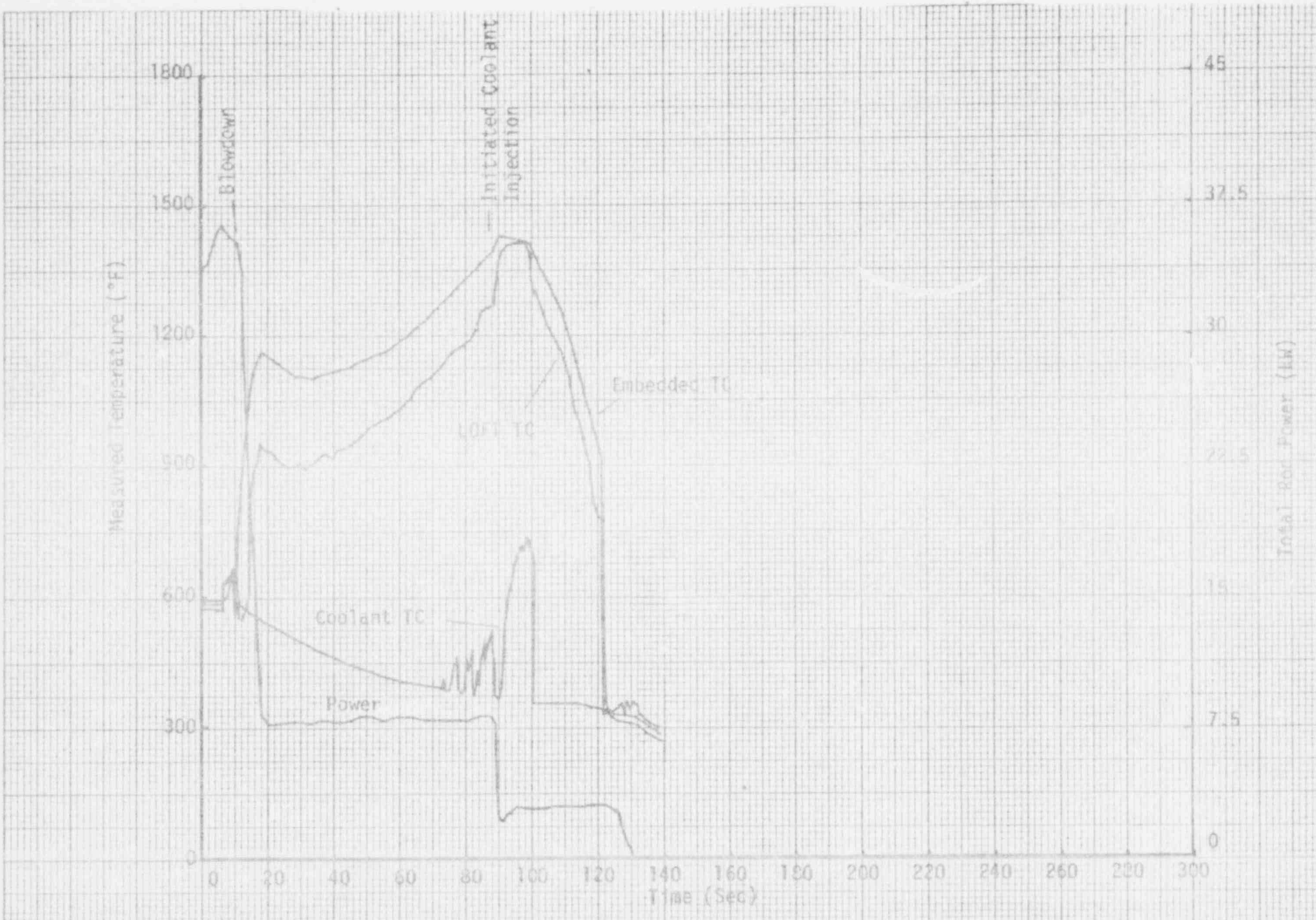


Figure 8b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 5

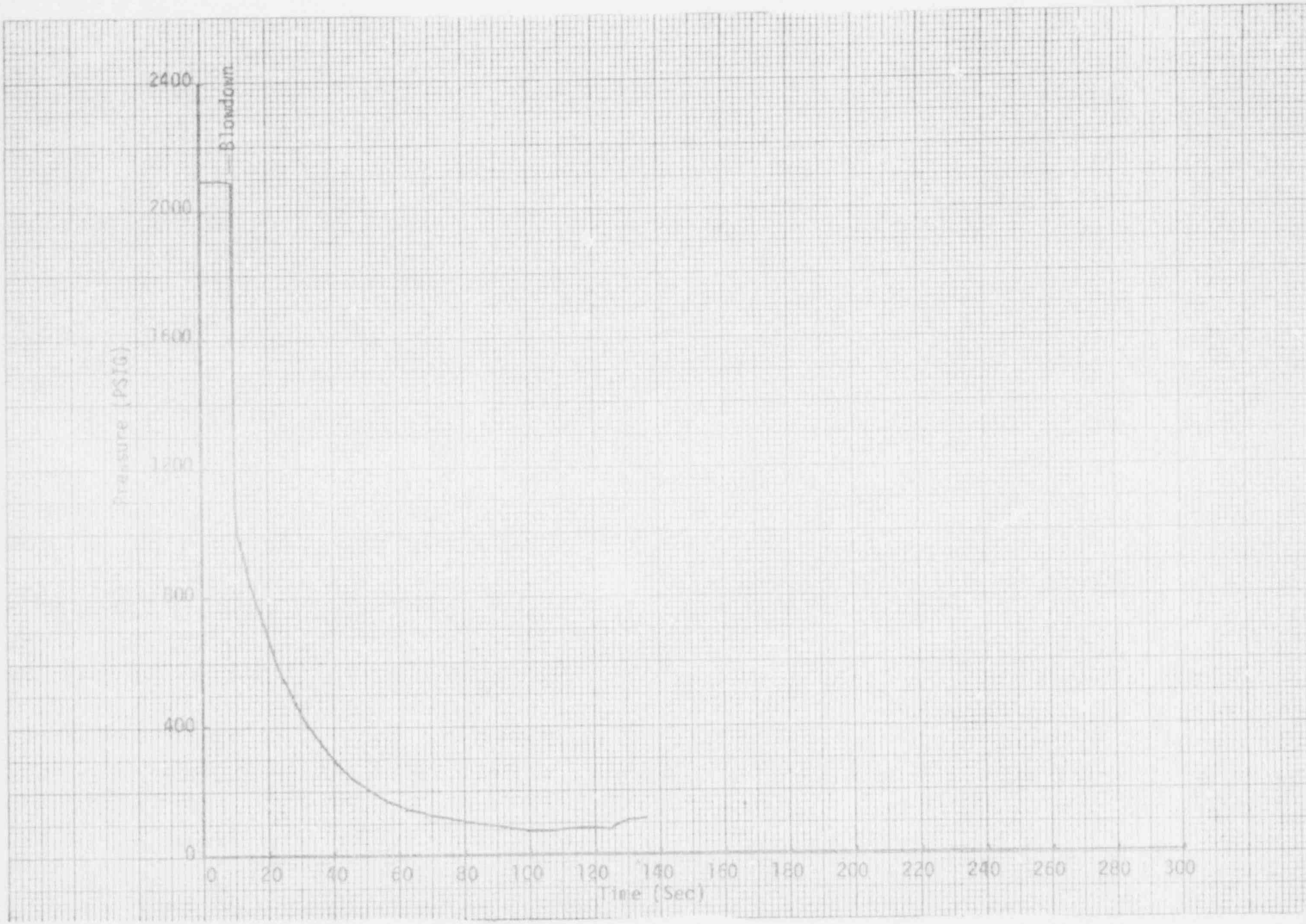


Figure 8c. System Pressure During Run 5

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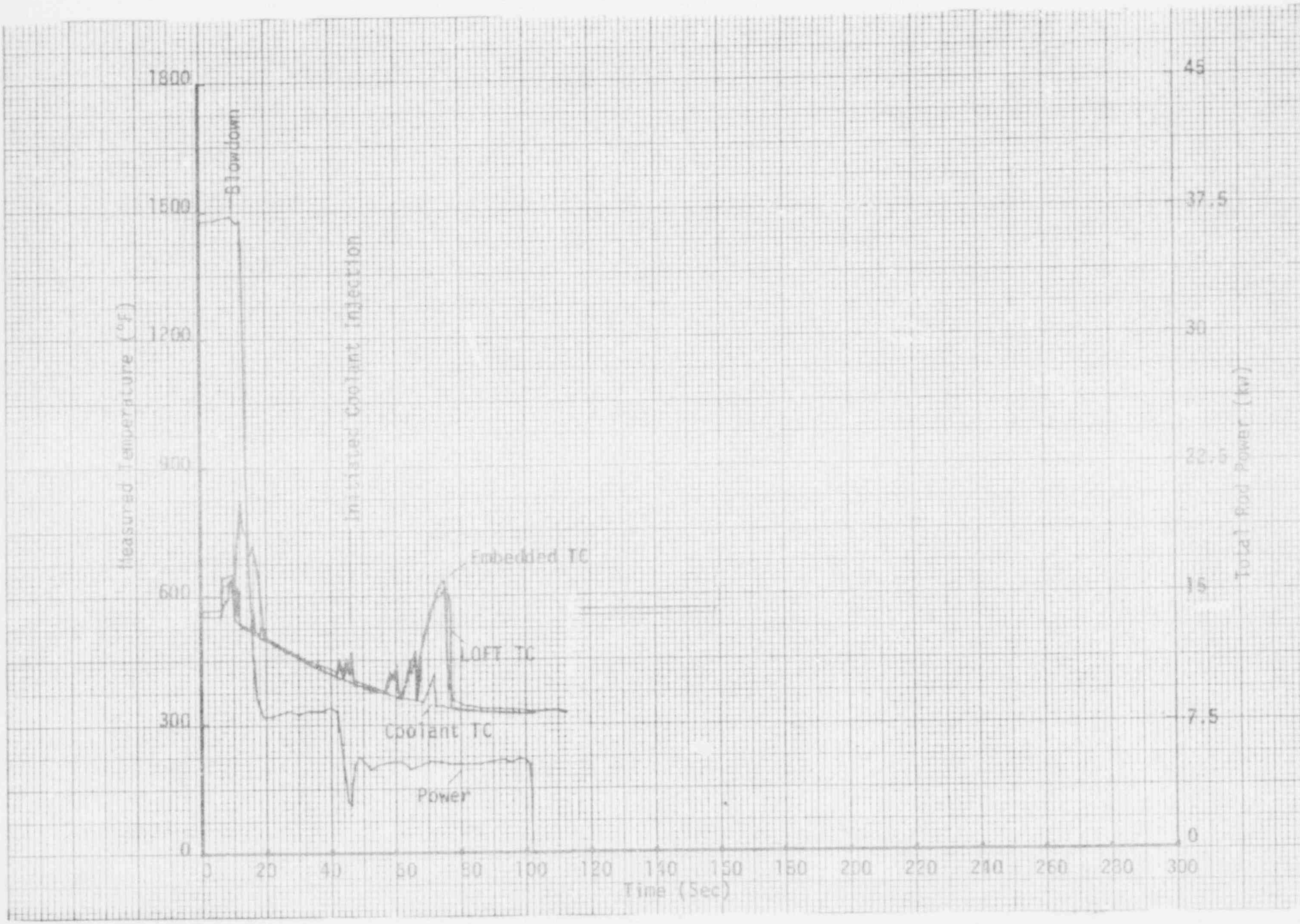

Figure 9a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 6

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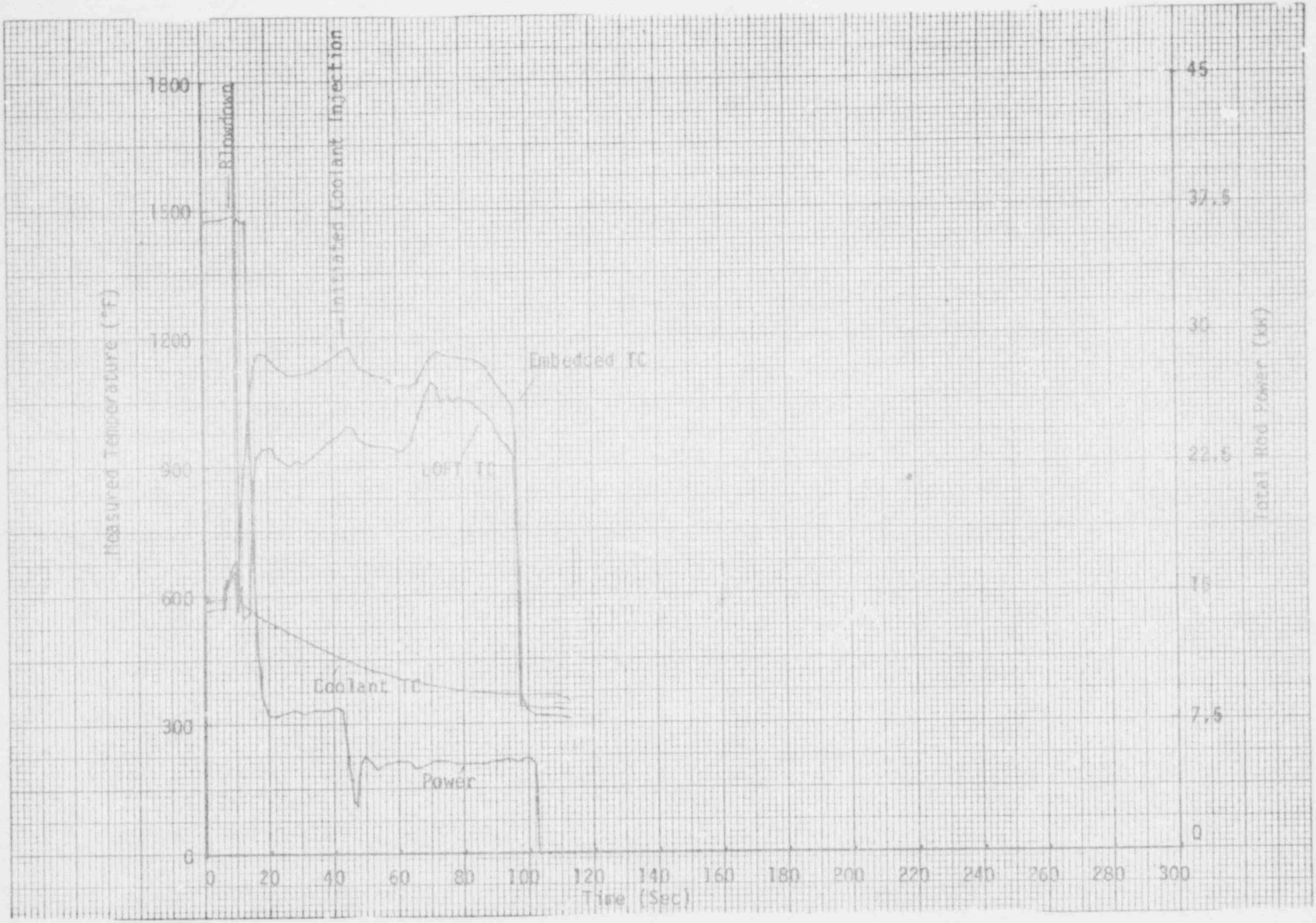
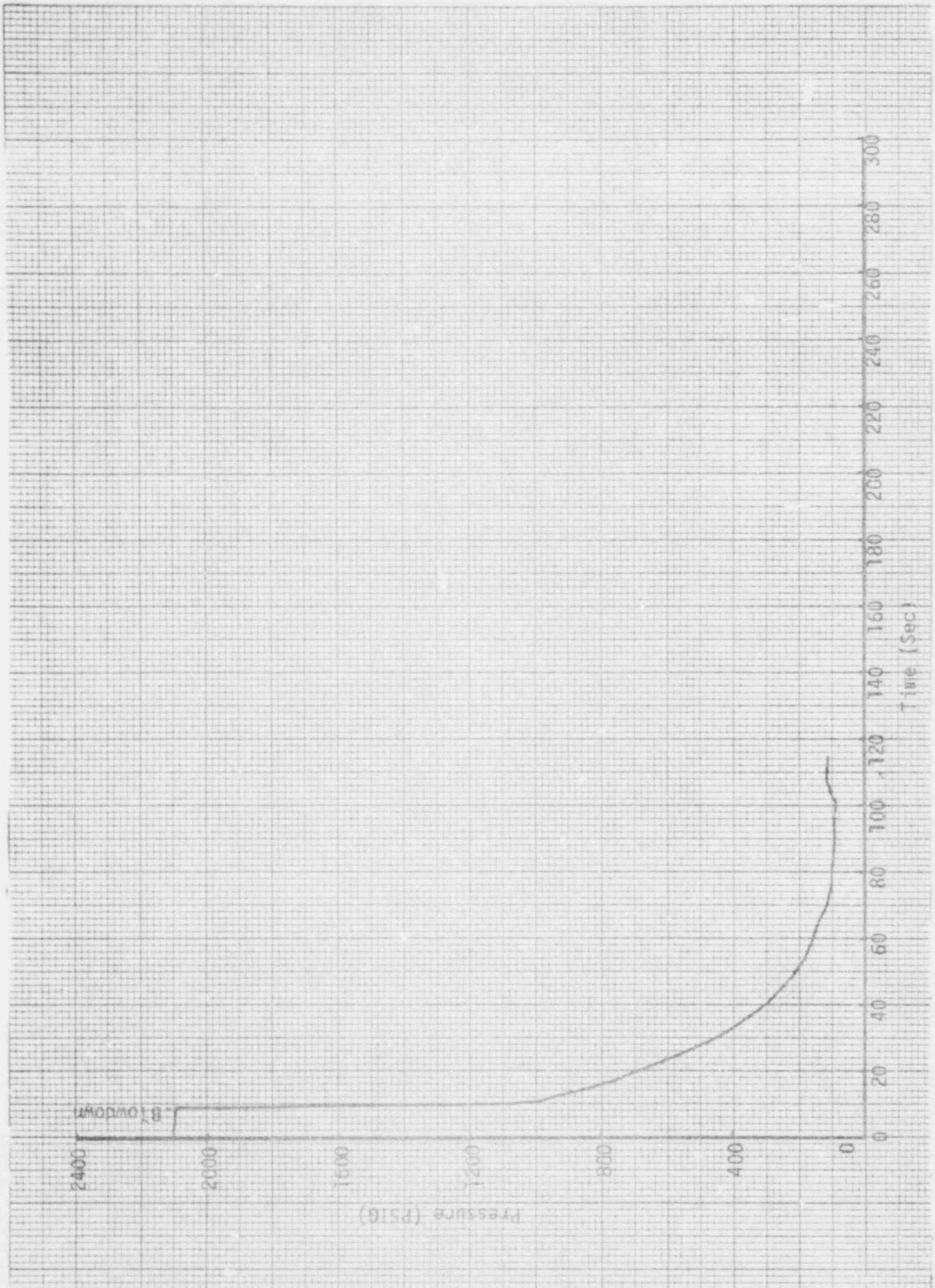


Figure 9b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 6



Figures 9c. System Pressure During Run 6

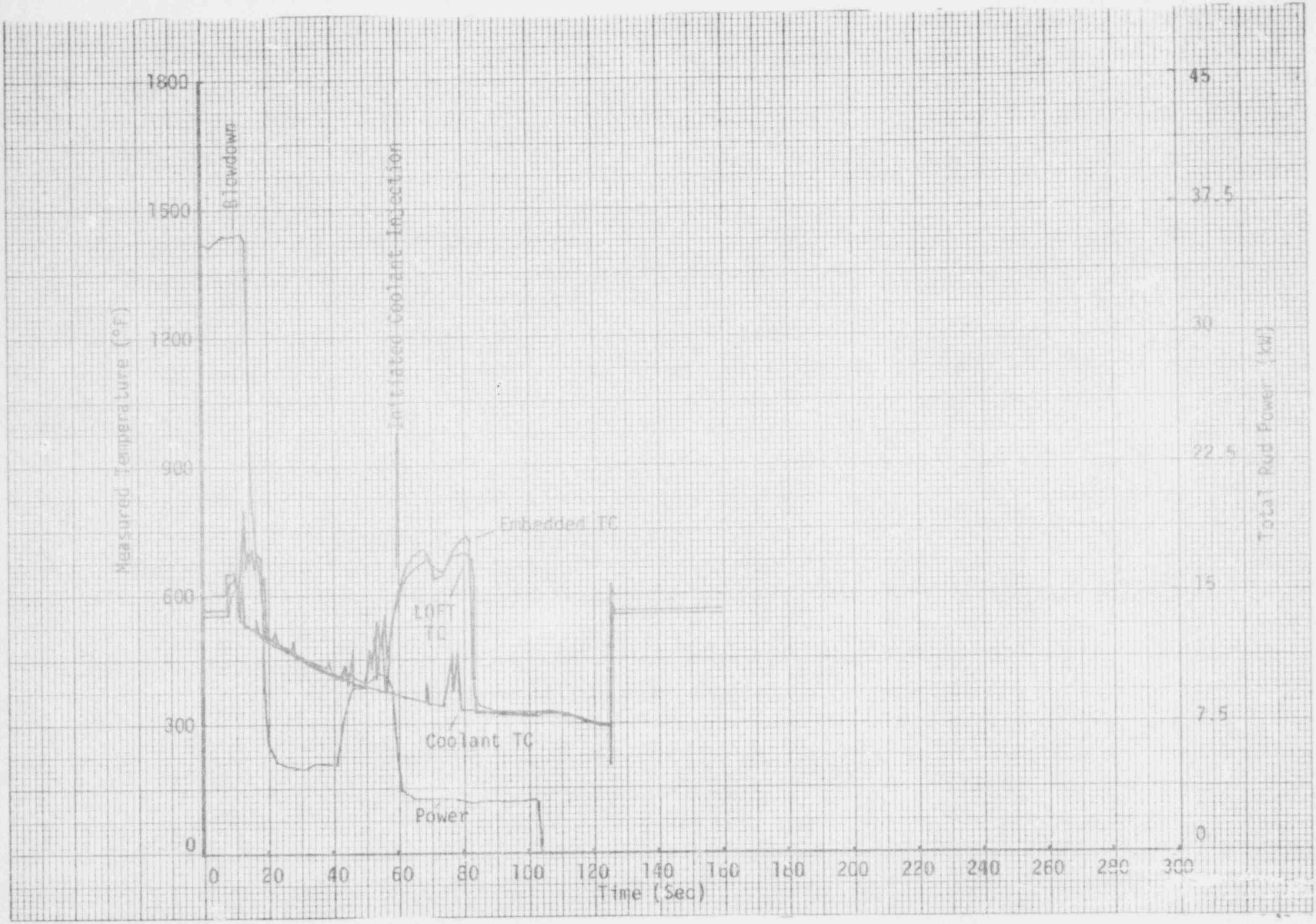


Figure 10a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 7

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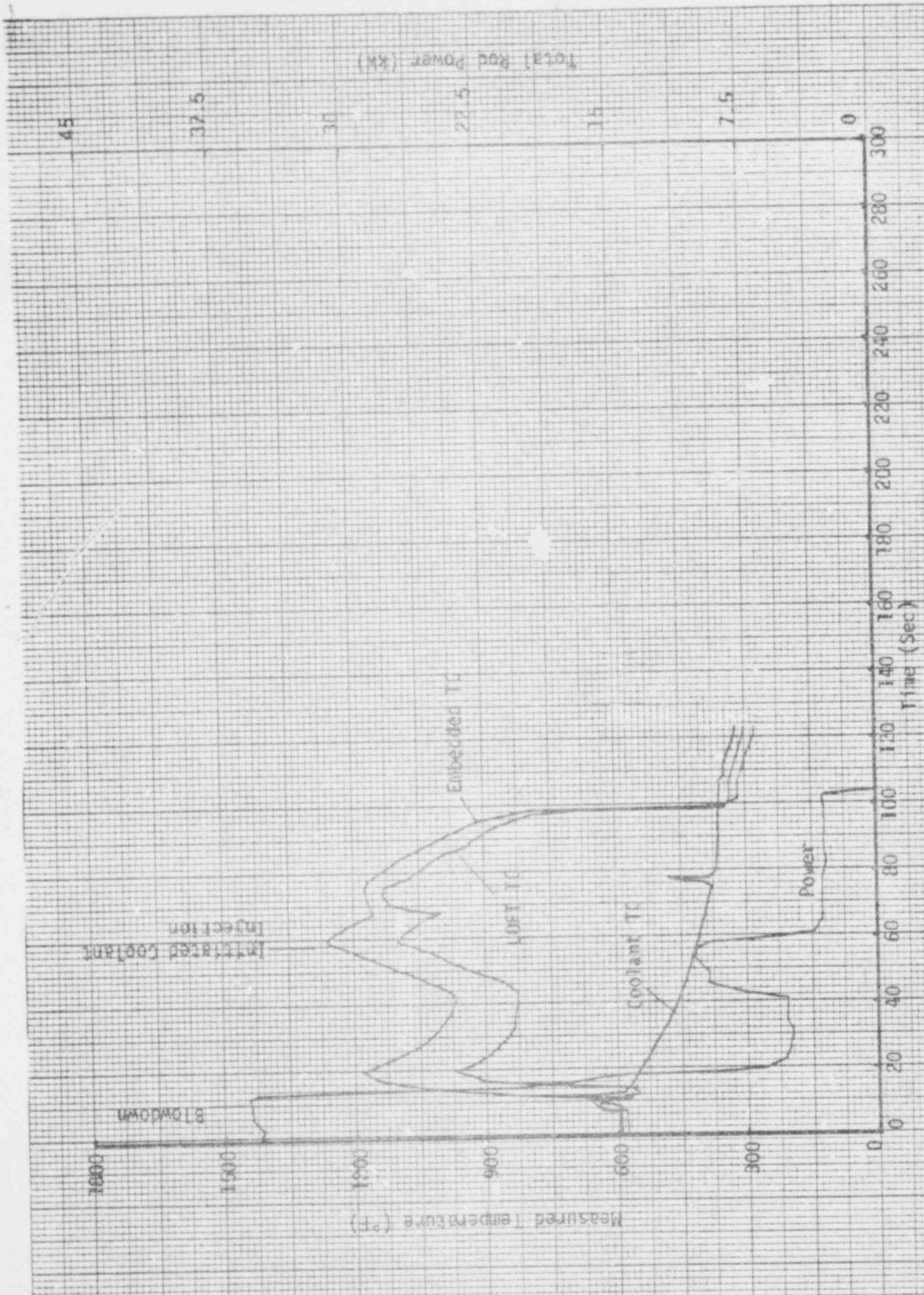

Figure 10b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 7

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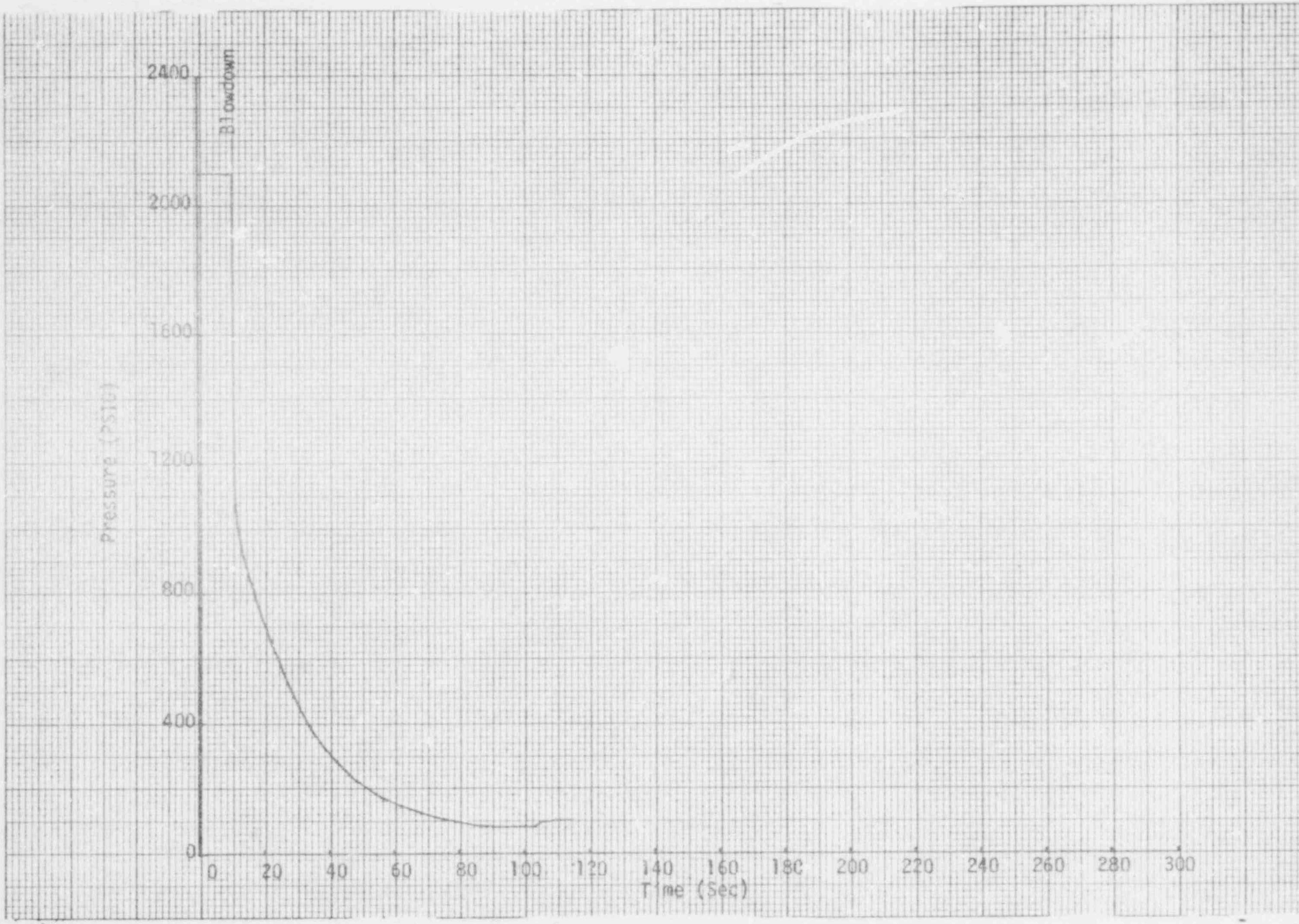

Figure 10c. System Pressure During Run 7

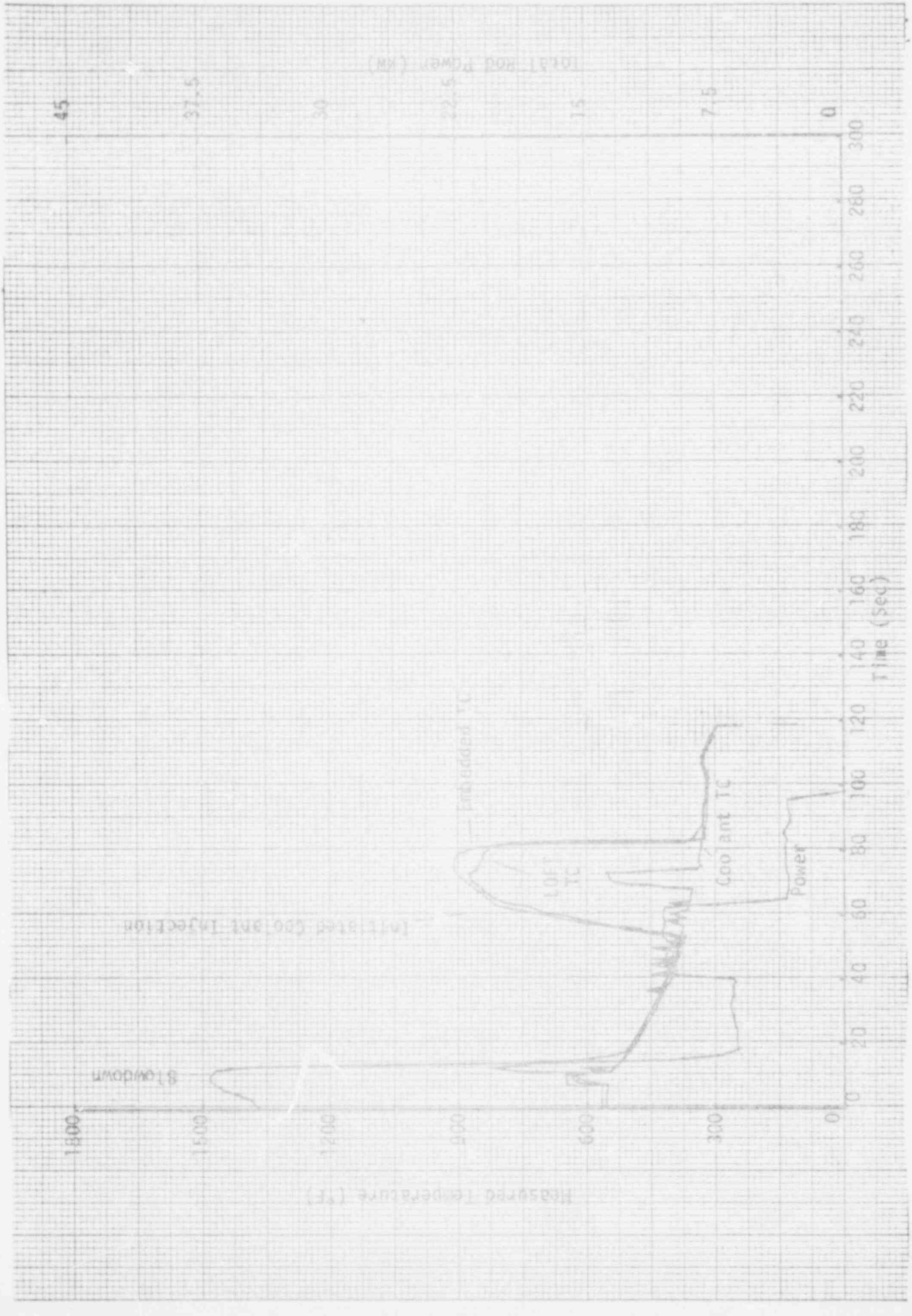

Figure 11a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 8

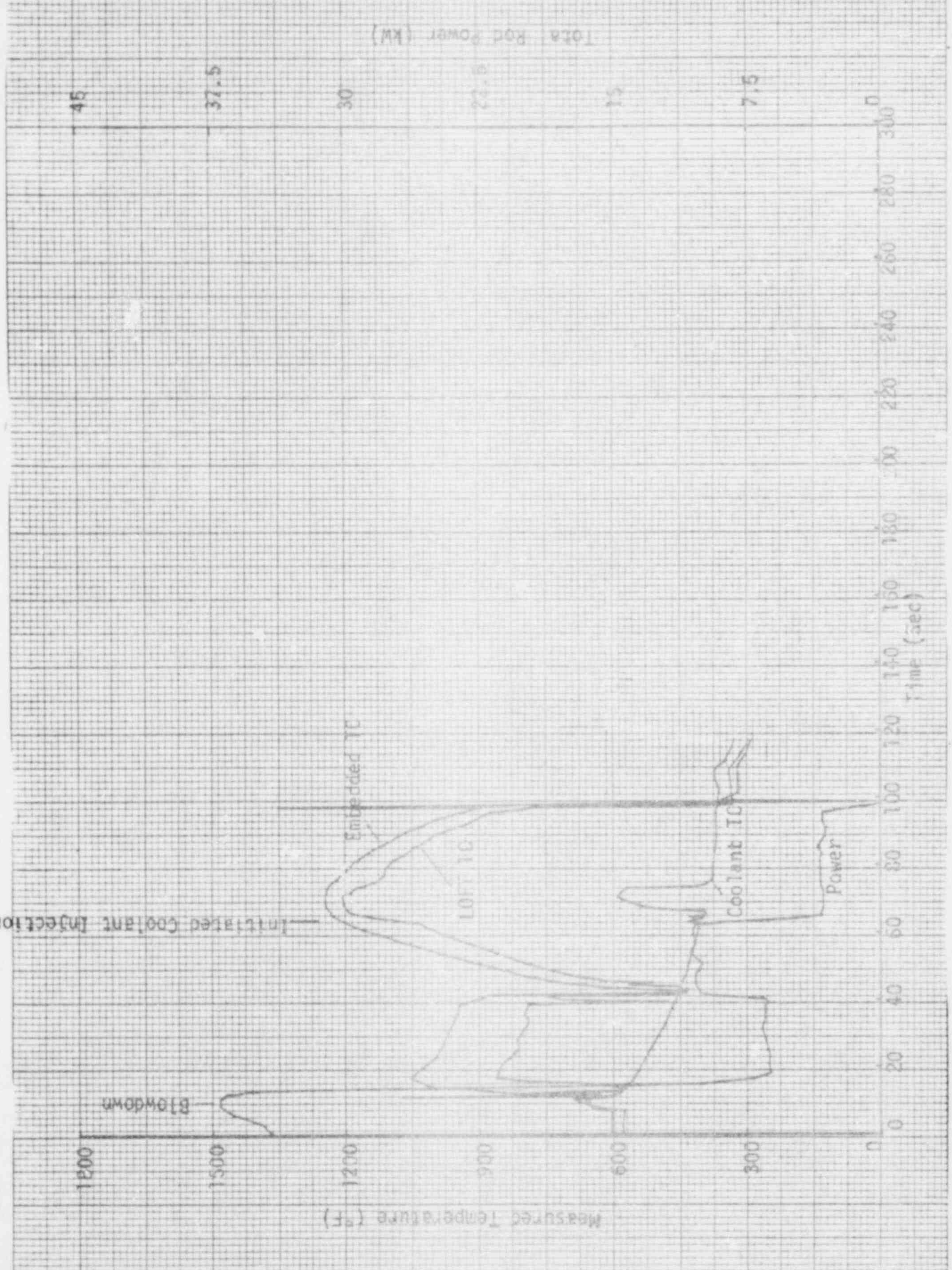

Figure 11b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 8

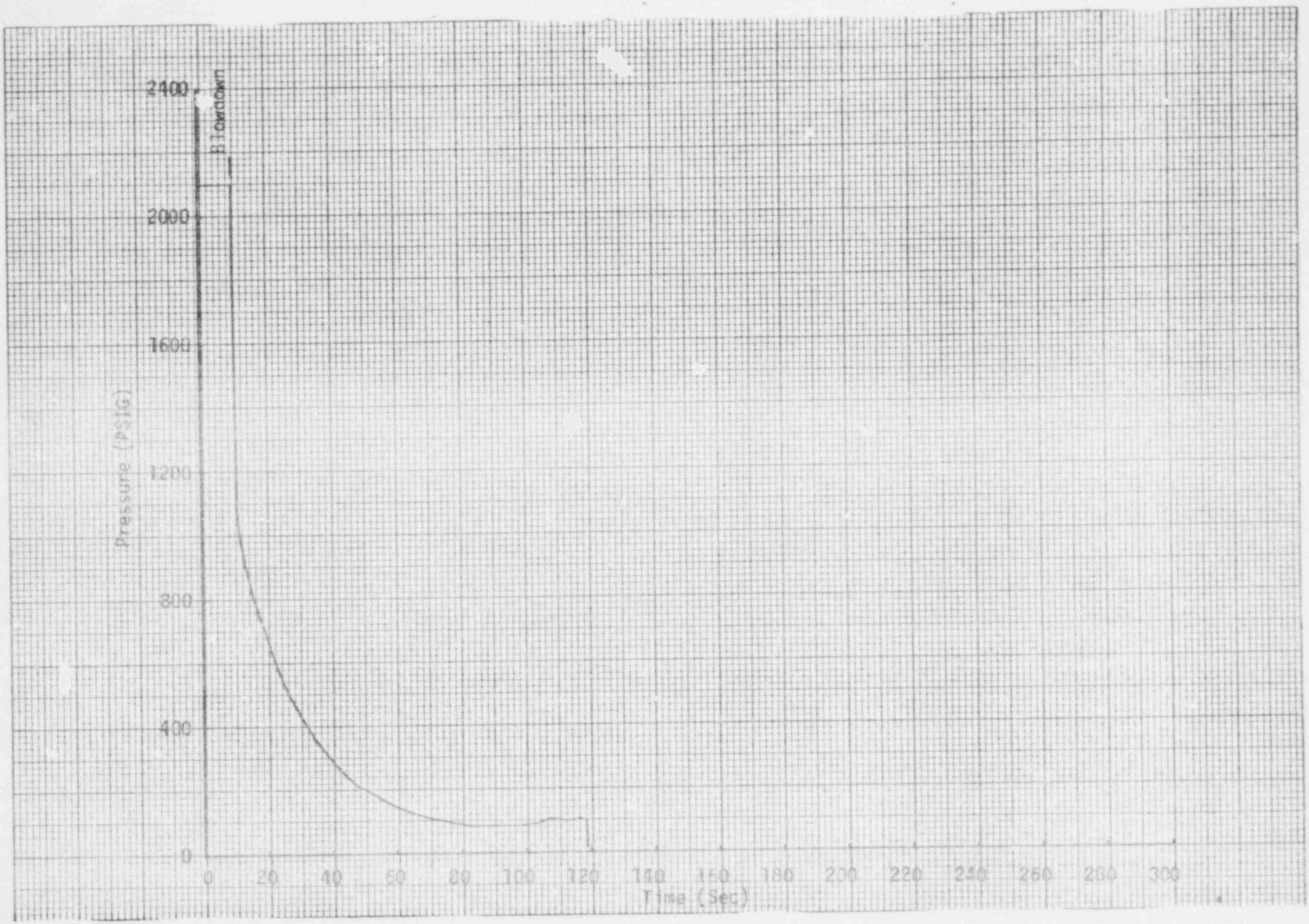

Figure 11c. System Pressure During Run 8

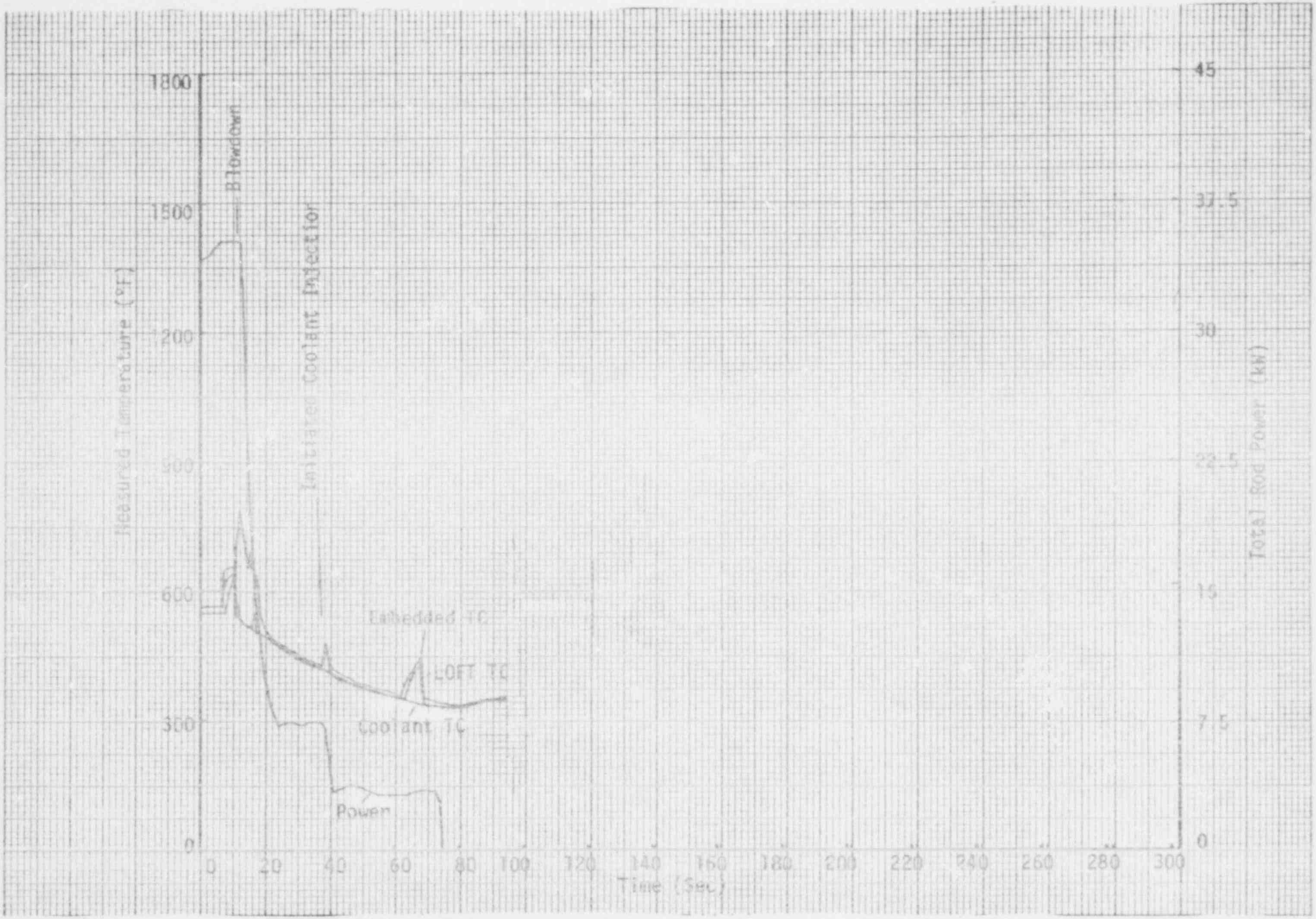

Figure 12a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 9

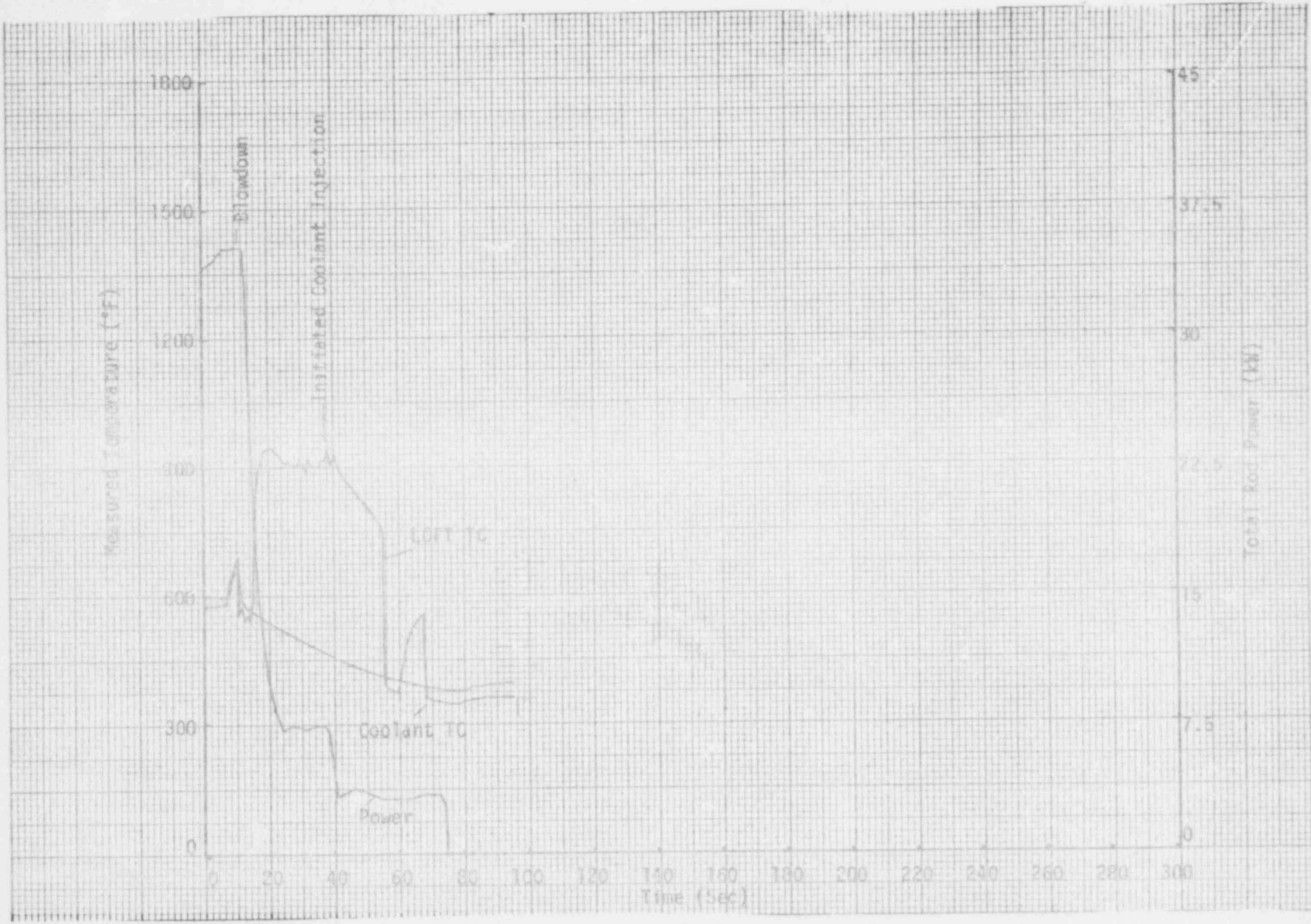

Figure 12b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 9

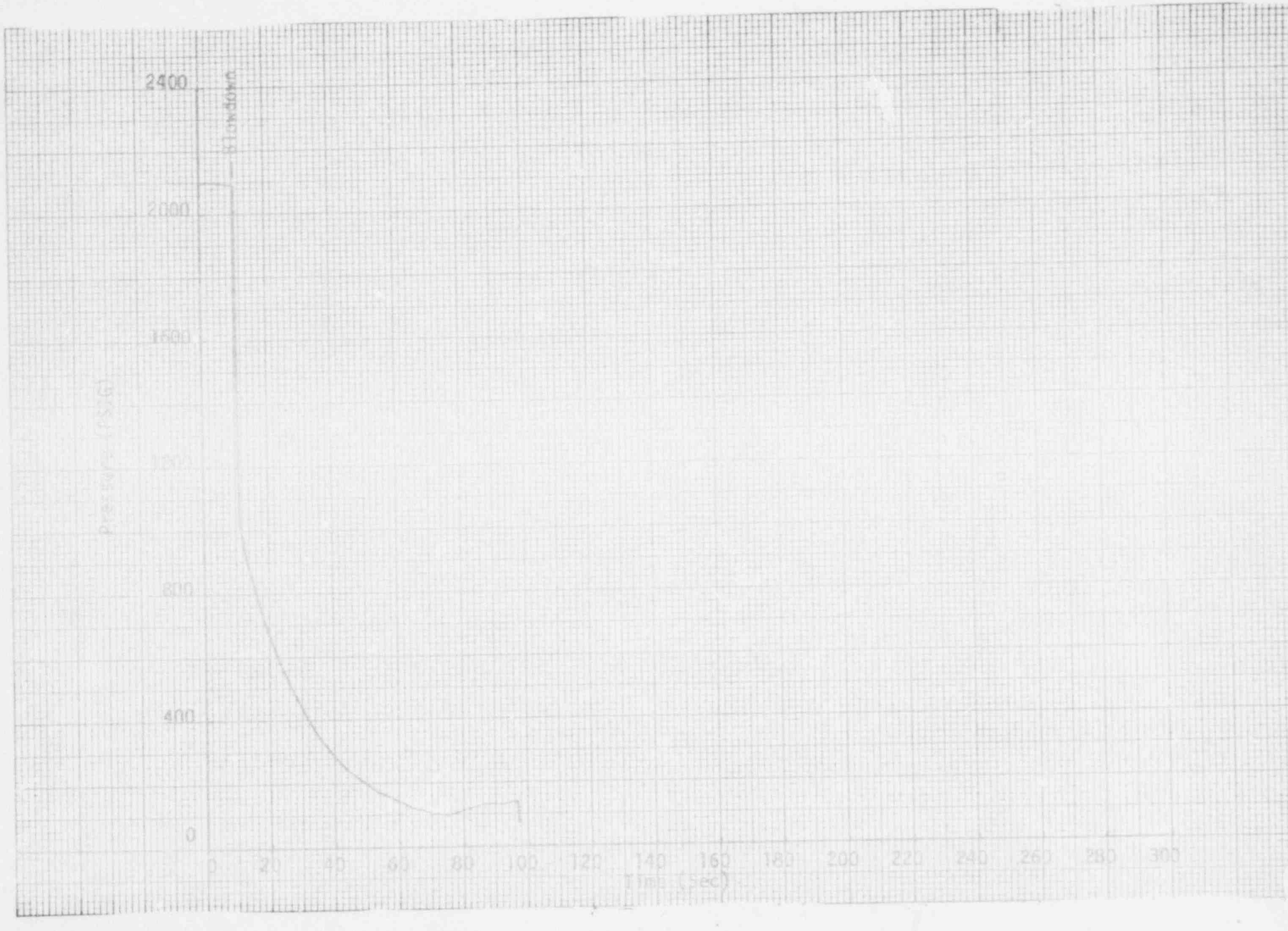

Figure 12c. System Pressure During Run 9

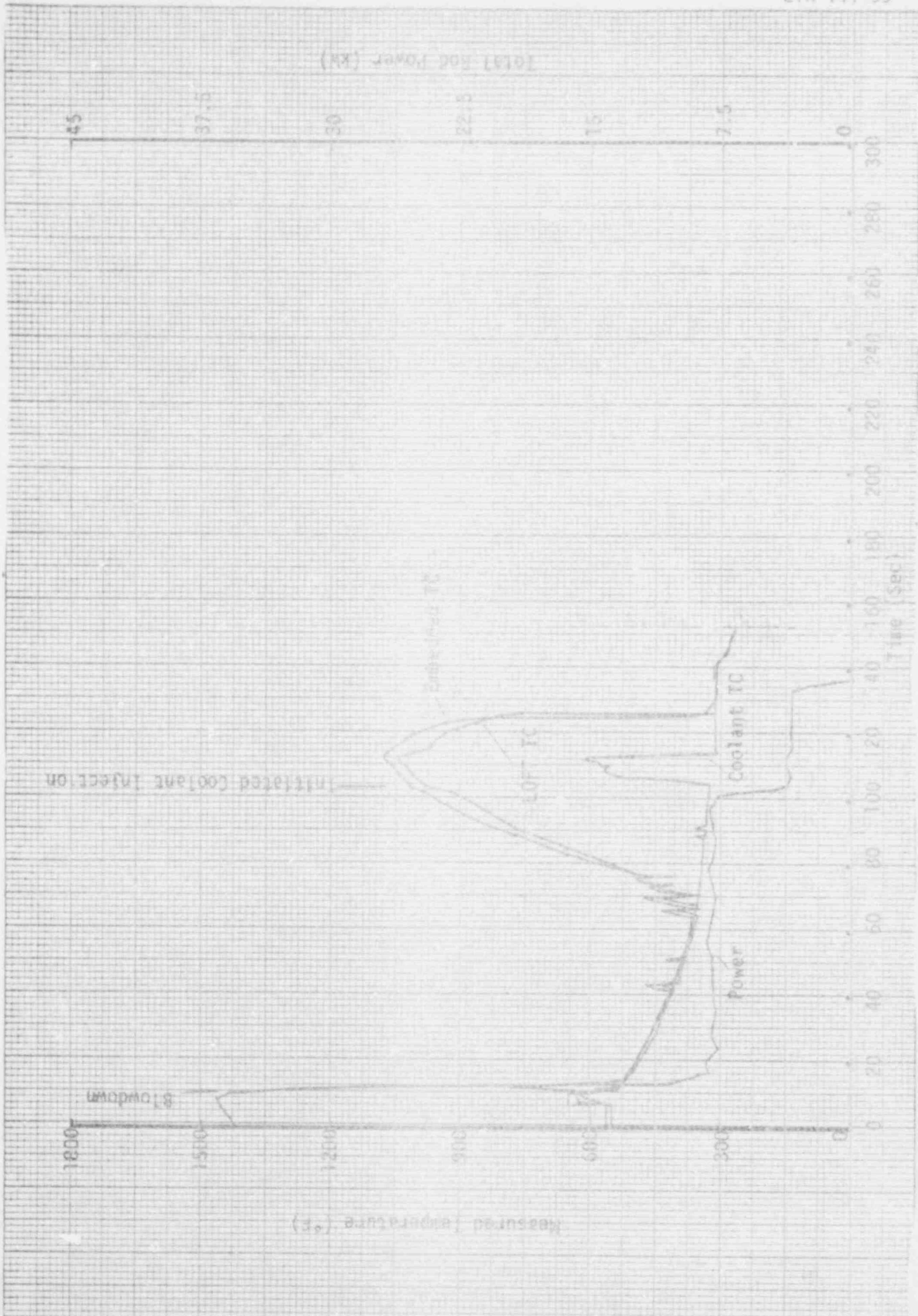

Figure 13a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 10

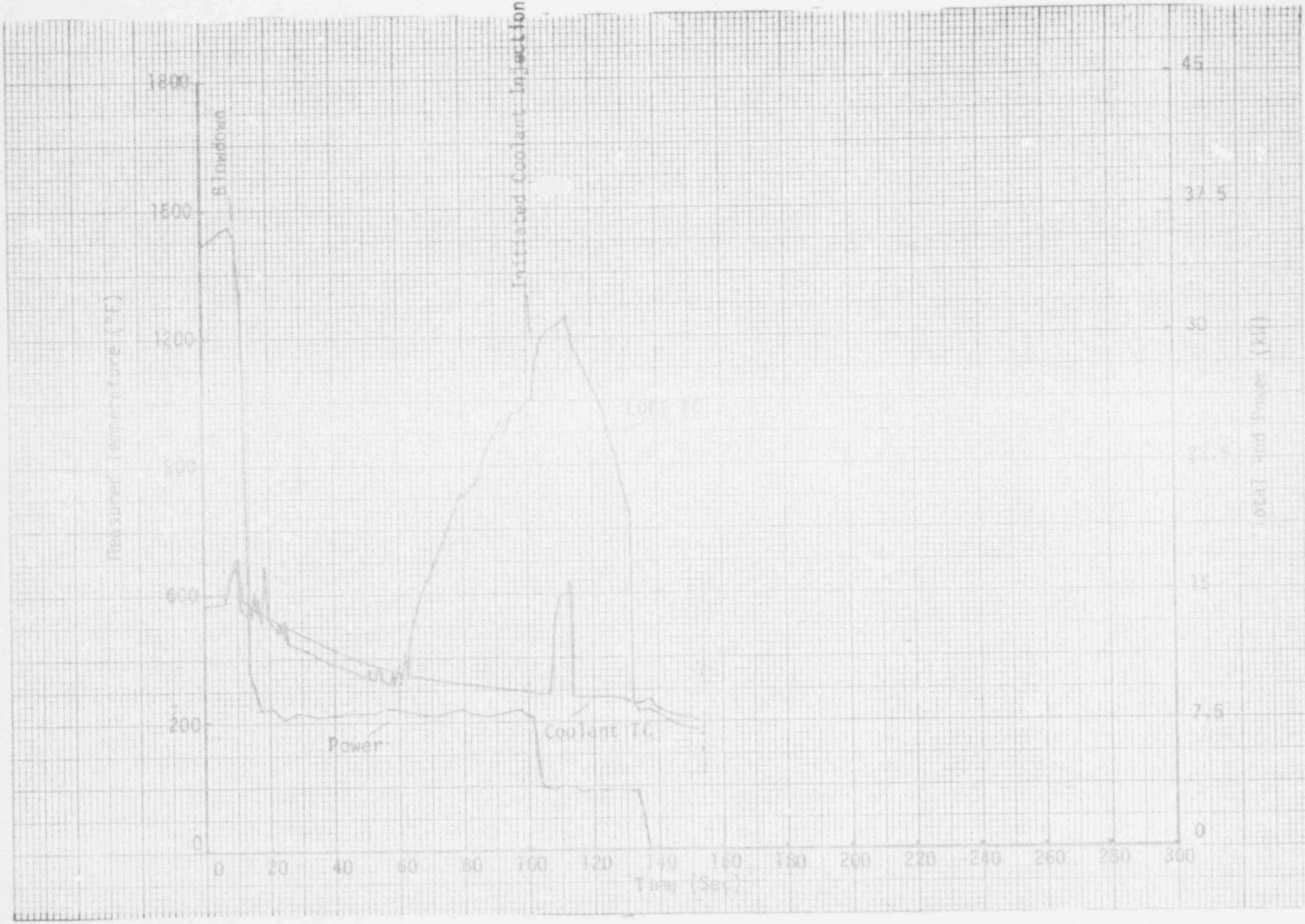

Figure 13b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 10

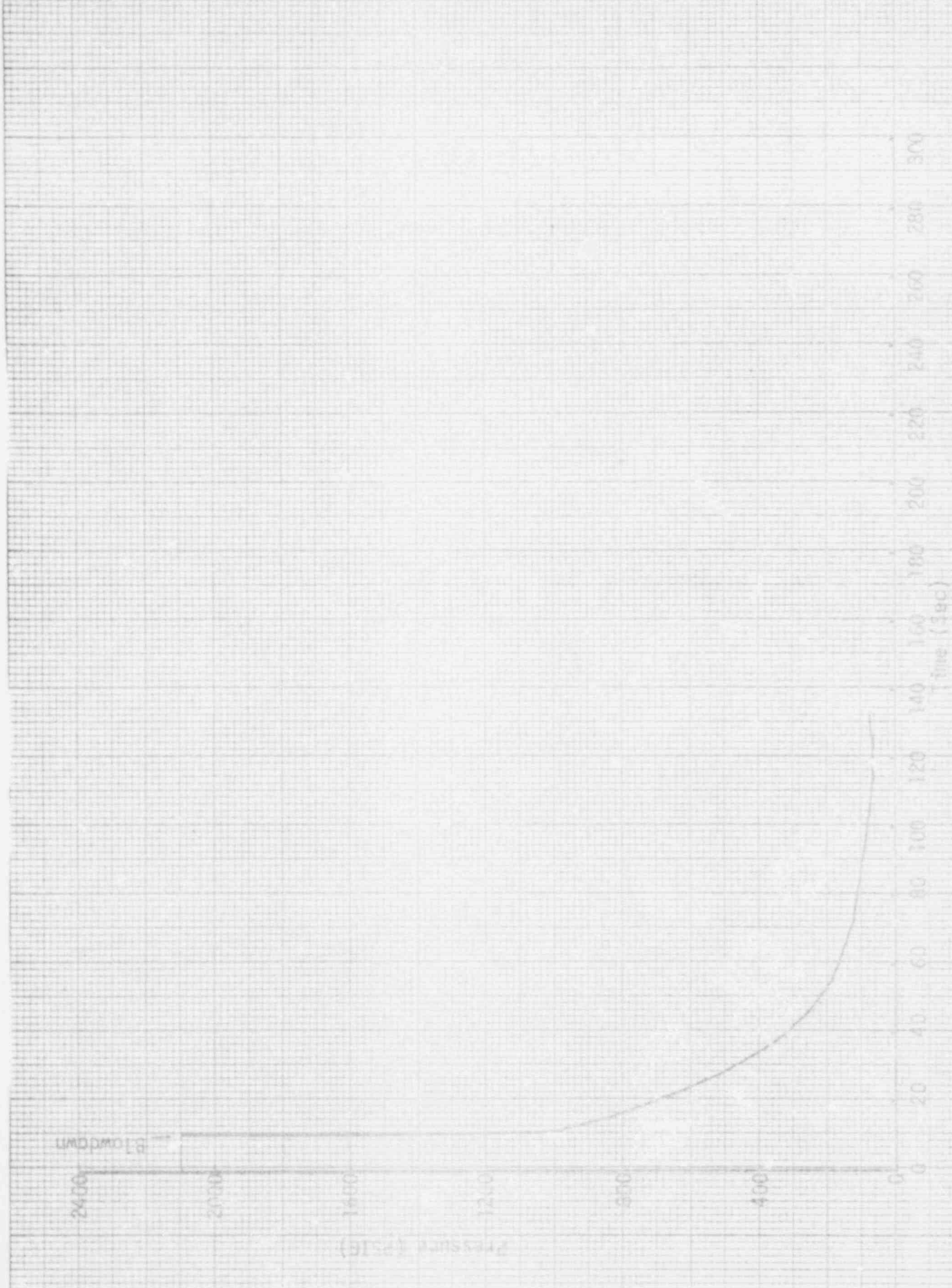

Figure 13c. System Pressure During Run 10

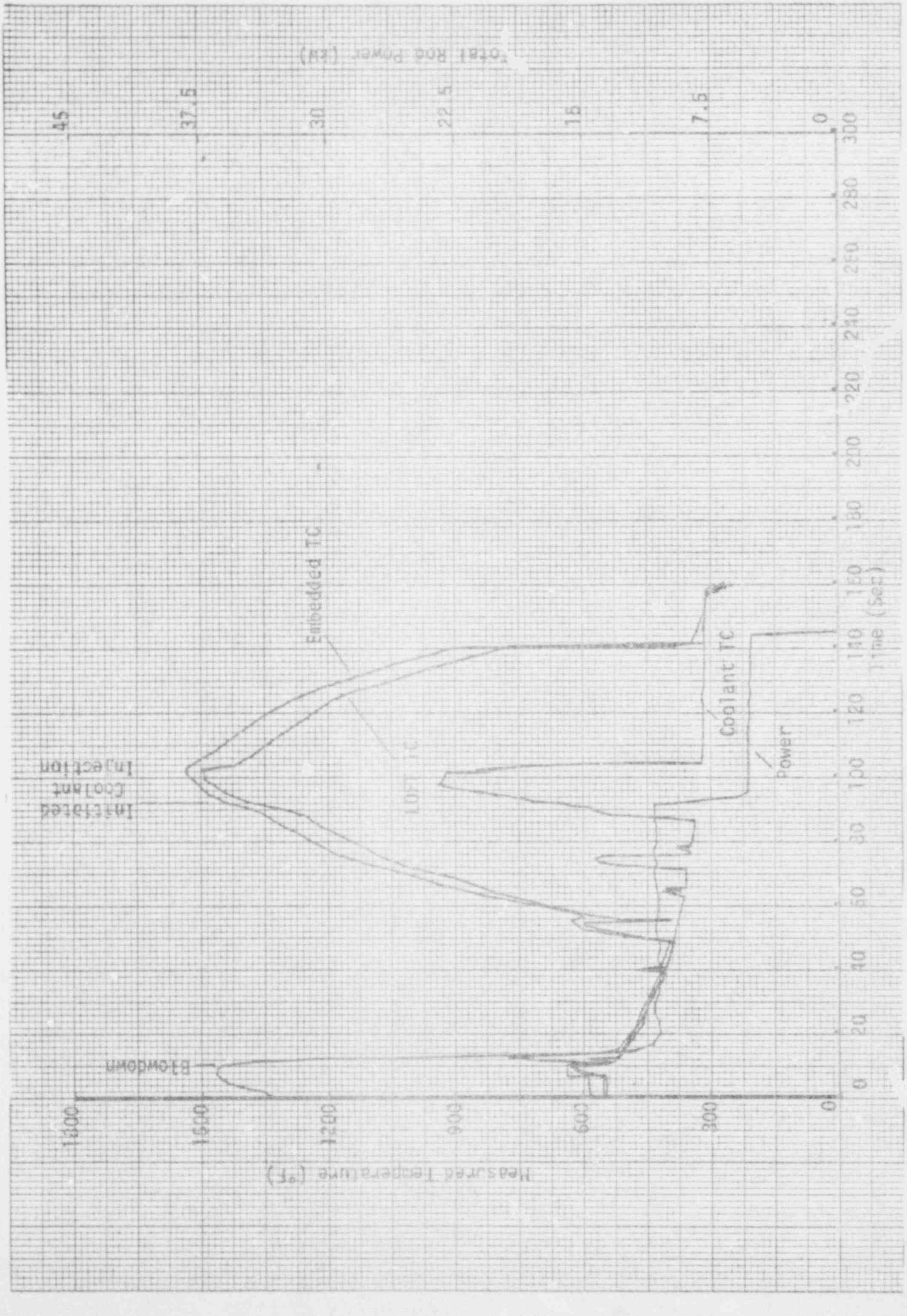

Figure 14a. Thermocouple Response 33 Inches From Bottom of Rod 8879 - Run 11

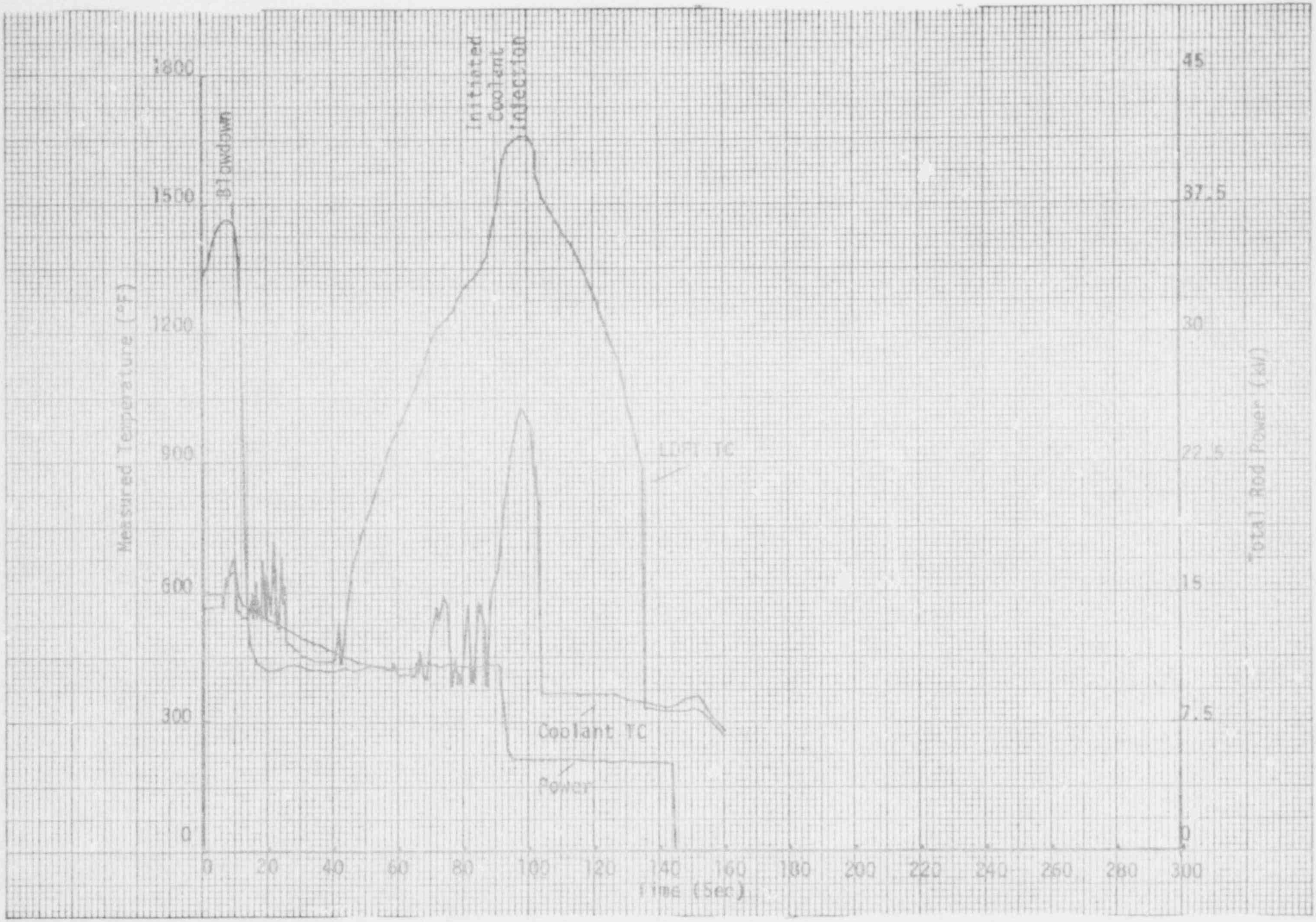

Figure 14b. Thermocouple Response 38.9 Inches From Bottom of Rod 8879 - Run 11

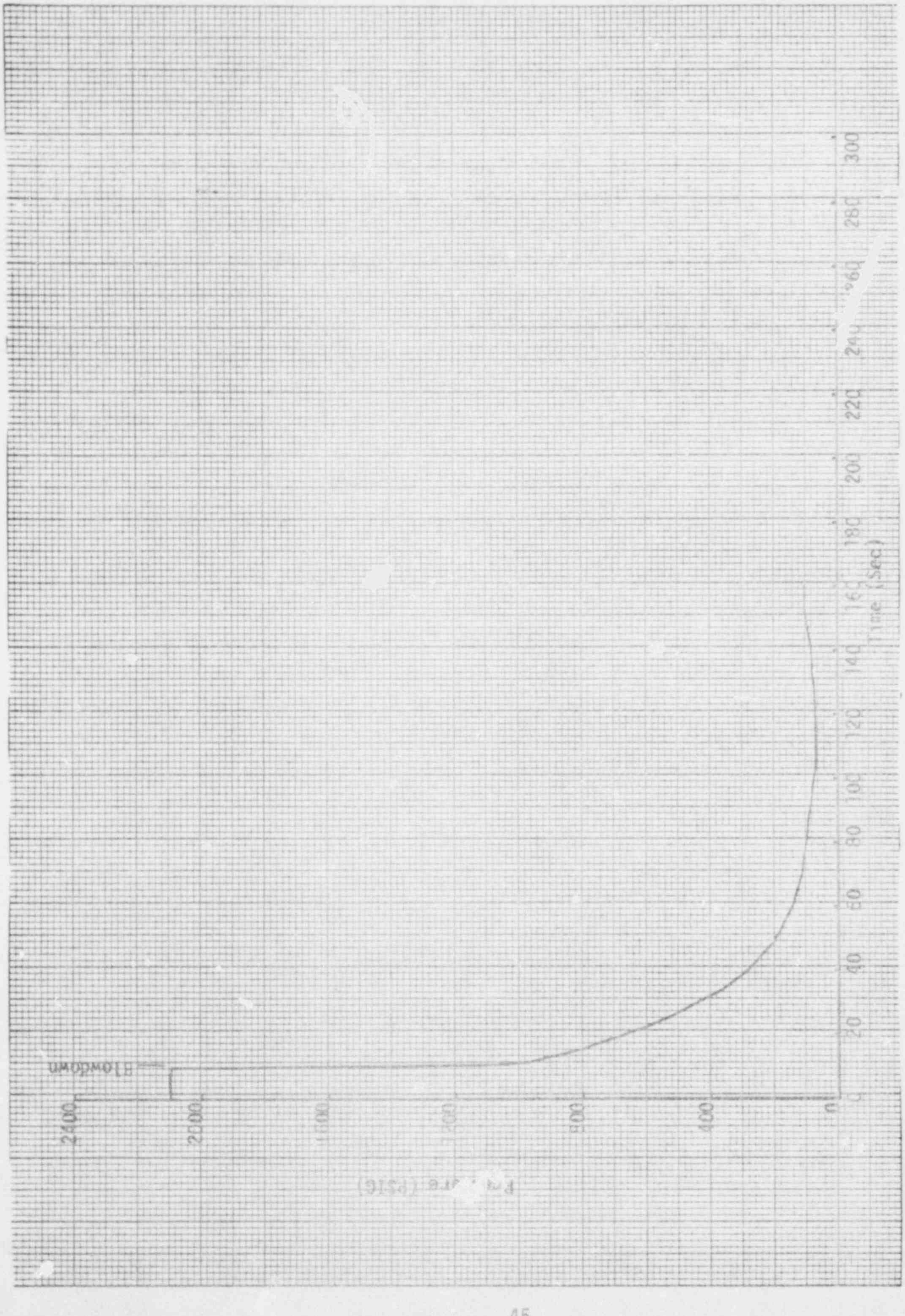

Figure 14c. System Pressure During Run 11

4.0 DISCUSSION OF RESULTS

Run 2, Figure 5, exhibits a typical temperature response for the four thermocouples. During steady state, the embedded thermocouple exhibited a 30°F higher temperature than the LOFT thermocouple. A steady state analysis at this power level indicated that such a temperature difference could occur solely due to the different radial locations and the increased surface area of the LOFT thermocouple. A slight temperature rise occurred on each thermocouple before blowdown. This is due to the stagnation in the test section caused by closing the valve at the inlet to the heater test section before the blowdown valve was opened. At the maximum power location (33 inches from the bottom of the rod), a modest rise in temperature (200°F) is noted with the embedded thermocouple caused by this location briefly experiencing departure from nucleate boiling (DNB). The temperature decreases as soon as the power to the rod is reduced. The transient is too mild to be recorded by the LOFT thermocouple. Both thermocouples then appear to follow the saturation temperature until some time after the power is increased to force the rod into DNB again. Both thermocouples responded in an almost identical fashion for the rest of the transient. The temperature increase began about ten seconds after the power was increased and began to rise at a rate of about 40°F/sec. Temperature turnaround occurred shortly after the power was reduced and ECC water began to flood the test section. Quench occurred about 30 seconds after temperature turnaround. The temperature difference at the maximum temperature in reflood is only 30°F. It appears that because the rod is nearly adiabatic at the time of peak temperature, the rod temperature profile is very flat causing the maximum temperatures measured by the embedded and LOFT thermocouples to agree closely.

The thermocouples at the lower power location (38.9 inches from the rod bottom) responded somewhat differently than those at the higher power location. The first temperature rise was larger and lasted longer. A difference in time to DNB was observed with the LOFT thermocouple encountering DNB about four seconds after the embedded thermocouple. Quench was observed by the embedded thermocouple about 20 seconds after the power was decreased whereas the LOFT thermocouple experienced quench after 15 seconds. Both temperatures followed the saturation temperature until the power was increased. Both thermocouples responded to the increased power almost immediately which contrasts to the time delay observed for the higher power location. The maximum temperature observed was 280°F higher than the higher power location. Temperature turnaround occurred with the power decrease and ECC injection. Quench was observed to occur about seven seconds after quench at the higher power location. Both thermocouples at 38.9 inches agreed to within 100°F during the reflood portion with the temperature difference at the maximum temperature being about 30°F which matches that at the higher power location. The higher temperature observed at the lower power location but higher up on the rod is to be expected and is usually observed in computer code calculations.

Most of the other experiments evidenced the same type of behavior at the 33 inch location with differences which could be accounted for by the different power histories. The thermocouples at the lower power location showed considerably different behavior from run to run. For example, Run 7 indicated a large temperature difference between thermocouples (about 250°F) for the entire experiment. No quench was observed between the blowdown and reflood phase. Quench was noted for power levels below 4.06 kW but not for powers higher than this. A summary of the behavior of the various experiments is included in Table 3.

An interesting phenomena occurred in the reflood time period. The temperature difference between the LOFT and embedded thermocouples was always larger just before ECC injection was initiated. From then on the behavior of both was very similar. This temperature rise was observed in Runs 1, 2, 3, 4, 5, 10, and 11. This behavior may be caused by a sudden flow stagnation which could occur when accumulator water is introduced. The cold ECC water in the inlet piping is postulated to cause sufficient condensation to stop the valve leakage flow past the heater rod. The reduced flow results in a nearly adiabatic condition to occur on the rod causing the LOFT and the embedded thermocouple temperatures to be nearly the same.

TABLE 3

SUMMARY OF TEMPERATURE RESPONSE RESULTS FOR ROD 8879

Run No.	T.C. ID	Time to CHF (S)	Time Difference (S)	LOFT-Embedded TC Difference at Peak in Blowdown	Temp. Decrease Rate During Power Level 2 After Quench (°F/sec)	Time Delay After Adjustment 2 (PL-3) to Temp. Increase	Initial Temp. Rise Rate at End of Delay	LOFT-Embedded TC Difference at Peak in Reflood
1	LSE5	0	1	185°F	3.75°F/sec	No Adjustment	37.5°F/sec	30°F
	LSL5	1			3.75°F/sec	No Adjustment	37.5°F/sec	
	LSE6	0	2	165°F	No Quench	No Adjustment	5.7°F/sec	30°F
	LSL6	2			No Quench	No Adjustment	5.0°F/sec	
2	LSE5	0	1	150°F	5.0°F/sec	10 sec	60.0°F/sec	30°F
	LSL5	1			5.0°F/sec	10 sec	60.0°F/sec	
	LSE6	0	3	170°F	3.46°F/sec	0 sec	60.0°F/sec	10°F
	LSL6	3			4.62°F/sec	0 sec	25.0°F/sec	
3	LSE5	0	0	210°F	4.09°F/sec	9 sec	75.0°F/sec	45°F
	LSL5	0			6.43°F/sec	9 sec	62.5°F/sec	
	LSE6	0	4	180°F	5.25°F/sec	3 sec	52.5°F/sec	25°F
	LSL6	4			3.75°F/sec	5 sec	48.75°F/sec	
4	LSE5	0	0	195°F	8.13°F/sec	18 sec	75.0°F/sec	40°F
	LSL5	0			8.13°F/sec	18 sec	75.0°F/sec	
	LSE6	0	4	180°F	No Quench	4 sec	16.88°F/sec	45°F
	LSL6	4			No Quench	2 sec	13.3°F/sec	
5	LSE5	0	1	195°F	6.0°F/sec	No Adjustment	36.0°F/sec	25°F
	LSL5	1			6.0°F/sec	No Adjustment	25.7°F/sec	
	LSE6	0	4	225°F	No Quench	No Adjustment	6.0°F/sec	30°F
	LSL6	4			No Quench	No Adjustment	9.0°F/sec	
6	LSE5	0	0	195°F	3.75°F/sec	No Adjustment	60.0°F/sec	15°F
	LSL5	0			3.75°F/sec	No Adjustment	60.0°F/sec	
	LSE6	2	3	218°F	No Quench	No Adjustment	15.0°F/sec	67.5°F
	LSL6	5			No Quench	No Adjustment	15.0°F/sec	
7	LSE5	0	1	165°F	11.25°F/sec	10 sec	37.5°F/sec	45°F
	LSL5	1			4.09°F/sec	10 sec	75.0°F/sec	
	LSE6	1	3	210°F	No Quench	0 sec	15.0°F/sec	157.5°F
	LSL6	4			No Quench	0 sec	18.75°F/sec	
8	LSE5	0	1	210°F	5.0°F/sec	12 sec	30°F/sec	35°F
	LSL5	1			5.63°F/sec	12 sec	30°F/sec	
	LSE6	2	4	187.5°F	375°F/sec	0 sec	195°F/sec	40°F
	LSL6	6			105°F/sec	0 sec	63.75°F/sec	
9	LSE5	0	0	210°F	5.0°F/sec	No Adjustment	225°F/sec	15°
	LSL5	0			4.69°F/sec	No Adjustment	37.5°F/sec	
	LSL6	4	NA	NA	3.75°F/sec	4 sec	45°F/sec	NA
10	LSE5	0	1	187.5°F	7.5°F/sec	No Adjustment	22.5°F/sec	30°F
	LSL5	1			7.5°F/sec	No Adjustment	15°F/sec	
	LSE6	4	NA	NA	2.0°F/sec	No Adjustment	55°F/sec	NA
11	LSE5	1	2	180°F	5.63°F/sec	No Adjustment	30°F/sec	35°F
	LSL5	3			3.75°F/sec	No Adjustment	27.5°F/sec	
	LSE6	5	NA	NA	6.88°F/sec	No Adjustment	37.5°F/sec	NA

5.0 CONCLUSIONS

Several immediate observations can be made about the temperature agreement of the LOFT and embedded thermocouples: (1) the thermocouples at the higher power location are similar and both thermocouples seem to be responding to the same physical phenomena; (2) the thermocouples at the lower power location showed differences in time to CHF but in the majority of experiments, the thermocouples appeared to be responding to the same physical phenomena. In general, the LOFT thermocouple appeared to respond more to the liquid in the two-phase mixture. That is, DNB occurred later and quench occurred earlier. (3) The embedded thermocouple always measured a higher temperature than the LOFT thermocouple. (4) When the temperatures were high, the two thermocouples at a given location always seemed to be responding to the same physical phenomena. Because of these observations, the authors conclude that an analytical model can be formulated which relates the LOFT thermocouple measurements to the surface temperature during the high temperature portions of the experiments.

APPENDIX A

COMMENTS HISTORY

RRF-A-8879

Run 1 - 13:50:01 - 14:01:38

(Operator) 13:59 551°F - 2260 psi
(Graphs) No comments

Run 2 - 14:32:35 - 14:35:05

(Operator) 14:33 551°F - 2270 psi
14:35 Filled CI Accum.
(Graphs) No comments

Run 3 - 15:01:35 - 15:03:57

(Operator) 15:02 551°F - 2250 psi
(Graphs) No comments

Run 4 - 15:30:03 - 15:32:15

(Operator) 15:30 550°F - 2260 psi
15:32 Filled CI Accum.

(Graphs) No comments

Run 5 - 16:03:30 - 16:05:55

(Operator) 16:34 549°F - 2250 psi

(Graphs) No comments

Run 6 - 16:33:22 - 15:35:19

(Operator) 16:34 550°F - 2250 psi
16:35 Filled CI Accum.

(Graphs) No comments

Run 7 - 17:02:50 - 17:05:00

(Operator) 17:03 550°F - 2250 psi

(Graphs) No comments

Run 8 - 17:31:38 - 17:33:41

(Operator)	17:32	551°F - 2250 psi
	17:33	Filled CI Accum.
(Graphs)		No Comments

Run 9 - 18:40:05 - 18:41:45

(Operator)	18:01	Commenced Run 9 550°F - 2230 psi
	18:02	Stopped blowdown - test heater tripped electrically (high pin temp. trip), cause unknown
	18:25	Commenced Run 9
	18:25	Stopped blowdown, same problem as at time 18:02; disconnected high pin temp. trip ckt. input after second blowdown , abort suspect bad TC-LSE6
	18:40	Commenced Run 9; 550°F - 2250 psi
	18:41	Completed Run 9, LSE6 pegged high on chart recorder at approximately time of blowdown. Using LSL6 (TC) vice LSE6 info. for CI initiation
(Graphs)		LSE6 - bad transducer

Run 10 - 19:09:27 - 19:12:04

(Operator)	19:10	551°F - 2250 psi
	19:12	Filled CI Accum.
(Graphs)		LSE6 - bad transducer

Run 11 - 19:54:06 - 19:56:46

(Operator)	19:40	Commenced Run 11 - 550°F - 2250 psi
	19:40	Aborted Run 11 - procedural misunderstanding
	19:54	Commenced Run 11 - 550°F - 2250 psi
(Graphs)		LSE6 - bad transducer