NSSS Design and Cycle 1 Operating History Data for Arkansas Nuclear One, Unit-2

NP-1707
Research Project 1385-1

Final Report, March 1981

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EPRI PERSPECTIVE

PROJECT DESCRIPTION

This report, together with two companion reports, documents a series of tests run at Arkansas Nuclear One, Unit-2 (ANO-2). The companion reports are: (1) EPRI Final Report NP-1708, NSSS Transient Tests at ANO-2, and (2) EPRI Final Report NP-1709, Reactor Transient Tests at ANO-2. These transient tests consisted of: (1) complete loss of forced circulation from an operating power level near 80% of rated power; (2) drops of part-length and full-length control element assemblies from operating power levels near 50% of rated power; and (3) a turbine trip from an operating power level near 100% of rated power.

PROJECT OBJECTIVE

The objective of these transient tests is to gather high-quality data from an operating nuclear power plant for use in a qualification of reactor system transient analysis computer codes, such as RETRAN and MEKIN. Since ANO-2 is a pressurized water reactor, these tests are complementary to the turbine trip and plant stability tests performed at Peach Bottom-2 boiling water reactor in 1977 and 1978 (EPRI Topical Reports NP-563 and NP-564 and EPRI Final Reports NP-971 and NP-972). The objective of these activities is to provide a basis for increased confidence in the ability of RETRAN, MEKIN, and other industry computer codes to predict the course of various operating transients.

PROJECT RESULTS

In addition to these three reports, the data from each of the four tests have been organized in files on a magnetic tape. This information will be useful to and available to utility engineers who wish to model the ANO-2 system and to test the ability of some particular transient analysis computer code to predict the measured data.

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ABSTRACT

This report contains design and cycle 1 operating data for the Arkansas Nuclear One, Unit-2 nuclear steam supply system. The design data include descriptions of the reactor core, reactor coolant system, and control systems which are a part of the nuclear steam supply system. Operating history data are provided for the period of December 1978 through January 1980. The most important operating history data provided include reactor power, cumulative fuel burnup, control rod position, primary coolant temperature, and a series of power distribution state points.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont.)

ILLUSTRATIONS (Cont.)

ILLUSTRATIONS (Cont.)

TABLES

SUMMARY

This report contains reference design and operating data to be used for the development of Nuclear Steam Supply System (NSSS) and nuclear reactor simulation codes. Design and cycle 1 operating data for the Arkansas Nuclear One, Unit-2 NSSS are included. These data are specifically intended to be used in conjunction with two companion reports which document NSSS and reactor transient test data recorded at Arkansas Nuclear One, Unit-2.

The design data describes all of the major components and control systems which make up the NSSS. Operating history data, in the form of time histories and state points, are provided for key plant process parameters from the initial reactor criticality through completion of the plant transient tests.

NSSS and reactor simulation codes developed using the reference data contained in this report may be used to simulate a broad range of transients. In turn, these simulations may be used for code qualification or further engineering analysis of the NSSS.

Section 1

INTRODUCTION

This report contains system design and cycle 1 operating data for the Arkansas Nuclear One-Unit 2 nuclear steam supply system (NSSS). This information is intended to provide reference data for the development of reactor core and NSSS simulation codes.

Design data for the reactor include descriptions of the reactor core arrangement, vessel internal components, fuel assemblies, control element assemblies, and nuclear instrumentation. The NSSS components section presents reactor coolant system and control system descriptions. The reactor coolant system description depicts the reactor vessel, steam generators, pressurizer, and reactor coolant pumps. The control system descriptions include the steam dump and bypass control system, feedwater control system, reactor regulating system, and pressurizer level and pressure control systems.

The operating data provide plant parameters in the form of time history and state point data. These parameters consist of average daily reactor power, cumulative nuclear fuel burnup, control rod position, primary coolant boron concentration, pressurizer pressure, and hot and cold leg coolant temperatures.

BACKGROUND

Qualification of computer codes is of interest to the electric power industry to improve the accuracy of existing models and meet regulatory requirements. EPRI has published design and test data for the Peach Bottom 2 boiling water reactor (References 1 and 2) and has used this data to further qualify the RETRAN code (Reference 3). The design and operating data contained in this report together with the test data documented in two companion reports (References 4 and 5) established a qualification data base derived from the ANO-2 pressurized water reactor.

The design data contained here also establish a reference from which basic NSSS and reactor models can be developed. The basic model may in turn be used, with appropriate modifications, to simulate a broad range of transients for the ANO-2 plant.

Section 2

REACTOR DESIGN DATA

The following section provides the design data necessary to develop a digital computer model of the Arkansas Nuclear One - Unit 2 reactor. The descriptions include data for the fuel assemblies, control element assemblies, reactor core arrangement, vessel internal components, and nuclear instrumentation.

2.1 FUEL ASSEMBLY

1. Table 2-1 provides specifications for the fuel assembly, individual fuel rod, and fuel pellets.

2. Table 2-2 provides specifications for a control element assembly.

3. Descriptions of the fuel pellet and fuel pin are shown in Figures 2-1 and 2-2.

4. A fuel assembly elevation view of the upper and lower end fittings and spacer grids is shown in Figure 2-3.

5. A plan view showing the distribution and location of fuel pins and burnable poisons is shown in Figure 2-4.

2.2 CONTROL ELEMENT ASSEMBLY

1. Table 2-2 provides a description of the control element assembly composition and dimensions.

2.3 REACTOR CORE ARRANGEMENT

1. Table 2-3 quantifies fuel assembly types, control element assemblies, in-core instrumentation, and core shroud specifications.

2. Figure 2-5 shows a reactor core plan view indicating the location and orientation of the fuel assemblies, control element assemblies, control rod banks or groups, and in-core neutron detectors.

2.4 REACTOR VESSEL INTERNAL COMPONENTS

1. A description of the core support barrel assembly is shown in Figure 2-6.

2. Figure 2-7 depicts the core plate and lower support assembly.

2.5 NUCLEAR INSTRUMENTATION

1. Table 2-4 provides the material composition and dimensions of the instrument cell.

2. Figures 2-8 through 2-9 present a description of the in-core instrumentation assembly and axial arrangement.

Table 2-1

FUEL ASSEMBLY DESCRIPTION

Fuel Assembly Pitch, in.		8.180
Assembly Geometry		square lattice
Fuel Pin Pitch, in.		.506
Fuel Pin Geometry		cylindrical
Number of Fuel Rods per Assembly		
	Type A	236
	Type B	224
	Type C1	224
	Type C2	224
	Type C3	234
	Type C4	233
	Type C5	224
Number of Water Holes (Guide Tubes) per Assembly		5
Number of Burnable Poison Positions per Assembly		
	Type A	0
	Type B	12
	Type C1	12
	Type C2	12
	Type C3	2
	Type C4	3
	Type C5	12
Number of Control Positions per Assembly		5
Number of Spacer Grids per Assembly		12 (plus 2 end plates)
Spacer Grid Material		11 grids - Zirc /4 1 grid - Inconel
Spacer Grid Height, in.		1.375
Spacer Grid Width, in.		8.130
End Fitting Material		Stainless Steel
Upper End Fitting Spring Material		Inconel
Assembly Average Fuel Composition - as Loaded, Total Core, lbs.		
	U-235	3825
	U-238	158,216
Fuel Pellet Material		UO_2
Nominal — % of U235	Batch A	1.93 $\pm$ .05
	Batch B	2.27 $\pm$ .05
	Batch C	2.94 $\pm$ .05
As Built	Batch A	1.928 $\pm$ .006
	Batch B	2.253 $\pm$ .007
	Batch C	2.938 $\pm$ .004

Table 2-1 (Cont'd.)

FUEL ASSEMBLY DESCRIPTION

Effective Stack Density, % T.D.	91.79
Fuel Pellet Density, % T.D.	94.75
Fuel Pellet Length, in.	.390
Fuel Pellet O.D., in.	.3250
Fuel Pellet Dish I.D., in.	.125
Fuel Clad Material	Zirc-4
Fuel Clad Density, lbs./in^3	.237
Fuel Clad O.D., in.	.382
Fuel Clad I.D., in.	.332

Table 2-2

CONTROL ELEMENT ASSEMBLY DESCRIPTION
(FULL AND PART LENGTH)

Control Rod - Pin Cluster Type

Guide Tube Material	Zirc-4
Guide Tube Density, lbs./in.^{3}	.237
Guide Tube O.D., in.	.980
Guide Tube I.D., in.	.900
Absorber Clad Material	Inconel 625
Absorber Clad Density, lbs./in.^{3}	.305
Absorber Clad O.D., in.	.816
Absorber Clad I.D., in.	.746
Absorber Material, % T.D.	
B_4C	73
AgInCd	79/15/5
Absorber Density, lbs./in^3	.091
Absorber Composition, w/o Boron	77.5 - 81.0

Table 2-3

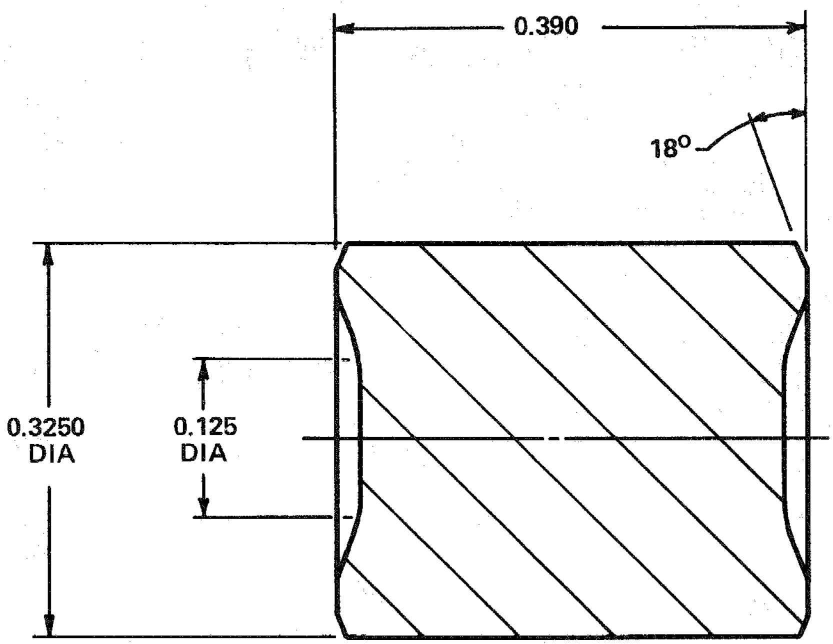
REACTOR CORE DESCRIPTION

Total Number of Fuel Assemblies		177
Number of Fuel Assembly Types		7
Number of Fuel Assemblies of Each Type		
	Type A	61
	Type B	60
	Type C1	8
	Type C2	16
	Type C3	12
	Type C4	16
	Type C5	4
	Total	177
Total Number of Control Elements (clusters)		81
Number of Control Element Types		2
Number of Control Elements of Each Type		
	Full length	73
	Part length	8
	Total	81
Total Number of In-Core Instrument Cells		44
Core Shroud Material	Stainless Steel	
Core Shroud Thickness, in.	3/4 to 1	

Table 2-4

IN-CORE INSTRUMENTATION DESCRIPTION

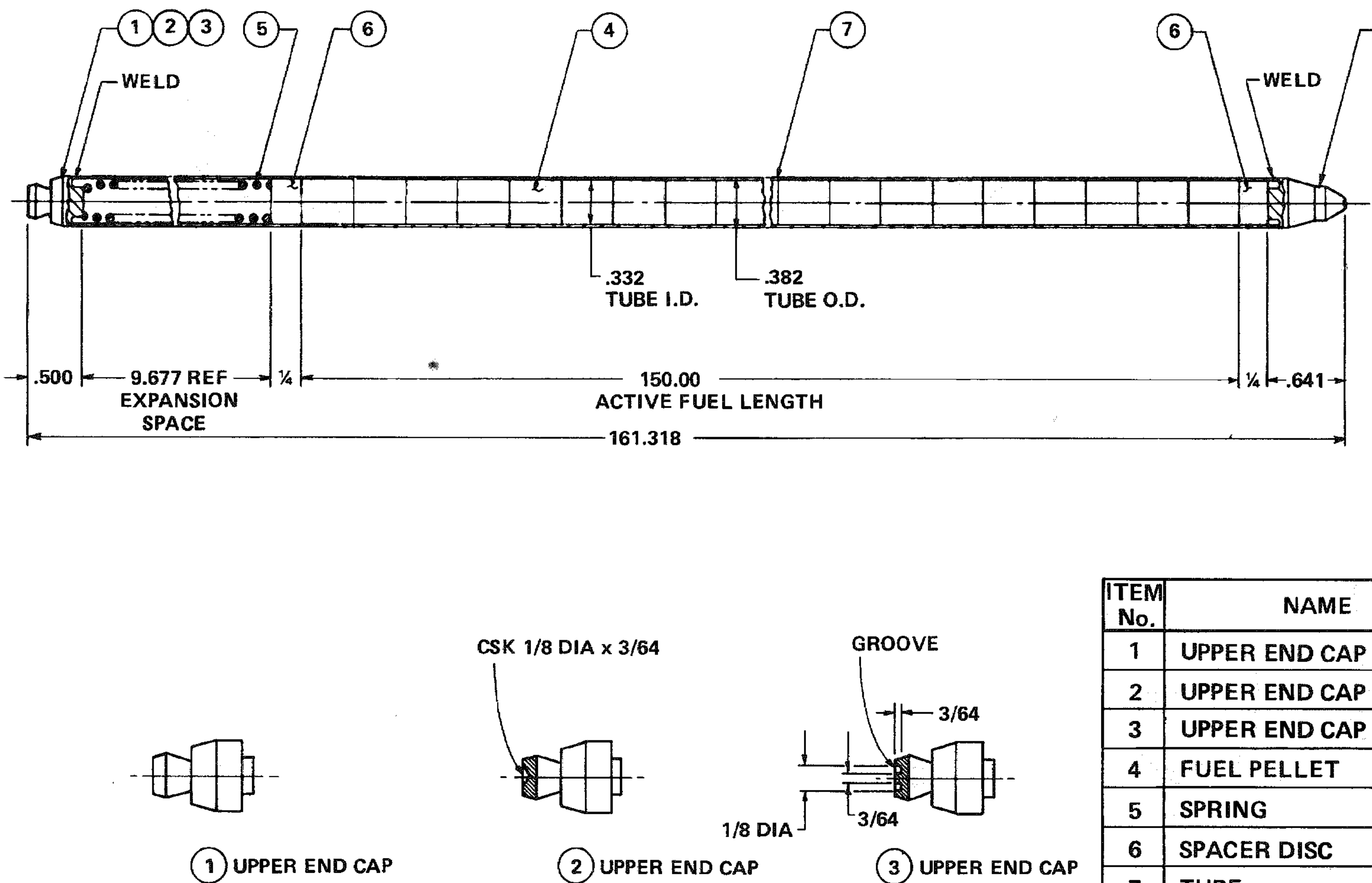
Instrument Tube Material	Inconel 600
Instrument Tube O.D., in.	.350
Instrument Tube Density, lbs./in.^{3}	.304
Outer Sheath Tube Material	Inconel 600
Outer Sheath Tube O.D., in.	.344
Outer Sheath Tube Density, lbs./in.^{3}	.304
Detector Sheath Material	Inconel 600
Detector Sheath O.D.	.062
Detector Sheath Density, lbs./in.^{3}	.304
Insulation Material	Al_2O_3
Insulation Density, lbs./in.^{3}	.0833
Emitter Material	Rhodium 103
Emitter Diameter, in.	.018
Lead Wire Material	Inconel 600
Lead Wire Diameter, in.	.010



NOMINAL DIMENSIONS IN INCHES

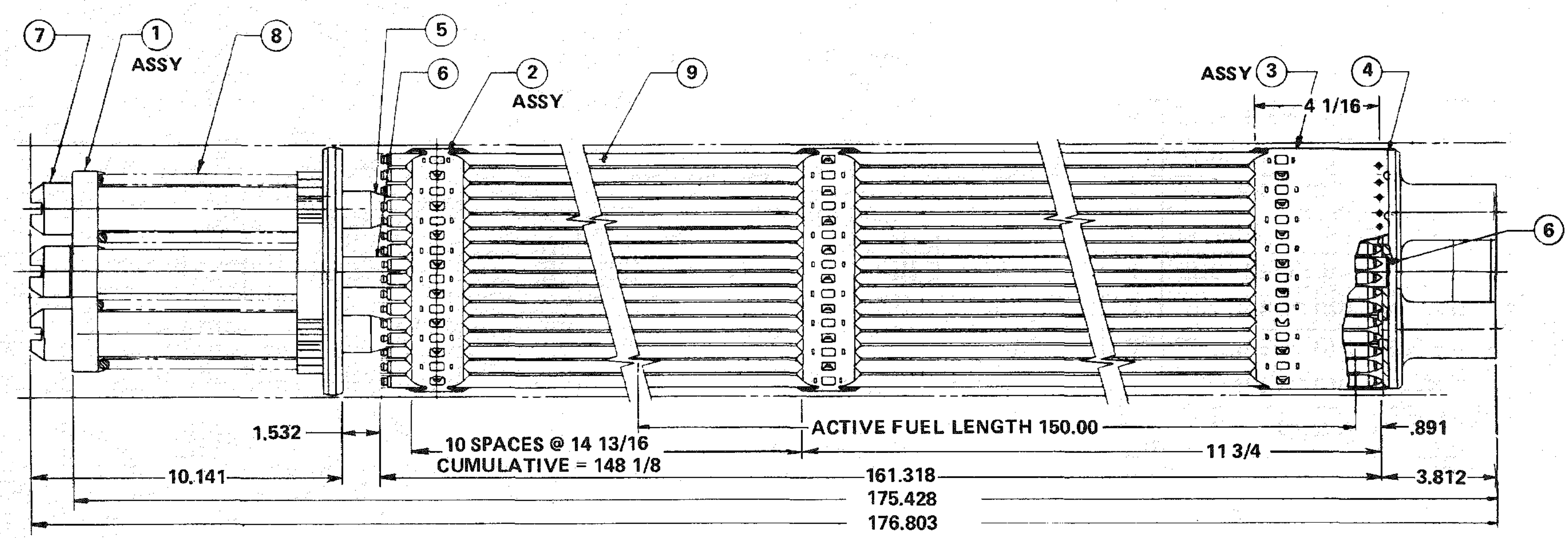
PELLET L/D	=	1.2
PELLET DENSITY (%TD)	=	94.75 (NOMINAL)
ENRICHMENT (w/o U-235)		
BATCH A	=	1.93
BATCH B	=	2.27
BATCH C	=	2.94

Figure 2-1. Fuel Pellet



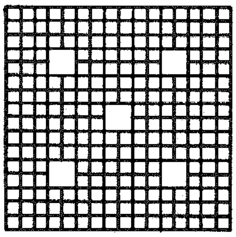
ITEM No.	NAME
1	UPPER END CAP BATCH A
2	UPPER END CAP BATCH B
3	UPPER END CAP BATCH C
4	FUEL PELLET
5	SPRING
6	SPACER DISC
7	TUBE
8	LOWER END CAP

Figure 2-2. Fuel Rod

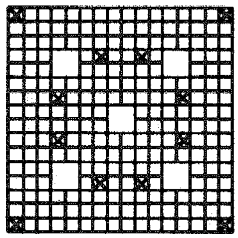


ITEM No.	NAME
1	UPPER END FITTING ASSY
2	SPACER GRID ASSY
3	INCONEL SPACER GRID ASSY
4	LOWER END FITTING
5	GUIDE TUBE ASSY
6	CENTER GUIDE TUBE
7	UPPER END FITTING POST
8	HOLDDOWN SPRING
9	FUEL ROD ASSY

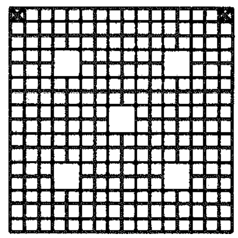
Figure 2-3. Fuel Bundle Assembly



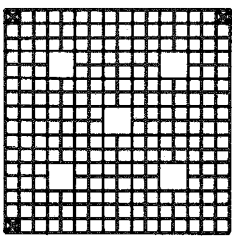
FUEL BUNDLE ASSY A
FUEL BUNDLE ASSY A1



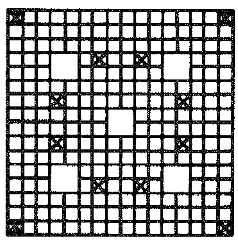
FUEL BUNDLE ASSY B
FUEL BUNDLE ASSY C1
FUEL BUNDLE ASSY C2



FUEL BUNDLE ASSY C3

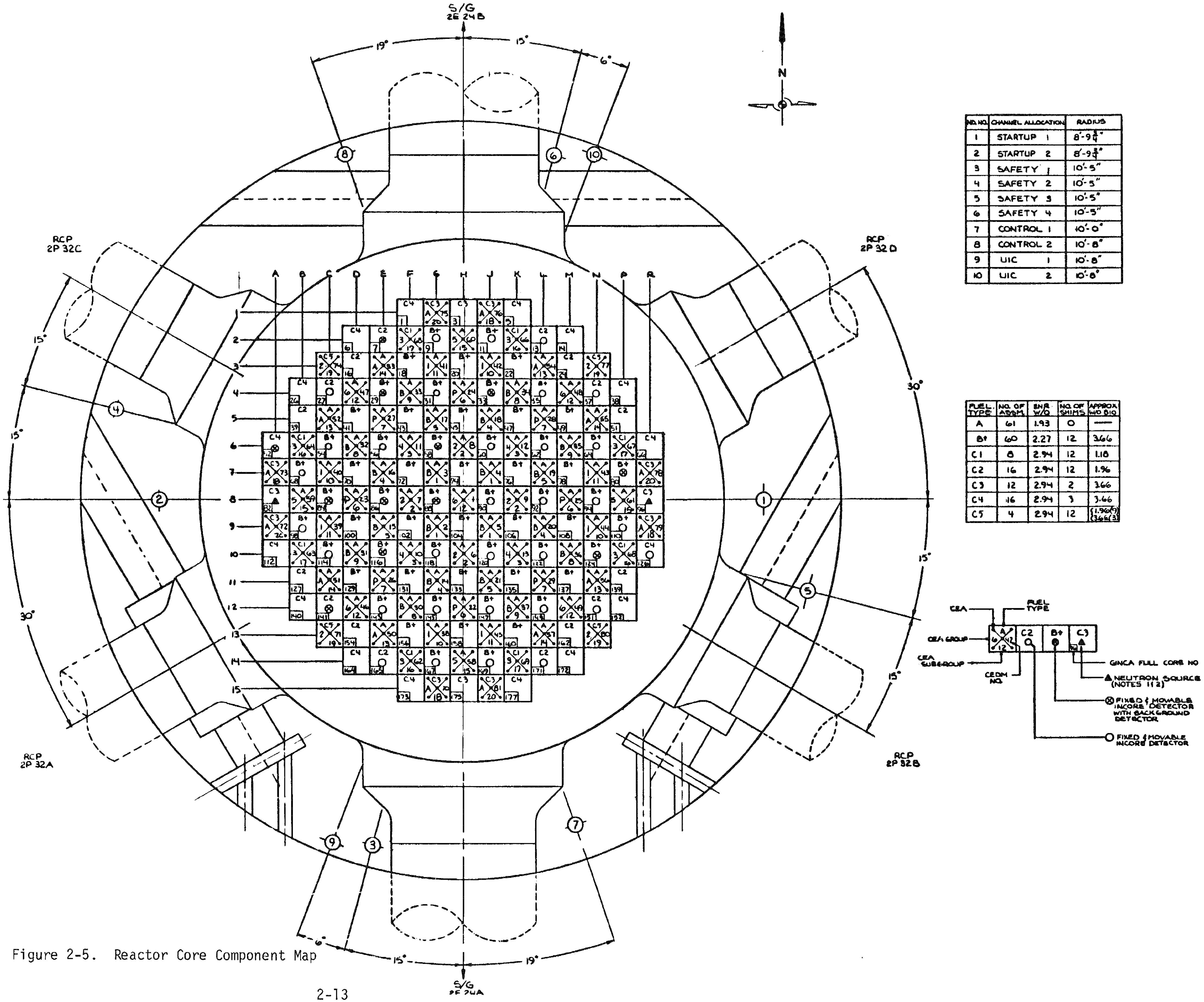


FUEL BUNDLE ASSY C4



FUEL BUNDLE ASSY C5

Figure 2-4. Rod Location Plan

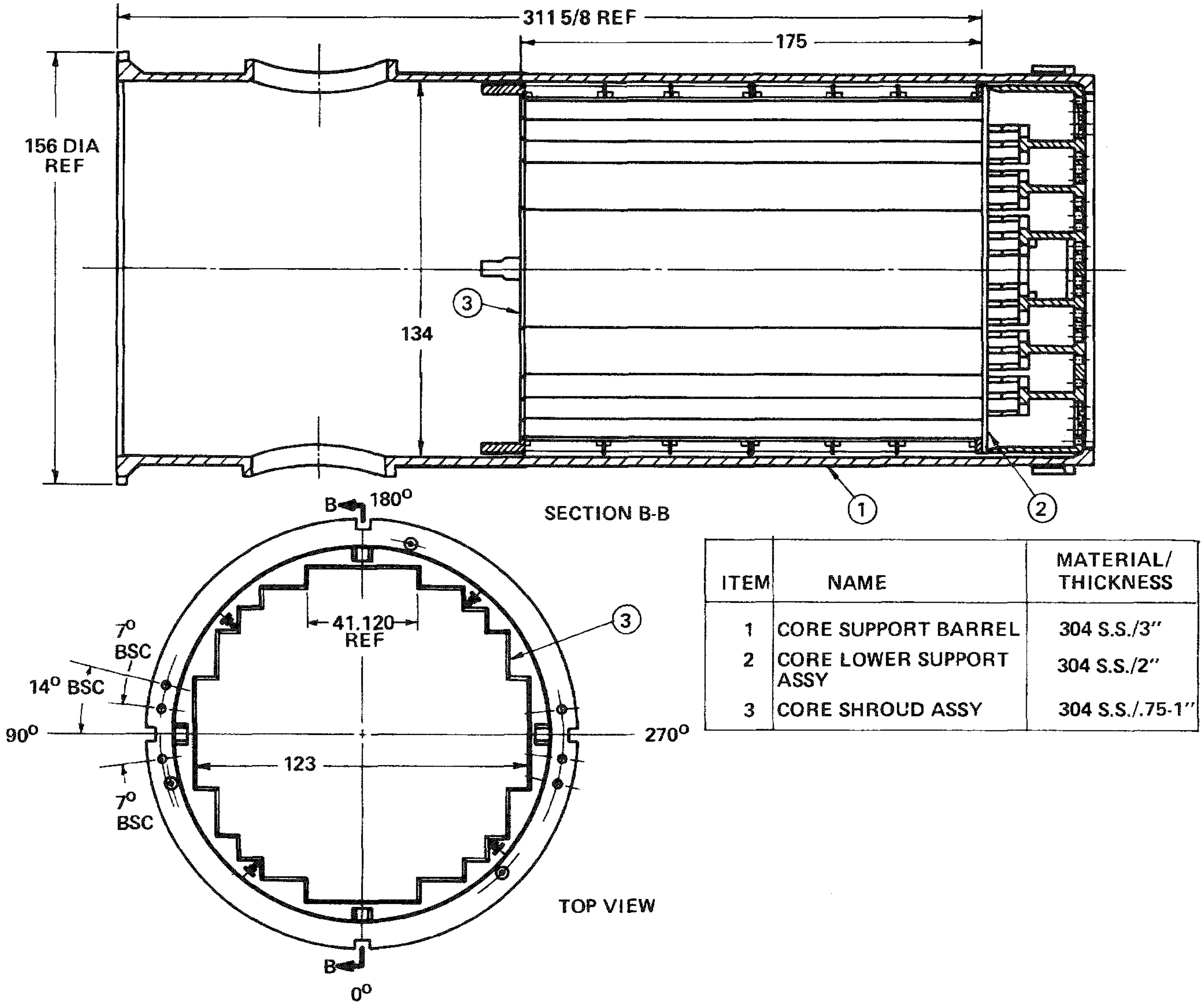


NO. NO.	CHANNEL ALLOCATION	RADIUS
1	STARTUP 1	8'-9 3/4"
2	STARTUP 2	8'-9 3/4"
3	SAFETY 1	10'-5"
4	SAFETY 2	10'-5"
5	SAFETY 3	10'-5"
6	SAFETY 4	10'-5"
7	CONTROL 1	10'-0"
8	CONTROL 2	10'-8"
9	UIC 1	10'-8"
10	UIC 2	10'-8"

FUEL TYPE	NO. OF ASSM.	ENR W/O	NO. OF SHIMS	APPROX W/O B10
A	61	1.93	0	—
B+	60	2.27	12	3.66
C1	8	2.94	12	1.18
C2	16	2.94	12	1.96
C3	12	2.94	2	3.66
C4	16	2.94	3	3.66
C5	4	2.94	12	{1.96(9) 3.66(3)}

Figure 2-5. Reactor Core Component Map

Blank



ITEM	NAME	MATERIAL/ THICKNESS
1	CORE SUPPORT BARREL	304 S.S./3"
2	CORE LOWER SUPPORT ASSY	304 S.S./2"
3	CORE SHROUD ASSY	304 S.S./.75-1"

Figure 2-6. Core Support Barrel Assembly

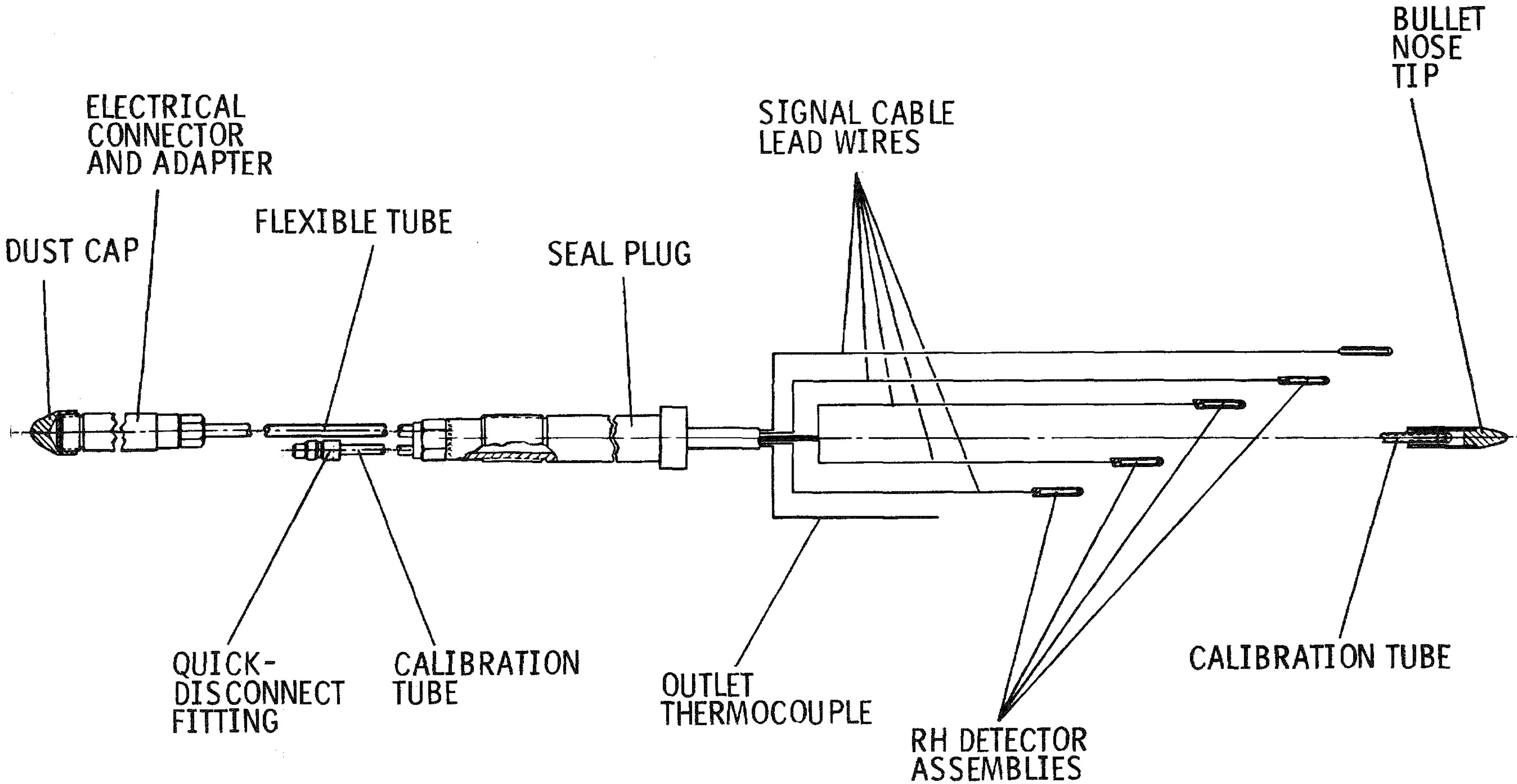


Figure 2-7. In-core Detector Assembly

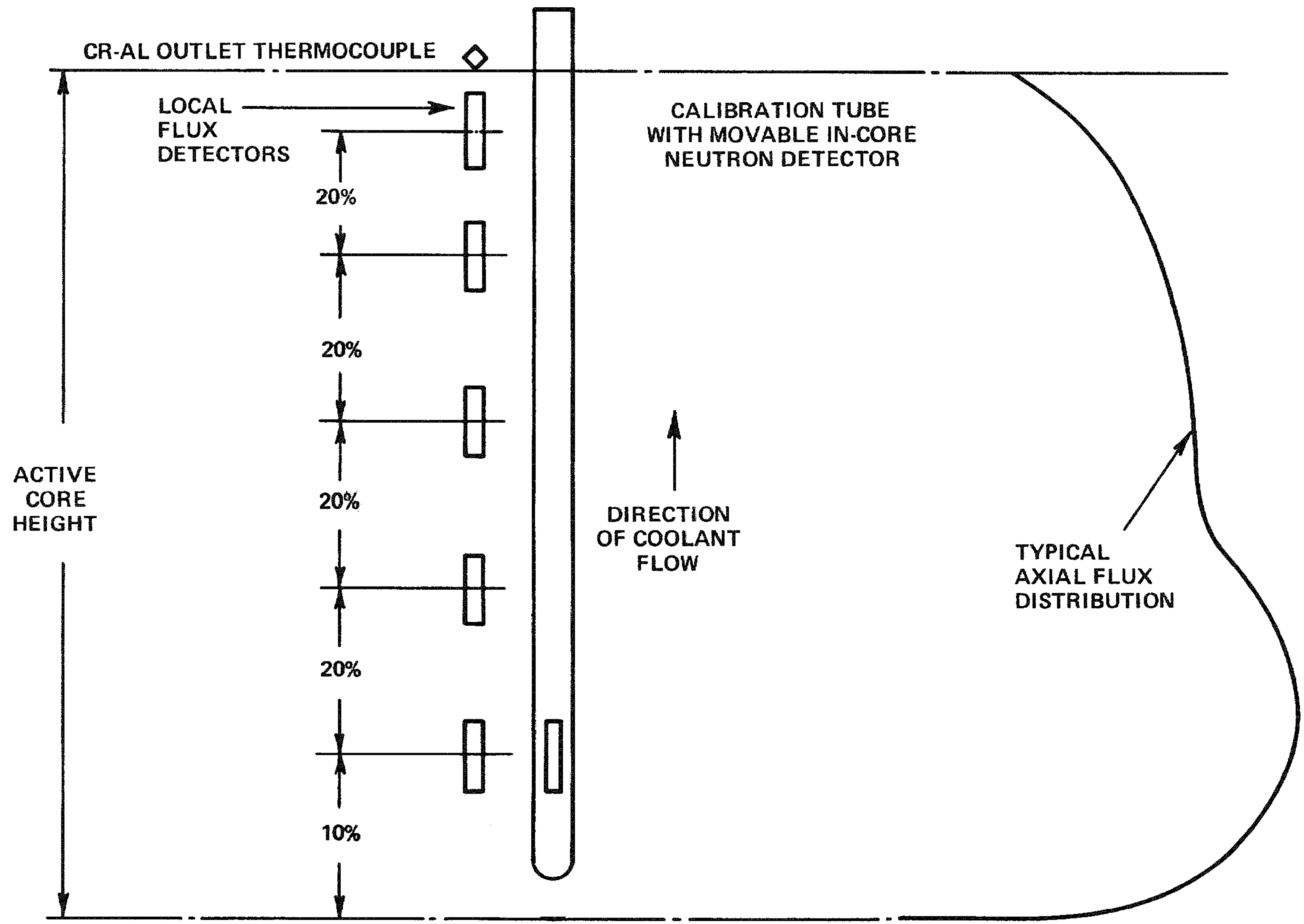


Figure 2-8. In-core Detector Axial Arrangement

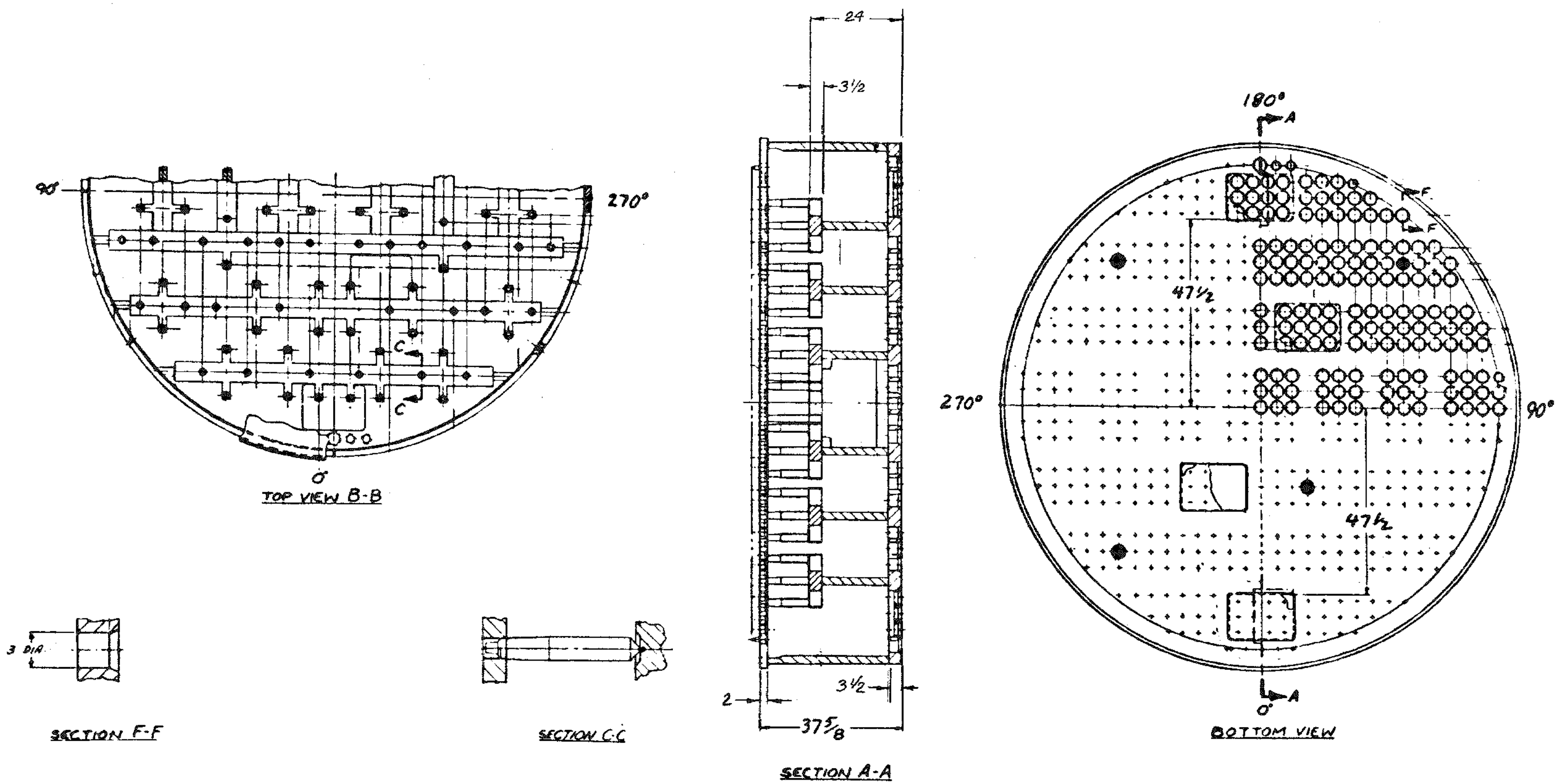


Figure 2-9. Core Plate and Lower Support Assembly

Section 3

NSSS COMPONENTS

The following section presents the information necessary to develop a digital computer model of the Nuclear Steam Supply System. Included are reactor coolant system (RCS) reference design data and major component descriptions, and control system descriptions.

3.1 REACTOR COOLANT SYSTEM

3.1.1 Reference Design Data

1. Table 3-1 provides thermal-hydraulic reference design data.

2. Figure 3-1 depicts the RCS sensor locations.

3. An elevation and plan view of the RCS is shown in Figures 3-2 and 3-3.

3.1.2 Major Components

3.1.2.1 Reactor Vessel

A description of the reactor vessel arrangement is shown in Figure 3-4.

3.1.2.2 Steam Generator

1. Table 3-2 presents the steam generator parameters.

2. Figures 3-5 provides a description of the steam generator arrangement.

3.1.2.3 Pressurizer

1. The pressurizer parameters are given in Table 3-3.

2. A description of the pressurizer arrangement is shown in Figure 3-6.

3.1.2.4 Reactor Coolant Pumps

Table 3-4 lists the reactor coolant pump parameters.

3.2 CONTROL SYSTEMS

The Plant Control System initiates automatic action of control devices (pumps, valves, etc.) so that applicable NSSS variables are maintained within prescribed operational limits for performance related design basis events. During a transient, the control systems act to limit the deviation of process parameters from normal operating conditions and thereby reduce the possibility of challenging plant safety systems. The following sections describe the ANO-2 NSSS control systems.

3.2.1 Steam Dump and Bypass Control System

The Steam Dump and Bypass Control System (SDBCS) relieves abnormally high main steam pressure through the atmospheric dump and turbine bypass valves in order to prevent the opening of primary or secondary safety valves and to reduce the likelihood of reactor trips. The SDBCS operates in either a quick open or modulation mode. The quick open mode opens valves fully when rapid load reductions occur. The modulation mode is used to control slow transients by modulating valve positions.

The SDBCS utilizes two parallel control channels; the main channel and the permissive channel. The permissive channel prevents postulated failures from causing spurious valve actuation. Both channels receive similar input and use similar algorithms, yet the permissive channel has lower quick open setpoints. The lower setpoints allow generation of the permissive quick open signal prior to the main channel in order to ensure proper valve response.

3.2.2 Feedwater Control System

The Feedwater Control System (FWCS) maintains a specified steam generator downcomer water level, 32.4 ft. above the tube sheet, by regulating the feedwater flow rate. Downcomer level control ensures that the steam generator secondary fluid inventory is adequate to remove primary system energy without excessive main steam moisture content. This control action is achieved through integrated adjustments of the main and bypass feedwater valve positions and the feedwater pump speed. The FWCS is designed to continuously remove primary system heat during various plant conditions without overcooling the system. During a reactor trip this is accomplished by closing the main feedwater regulating valve, reducing the pump speed to its minimum value and reducing the bypass feedwater flow to 5% of the full power flow. Each of the two

FWCS's receives input from a single steam generator and controls the valve position associated with that steam generator. However, the feedwater pump speed setpoint for both pumps is based on the higher of the two control system flow demand signals.

3.2.3 Reactor Regulating System

The Reactor Regulating System (RRS) automatically controls the average primary coolant temperature (Tavg), and hence secondary pressure, as a function of turbine power. The system accomplishes Tavg control by sending status (withdraw or insert) and rate signals to the Control Element Drive Mechanism Control System (CEDMCS) which in turn controls the positioning of CEA's.

Control of Tavg to a turbine load dependent program limits reactor energy generation and heat transfer to the secondary system during load reduction transients. This function assists the SDBCS in controlling secondary pressure. In addition, the RRS generates a pressurizer water level setpoint as a function of the average primary coolant temperature. Two RRS's are incorporated in the plant, however only one system is used for control at any one time.

3.2.4 Pressurizer Level Control System

The Pressurizer Level Control System (PLCS) regulates the pressurizer water level to a setpoint generated by the RRS. The level setpoint is a function of average coolant temperature. Pressurizer level control is accomplished by modulating letdown flow rate and starting (or stopping) two standby charging pumps based on the deviation of the measured level from the level setpoint. Maintaining the level at the setpoint value ensures that an adequate pressurizer steam volume exists to limit RCS pressure transients during performance related design basis events. Furthermore, the PLCS maintains an adequate primary coolant inventory for reactor heat transfer.

3.2.5 Pressurizer Pressure Control System

The Pressurizer Pressure Control System (PPCS) provides control of the pressurizer pressure and thus reactor coolant system pressure. The PPCS maintains the pressurizer pressure at 2250 psia during steady state operations and minimizes excursions from the specified value during transients. This is achieved by controlling heater power and spray flow. Two PPCS channels are installed; however, only one system is used to control the pressurizer pressure at any time.

Table 3-1

THERMAL - HYDRAULIC DATA
(Full Power Conditions)

I.	Reactor Vessel	
	a. Rated core thermal power (Mwt)	2815
	b. Design pressure (psia)	2500
	c. Operating pressure (psia)	2250
	d. Coolant outlet temperature (F)	612.5
	e. Coolant inlet temperature (F)	553.5
	f. Coolant outlet state	Subcooled
	g. Design vessel coolant flow (10^6 lb/hr)	120.4
	h. Best estimate vessel coolant flow (% Design)	112
	i. Core coolant flow (% vessel)	96.3
II.	Steam Generators	
	a. Number of Units	2
	b. Primary Side (or tube side)	
	1. Design pressure/temperature (psia/F)	2500/650
	2. Operating pressure (psia)	2250
	3. Inlet temperature (F)	612.5
	4. Outlet temperature (F)	553.5
	c. Secondary (or Shell Side)	
	1. Design pressure/temperature (psia/F)	1100/560
	2. Full load steam pressure/temperature (psia/F)	
	a. Warranted	900/532
	b. best estimate	923/535
	3. Zero load steam pressure (psia)	1000
	4. Total steam flow per gen. (lb/hr)	6.32×10^6
	5. Full load steam quality (%)	99.8
	6. Feedwater temperature, full power (F)	452
III.	Pressurizer	
	a. Design pressure (psia)	2500
	b. Design temperature (F)	700
	c. Operating pressure (psia)	2250
	d. Operating temperature (F)	653
	e. Internal volume (ft^3)	1200
	f. Heaters	
	1. Type and Rating of Heaters (kw)	Immersion/12.5
	2. Installed heater capacity (kw)	1200

Table 3-1 (Cont.)

IV.	Reactor Coolant Pumps		
	a.	Number of units	4
	b.	Type	Vertical-Centrifugal
	c.	Design capacity (gpm)	80,500
	d.	Best estimate (% design)	112
	e.	Design pressure/temperature (psia/F)	2500/650
	f.	Operating pressure (psia)	2250
	g.	Type drive	Squirrel cage induction mot.
	h.	Total dynamic head (ft)	275
	i.	Rated Power (hp)	4800
	j.	Pump speed, rpm	900
V.	Reactor Coolant Piping		
	a.	Design flow per loop (10^6 lb/hr)	60.2
	b.	Pipe size (inside dia./wall thickness) (in.)	
		1. Hot leg	42/4.31
		2. Cold leg	30/3.25
	c.	Pipe design press./temp. (psia/F)	2500/650

Table 3-2

STEAM GENERATOR PARAMETERS

Number	2
Type	Vertical U-Tube
Number of Tubes, As Built	8411
Tubes Outside Diameter, in.	0.750
Tube Wall Thickness, in.	0.048
Nozzles and Instrument Taps	
Primary Inlet Nozzle (1 ea.), ID, in.	42
Primary Outlet Nozzle (2 ea.), ID, in.	30
Steam Nozzle (1 ea.), ID, in.	34
Feedwater Nozzle (1 ea.), nominal, in.	18 schedule 80
Instrument Taps (12 ea.), nominal, in.	.75 schedule 160
Bottom Blowdown (1 ea.), nominal, in.	2 schedule 80
Reactor Coolant Side	
Design Pressure, psia	2500
Design Temperature, F	650
Coolant Flow (each), lb/hr	60.2×10^6
Normal Operating Pressure, psia	2250
Coolant Volume, (each) ft^3	1598
Secondary Side	
Design Pressure, psia	1100
Design Temperature, F	560
Normal Operating Steam Pressure, Full Load psia	900
Normal Operating Steam Temperature, Full Load, F	532
Blowdown Flow, Design, Maximum, Each, lb/hr	126,400
Steam Flow, Each, lb/hr	6.32×10^6
Steam Moisture Content, Max. full power, percent	0.20
Feedwater Temperature, F	452
Number of Steam Separators, each	166
Number of Steam Dryers, each	126
Dimensions	
Overall Height, Including Support Skirt, in.	740-7/8
Upper Shell Outside Diameter, in.	240-1/4
Lower Shell Outside Diameter, in.	165-3/4
Weights	
Dry, lb	1,041,987
Flooded, lb	1,627,841
Operating, full power, lb	1,318,317

Table 3-3

PRESSURIZER PARAMETERS

Design Pressure, psia	2500
Design Temperature, F	700
Normal Operating Pressure, psia	2250
Normal Operating Temperature, F	653
Internal Free Volume, ft^3	1200
Normal Operating Water Volume, ft^3	600
Normal Steam Volume, Full Power, ft^3	600
Installed Heater Capacity, kw	1200
Spray Flow, Maximum, gpm	375
Spray Flow, Minimum, gpm	1.5
Nozzles	
Surge Line (1 ea) nominal, in.	12, schedule 160
Safety Valves (2), ID, in.	6, flanged
Spray (1) nominal, in.	4, schedule 120
Heaters (96 OD), in.	0.875
Instrument, Level (4) nominal, in.	3/4, schedule 160
Temperature (1) nominal	1, schedule 160
Pressure (2) nominal, in.	3/4, schedule 160
Vent (1) nominal, in.	3/4, schedule 160
Dimensions	
Overall Length, including skirt and spray nozzle, in.	369-3/8
Outside Diameter, in.	106-1/2
Inside Diameter, in.	96
Cladding Thickness, in. (minimum)	1/8
Dry Weight, Including Heaters, lb	161,000
Flooded Weight, Including Heaters, lb	235,200

Table 3-4

REACTOR COOLANT PUMP PARAMETERS

Number	4
Type	Vertical, Limited Leakage, Centrifugal
Shaft Seals, Type, Number	Mechanical, 4
Design Pressure, psig	2485
Design Temperature, F	650
Normal Operating Pressure, psia	2250
Normal Operating Temperature, F	553.5
Design Flow, gpm	80,500
Total Dynamic Head, ft.	275
Reactor Coolant Volume, ft^3	112
Motor	
Voltage, volts	6600
Frequency, hz/phase	60/3
Horsepower/Speed, Hot, hp/rpm	4800/900 (nominal)
Horsepower/Speed, Cold, hp/rpm	6750/900 (nominal)

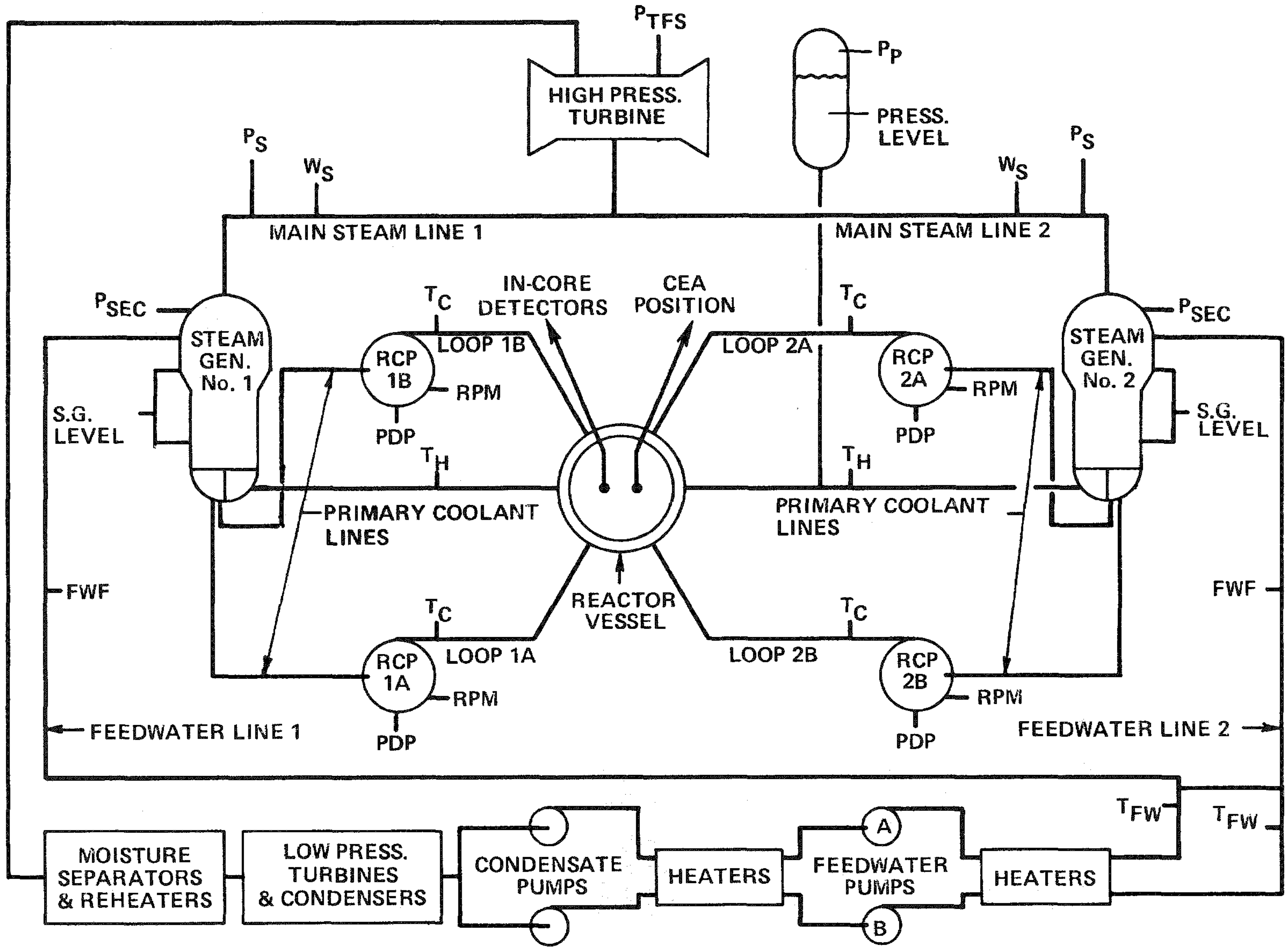
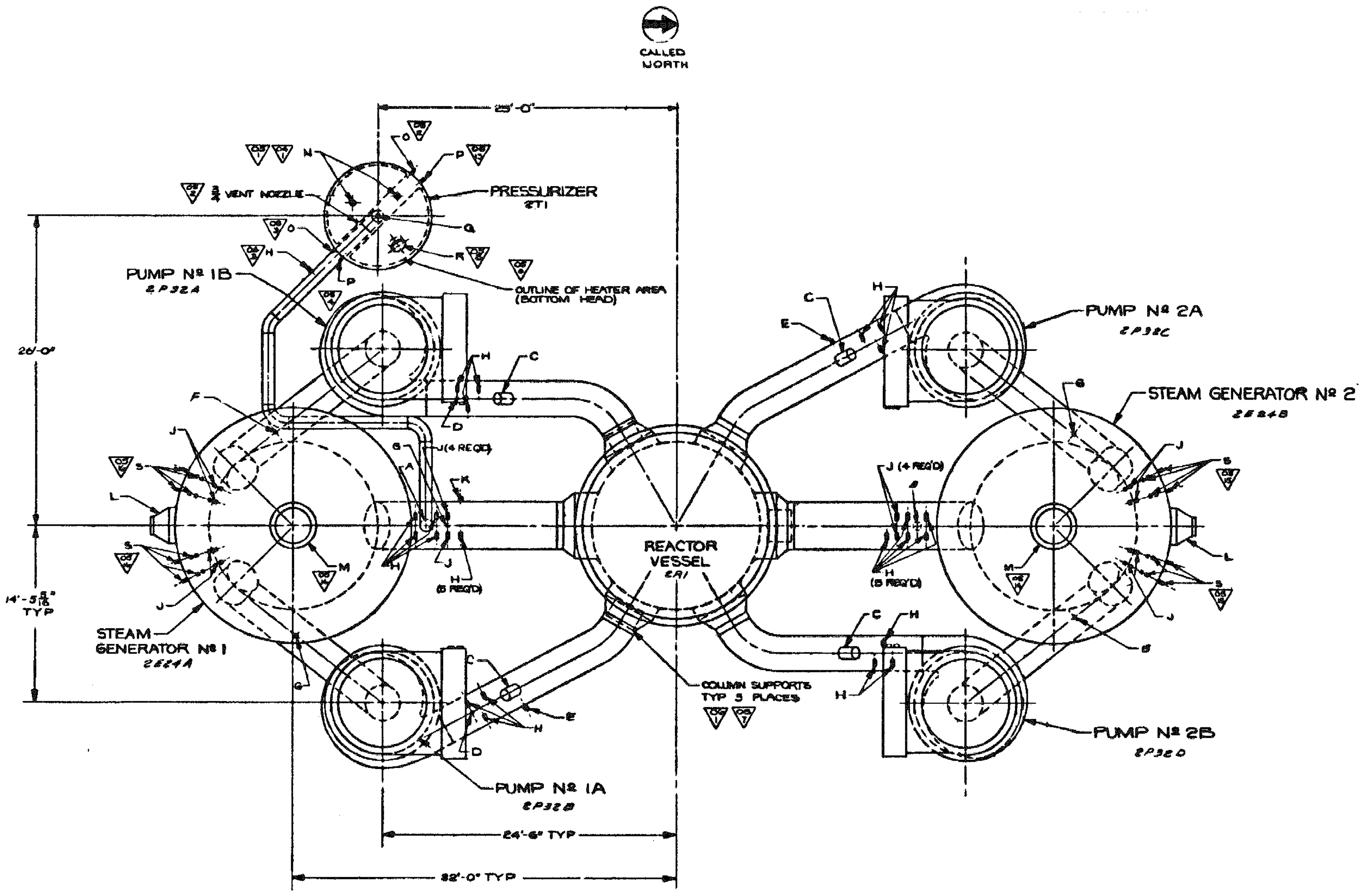


Figure 3-1. Sensor Locations



NOZZLE IDENTIFICATION				
CODE LETTER	FUNCTION	PIPE SIZE	END PREPARATION	QTY
A	PRESSURIZER SURGE	12 SCH 160	BUTT WELD	2
B	SHUTDOWN COOLING OUTLET	14 SCH 140	BUTT WELD	1
C	SAFETY INJECTION AND SHUTDOWN COOLING INLET	12 SCH 140	BUTT WELD	4
D	PRESSURIZER SPRAY	3 SCH 160	BUTT WELD	2
E	CHARGING INLET	2 SCH 160	BUTT WELD	2
F	LETDOWN AND DRAIN	2 SCH 160	BUTT WELD	1
G	DRAIN	2 SCH 160	BUTT WELD	4
H	TEMPERATURE MEASUREMENT			25
J	PRESSURE MEASUREMENT	$\frac{3}{4}$ SCH 160	SOC. WELD	16
K	SAMPLING	$\frac{3}{4}$ SCH 160	SOC. WELD	2
L	FEEDWATER	18 SCH 80	BUTT WELD	2
M	STEAM OUTLET	34 I.D.	BUTT WELD	2
N	SAFETY VALVE INLET	6 SCH 160	FLANGED	2
O	PRESSURIZER LEVEL	$\frac{3}{4}$ SCH 160	SOC. WELD	4
P	PRESSURIZER PRESSURE	$\frac{3}{4}$ SCH 160	SOC. WELD	2
Q	PRESSURIZER SPRAY	4 SCH 120	BUTT WELD	1
R	MANWAY	16 I.D.		9
S	S.G. LEVEL	$\frac{3}{4}$ SCH 160	SOC. WELD	16

Figure 3-2. Reactor Coolant System Arrangement Plan

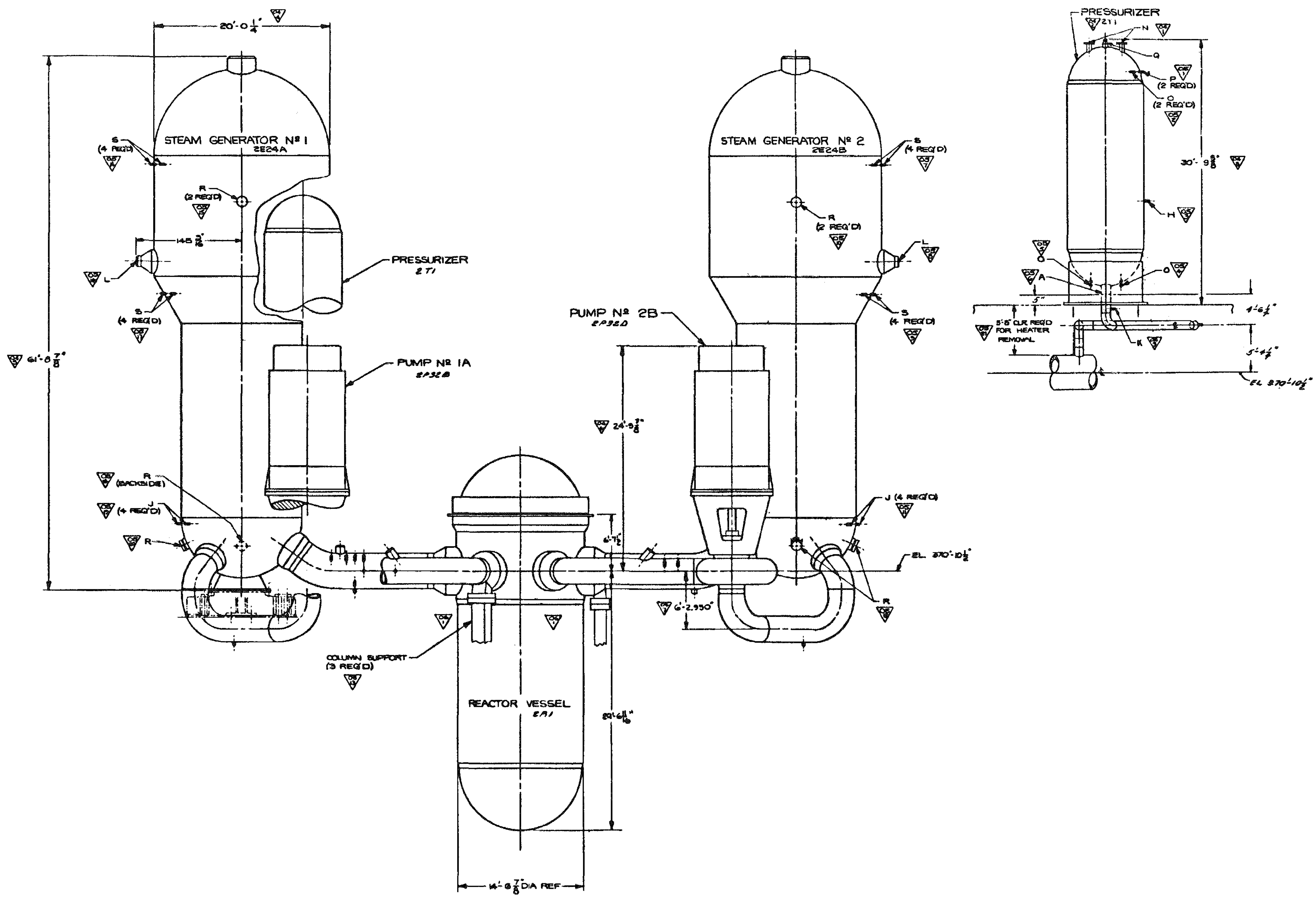


Figure 3-3. Reactor Coolant System Arrangement Elevation

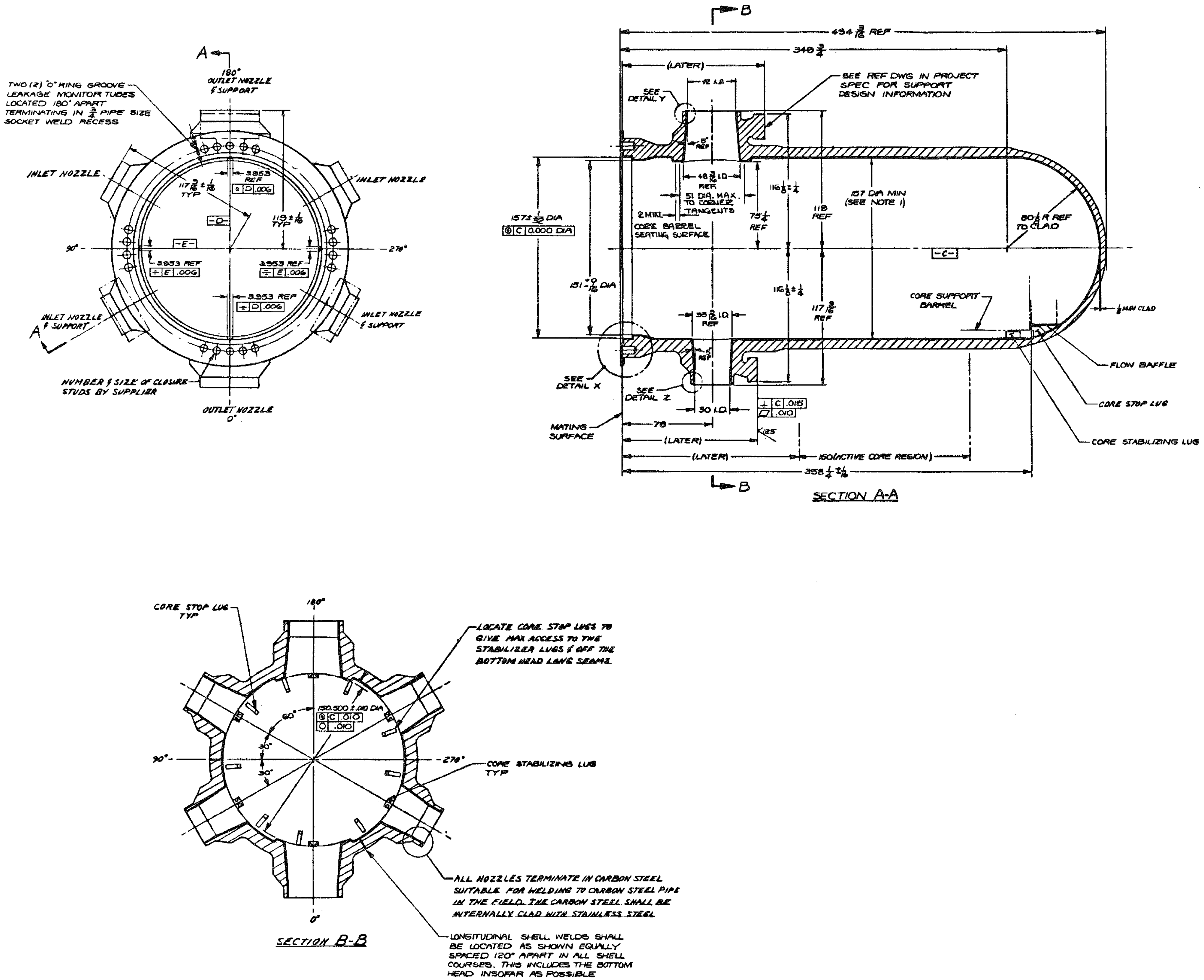


Figure 3-4. Reactor Vessel Arrangement

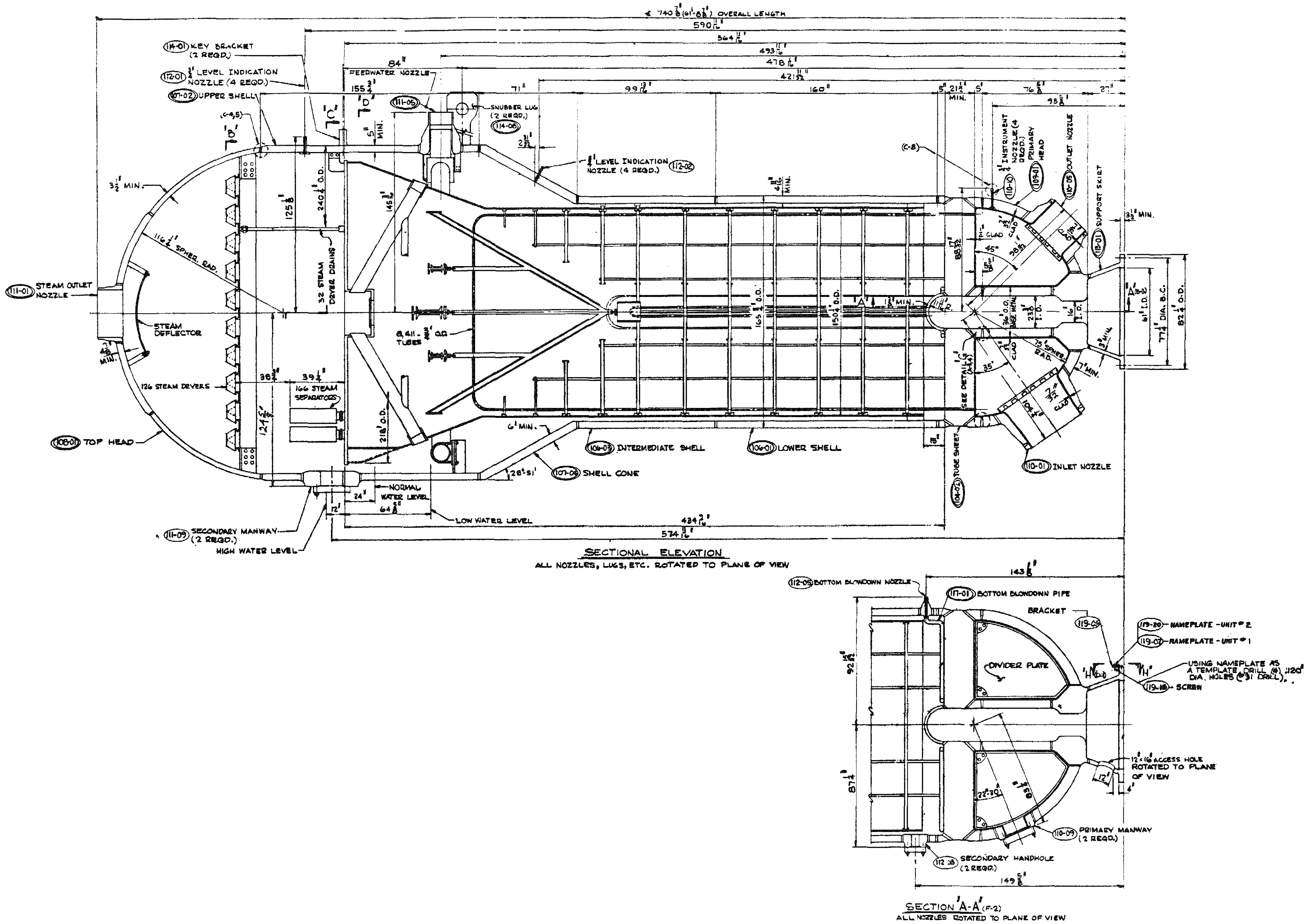


Figure 3-5. Steam Generator Arrangement

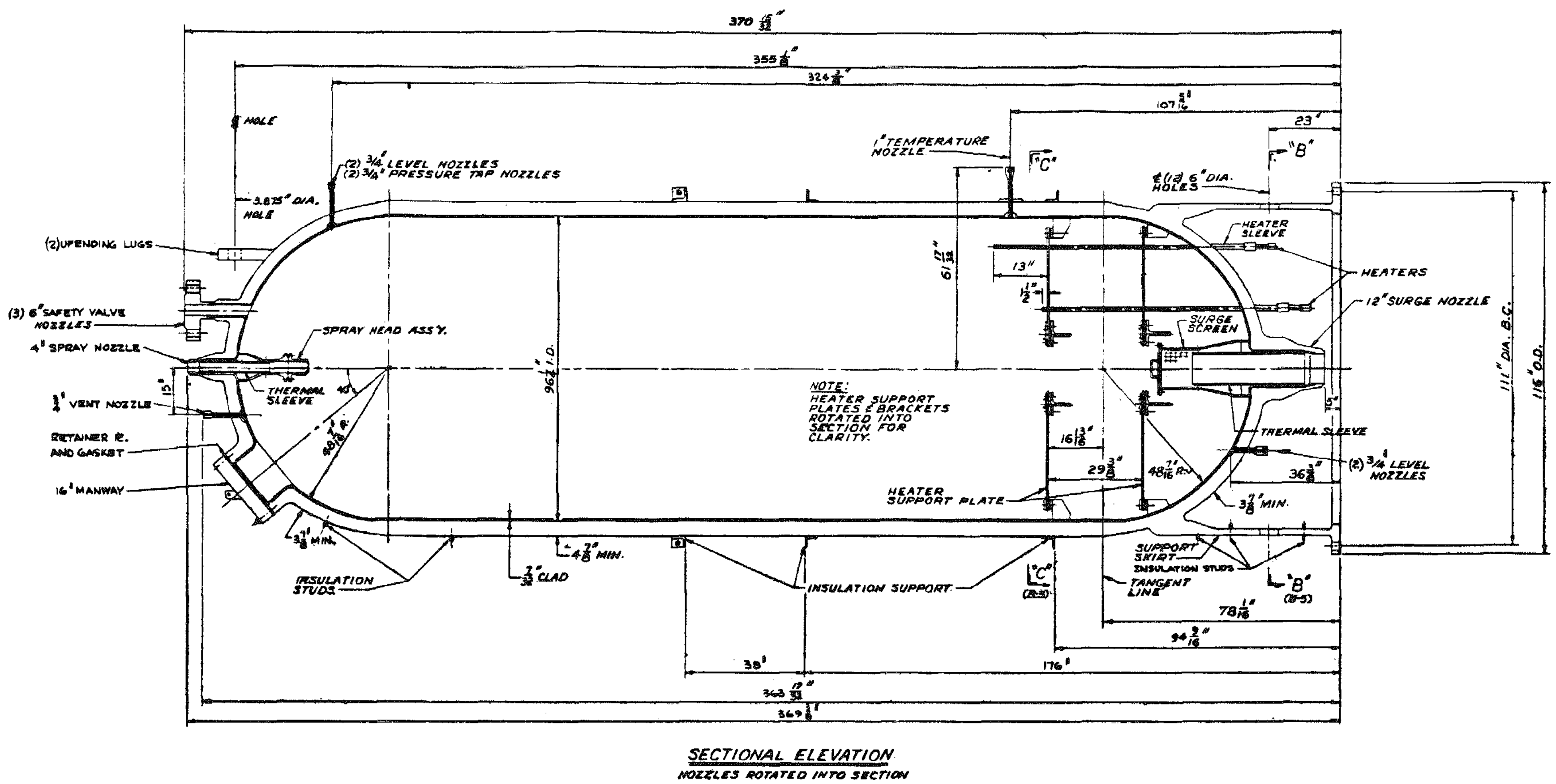


Figure 3-6. Pressurizer Arrangement

Section 4

OPERATING DATA

The following section provides time history and state point data during the power ascension from initial criticality (December 1978) through the end of the transient tests (January 1980). These descriptions include full-core power distributions, cumulative burnups, average daily power, boron concentrations, pressurizer pressure, and hot and cold leg temperatures. These data, in conjunction with the reactor design data (Section 2), provide the basis for calculating reactor fission product and fissile material inventories at the inception of plant transient tests conducted during December 1979 and January 1980 (Reference 1 and 2).

4.1 TIME HISTORY DATA

4.1.1 Figures 4-1 through 4-10 provide the average daily power.

4.1.2 The cumulative burnup is presented in Figures 4-11 through 4-20.

4.1.2 Figures 4-21 through 4-29 depict daily values of control rod group six position.

4.1.4 Figures 4-30 through 4-47 show the reactor coolant system (RCS) boron concentration as determined by both a chemical analysis and a boronometer. Since the chemical analysis uses a direct sample of the RCS water, it is an accurate determination of the actual boron concentration. However, this analysis is not performed on a daily basis. The boronometer gives a continuous reading of the boron concentration but is not as accurate as a chemical analysis. Thus for the days when a chemical analysis was not performed, the actual RCS boron concentration should be determined by assuming the previous concentration calculated by a chemical analysis and adjusting this value by observing trends in the boronometer readings.

4.1.5 The pressurizer pressure is presented in Figures 4-48 through 4-56.

4.1.6 Figures 4-57 through 4-74 depict the hot and cold leg temperatures.

4.2 STATE POINT DATA

4.2.1 The primary loop state point data is listed in Table 4-1.

4.2.2 Tables 4-2 through 4-12 present the in-core detector measurements at various power plateaus during the power ascension.

4.2.3 Figures 4-75 through 4-85 illustrate the full-core power distribution which corresponds to the tabulated flux measurements. Tables 4.2 through 4-12 and Figures 4-75 through 4-85 are data from power plateaus (appxoximately 20%, 50%, 80% and 100%) throughout the testing period. These data were selected from a point on the plateau which best represented core equilibrium conditions.

Table 4-1

STATE POINT DATA

DATE (M.D.Y.)	TIME (HR:M)	CEA GROUP 4 (Inches)	CEA GROUP 5 (Inches	CEA GROUP 6 (Inches)	B-METER (PPM)	B-CHEM (PPM)	PRZ PRESS (PSIA)	T COLD (Deg.-F)	T HOT (Deg.-F)	POWER (%)
12-29-78	24:00	150	150	150	895	884	2250	547.7	560.0	18.5
1-13-79	9:20	150	150	150	870	839	2250	544.4	555.0	17.2
1-27-79	3:30	150	150	150	865	827	2257	545.0	562.0	19.4
6-12-79	3:58	150	150	150	790	858	2252	545.5	561.5	18.9
6-27-79	8:15	150	150	150	720	779	2255	551.7	577.0	47.7
7-13-79	13:10	150	150	150	668	718	2250	553.0	578.0	50.0
7-27-79	15:00	150	150	150	675	729	2250	551.5	580.5	50.0
8-9-79	18:23	150	150	150	680	733	2254	551.6	579.6	51.7
8-27-79	10:00	150	150	150	675	724	2261	553.1	581.0	51.0
9-5-79	6:00	150	150	150	685	732	2261	551.9	579.4	51.0
9-29-79	4:12	150	150	150	754	815	2264	549.5	566.2	31.0
10-3-79	6:55	150	150	150	682	758	2264	552.1	579.4	50.7
12-10-79	17:57	150	150	150	741	731	2261	551.4	578.6	50.1
12-23-79	16:55	150	150	150	667	666	2264	552.0	594.9	79.2
1-5-80	5:06	150	150	121	671	652	2254	549.2	592.7	80.5
1-28-80	6:14	150	150	121	607	602	2263	553.3	606.6	99.8

TABLE 4-2

IN-CORE DETECTOR FLUX

MEASUREMENTS (X 10^{14} NV)

16.0% POWER, 12/30/78, 1:02

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.064	.136	.131	.135	.072
2	9	.093	.172	.192	.173	.101
3	11	.095	.172	.194	----*	.107
4	13	.062	.116	.127	.115	.068
5	27	.080	.146	.163	.147	.085
6	29	.094	.172	.196	.176	.103
7	31	.102	.188	.207	.192	.115
8	33	.092	.173	.197	----	.104
9	35	.089	.169	.187	.173	.103
10	37	.079	.142	.161	.147	.086
11	52	.046	----	.081	----	.040
12	54	.096	.176	.202	.174	.101
13	56	.095	.186	.204	.185	.109
14	58	.105	.190	.209	.192	.134
15	60	.101	.187	.212	.191	.116
16	62	.104	.186	.208	.188	.113
17	64	.111	.173	.195	.178	.107
18	68	.114	.172	.206	.172	.114
19	80	.089	.166	.183	.168	.098
20	84	.099	.178	.199	.186	.105
21	86	.102	.188	.211	.192	.133
22	88	.104	.196	.219	.197	.116
23	90	.109	.193	.216	.195	.133
24	92	.102	.185	.214	.189	.109
25	94	.098	.177	.197	.179	.105

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-2 (Continued)

Instrument Number	Box Number	Level				
		Bottom	2	3	4	Top
26	98	.091	.168	.185	.168	.096
27	110	.106	.169	.184	.168	.093
28	114	.098	.174	.192	.176	.106
29	116	.104	.185	.205	.185	.110
30	118	.106	.191	.212	.194	.116
31	120	.099	.184	.206	.188	.111
32	122	.100	.176	.197	.178	.104
33	124	.093	.172	.193	.173	.099
34	126	.051	.093	----	.096	.053
35	141	.081	.144	.163	.149	.090
36	143	.092	.171	.204	.176	.100
37	145	.100	.181	.207	.188	.111
38	147	.102	.186	.204	.188	.112
39	149	.093	.173	.198	.177	.106
40	151	.078	.143	.158	----	.086
41	165	.062	----	.132	.121	.081
42	167	.116	.176	.193	.169	.102
43	169	.090	.166	.187	.169	.105
44	171	.064	----	.132	----	.089

Table 4-3

IN-CORE DETECTOR FLUX

MEASUREMENTS (X 10^{14} NV)

20.2% POWER, 1/16/79, 12:09

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.064	.114	.125	.114	.069
2	9	.093	.164	.182	.166	.099
3	11	----*	.159	.181	.163	.097
4	13	.062	.110	.122	.110	.066
5	27	.080	.138	.154	.141	.084
6	29	.092	.164	.187	.168	.100
7	31	.101	.181	.197	.182	.111
8	33	.097	.173	.193	.177	.105
9	35	.089	.164	.179	.164	.097
10	37	.079	.138	.154	.140	.085
11	52	.046	----	.192	.085	.047
12	54	.096	.169	.184	.167	.099
13	56	.102	.185	.162	.164	.108
14	58	.104	.182	.198	.181	.113
15	60	.101	.180	.202	.183	.112
16	62	.103	.181	.198	.181	.111
17	64	.095	----	.186	.170	.103
18	68	.091	.164	.181	.162	----
19	80	.089	.160	.175	.161	.095
20	84	.099	.174	.188	.177	.102
21	86	.102	.180	.200	.181	.112
22	88	.104	.189	.209	.187	.113
23	90	.107	.186	.204	.186	.112
24	92	.103	.181	.200	.179	.108
25	94	.095	.169	.183	.169	.099
26	98	.090	.162	.177	.160	.093

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-3 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
27	110	.095	.162	.178	.160	----
28	114	.094	.165	.181	.166	.102
29	116	.103	.180	.195	.177	.107
30	118	.105	.182	.202	.185	.113
31	120	.099	.178	.195	.180	.109
32	122	.097	----	.187	.170	----
33	124	.093	.165	.185	.166	.095
34	126	.052	.091	----	.092	.051
35	141	.079	.138	.154	.143	.086
36	143	.092	.165	.185	.168	.098
37	145	.093	.175	.197	.178	.107
38	147	.100	.182	.196	.179	.109
39	149	.095	.166	.184	.166	.100
40	151	.078	.139	.149	----	.084
41	165	.064	----	.126	.114	.070
42	167	.097	----	.185	.164	.100
43	169	.090	.161	.179	.161	.101
44	171	.063	.115	.126	.115	.070

Table 4-4

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
19.8% POWER, 1/27/79, 3:35

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.060	----*	.123	.114	.071
2	9	.087	.155	.178	.165	.100
3	11	.087	.156	.179	.166	.102
4	13	.058	.106	.119	.113	.067
5	27	.075	.132	.152	.141	.085
6	29	.091	.160	.188	.173	.107
7	31	.096	.173	.194	.184	.111
8	33	.092	.166	.190	.180	.109
9	35	.089	.161	.182	.172	.106
10	37	.073	.131	.150	.141	.088
11	52	.046	----	.094	.089	.051
12	54	.089	.161	.180	.168	.100
13	56	.097	.178	.196	.183	.112
14	58	.095	.174	.194	.183	.114
15	60	.094	.174	.193	.184	.111
16	62	.097	.173	.194	.182	.112
17	64	.088	.159	.182	.170	.105
18	68	.088	.157	.178	.164	.093
19	80	.082	.152	.171	.160	.098
21	84	.093	.164	.185	.178	.104
21	86	.095	.176	.196	.183	.113
22	88	.098	.180	.206	.190	.116
23	90	.098	.176	.201	.186	.115
24	92	.096	.172	.196	.181	.109
25	94	.094	.165	.182	.172	.105

† Refer to Figures 4-75 through 4-85

* Indicates failed in-core detector.

Table 4-4 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
26	98	.085	.154	.171	.160	.107
27	110	.088	.153	.171	.159	.096
28	114	.089	.163	.180	.169	.104
29	116	.096	.170	.192	.179	.110
30	118	.099	.174	.200	.186	.115
31	120	.096	.174	.196	.184	.114
32	122	.096	.166	.190	.179	.110
33	124	.088	.158	.181	.166	.099
34	126	.049	.085	----	.092	.051
35	141	.074	.131	.150	.144	.087
36	143	.091	.163	.195	.175	.107
37	145	.096	.171	.197	.184	.114
38	147	.095	.172	.191	.181	.110
39	149	.092	.162	.185	.172	.107
40	151	.073	.132	.146	----	.086
41	165	.060	----	.123	.125	----
42	167	.191	.164	.184	.166	.103
43	169	.086	.153	.175	.161	.104
44	171	.059	.109	.122	.115	.070

Table 4-5

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
19.2% POWER, 6/12/79, 2:32

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.061	.111	.122	.110	.067
2	9	.090	.159	.174	.158	.095
3	11	.090	.158	.177	.159	.096
4	13	.060	.107	.117	.107	.063
5	27	.076	.133	.148	.133	.080
6	29	.094	.162	.185	.166	.101
7	31	.097	.175	.192	.177	.104
8	33	.095	.168	.188	.173	.104
9	35	.092	.164	.180	.164	.100
10	37	.075	.133	.147	.135	.081
11	52	.045	----*	.091	.084	.148
12	54	.092	.163	.177	.160	.095
13	56	.100	.180	.193	.175	.105
14	58	.100	.177	.192	.176	.110
15	60	.098	.176	.195	.178	.108
16	62	.100	.176	.192	.175	.105
17	64	.091	.161	.180	.163	.099
18	68	.091	.159	.176	.157	.087
19	80	.085	.153	.167	.153	.093
20	84	.096	.166	.183	.171	.097
21	86	.098	.179	.194	.177	.109
22	88	.101	.181	.203	.182	.107
23	90	.103	.180	.199	.178	.108
24	92	.099	.175	.193	.173	.103

† Refer to Figures 4-75 through 4-85

* Indicates failed in-core detector.

Table 4-5 (Continued)

Instrument Number	Box Number	Level				
		Bottom	2	3	4	Top
25	94	.095	.167	.180	.166	.100
26	98	.088	.156	.165	.155	.088
27	110	.091	.155	.162	.154	.092
28	114	.092	.166	.178	.163	.098
29	116	.099	.174	.189	.171	.104
30	118	.102	.176	.196	.179	.108
31	120	.099	.176	.192	.177	.108
32	122	.099	.168	.187	.171	.103
33	124	.090	.159	.177	.160	.094
34	126	.049	.085	----	.085	.049
35	141	.075	.133	.147	.137	.082
36	143	.094	.163	.191	.168	.099
37	145	.099	.173	.193	.176	.109
38	147	.095	.174	.188	.173	.105
39	149	.094	.164	.181	.164	.101
40	151	.075	.133	.141	----	.079
41	165	----	----	.126	.116	----
42	167	.090	.162	.176	.156	.095
43	169	.088	.154	.171	.154	.099
44	171	.062	.111	.120	.110	.067

Table 4-6

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
48.3% POWER, 6/28/79, 21:01

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.166	.291	.314	.280	.171
2	9	.241	.422	.459	.408	.248
3	11	.244	.422	.463	.412	.250
4	13	.167	.289	.309	.278	.168
5	27	----*	.354	.389	----	.208
6	29	.263	.446	.499	.442	.266
7	31	.277	.483	.520	.472	.285
8	33	.270	.469	.515	.466	.278
9	35	.258	.447	.487	.438	.264
10	37	.212	.356	.387	.348	.210
11	52	.126	----	.236	.211	.124
12	54	.260	.443	.476	.422	.253
13	56	.283	.503	.534	.476	.285
14	58	.287	.500	.537	.486	.299
15	60	.282	.499	.546	.491	.301
16	62	.287	.489	.529	.472	.286
17	64	.255	.441	.482	.432	.262
18	68	.249	.425	.460	.408	.227
19	80	.238	.413	.440	.397	.240
20	84	.268	.453	.491	.452	.261
21	86	.280	.497	.537	.482	.290
22	88	.300	.523	.569	.503	.305
23	90	.295	.511	.557	.494	.299
24	92	.288	.493	.538	.473	.288
25	94	.263	.455	.488	.443	.264
26	98	.246	.414	.442	.400	----

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-6 (Continued)

Instrument Number	Box Number	Level				
		Bottom	2	3	4	Top
27	110	.247	.415	----	.396	.237
28	114	.255	.445	.475	.429	.260
29	116	.280	.483	.521	.465	.282
30	118	.293	.499	.545	.491	.297
31	120	.284	.496	.537	.485	.294
32	122	.277	.411	.517	.463	.278
33	124	.254	.434	.472	.418	.249
34	126	.136	.224	----	.216	.127
35	141	.208	.354	.387	.353	.214
36	143	.263	.450	.499	.446	.263
37	145	.272	.483	.530	.478	.289
38	147	.276	.480	.516	.465	.280
39	149	.263	.448	.489	.433	.265
40	151	.206	.355	.369	----	.204
41	165	----	----	.322	.292	----
42	167	.247	.434	.460	.405	.242
43	169	.243	.415	.448	.398	.254
44	171	.168	.289	.312	.282	.171

Table 4-7

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
50.4% POWER, 7/22/79, 3:03

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.173	.305	.331	.295	.176
2	9	.259	.444	.483	.428	.256
3	11	.253	.443	.488	.433	.256
4	13	.174	.303	.329	.292	.173
5	27	----*	.373	.411	----	.215
6	29	.274	.472	.533	.467	.277
7	31	.289	.513	.555	.502	.296
8	33	.281	.502	.549	.496	.289
9	35	.270	.476	.516	.463	.274
10	37	.219	.375	.406	.365	.215
11	52	.129	----	.247	.221	.129
12	54	.270	.469	.506	.448	.262
13	56	.297	.535	.571	.507	.298
14	58	.302	.533	.575	.517	.312
15	60	.300	.532	.586	.524	.316
16	62	.299	.520	.563	.502	.299
17	64	.265	.466	.511	.457	.271
18	68	.257	.448	.485	.429	.233
19	80	.249	.433	.463	.417	.247
20	84	.279	.479	.521	.478	.270
21	86	.294	.523	.575	.512	.307
22	88	.317	.560	.610	.538	.318
23	90	.310	.545	.594	.528	.312
24	92	.304	.526	.575	.502	.300

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-7 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
25	94	.275	.482	.519	.467	.273
26	98	.255	.437	.464	.423	----
27	110	.255	.437	----	.415	.244
28	114	.266	.471	.504	.454	.269
29	116	.294	.514	.554	.494	.293
30	118	.307	.532	.583	.523	.310
31	120	.297	.530	.573	.517	.307
32	122	.291	.501	.551	.493	.290
33	124	.266	.460	.502	.443	.258
34	126	.138	.235	----	.226	.131
35	141	.216	.373	.408	.372	.221
36	143	.274	.477	.534	.471	.273
37	145	.284	.512	.565	.507	.302
38	147	.290	.511	.550	.492	.291
39	149	.276	.476	.520	.459	.274
40	151	.213	.373	.391	----	.212
41	165	----	----	.340	.306	----
42	167	.255	.455	.487	.425	.250
43	169	.252	.435	.472	.418	.262
44	171	.173	.305	.329	.296	.184

Table 4-8

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
50.1% POWER, 8/26/79, 9:44

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.170	.305	.331	.297	.177
2	9	.251	.441	.481	.429	.255
3	11	.250	.439	.487	.433	.255
4	13	.172	.303	.329	.293	.172
5	27	.212	----*	.412	----	.214
6	29	.274	.473	.534	.473	.278
7	31	.290	.516	.560	.507	.297
8	33	.280	.504	.554	.502	.292
9	35	.269	.478	.520	.467	.275
10	37	.217	.376	.408	.367	.215
11	52	.127	----	.244	.197	.127
12	54	.268	.471	.509	.452	.263
13	56	.299	.540	.576	.514	.300
14	58	.304	.539	.583	.527	.316
15	60	.303	.538	.592	.534	.318
16	62	.302	.526	.570	.510	.301
17	64	.267	.472	.518	.463	.272
18	68	.256	.447	.484	.431	.232
19	80	.253	.441	.471	.417	.246
20	84	.276	.479	.522	.482	.270
21	86	.296	.529	.582	.520	.311
22	88	.319	.566	.617	.551	.322
23	90	.313	.553	.603	.537	.315
24	92	.306	.532	.582	.510	.302

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-8 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
25	94	.277	.488	.525	.472	.274
26	98	.251	.432	.463	.422	----
27	110	.257	.441	----	.416	.244
28	114	.265	.472	.506	.458	.271
29	116	.295	.518	.560	.500	.296
30	118	.308	.538	.589	.531	.313
31	120	.299	.536	.580	.525	.310
32	122	.292	.506	.558	.501	.292
33	124	.266	.464	.509	.448	.258
34	126	.137	.233	----	.223	.130
35	141	.213	.372	.409	.374	.220
36	143	.273	.479	.537	.476	.275
37	145	.284	.515	.569	.514	.304
38	147	.289	.514	.555	.500	.292
39	149	.275	.479	.525	.464	.276
40	151	.212	.373	.390	----	.211
41	165	.177	----	.342	.306	.184
42	167	.252	.453	.486	.424	.250
43	169	.248	.433	.470	.418	.261
44	171	.172	.304	.329	.298	.176

Table 4-9

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
50.4% POWER, 10/4/79, 2:21

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.172	.302	.326	.294	.176
2	9	.254	.433	.469	.421	.253
3	11	.250	.433	.475	.425	.253
4	13	.172	.298	.323	.290	.171
5	27	.211	----*	.405	----	.213
6	29	.272	.467	.524	.467	.276
7	31	.289	.510	.549	.498	.296
8	33	.281	.496	.541	.493	.289
9	35	.270	.470	.509	.461	.274
10	37	.218	.370	.400	.362	.214
11	52	----	----	.239	----	.126
12	54	.270	.465	.496	.444	.262
13	56	.299	.533	.564	.507	.299
14	58	.305	.531	.568	.517	.313
15	60	.304	.529	.576	.524	.316
16	62	.303	.519	.557	.501	.301
17	64	.270	.466	.508	.458	.271
18	68	.255	.439	.475	.426	.231
19	80	.252	.433	.459	.412	.244
20	84	.276	.465	.508	.472	.268
21	86	.297	.521	.568	.512	.309
22	88	.319	.556	.600	.536	.320
23	90	.314	.544	.588	.527	.314
24	92	.306	.523	.569	.502	.302
25	94	.275	.475	.511	.462	.272

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-9 (Continued)

Instrument Number	Box Number	Level				
		Bottom	2	3	4	Top
26	98	.252	.426	.454	.415	----
27	110	.256	.436	----	.410	.242
28	114	.266	.466	.498	.451	.270
29	116	.294	.511	.547	.492	.294
30	118	.309	.530	.574	.521	----
31	120	.300	.529	.566	.516	.307
32	122	.291	.499	.546	.492	.290
33	124	.266	.459	.498	.442	.257
34	126	.138	.230	----	.220	----
35	141	.214	.369	.401	.370	.219
36	143	.274	.473	.526	.470	.273
37	145	.285	.508	.557	.508	.303
38	147	.290	.506	.542	.492	.292
39	149	.276	.472	.515	.458	.274
40	151	.212	.371	.381	----	.212
41	165	.178	----	.334	.304	.183
42	167	.253	.447	.474	.417	.248
43	169	.248	.426	.459	.412	.259
44	171	.172	.301	.325	.295	.175

Table 4-10

IN-CORE DETECTOR FLUX
MEASUREMENT (X 10^{14} NV)
50.0% POWER, 12/10/79, 00:5

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.171	.306	.333	.299	.173
2	9	.252	.431	.465	.418	.252
3	11	.247	.429	.471	.423	.252
4	13	.172	.297	.322	.287	.171
5	27	----*	----	.396	.369	.209
6	29	.272	.462	.519	.462	.276
7	31	.286	.504	.542	.497	.294
8	33	.279	.494	.535	.490	.288
9	35	.270	.471	.505	.459	.273
10	37	.217	.371	.401	.362	.212
11	52	----	----	.241	----	.125
12	54	.268	.461	.494	.443	.261
13	56	.291	.509	.550	.498	.292
14	58	.298	.517	.552	.505	.309
15	60	.303	.526	.573	.520	.317
16	62	.298	.511	.548	.495	.295
17	64	.265	.463	.503	.452	.268
18	68	.247	.419	.465	.417	.225
19	80	.251	.431	.457	.410	.244
20	84	.268	.451	.498	.462	.262
21	86	.292	.512	.558	.505	.302
22	88	.318	.553	.599	.535	.320
23	90	.309	.534	.577	.518	.309
24	92	.304	.521	.564	.501	.300
25	94	.276	.477	.508	.463	.267

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-10 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
26	98	.249	.423	.450	.413	.238
27	110	.253	.434	----	.410	----
28	114	.263	.462	.493	.449	.268
29	116	.290	.505	.542	.487	.291
30	118	.304	.520	.563	.513	.302
31	120	.297	.522	.559	.511	.307
32	122	.290	.495	.542	.491	.289
33	124	.265	.455	.495	.440	.256
34	126	.135	.231	----	.219	.125
35	141	.210	.366	.398	.368	.217
36	143	.271	.465	.515	.461	.271
37	145	.282	.507	.554	.505	.303
38	147	.286	.500	.534	.485	.287
39	149	.275	.470	.512	.457	.275
40	151	.210	.369	.382	----	.207
41	165	.177	.299	.326	.300	.183
42	167	.250	.444	.473	.418	.246
43	169	.247	.423	.457	.409	.257
44	171	.170	.302	.324	.295	.175

Table 4-11

IN-CORE DETECTOR FLUX
MEASUREMENTS (X 10^{14} NV)
77.2% POWER, 12/20/79, 11:39

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.280	.484	.519	.472	.279
2	9	.413	.680	.722	.654	.406
3	11	.408	.673	.723	.655	.407
4	13	.285	.467	.499	.451	.278
5	27	----*	----	.613	----	.340
6	29	.454	.729	.804	.724	.453
7	31	.474	.798	.842	.775	.481
8	33	.466	.782	.830	.770	.474
9	35	.447	.743	.785	.719	.449
10	37	.359	.588	.621	.564	.343
11	52	----	----	.374	----	.204
12	54	.441	.732	.766	.697	.421
13	56	.485	.799	.851	.781	.481
14	58	.496	.813	.853	.791	.507
15	60	.499	.831	.890	----	----
16	62	.493	.806	.850	.778	.483
17	64	.441	.731	.781	.708	.439
18	68	.411	.658	.714	.650	----
19	80	.410	.680	.707	.644	.391
20	84	.442	.708	.770	.729	.425
21	86	.487	.813	.866	.796	.495
22	88	.525	.872	.925	.843	.523
23	90	.511	.841	.893	.817	.510
24	92	.503	.823	.875	.788	.492
25	94	.457	.752	.788	.721	.437
26	98	.410	.670	.700	.648	.384

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-11 (Continued)

Instrument Number	Box Number	Level Bottom	2	3	4	Top
27	110	----	----	----	----	----
28	114	.438	.729	.767	.704	.440
29	116	.482	.802	.843	.771	.479
30	118	.503	.821	.875	.808	.495
31	120	.494	.823	.865	.803	.504
32	122	.483	.782	.841	.771	.477
33	124	.437	.724	.765	.691	.414
34	126	.223	.364	----	.346	.203
35	141	.350	.583	.620	.578	.355
36	143	.451	.734	.796	.725	.446
37	145	.473	.803	.862	.798	.500
38	147	.475	.791	.831	.763	.469
39	149	.459	.742	.794	.715	.449
40	151	.347	.581	.592	----	.335
41	165	.287	.468	.505	.464	.293
42	167	.415	.699	.732	.651	.402
43	169	.405	.671	.707	.642	.411
44	171	.280	.480	.506	.464	.281

Table 4-12

IN-CORE DETECTOR FLUX
MEASUREMENTS ($X10^{14}$ NV)
99.6% POWER, 1/25/80, 22:12

Instrument† Number	Box† Number	Level Bottom	2	3	4	Top
1	7	.393	.633	.663	.605	.368
2	9	.565	.876	.904	.825	.565
3	11	.561	.870	.910	.828	.526
4	13	.392	.610	.632	.574	.363
5	27	---*	----	.778	----	.443
6	29	.621	.948	1.014	.923	.589
7	31	.657	1.039	1.068	.986	.633
8	33	.639	1.008	1.048	.976	.617
9	35	.615	.961	.992	.919	.586
10	37	.496	.765	.788	.720	.450
11	52	----	----	.476	----	.263
12	54	.607	.948	.970	.888	.554
13	56	.662	1.021	1.066	.988	.624
14	58	.678	1.042	1.070	1.002	.660
15	60	.685	1.075	1.125	----	----
16	62	.679	1.044	1.076	.997	.638
17	64	.605	.947	.984	.904	.573
18	68	.559	.843	.899	.824	----
19	80	.561	.872	.885	.810	.507
20	84	.608	.911	.972	.926	.556
21	86	.669	1.052	1.090	1.010	.642
22	88	.722	1.127	1.169	1.075	.687
23	90	.697	1.080	1.124	1.037	.668
24	92	.690	1.063	1.106	1.007	.648
25	94	.622	.965	.987	.916	.565
26	98	.563	.865	.881	.821	.498

† Refer to Figures 4-75 through 4-85.

* Indicates failed in-core detector.

Table 4-12 (Continued)

Instrument Number	Box Number	Level				
		Bottom	2	3	4	Top
27	110	.573	.881	----	.808	.506
28	114	.606	.949	.973	.901	.573
29	116	.668	1.044	1.074	.991	.634
30	118	.692	1.062	1.105	1.033	.648
31	120	.676	1.060	1.087	1.021	.659
32	122	.661	1.007	1.062	.975	.620
33	124	.598	.932	.967	.876	----
34	126	.310	.475	----	.443	.264
35	141	.486	.763	.791	.740	.465
36	143	.618	.948	.999	.922	.580
37	145	.648	1.042	1.090	1.016	.653
38	147	.658	1.028	1.053	.974	.615
39	149	.630	.964	1.004	.910	.584
40	151	.479	.756	.751	----	.437
41	165	.393	.605	.639	.597	.377
42	167	.572	.909	.927	.824	.520
43	169	.556	.866	.888	.810	.533
44	171	.393	.625	.644	.592	.366

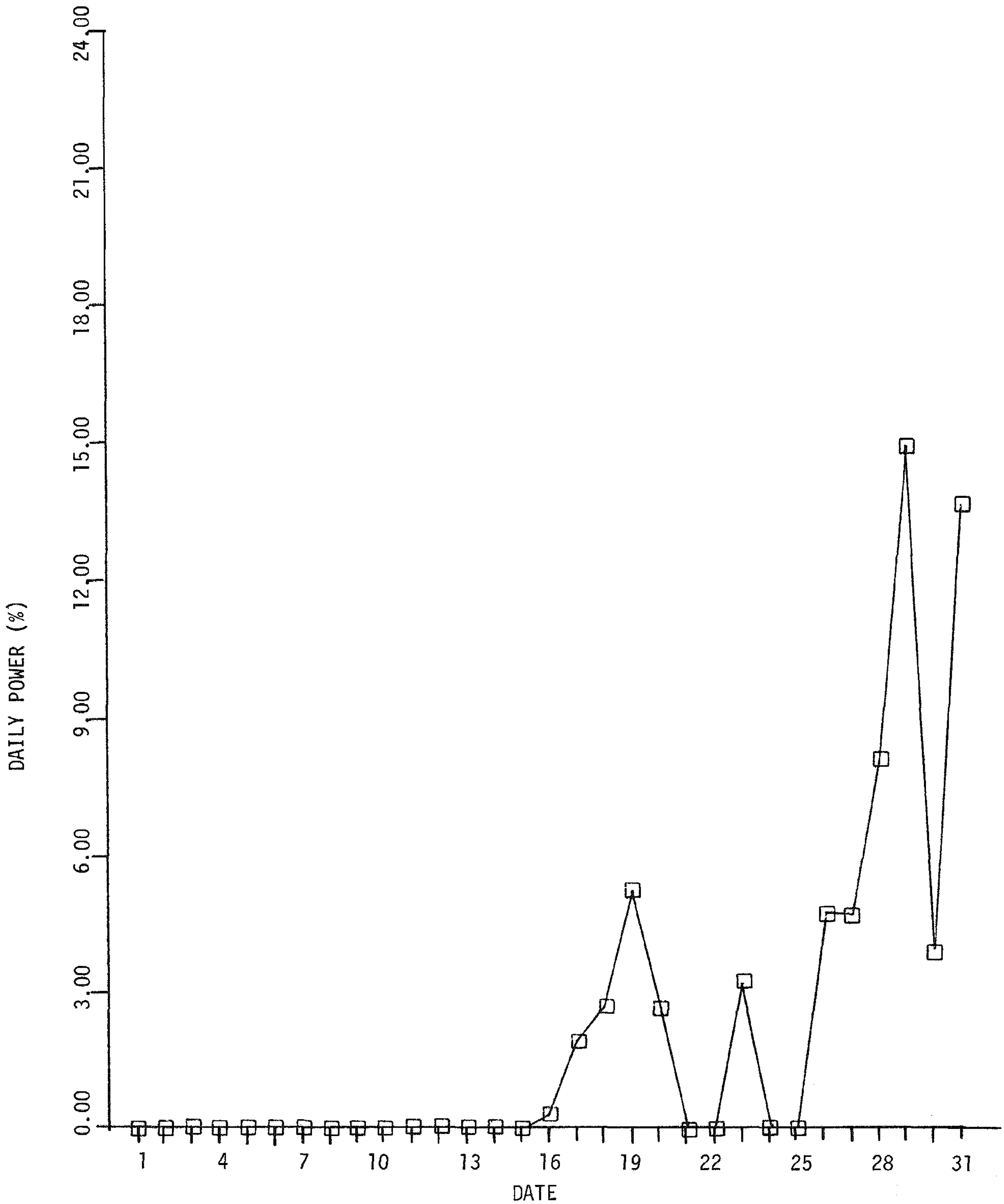


Figure 4-1 Average Daily Power - December 1978

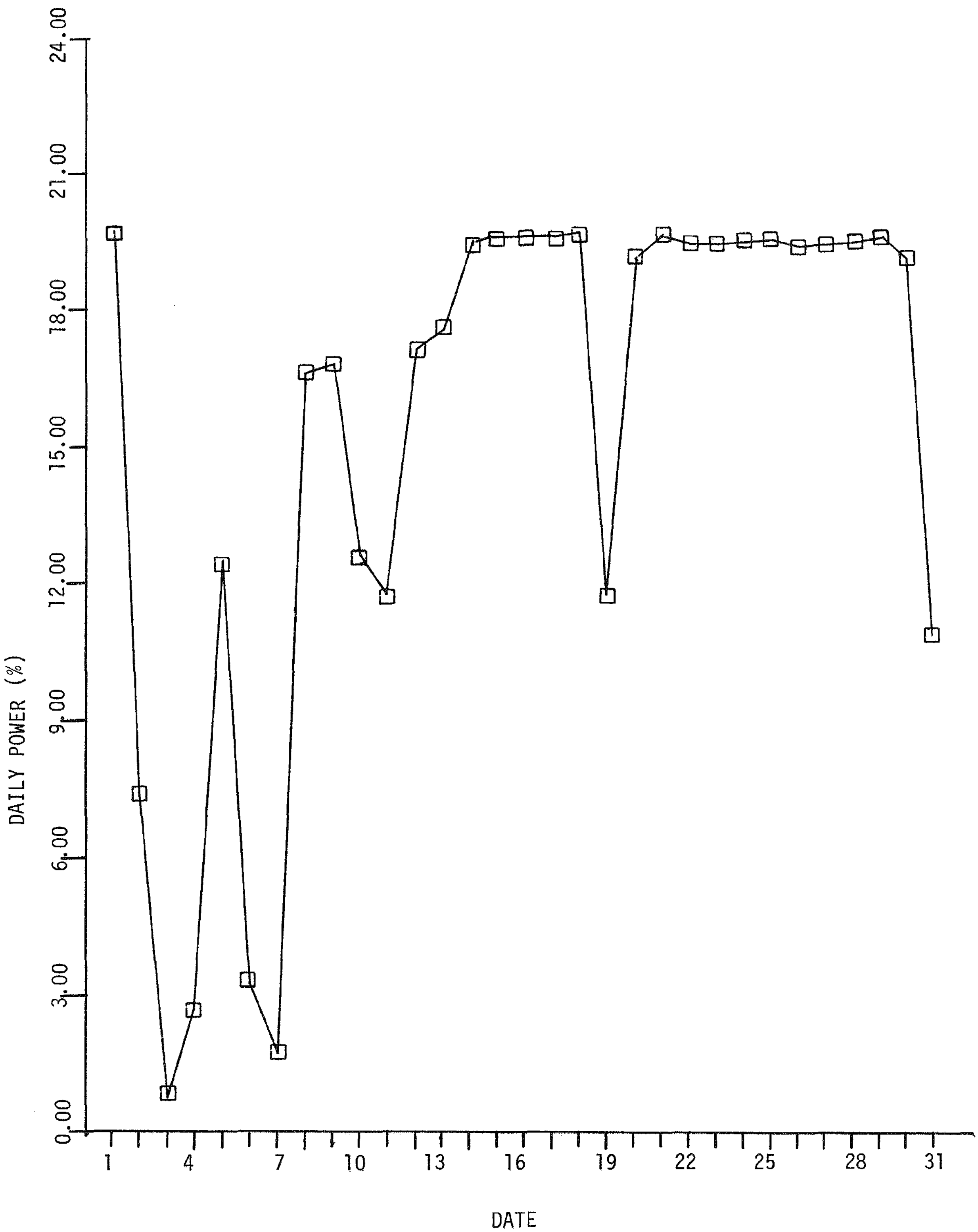


Figure 4-2. Average Daily Power - January 1979

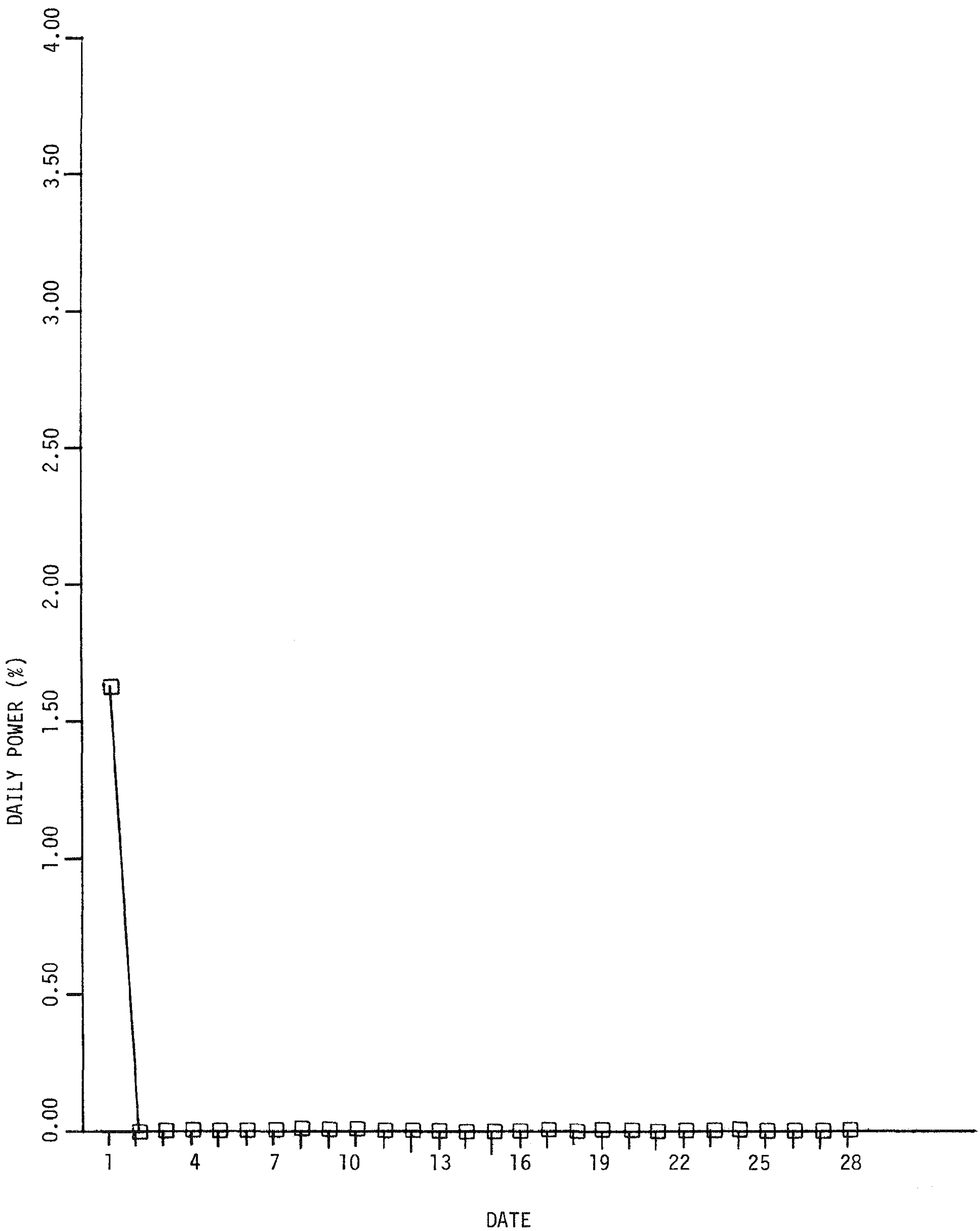


Figure 4-3. Average Daily Power - February 1979

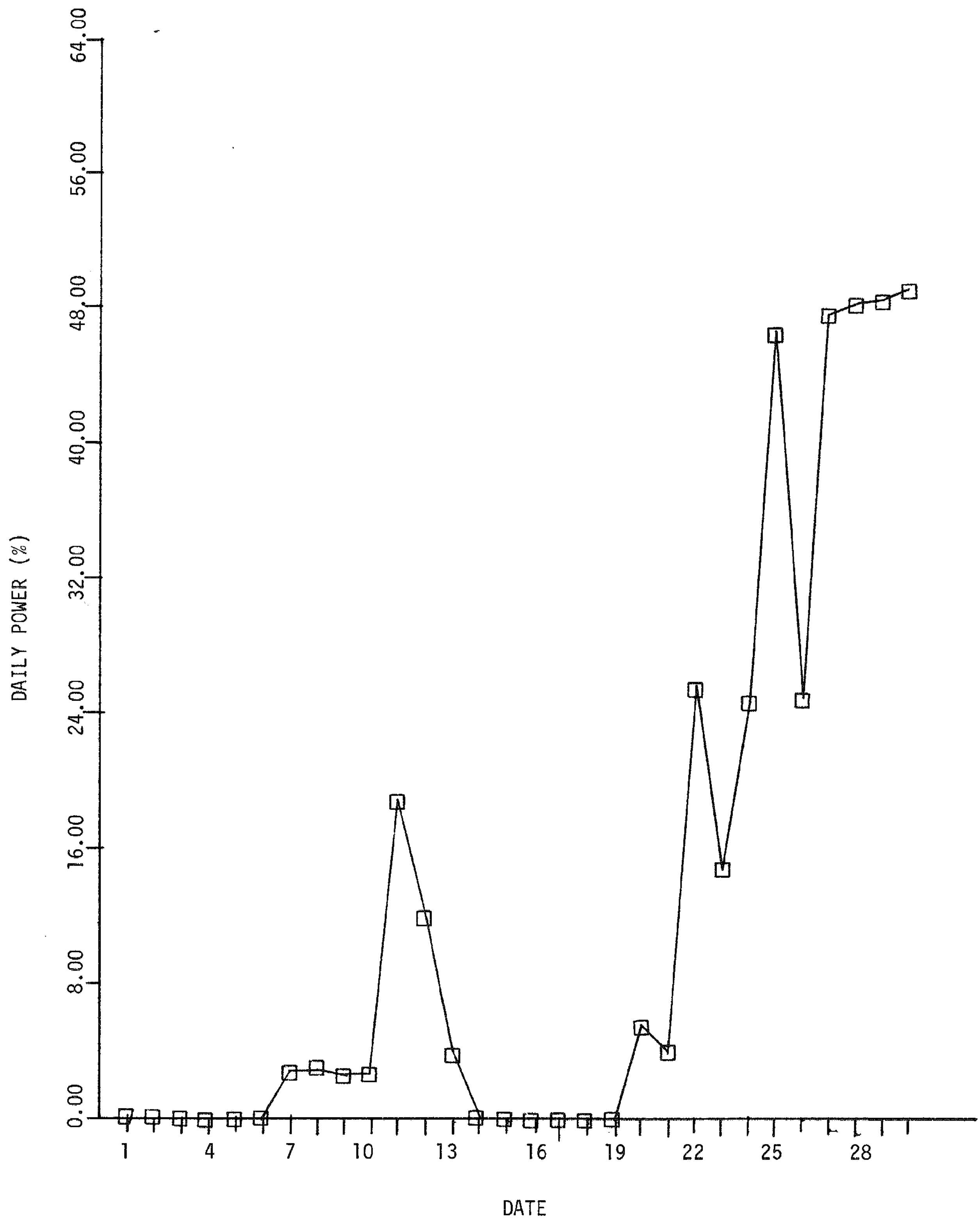


Figure 4-4. Average Daily Power - June 1979

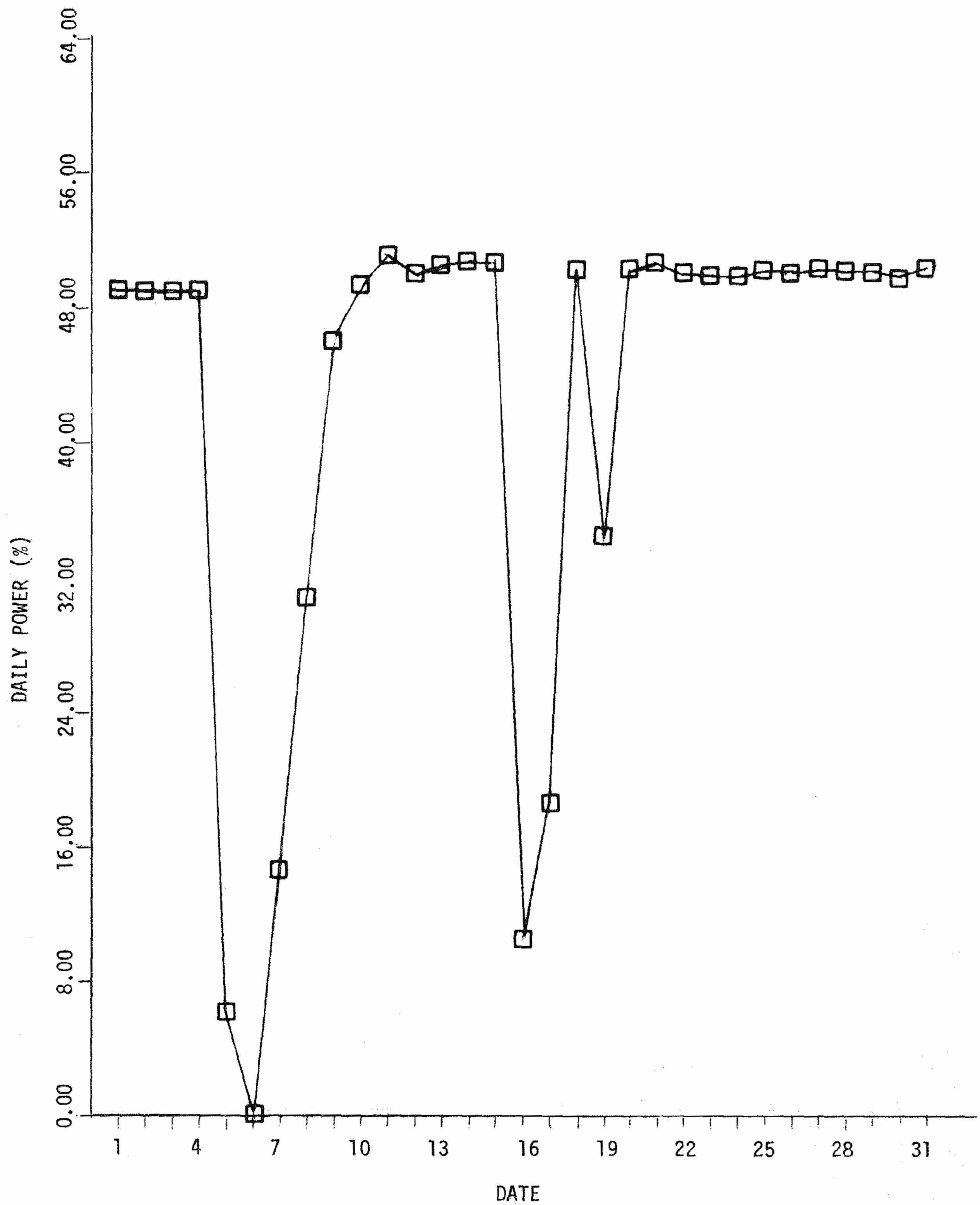


Figure 4-5. Average Daily Power - July 1979

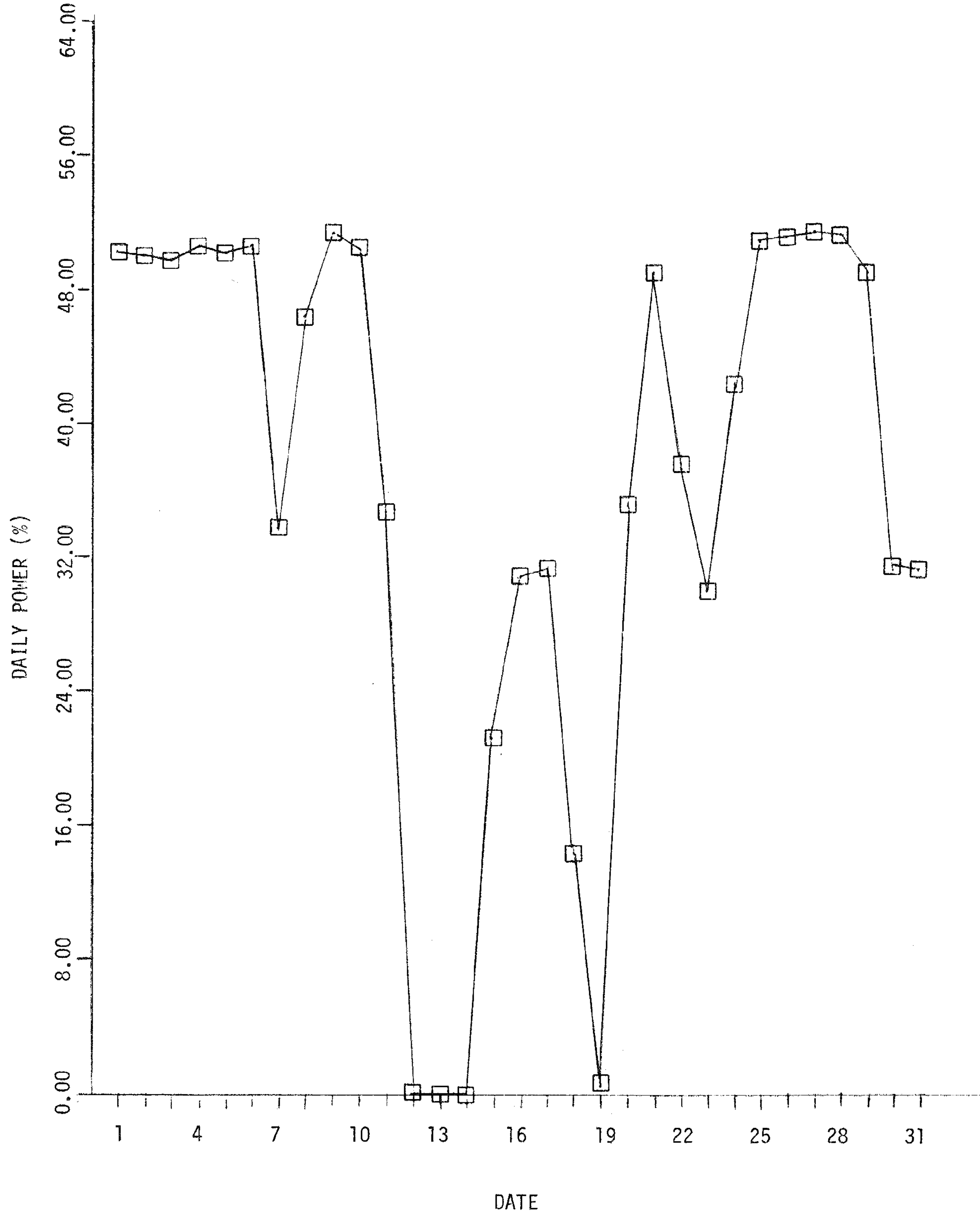


Figure 4-6. Average Daily Power - August 1979

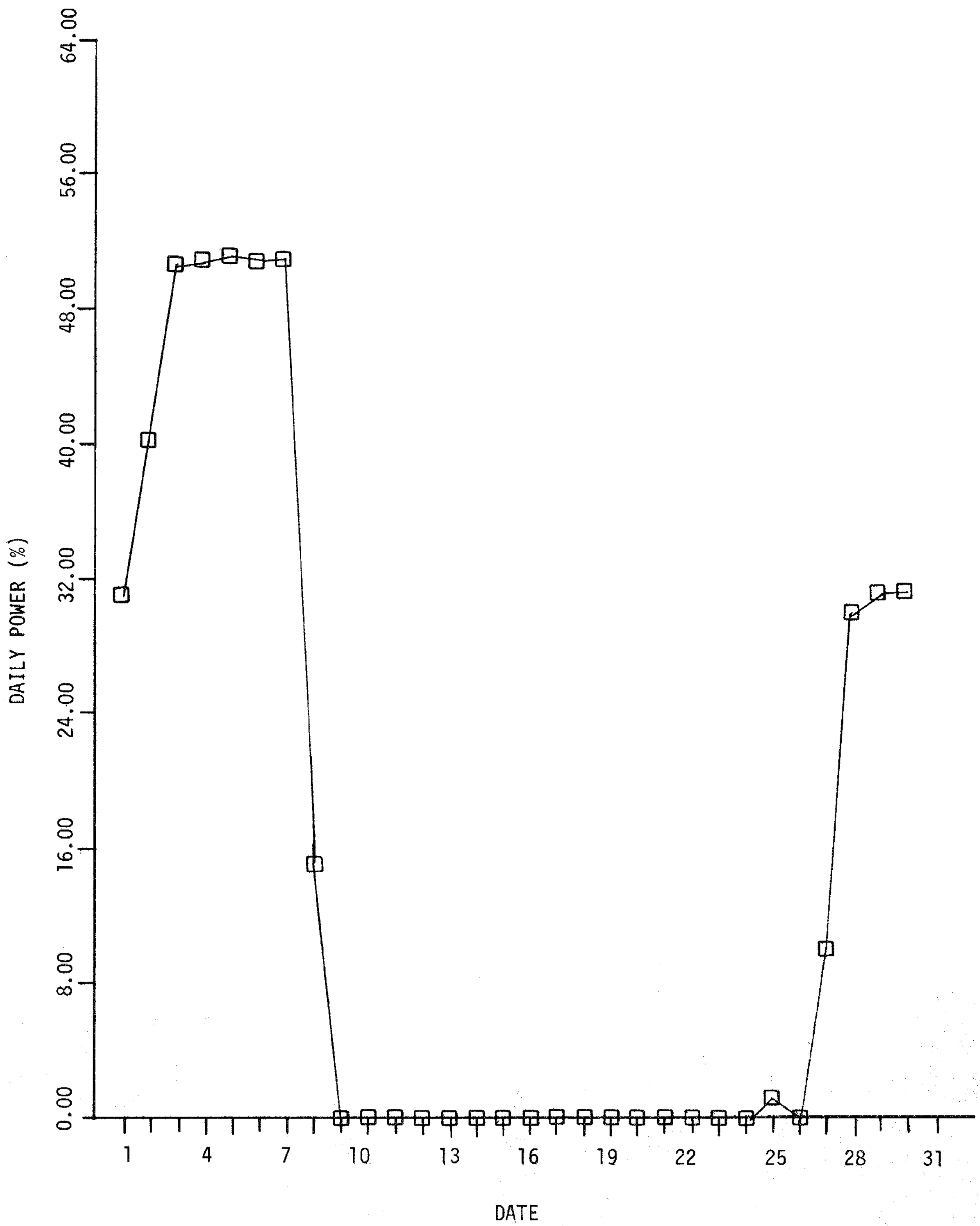


Figure 4-7. Average Daily Power - September 1979

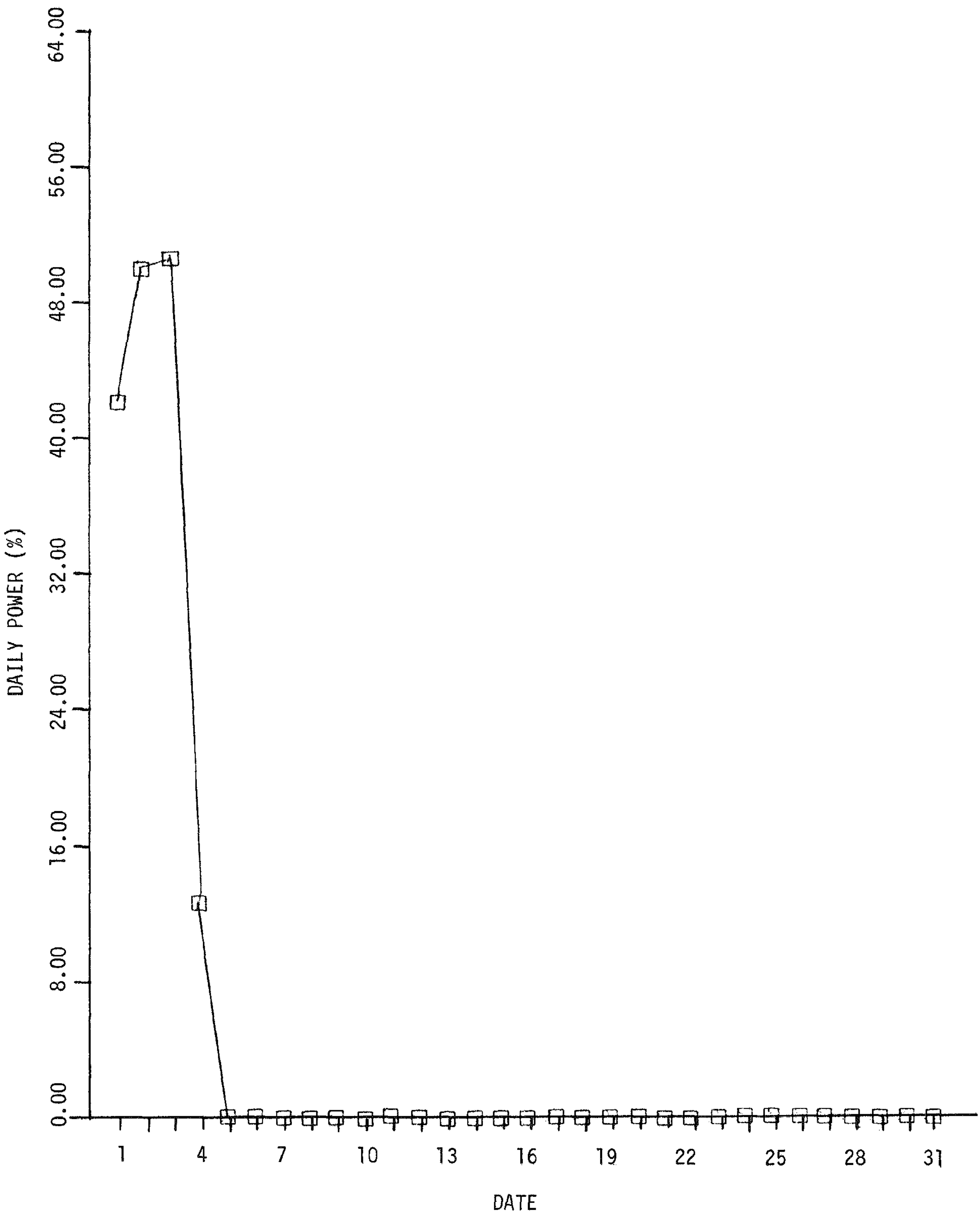


Figure 4-8. Average Daily Power - October 1979

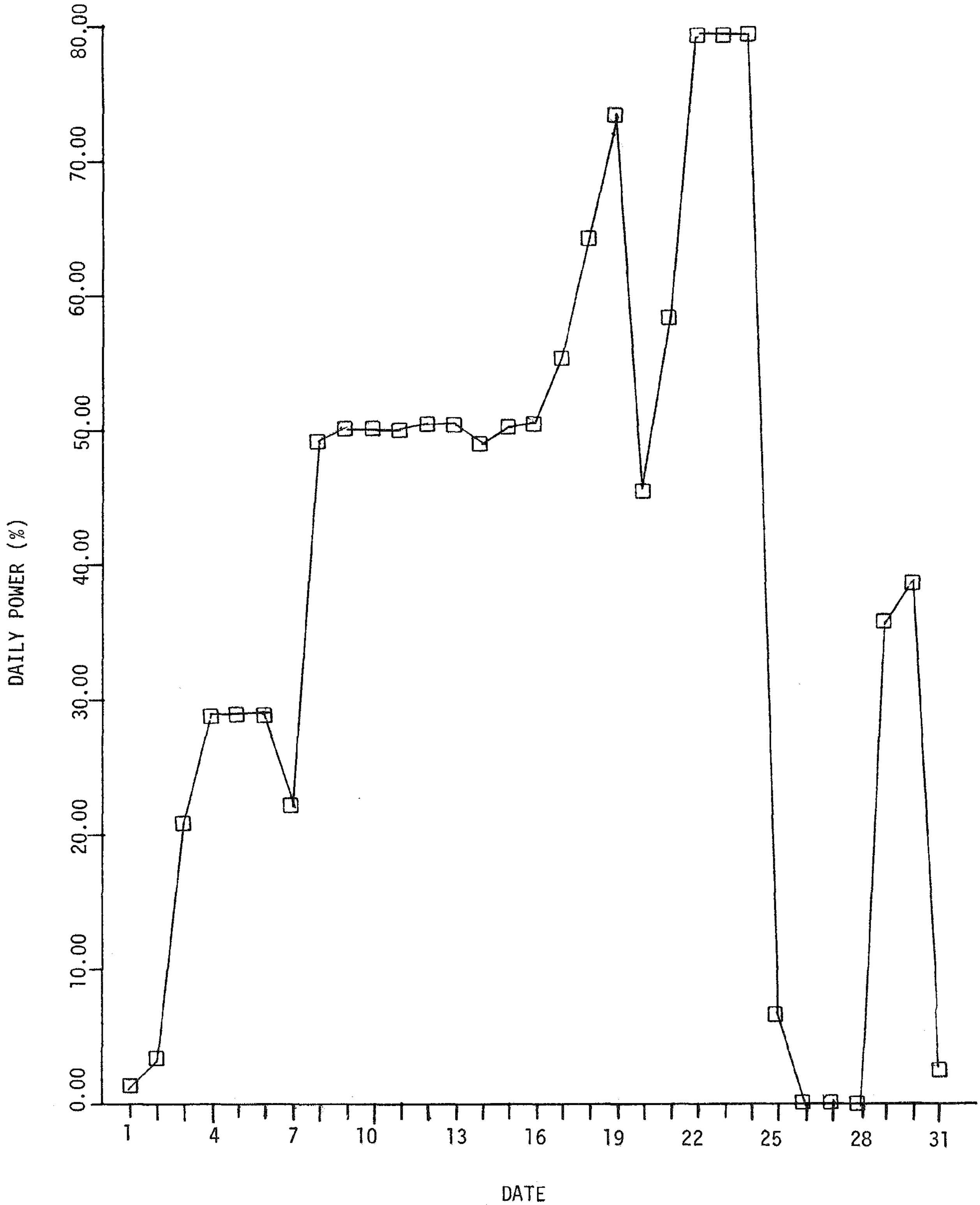


Figure 4-9. Average Daily Power - December 1979

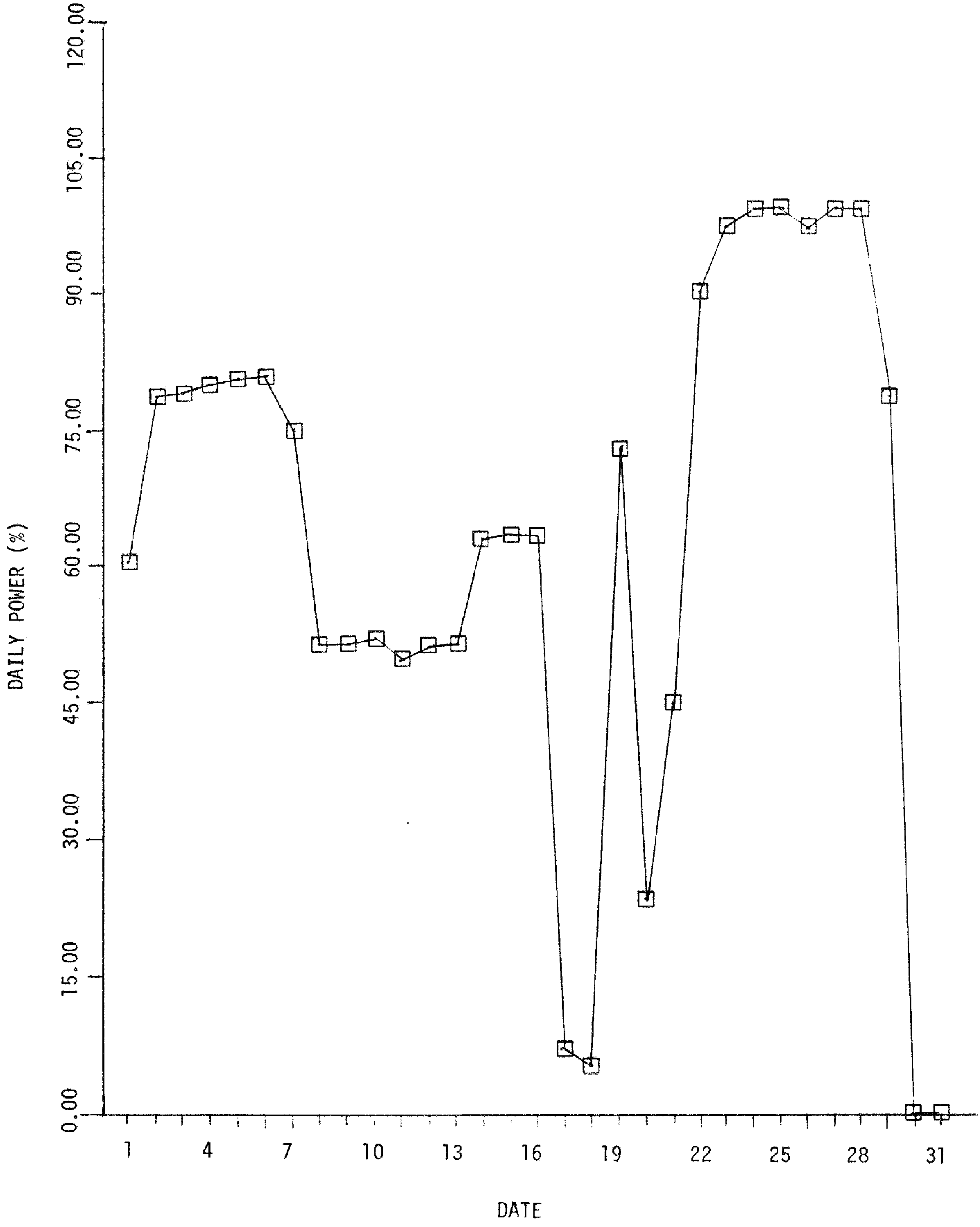


Figure 4-10. Average Daily Power - January 1980

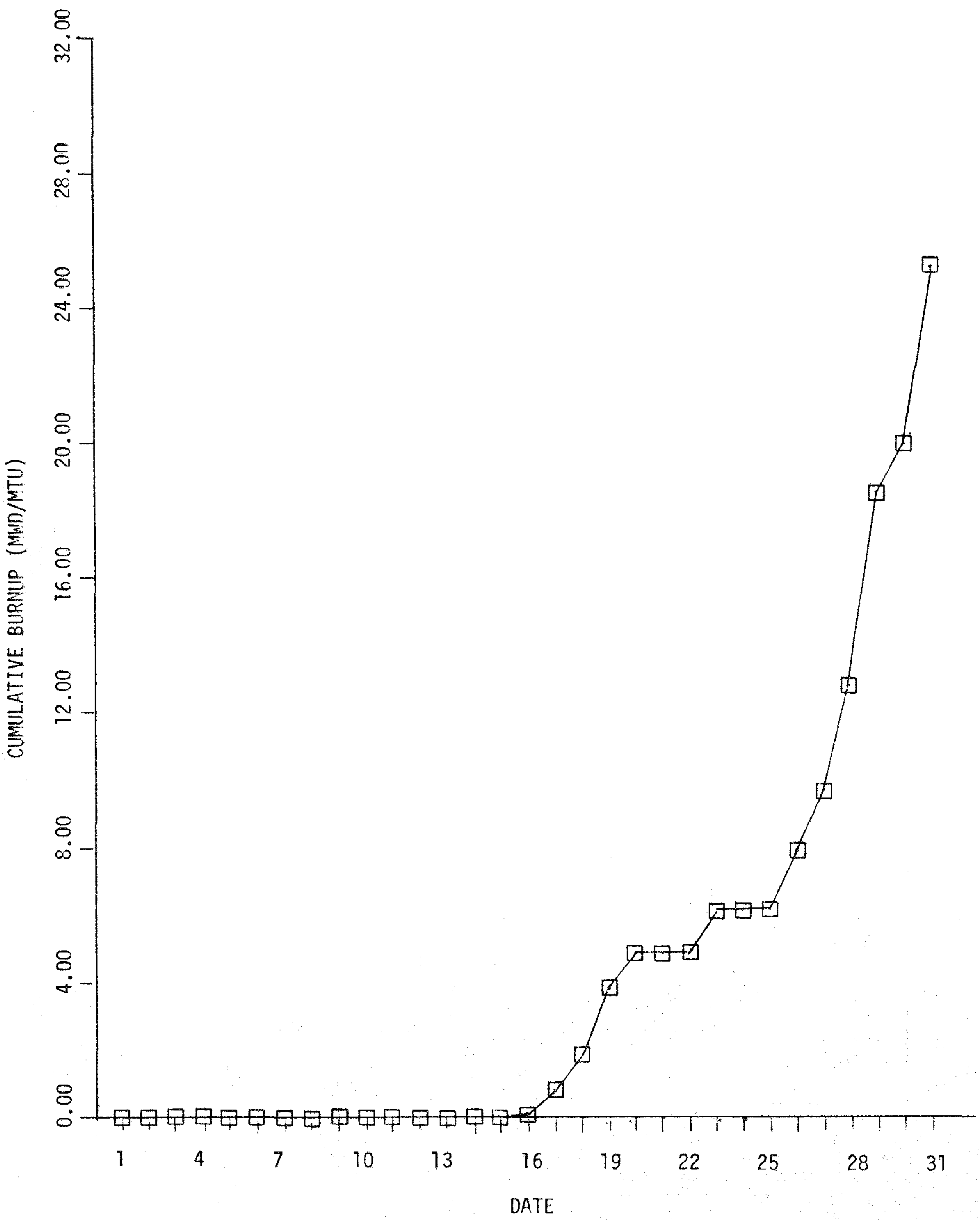


Figure 4-11. Cumulative Burnup - December 1978

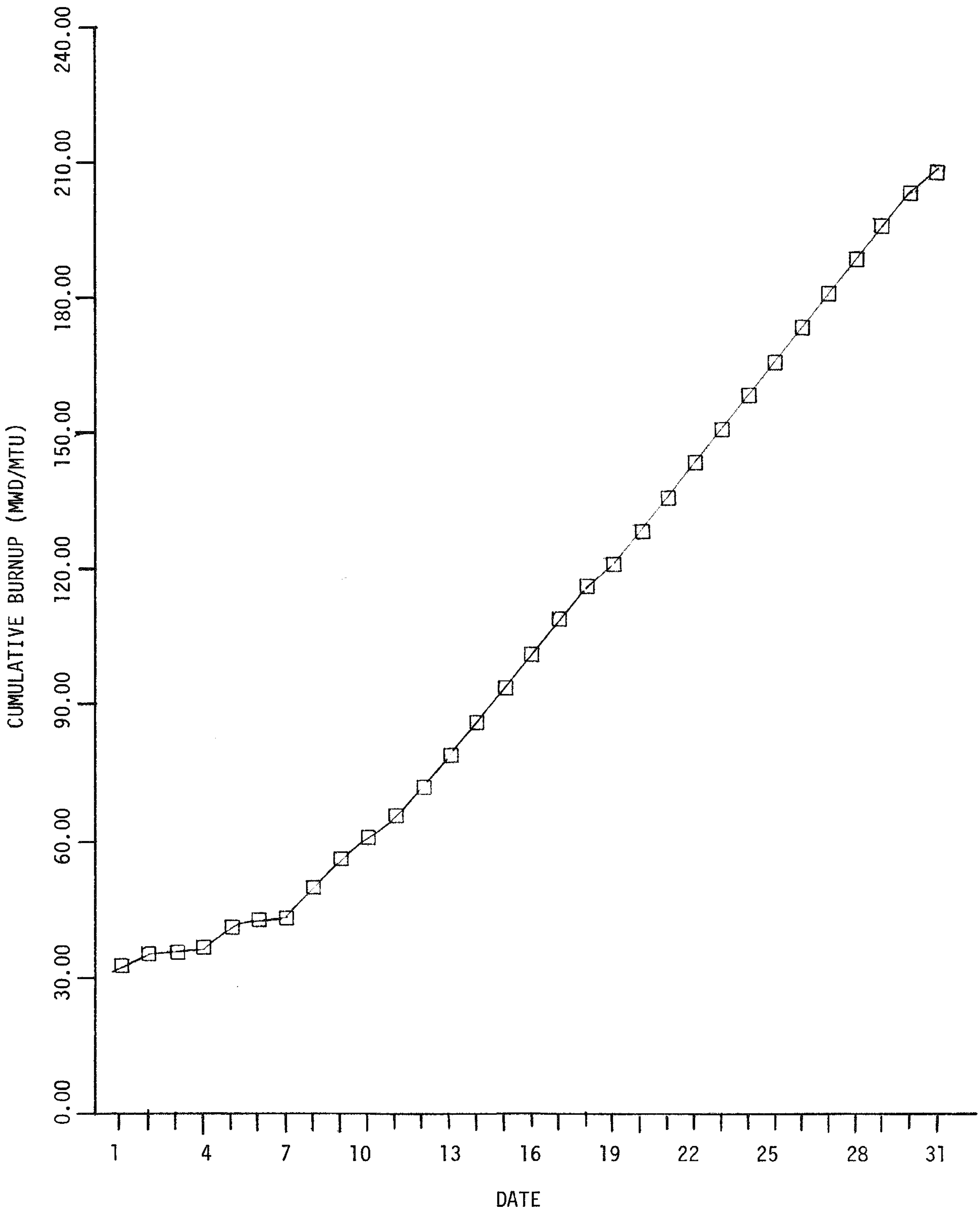


Figure 4-12. Cumulative Burnup - January 1979

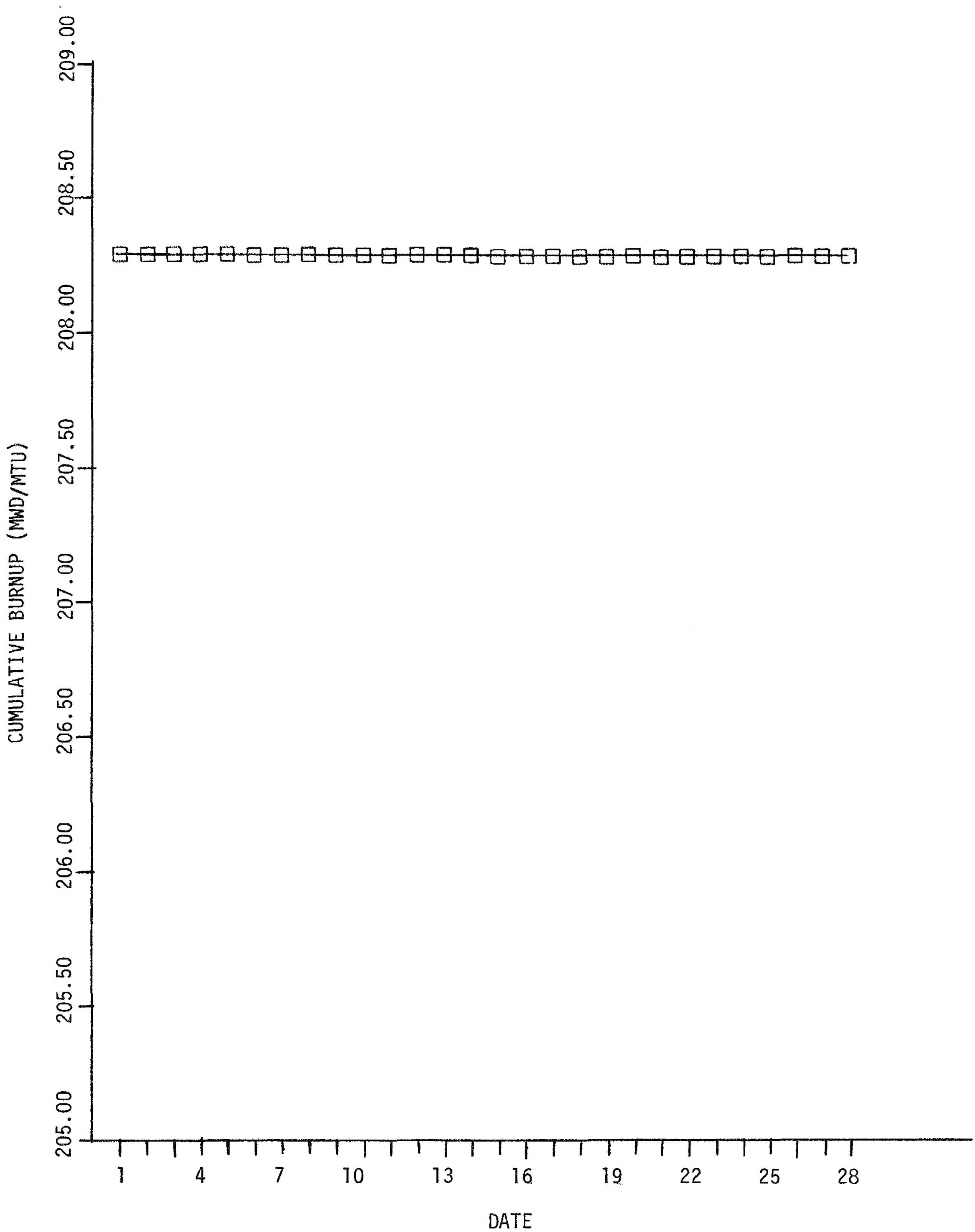


Figure 4-13. Cumulative Burnup - February 1979

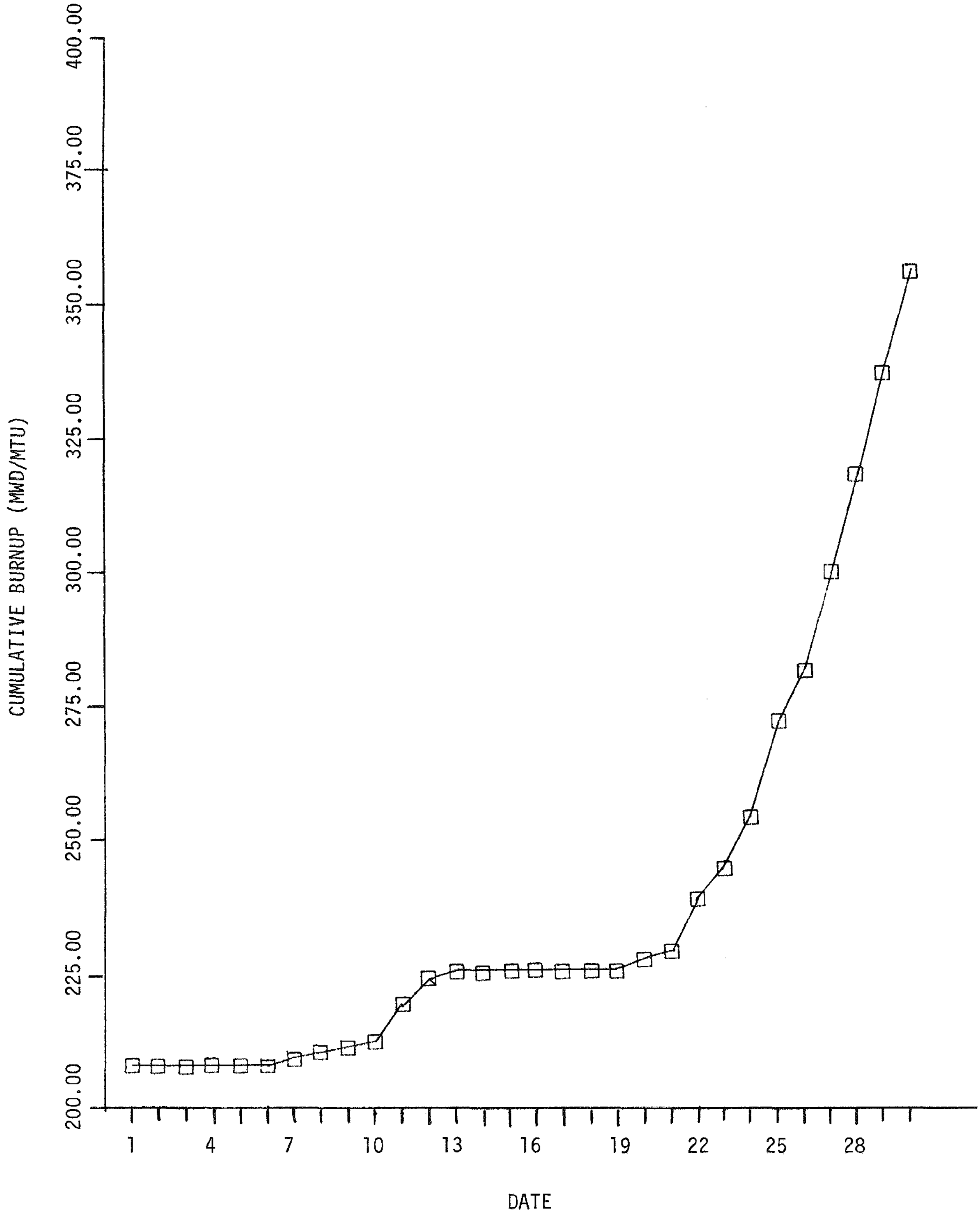


Figure 4-14. Cumulative Burnup - June 1979

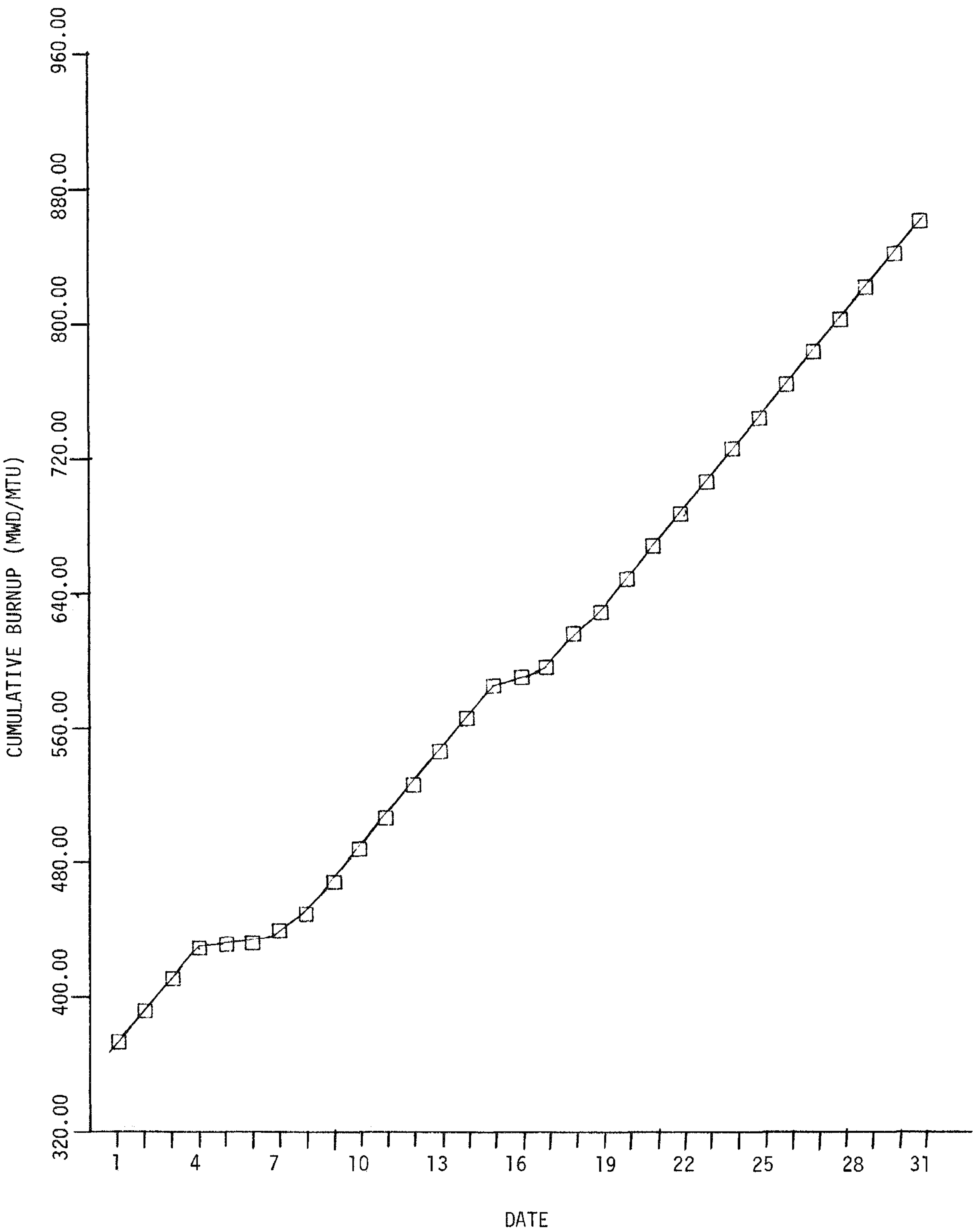


Figure 4-15. Cumulative Burnup - July 1979

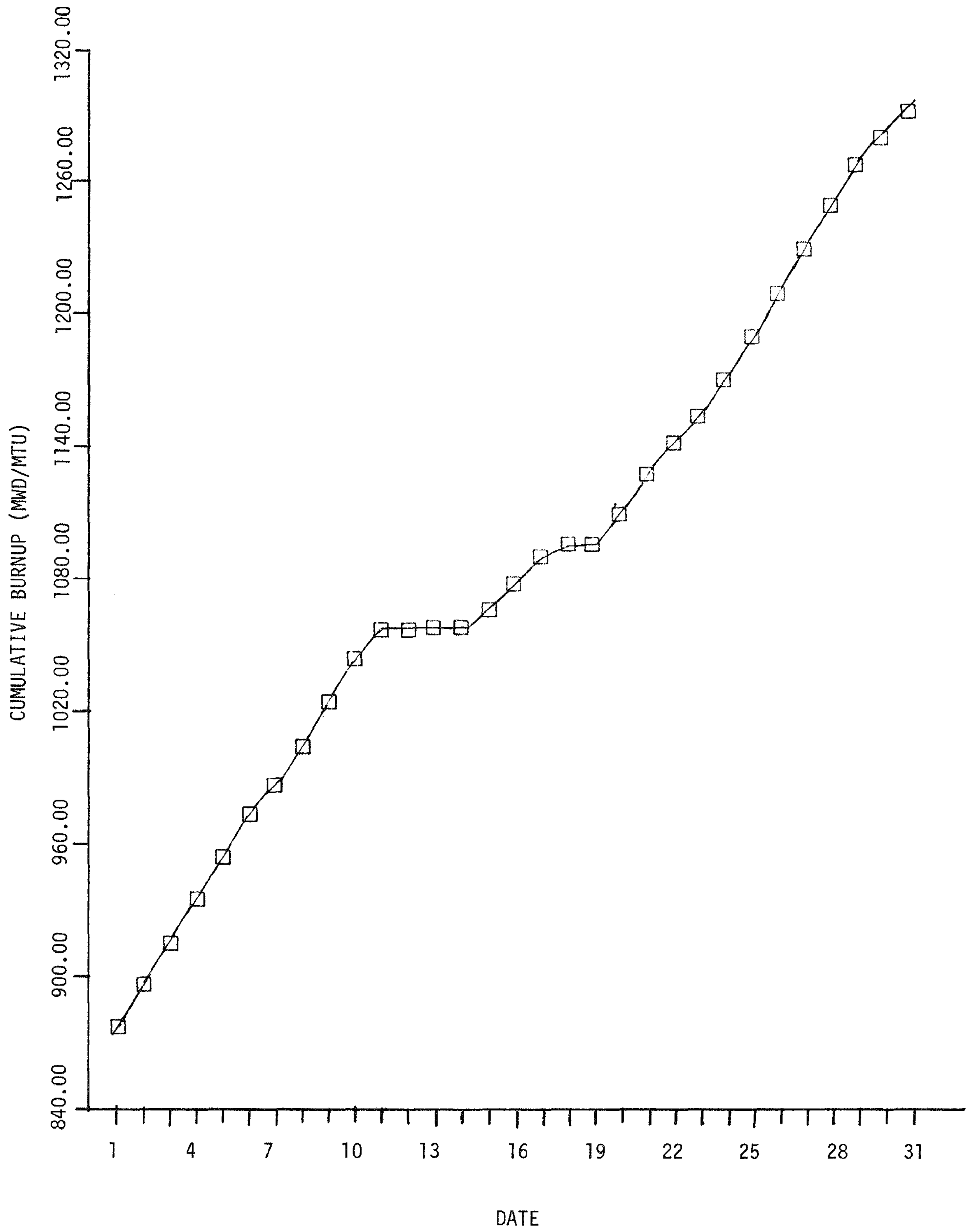


Figure 4-16. Cumulative Burnup - August 1979

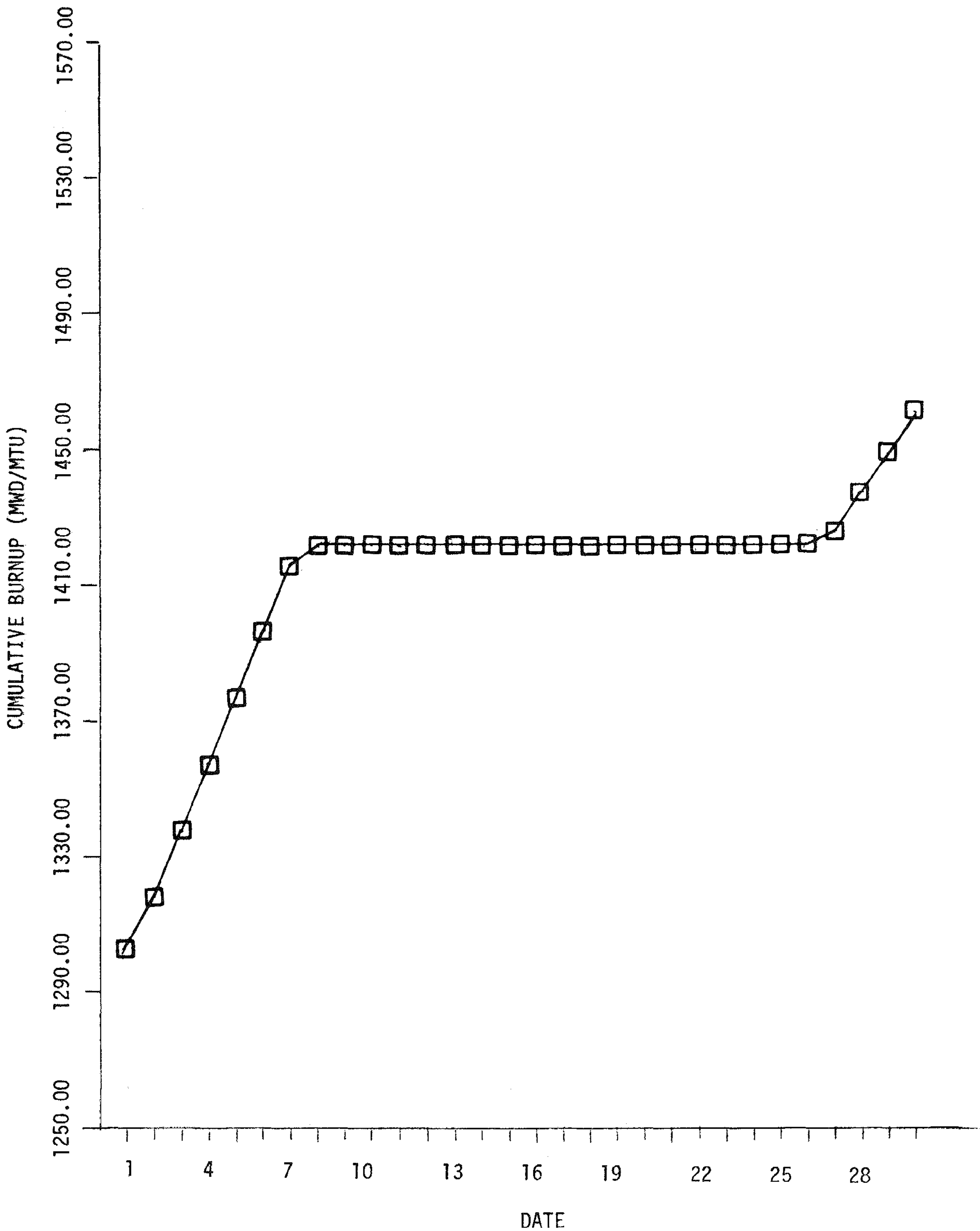


Figure 4-17. Cumulative Burnup - September 1979

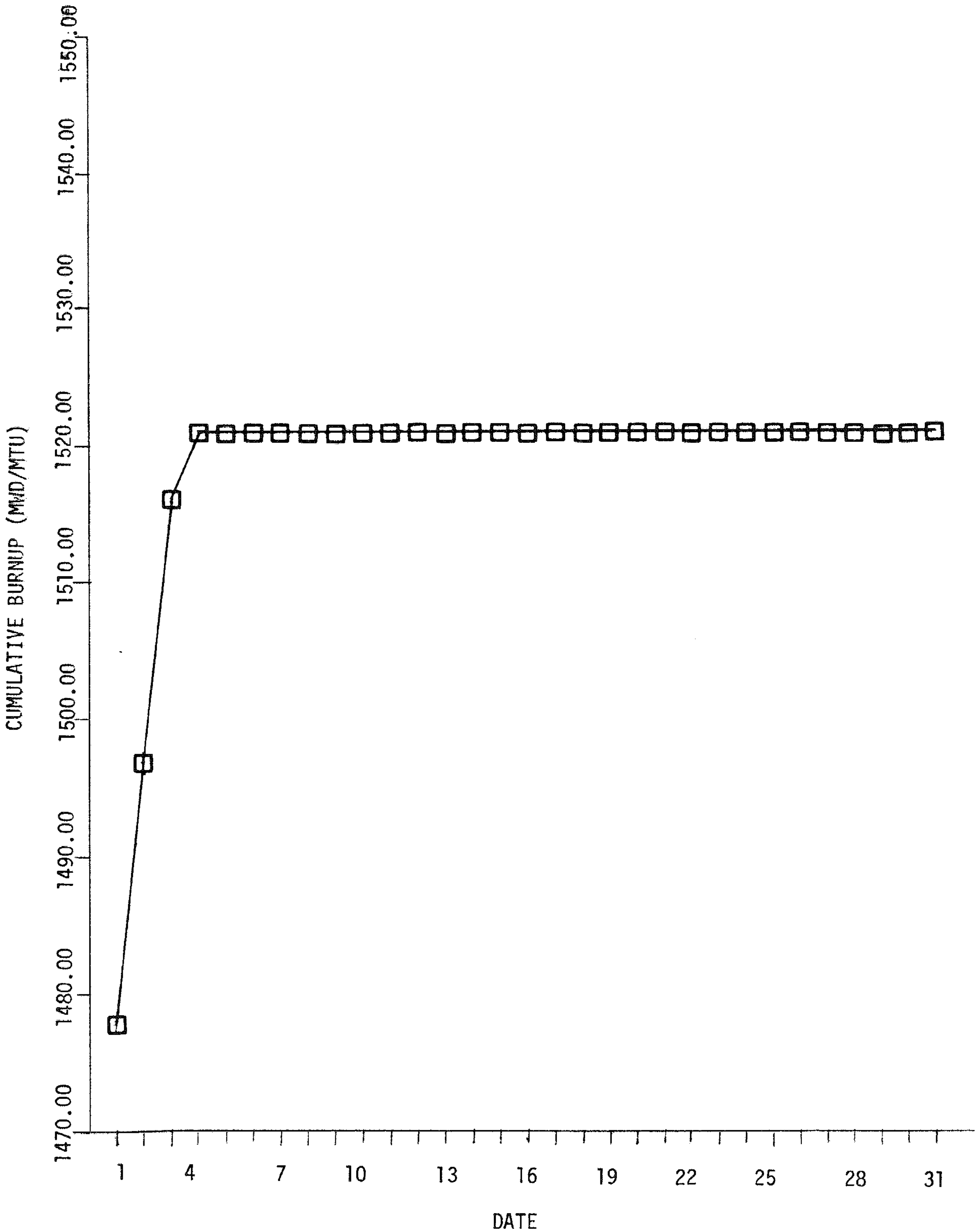


Figure 4-18. Cumulative Burnup - October 1979

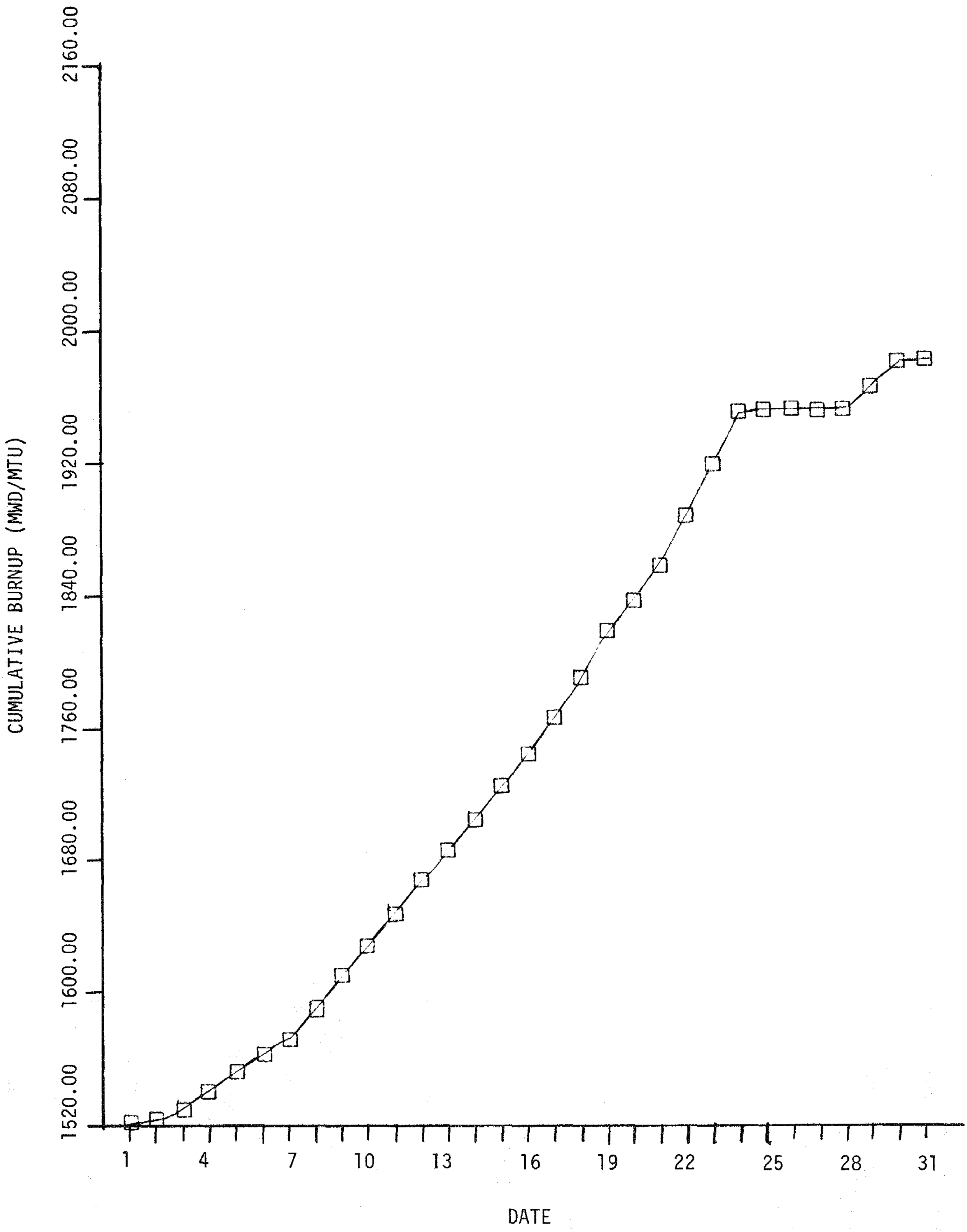


Figure 4-19. Cumulative Burnup - December 1979

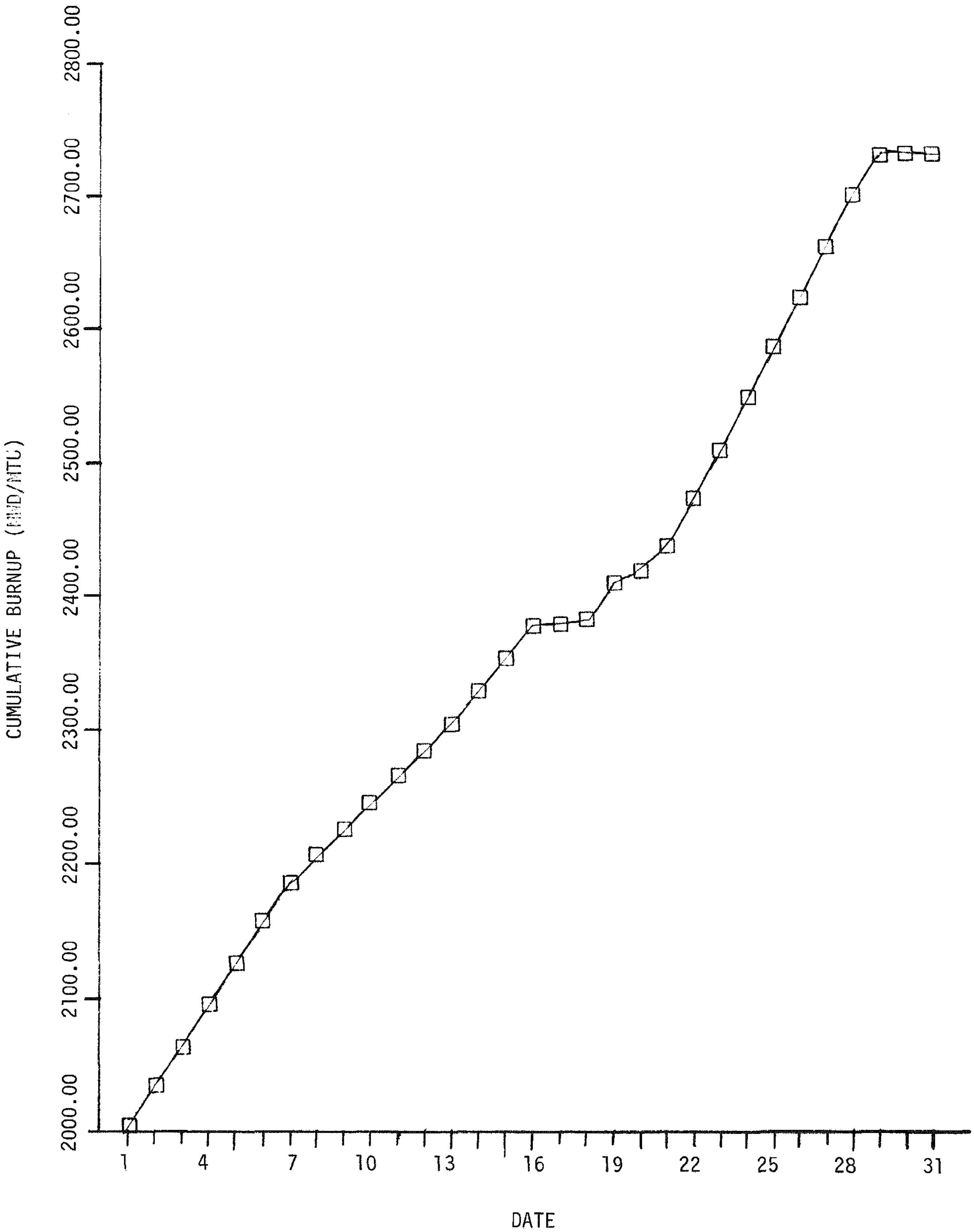


Figure 4-20. Cumulative Burnup - January 1980

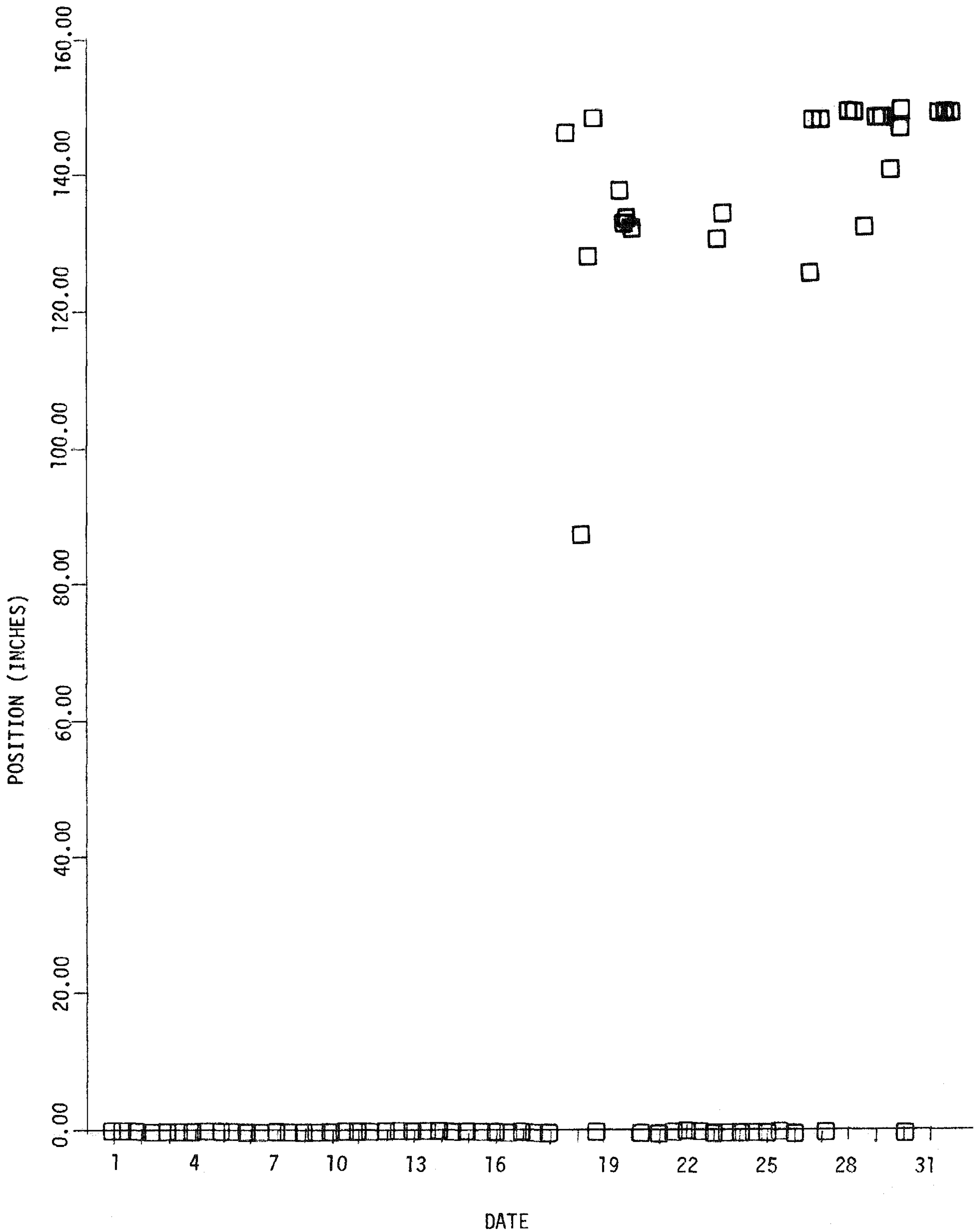


Figure 4-21. Control Rod Group Six Position - December 1978

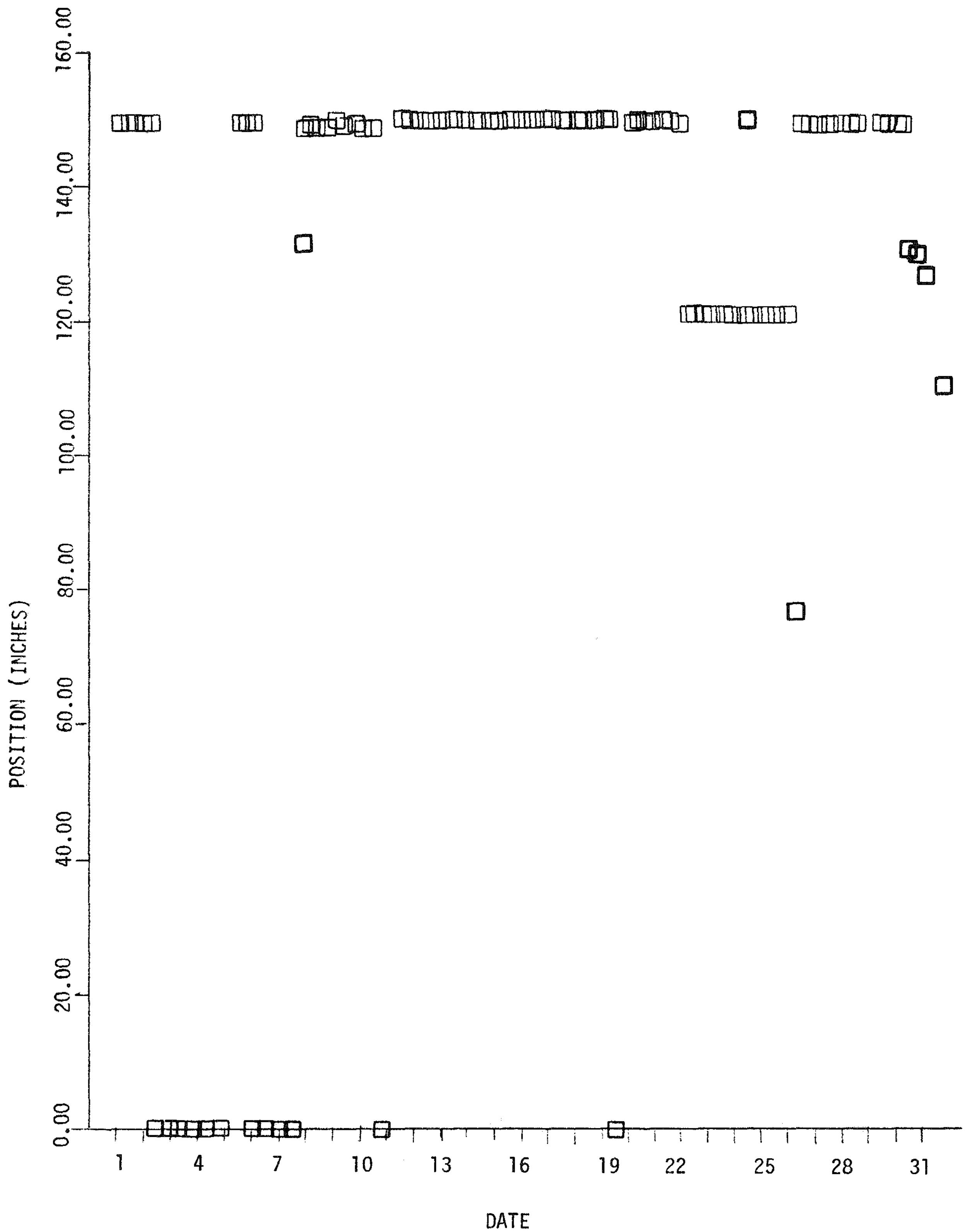


Figure 4-22. Control Rod Group Six Postion - January 1979

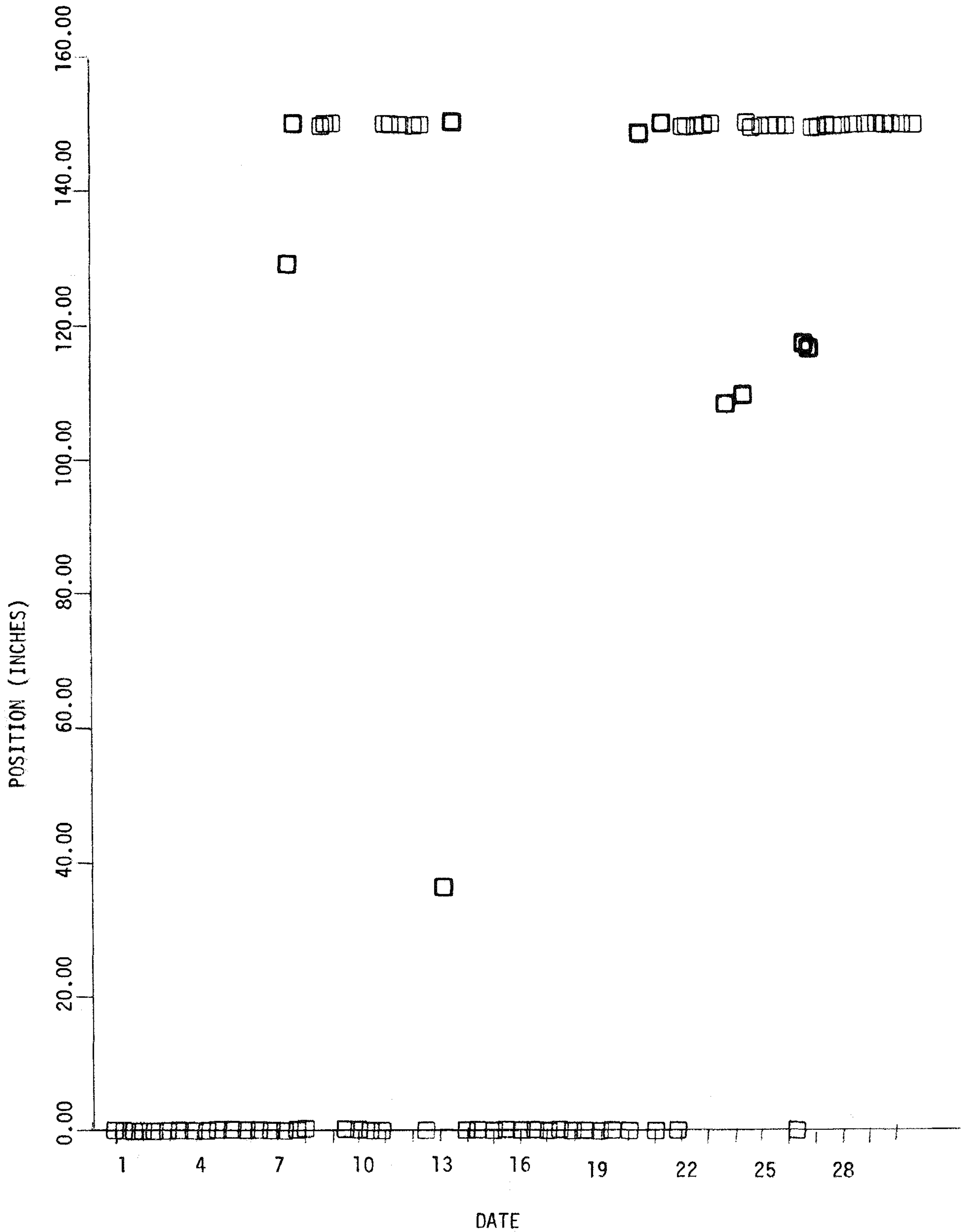


Figure 4-23. Control Rod Group Six Position - June 1979

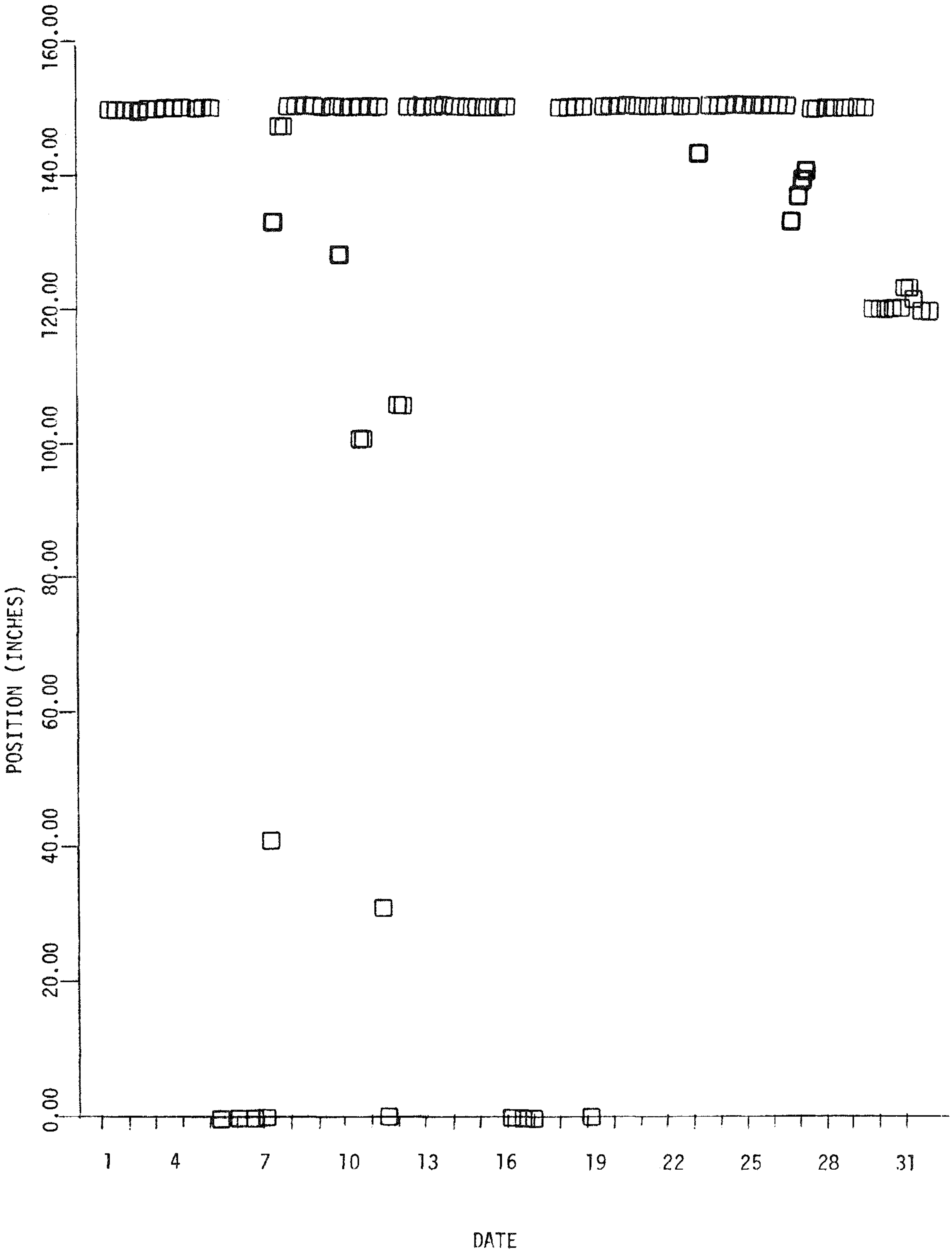


Figure 4-24. Control Rod Group Six Position - July 1979

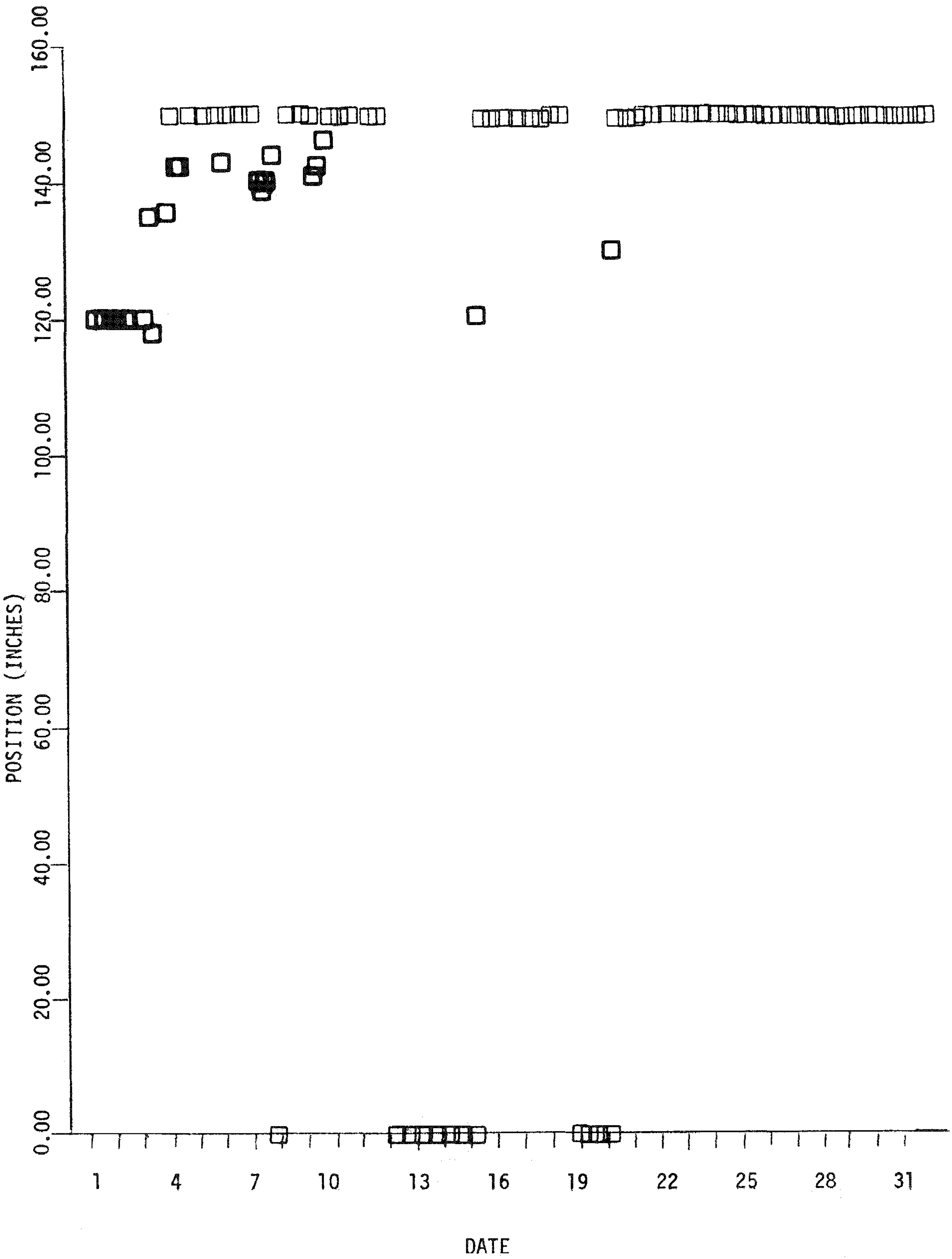


Figure 4-25. Control Rod Group Six Position - August 1979

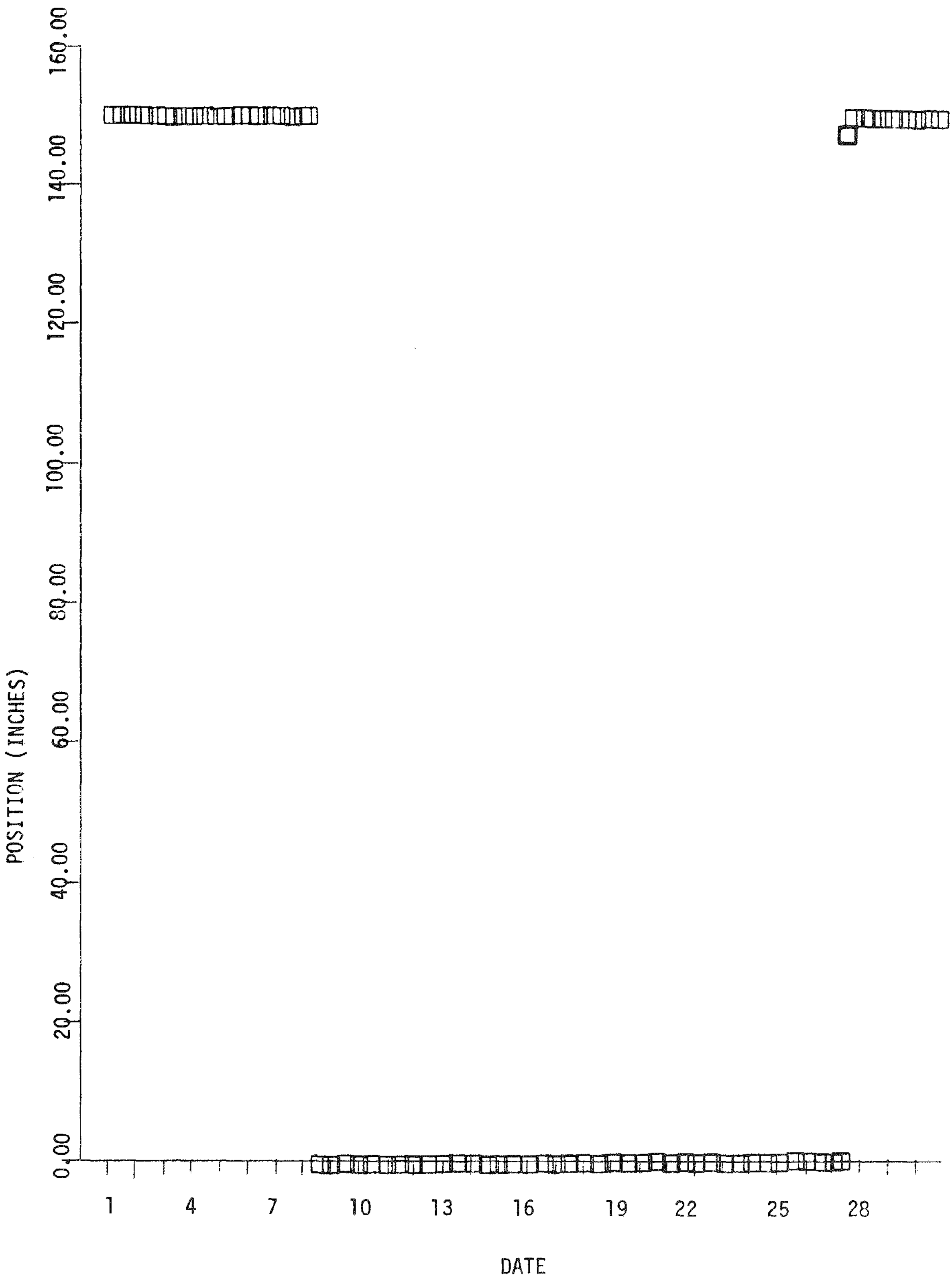


Figure 4-26. Control Rod Group Six Position - September 1979

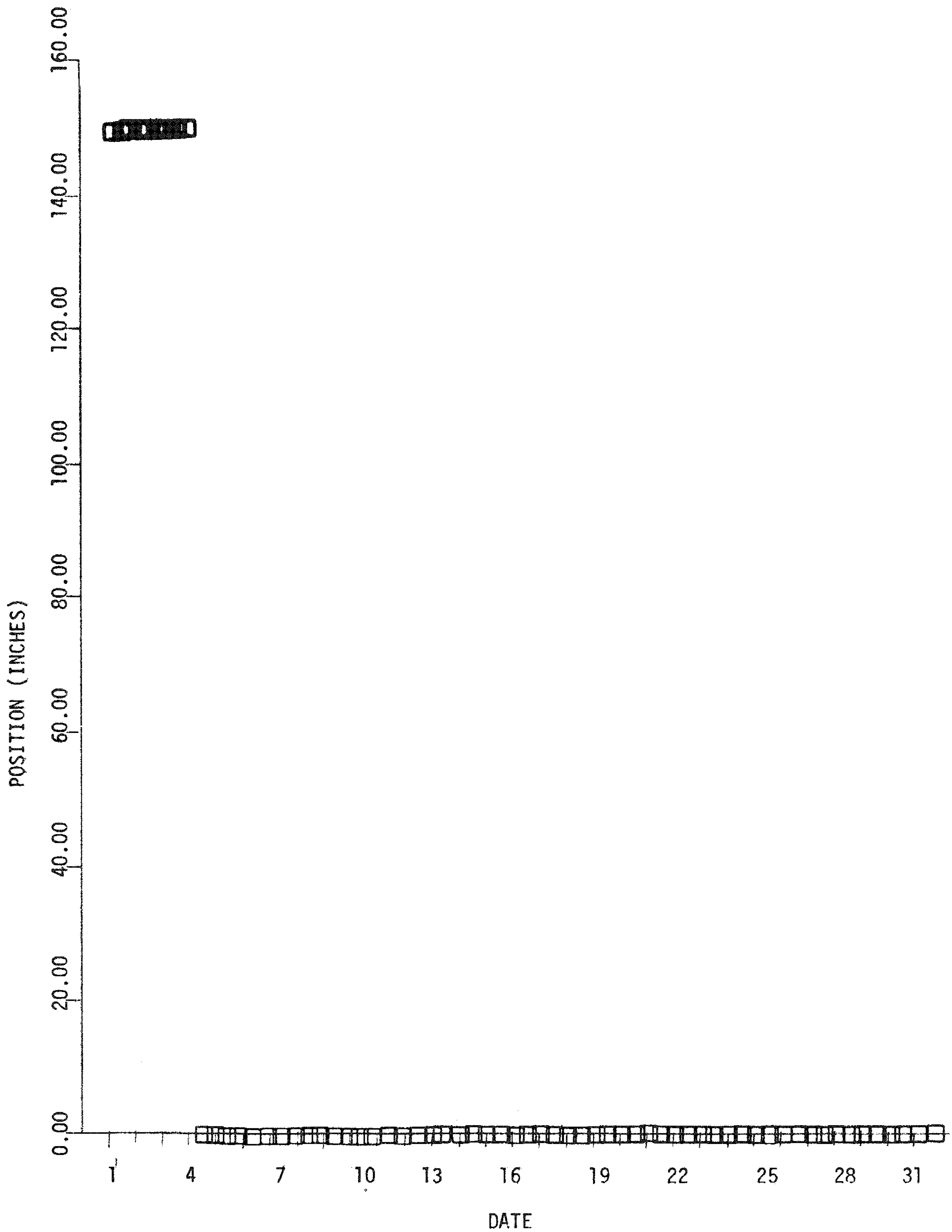


Figure 4-27 Control Rod Group Six Position - October 1979

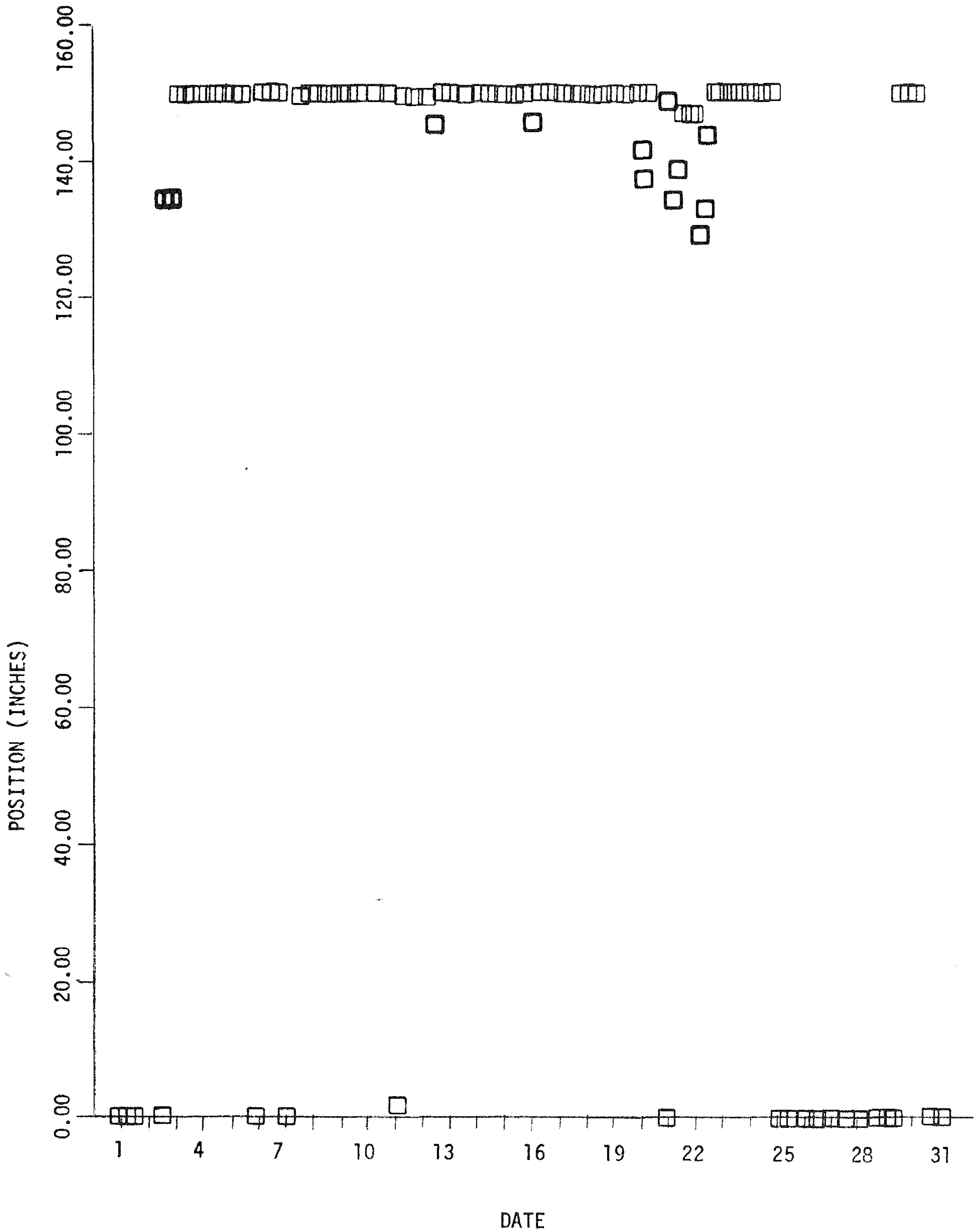


Figure 4-28. Control Rod Group Six Position - December 1979

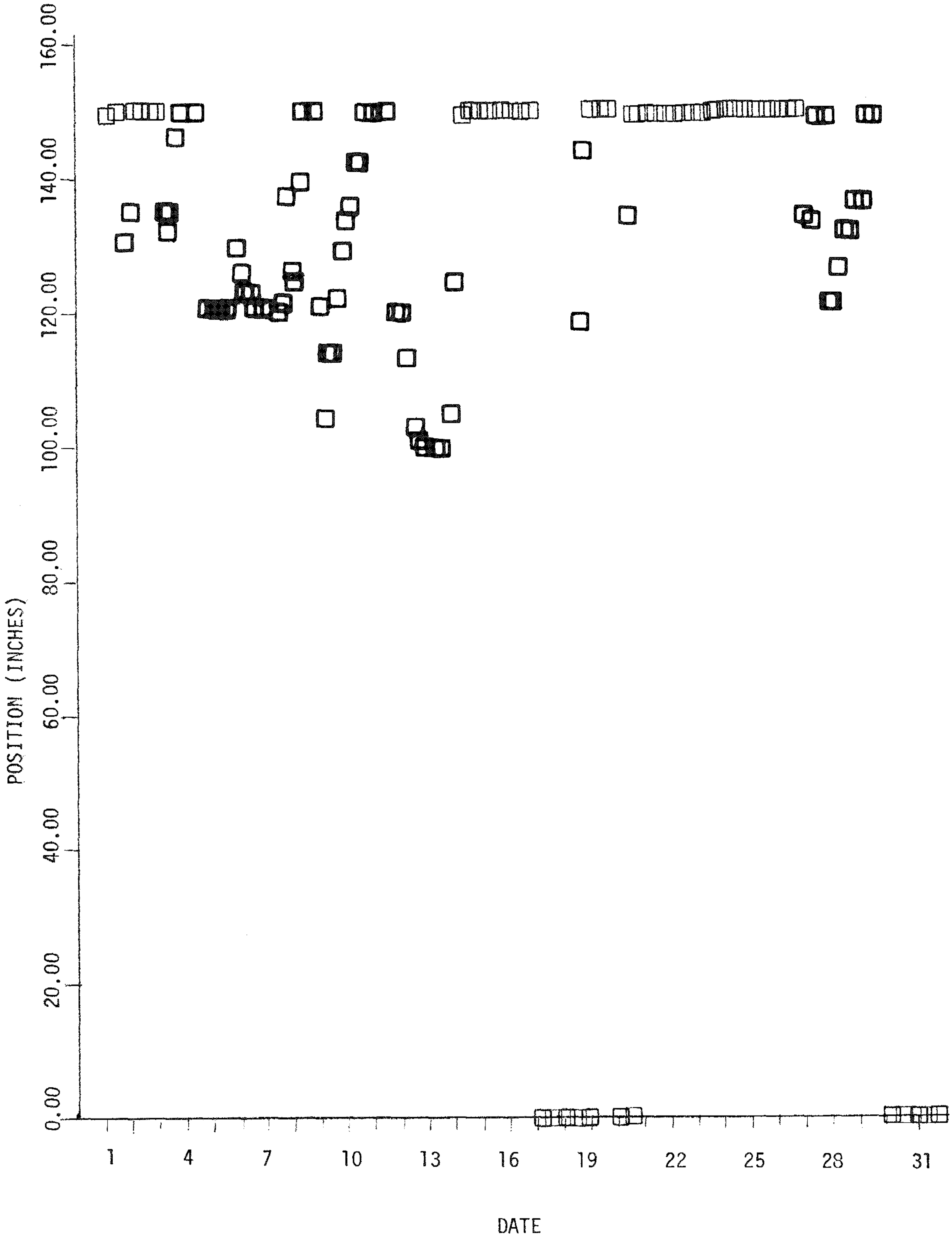


Figure 4-29. Control Rod Group Six Position - January 1980

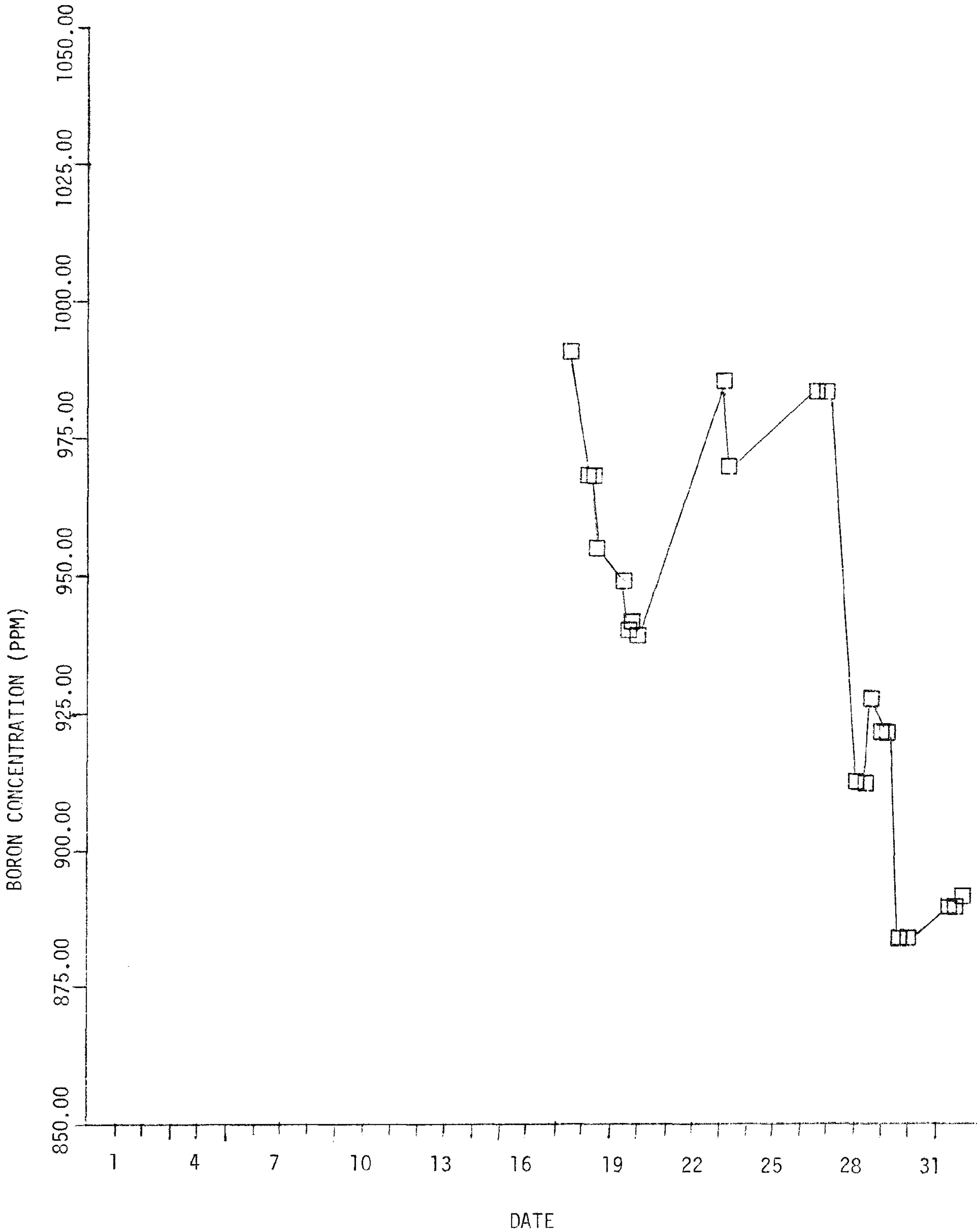


Figure 4-30. Boron Concentration (Chemical Analysis) - December 1978

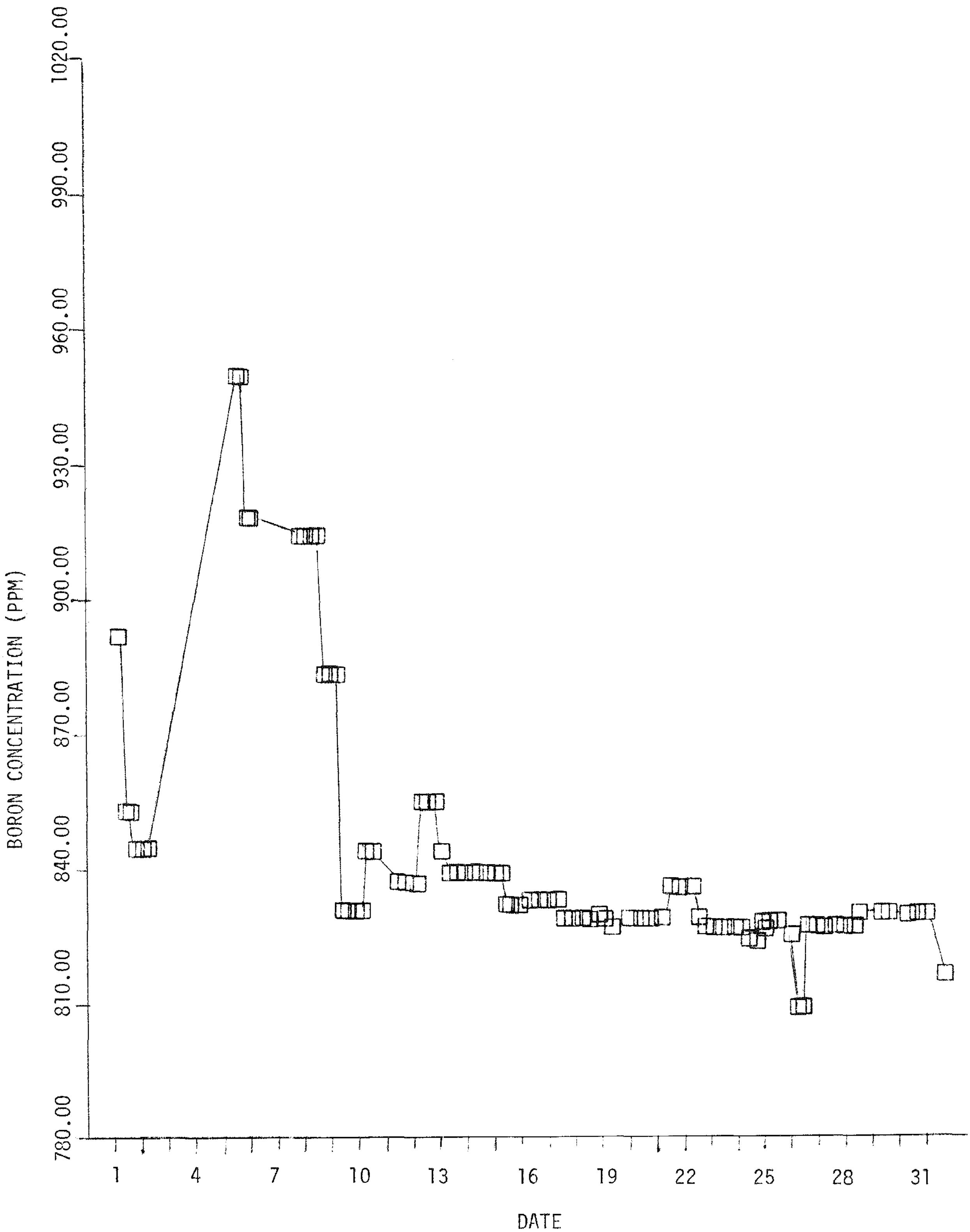


Figure 4-31. Boron Concentration (Chemical Analysis) - January 1979

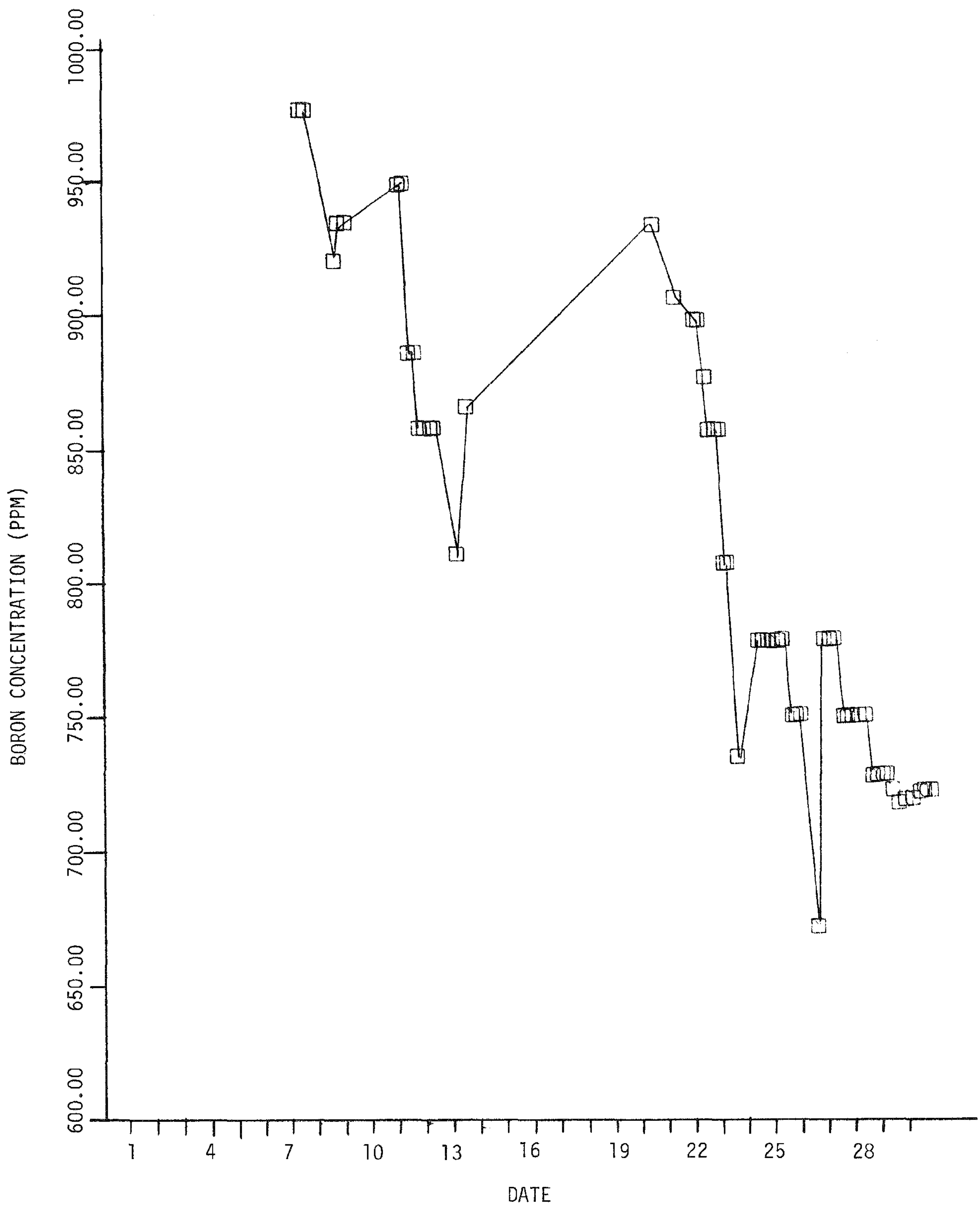


Figure 4-32. Boron Concentration (Chemical Analysis) - June 1979

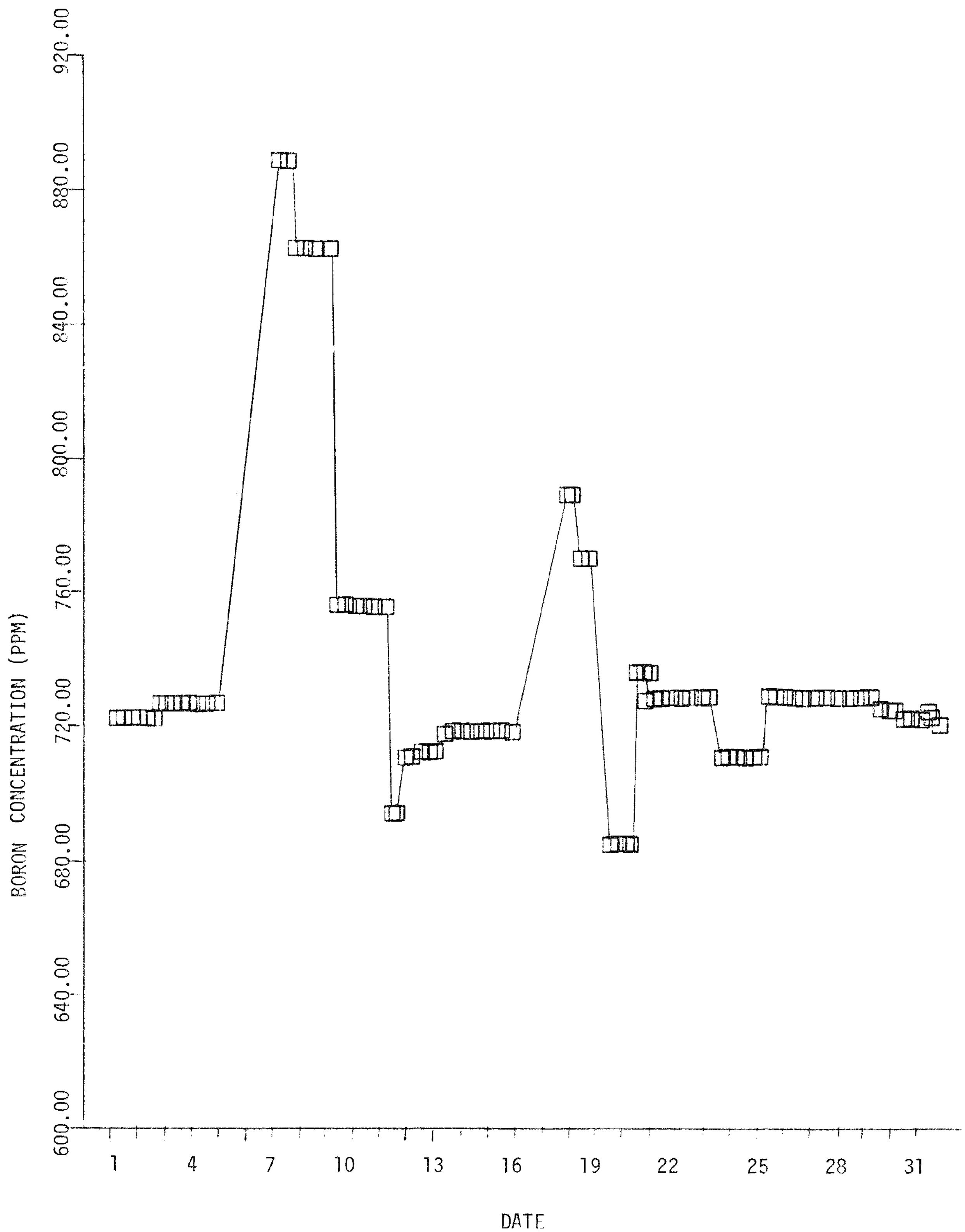


Figure 4-33. Boron Concentration (Chemical Analysis) - July 1979

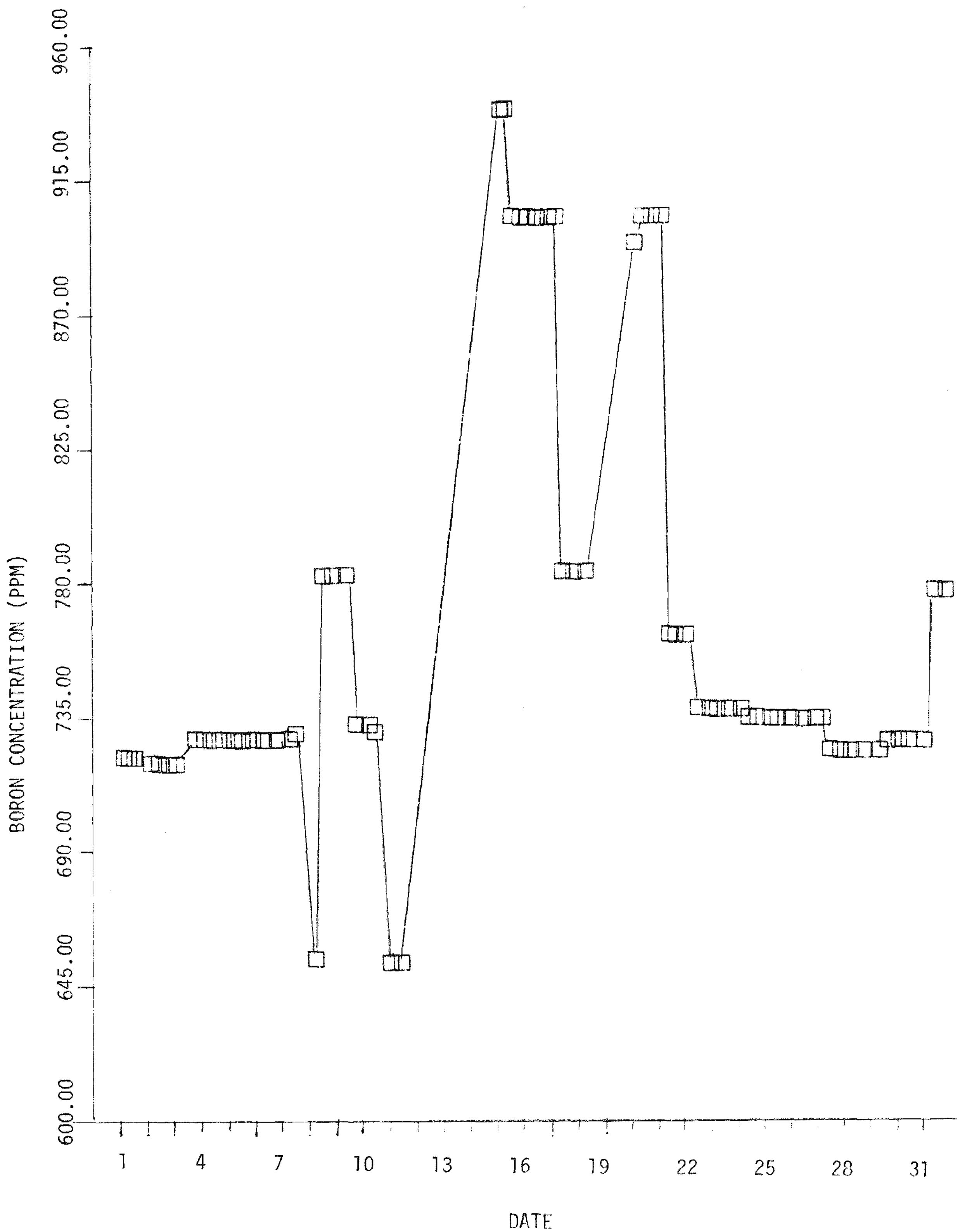


Figure 4-34. Boron Concentration (Chemical Analysis) - August 1979

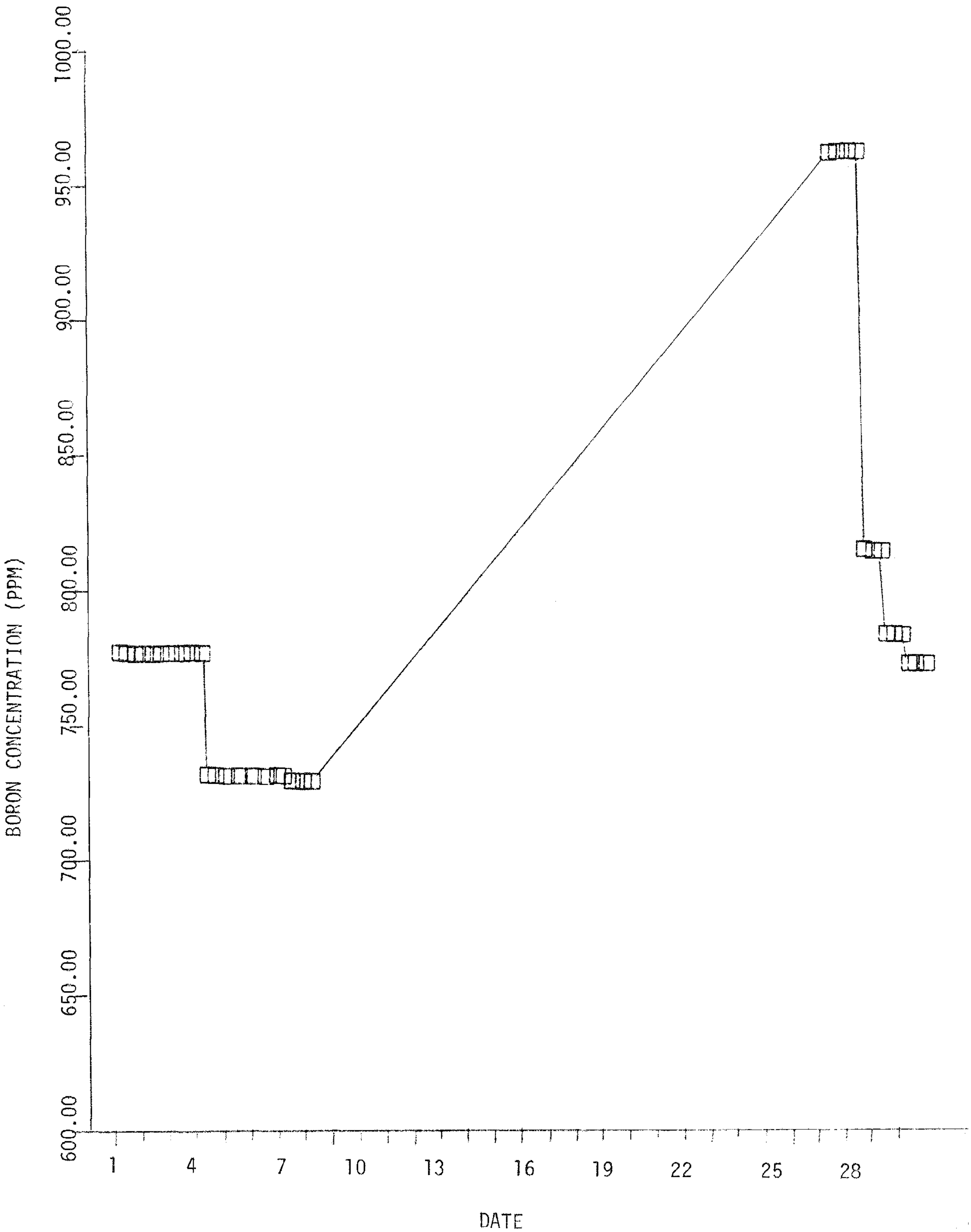


Figure 4-35. Boron Concentration (Chemical Analysis) - September 1979

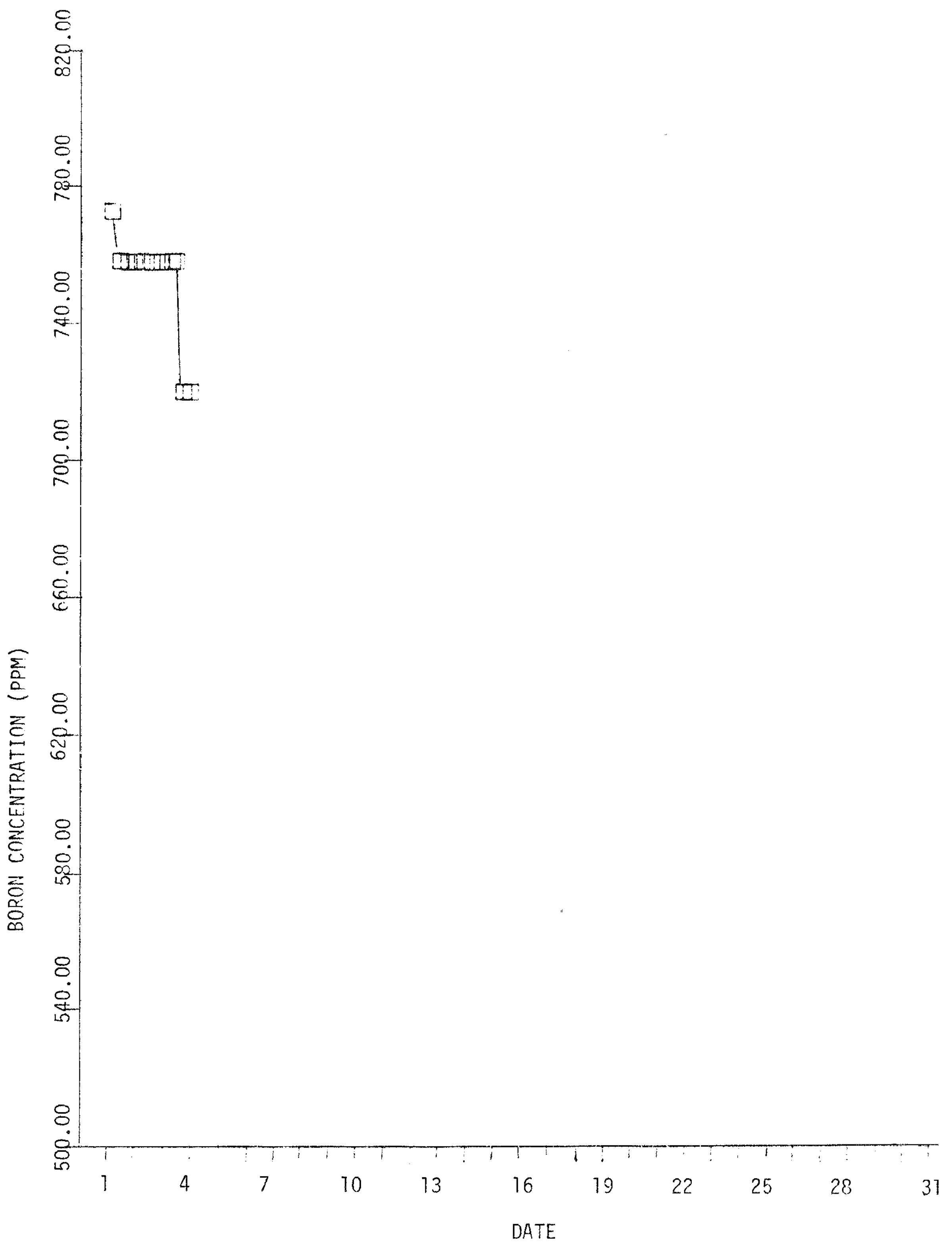


Figure 4-36. Boron Concentration (Chemical Analysis) - October 1979

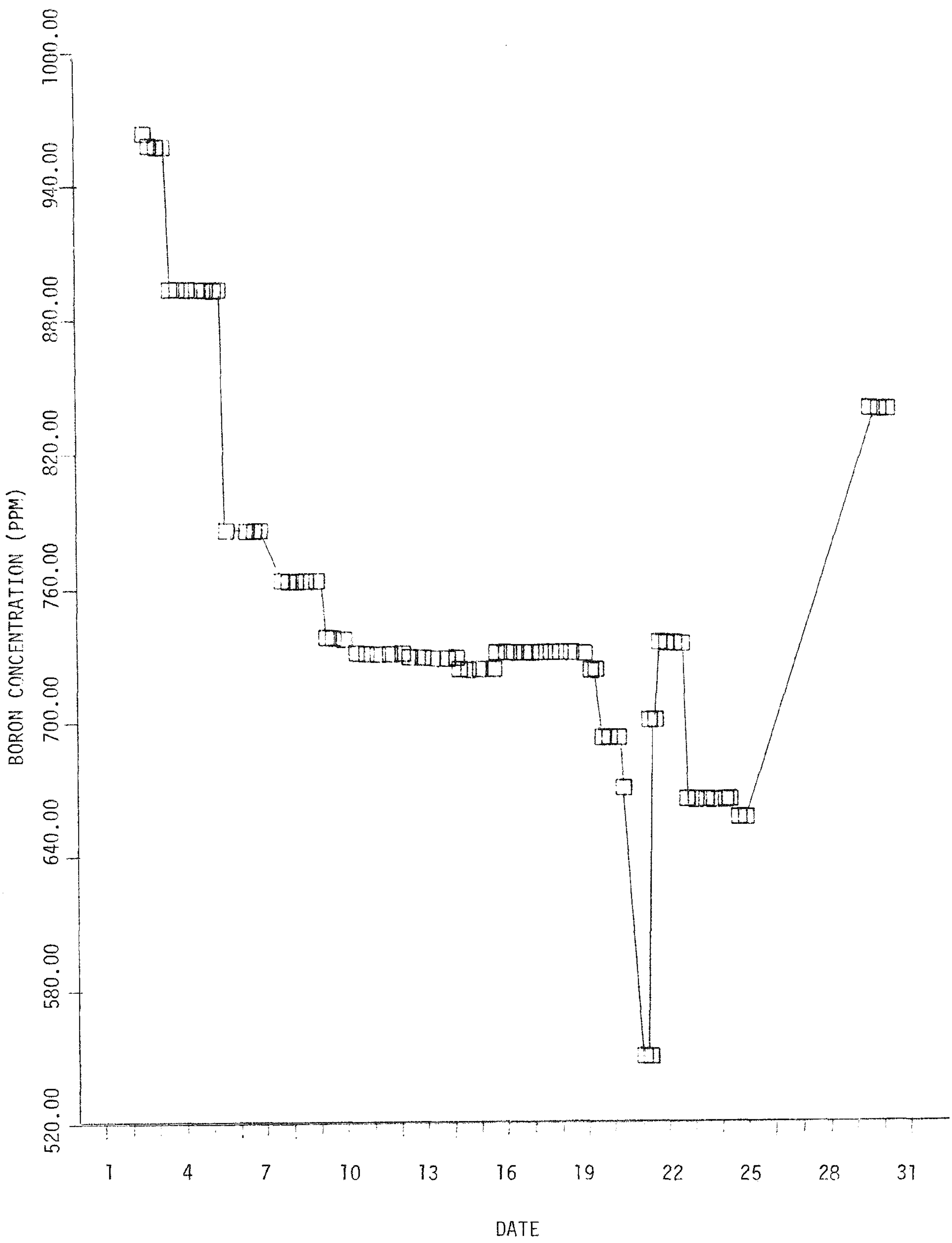


Figure 4-37. Boron Concentration (Chemical Analysis) - December 1979

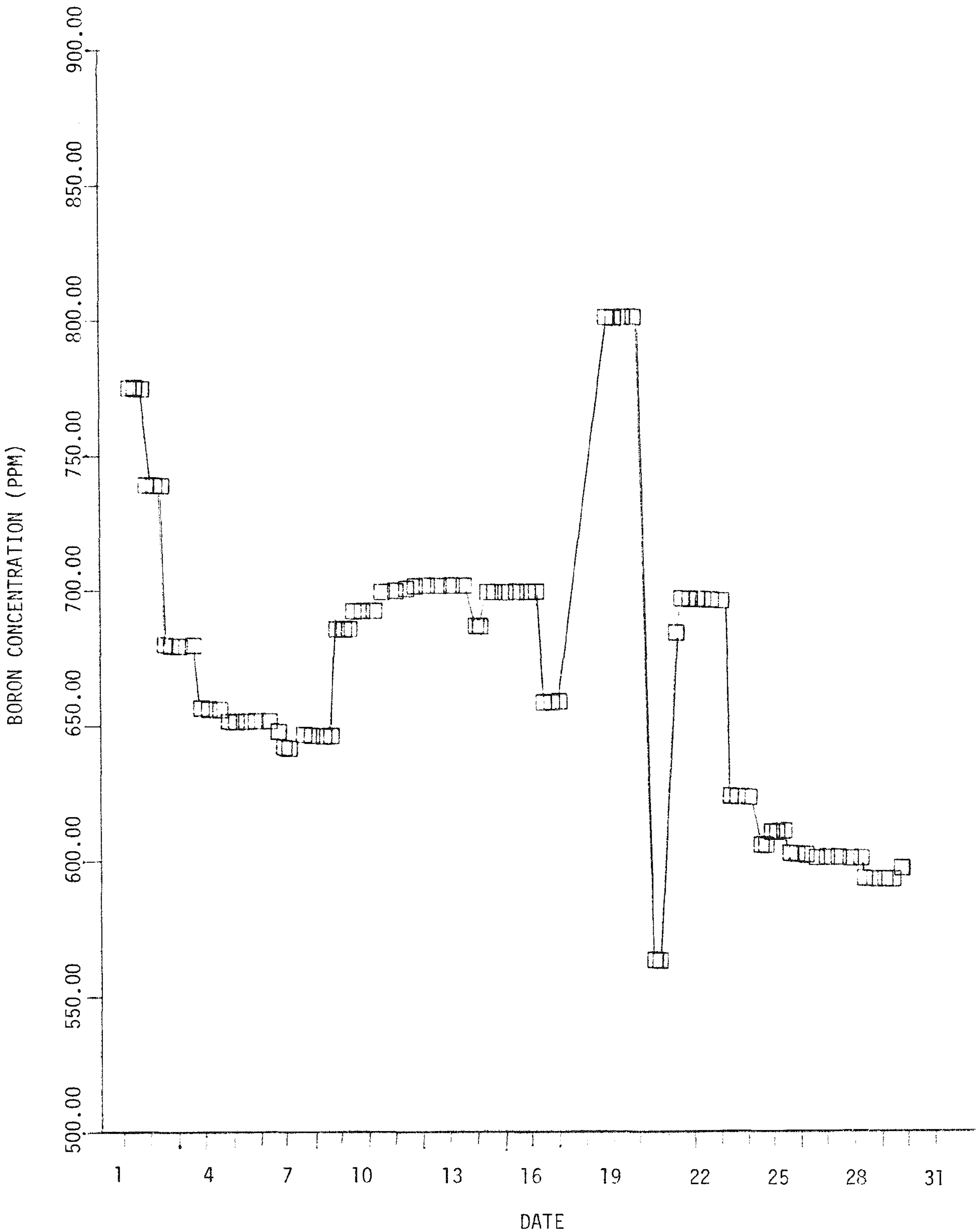


Figure 4-38. Boron Concentration (Chemical Analysis) - January 1980

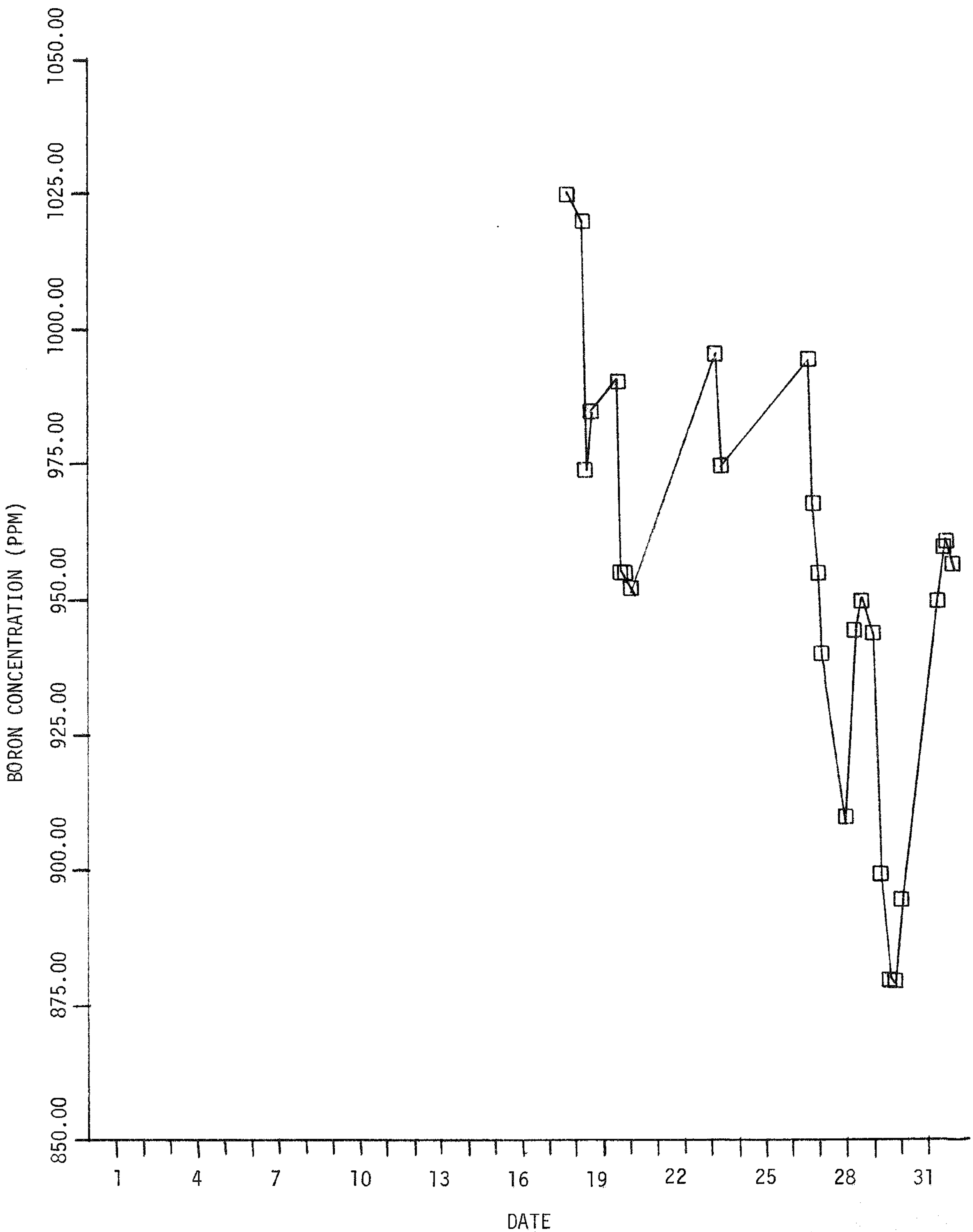


Figure 4-39. Boron Concentration (Boronometer) - December 1978

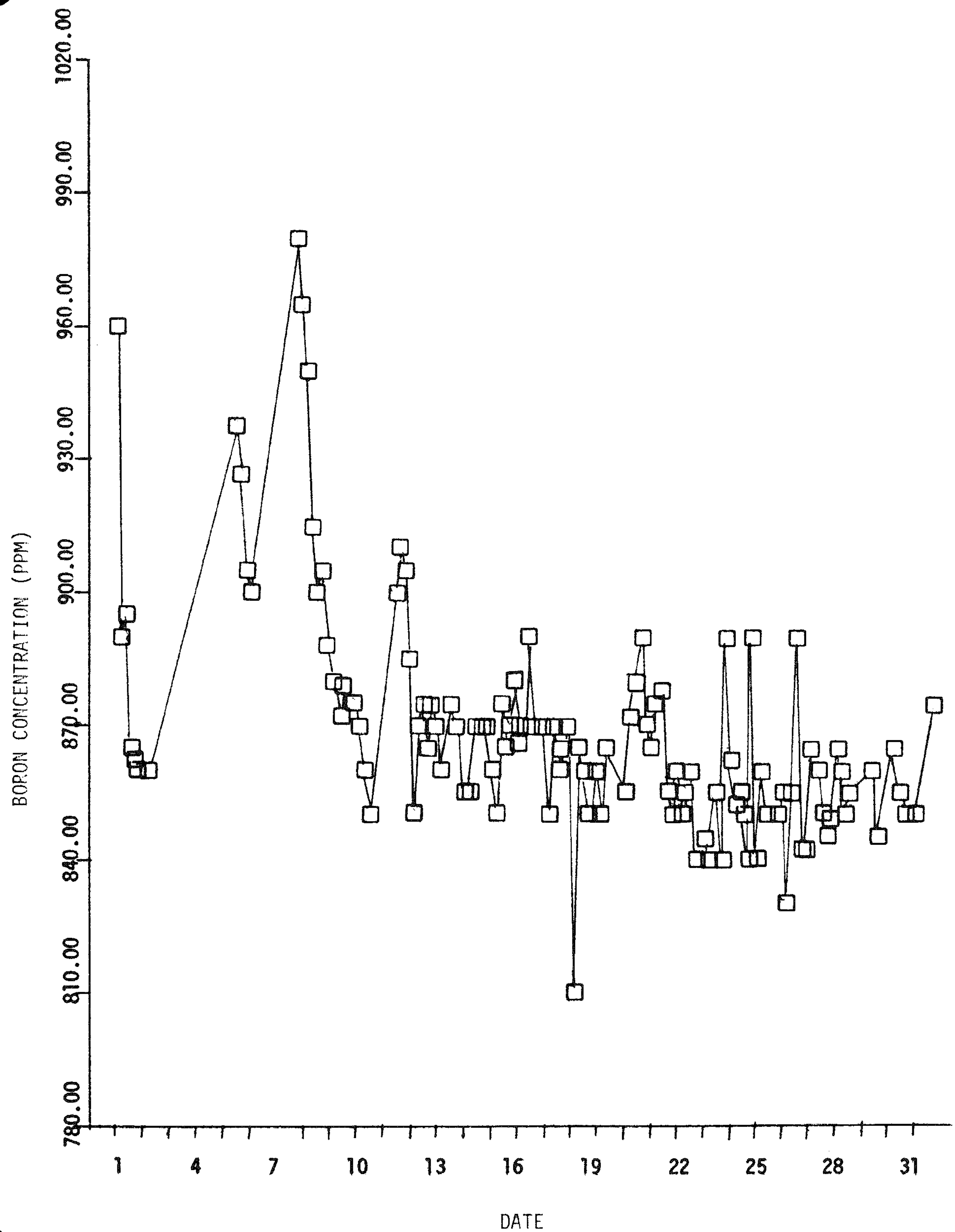


Figure 4-40. Boron Concentration (Boronometer) - January 1979

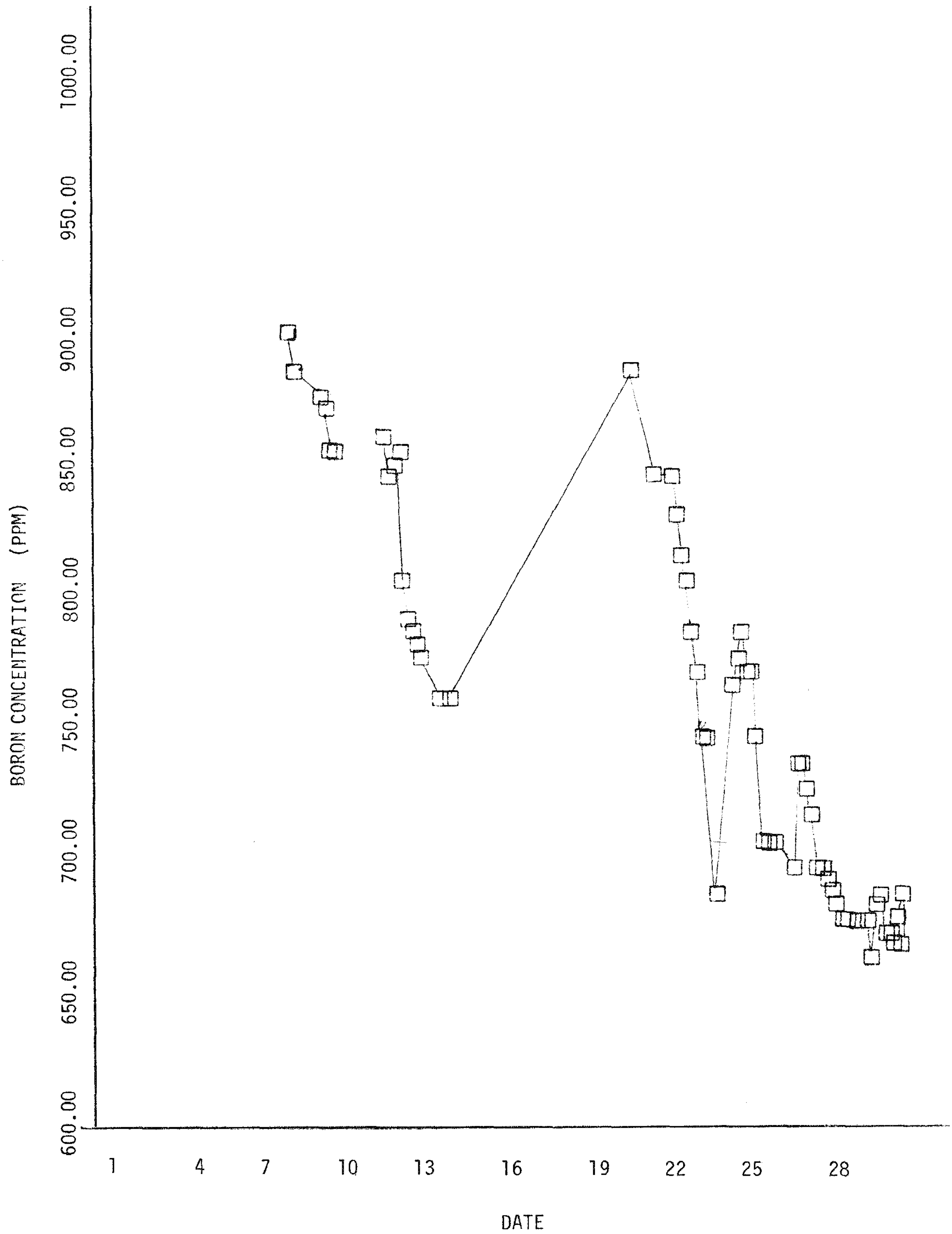


Figure 4-41. Boron Concentration (Boronometer) - June 1979

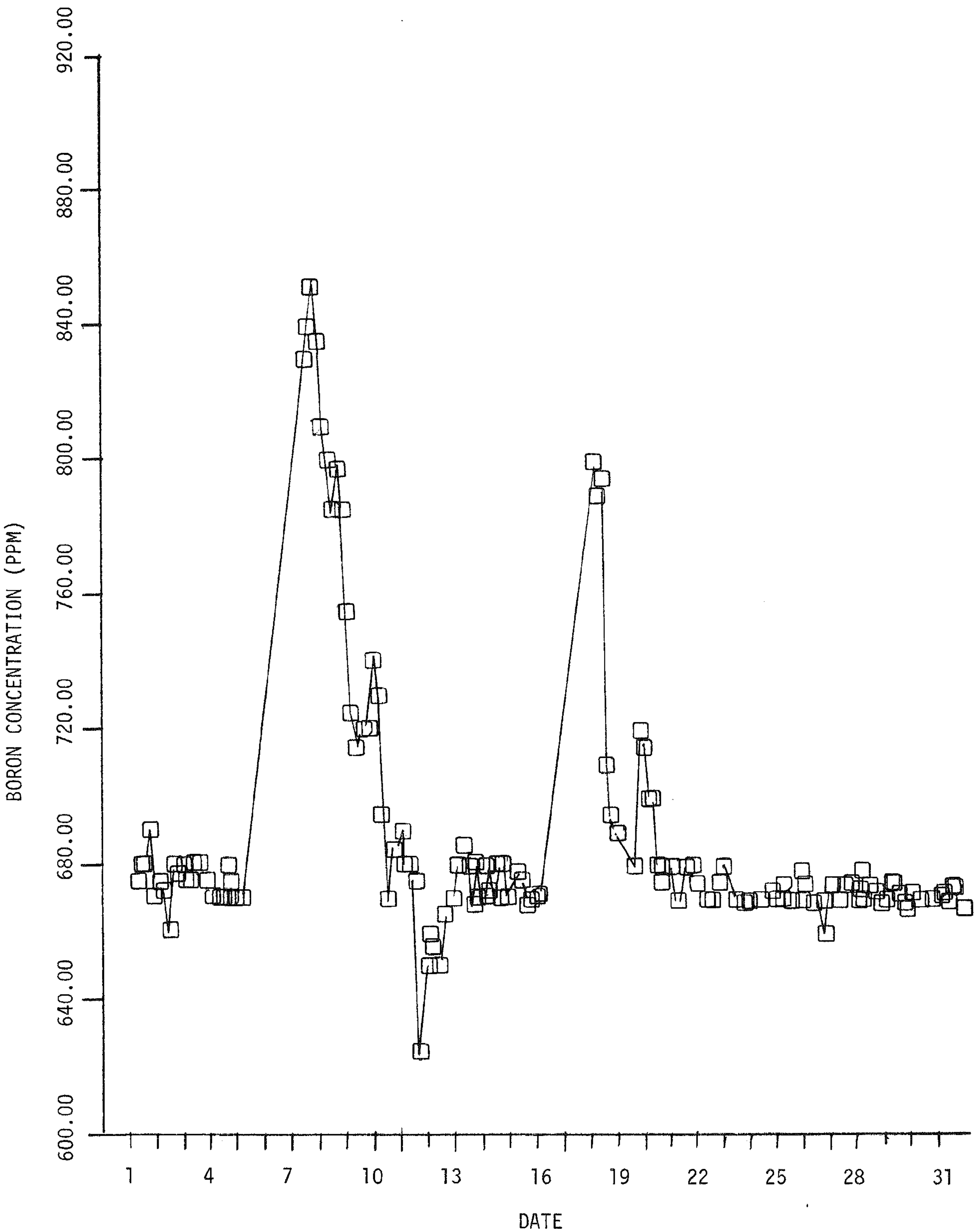


Figure 4-42. Boron Concentration (Boronometer) - July 1979

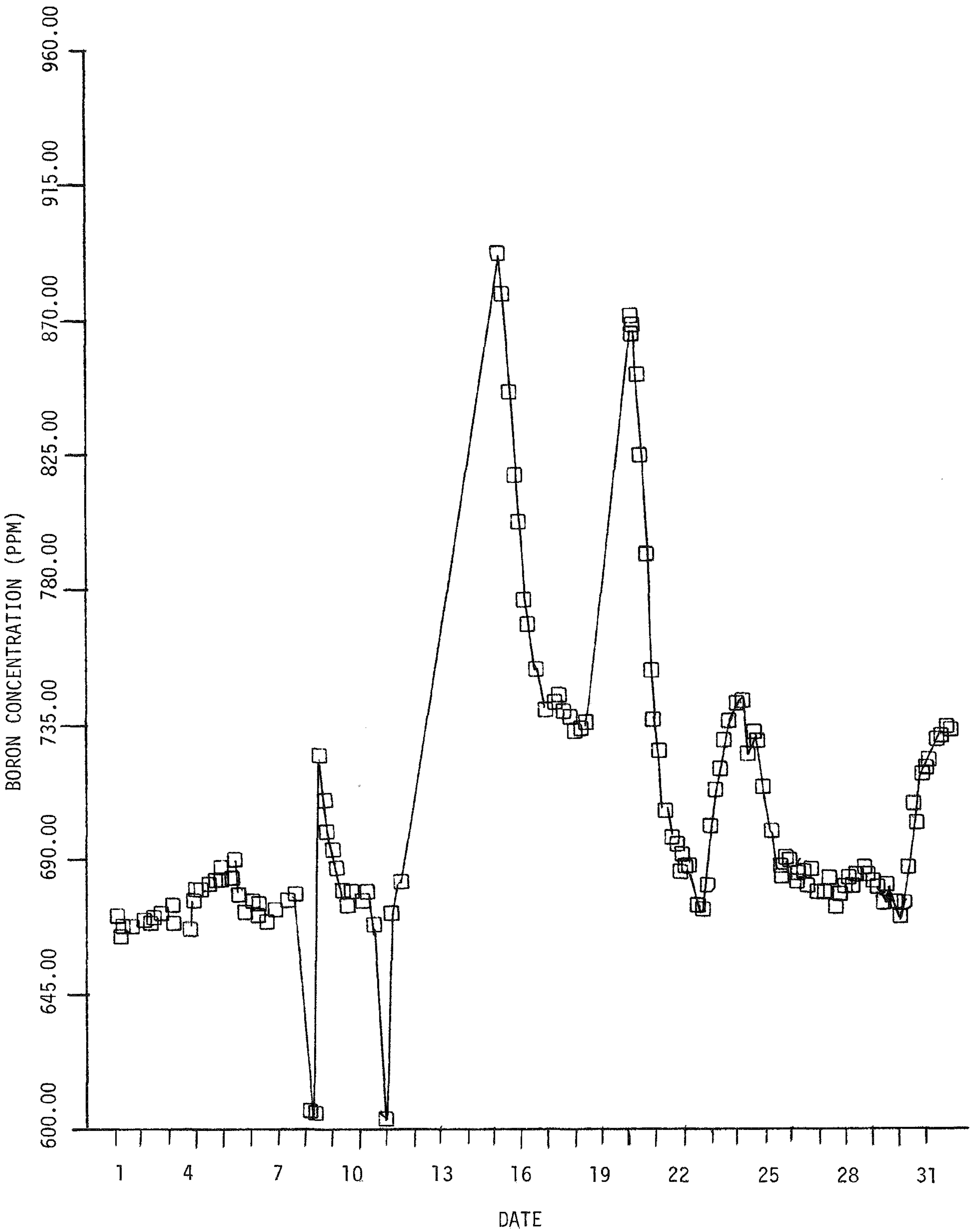


Figure 4-43. Boron Concentration (Boronometer) - August 1979

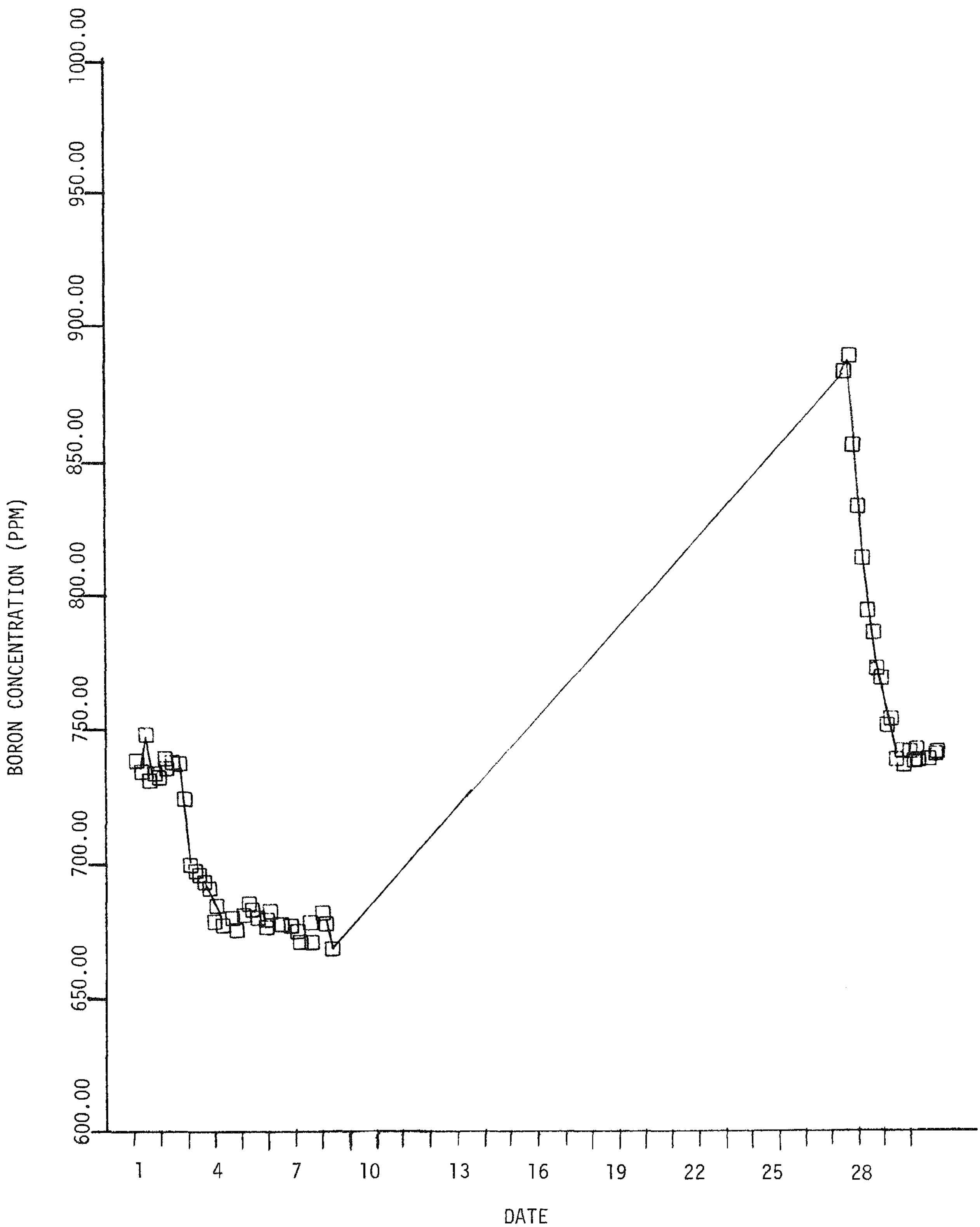


Figure 4-44. Boron Concentration (Boronometer) - September 1979

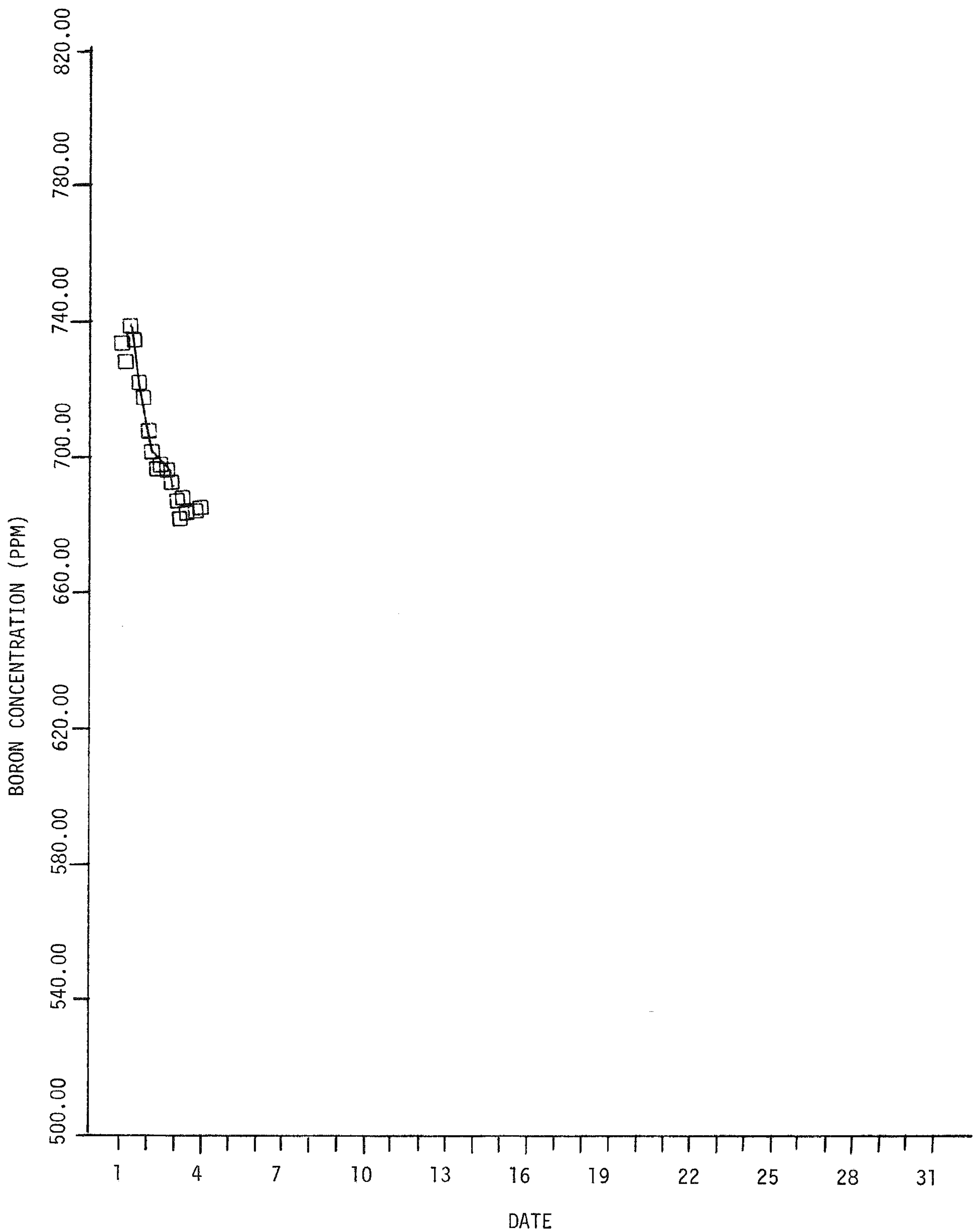


Figure 4-45. Boron Concentration (Boronometer) - October 1979

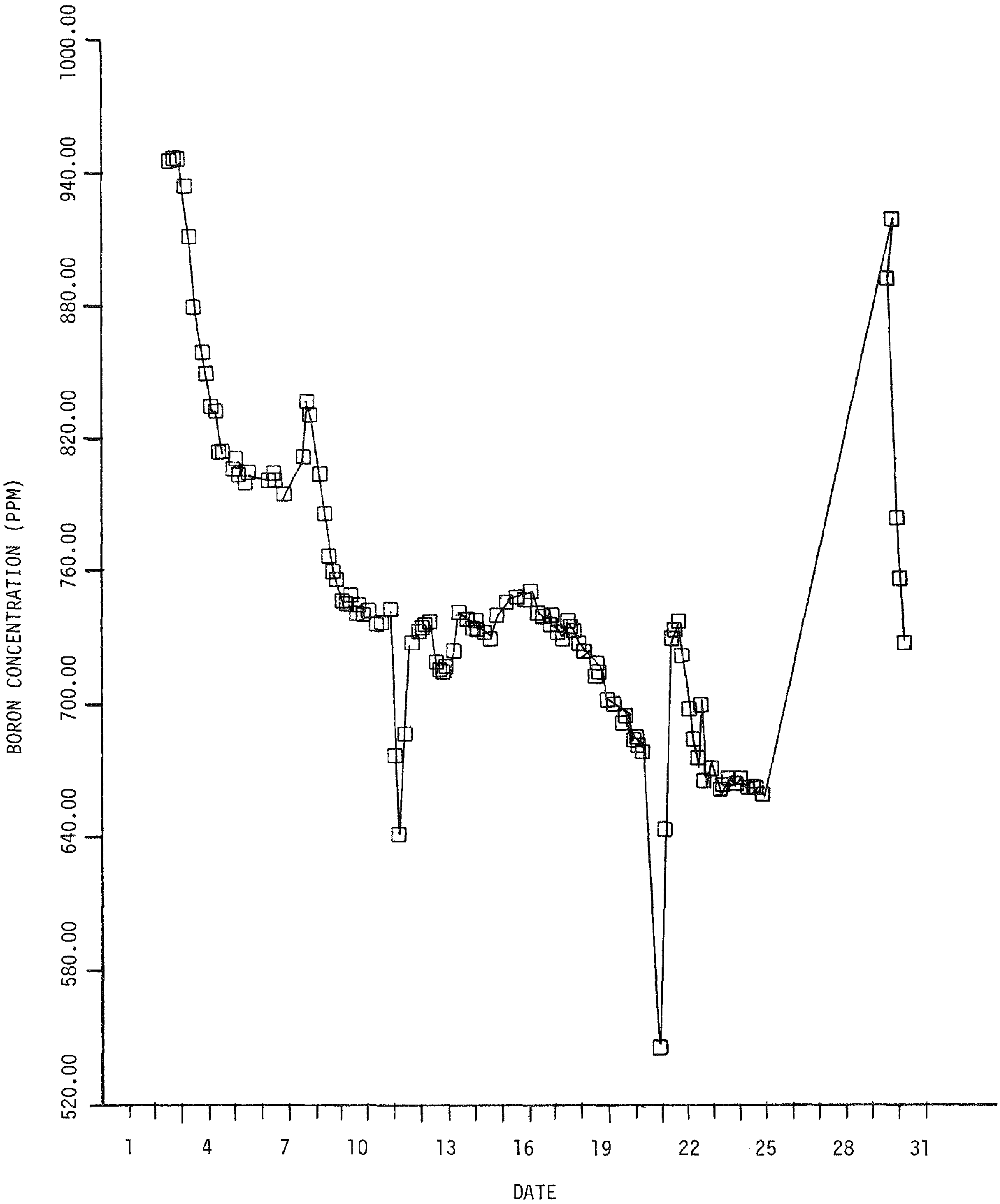


Figure 4-46. Boron Concentration (Boronometer) - December 1979

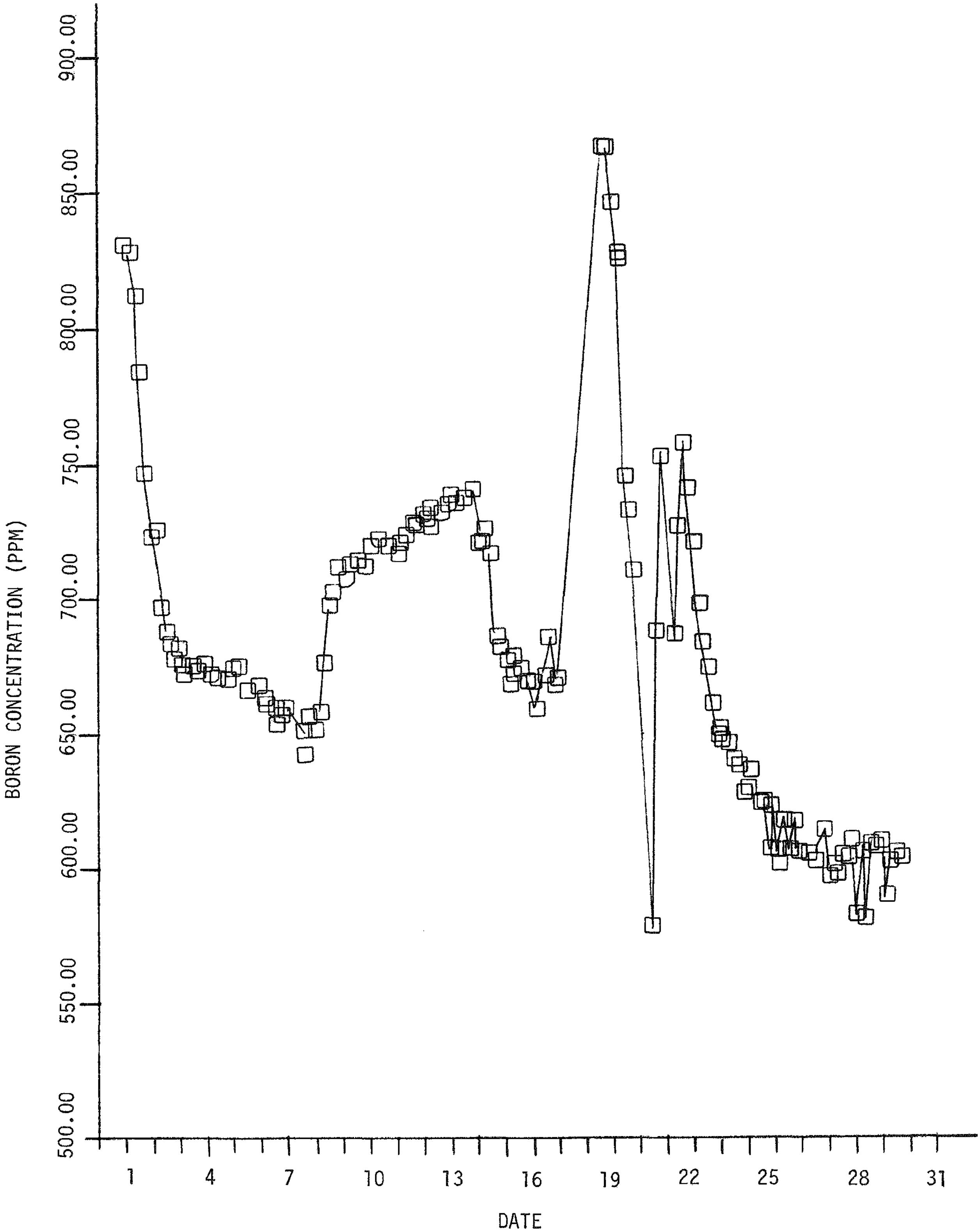


Figure 4-47. Boron Concentration (Boronometer) - January 1980

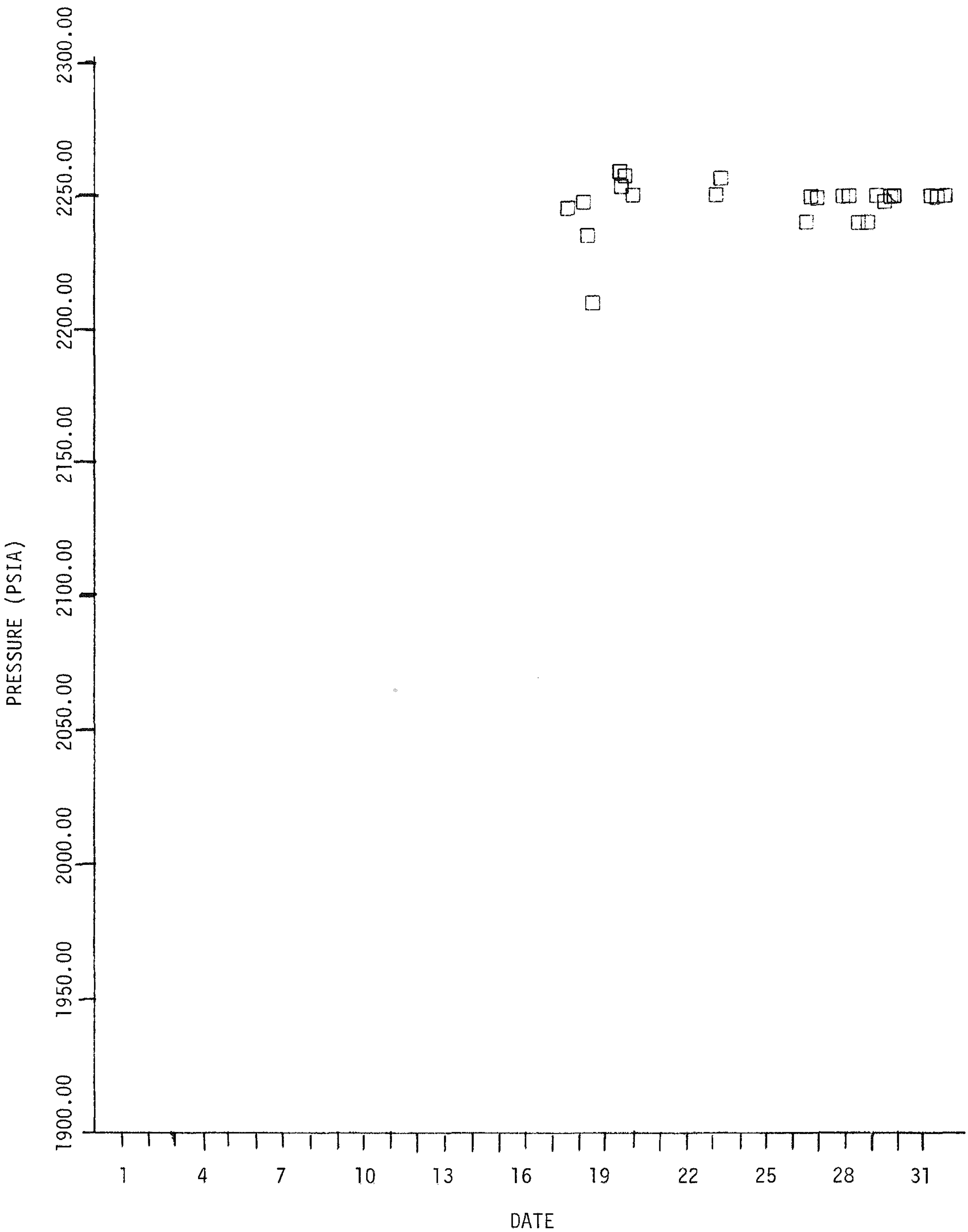


Figure 4-48. Pressurizer Pressure - December 1978

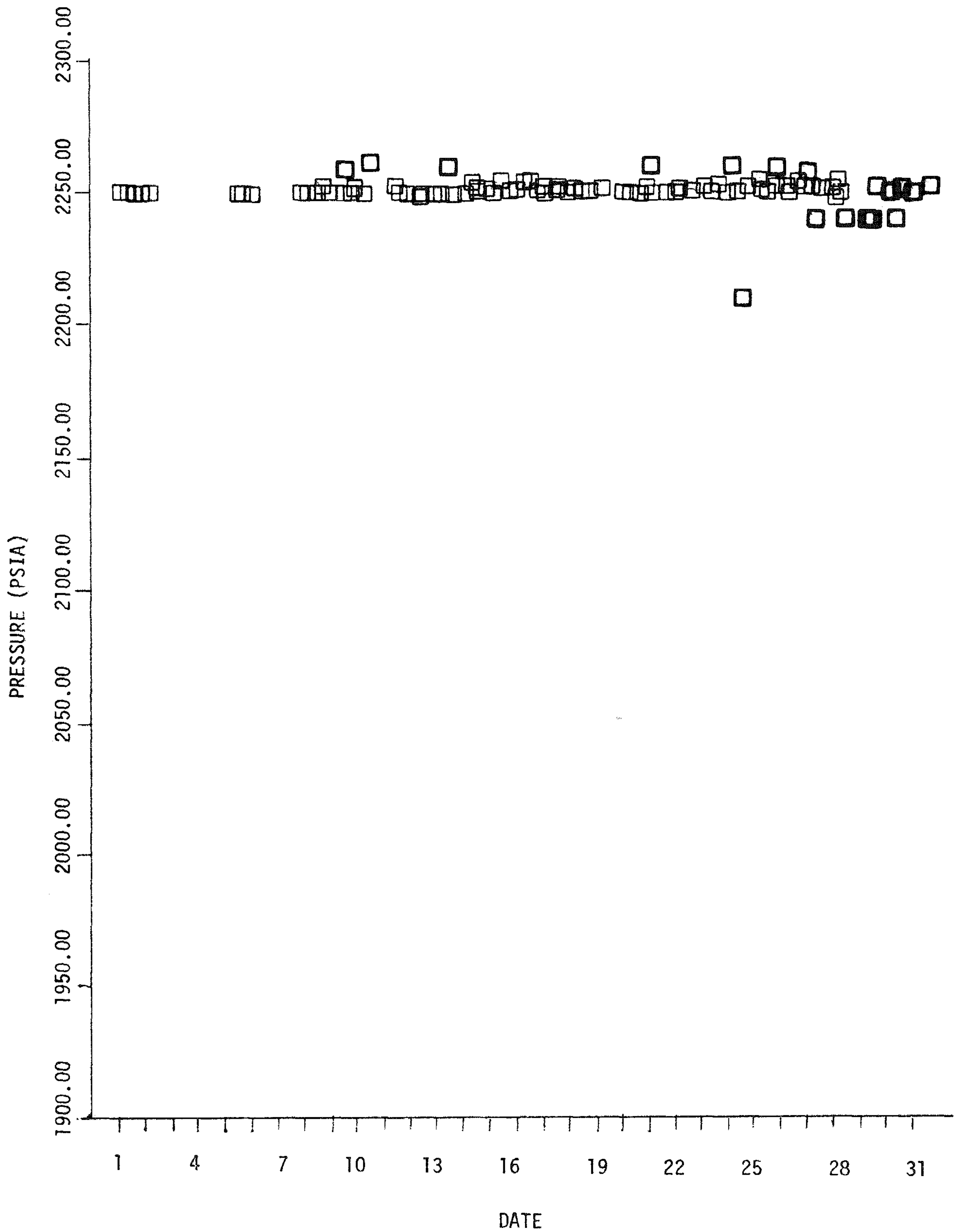


Figure 4-49. Pressurizer Pressure - January 1979

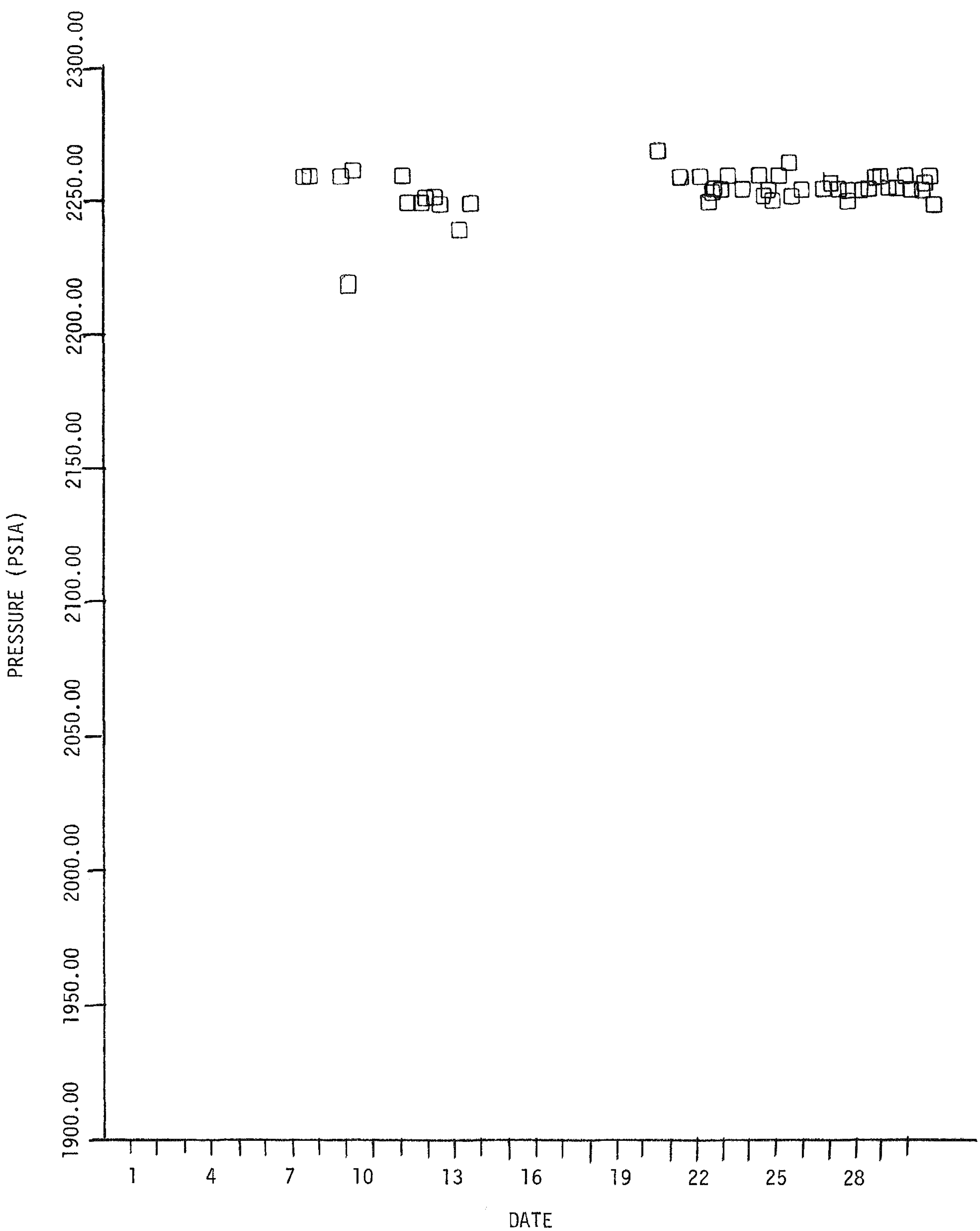


Figure 4-50. Pressurizer Pressure - June 1979

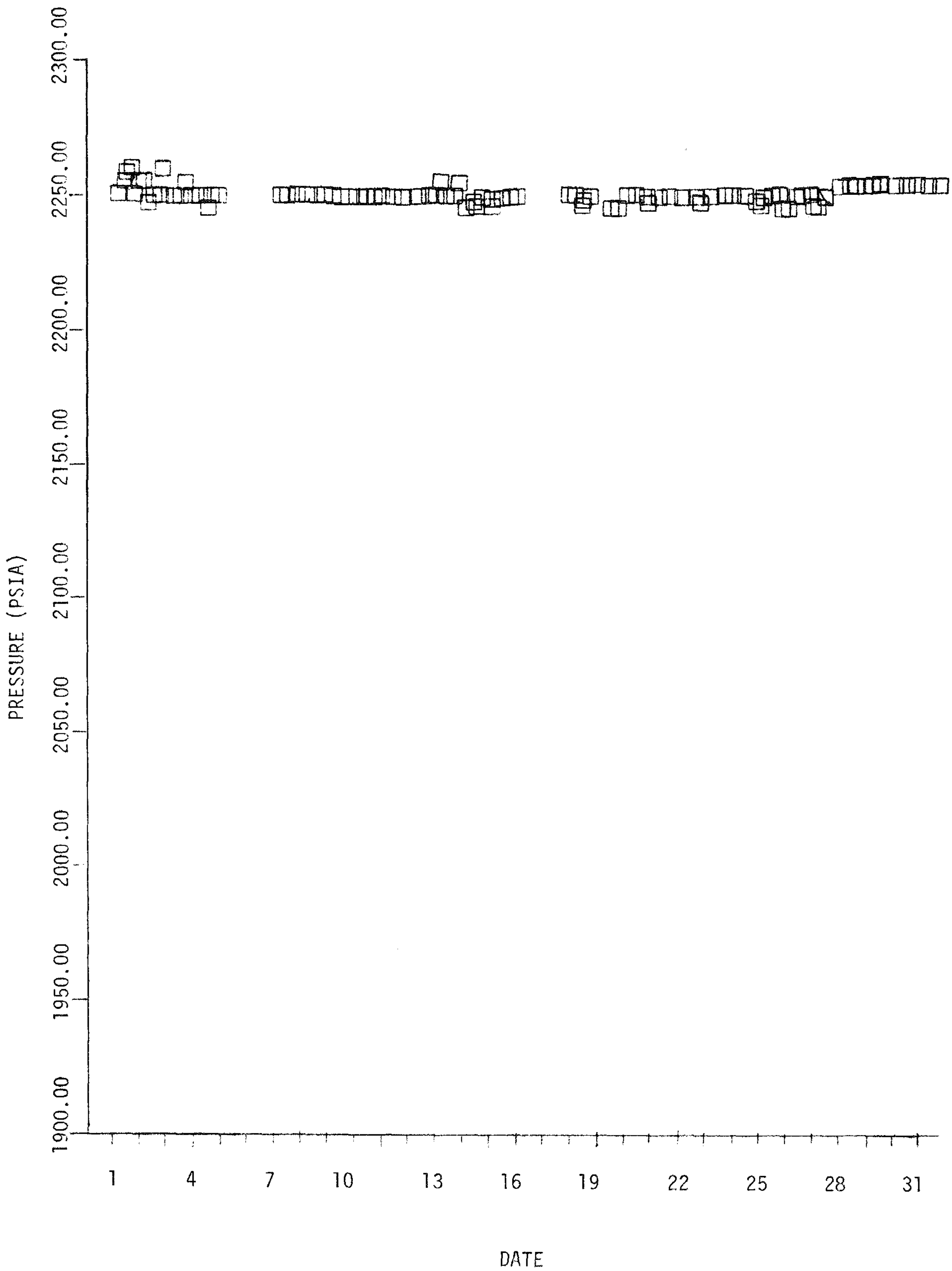


Figure 4-51. Pressurizer Pressure - July 1979

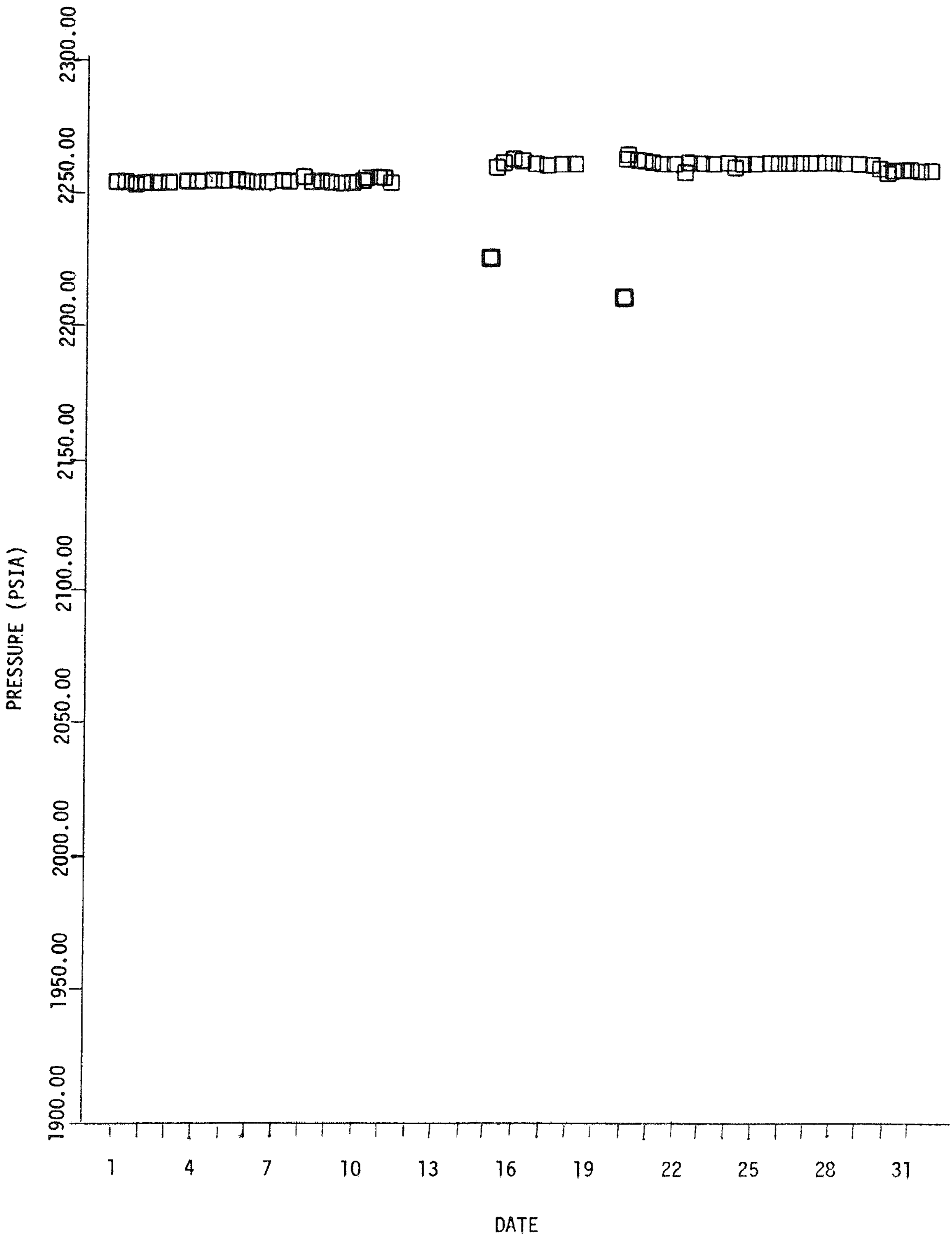


Figure 4-52. Pressurizer Pressure - August 1979

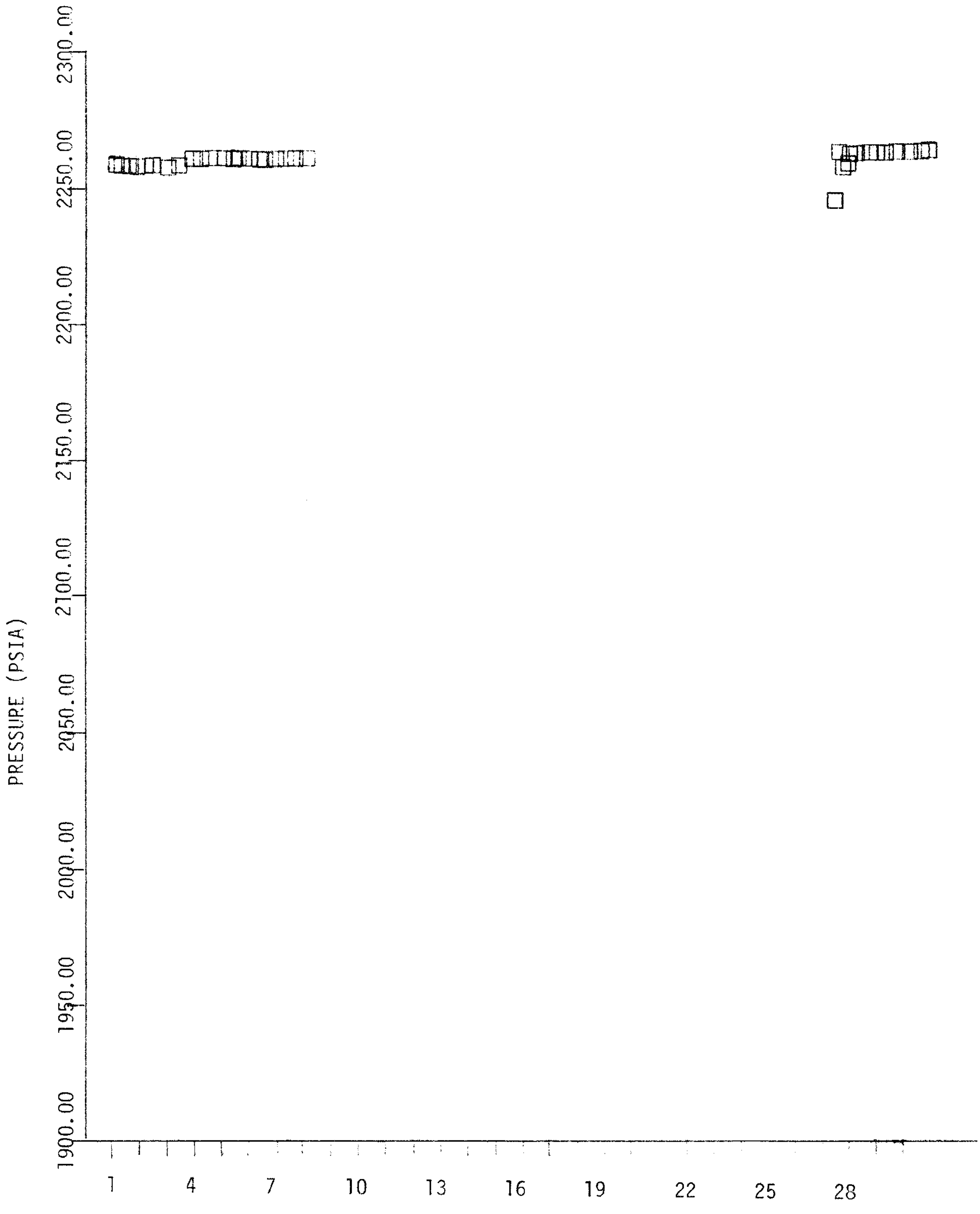


Figure 4-53. Pressurizer Pressure - September 1979

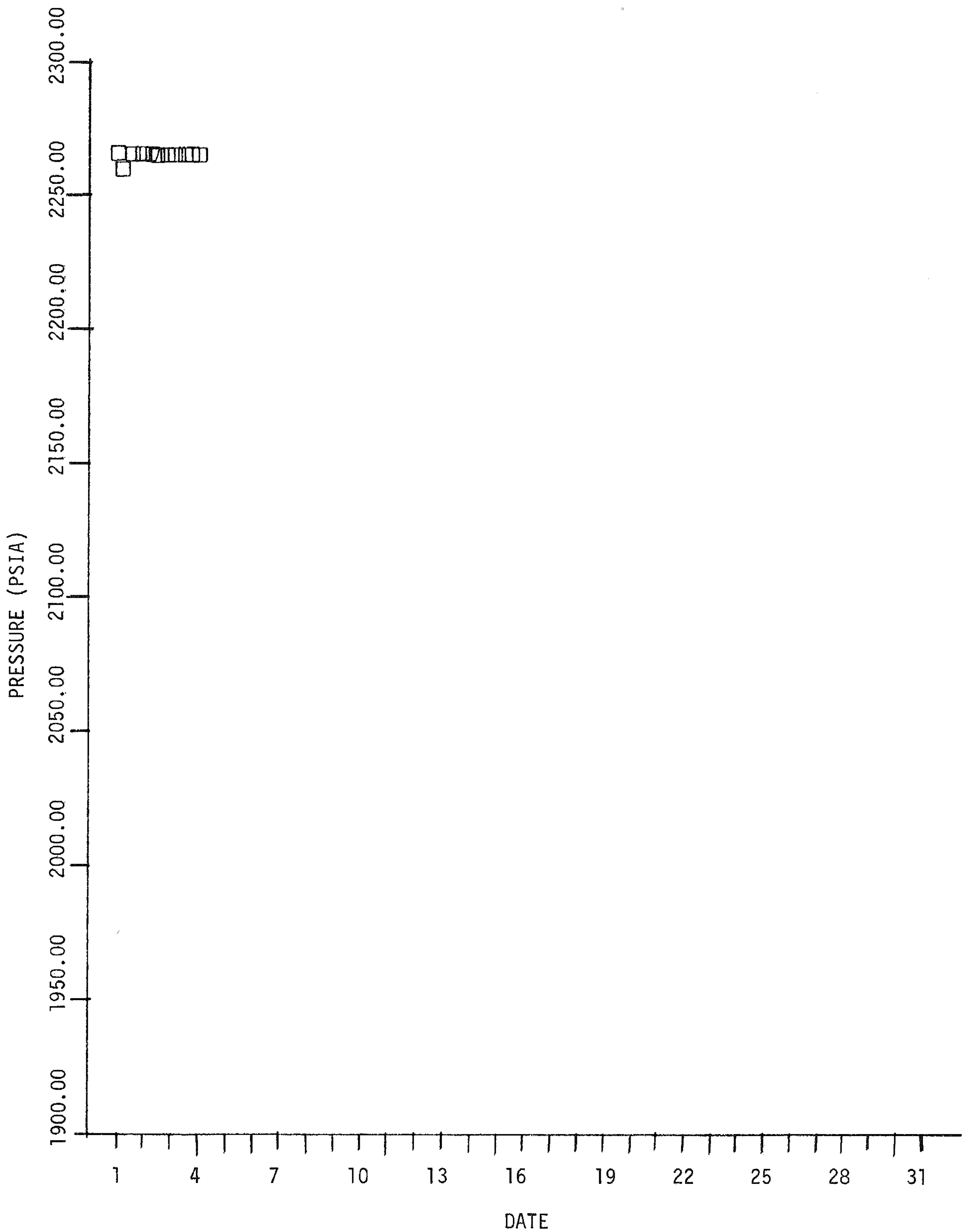


Figure 4-54. Pressurizer Pressure - October 1979

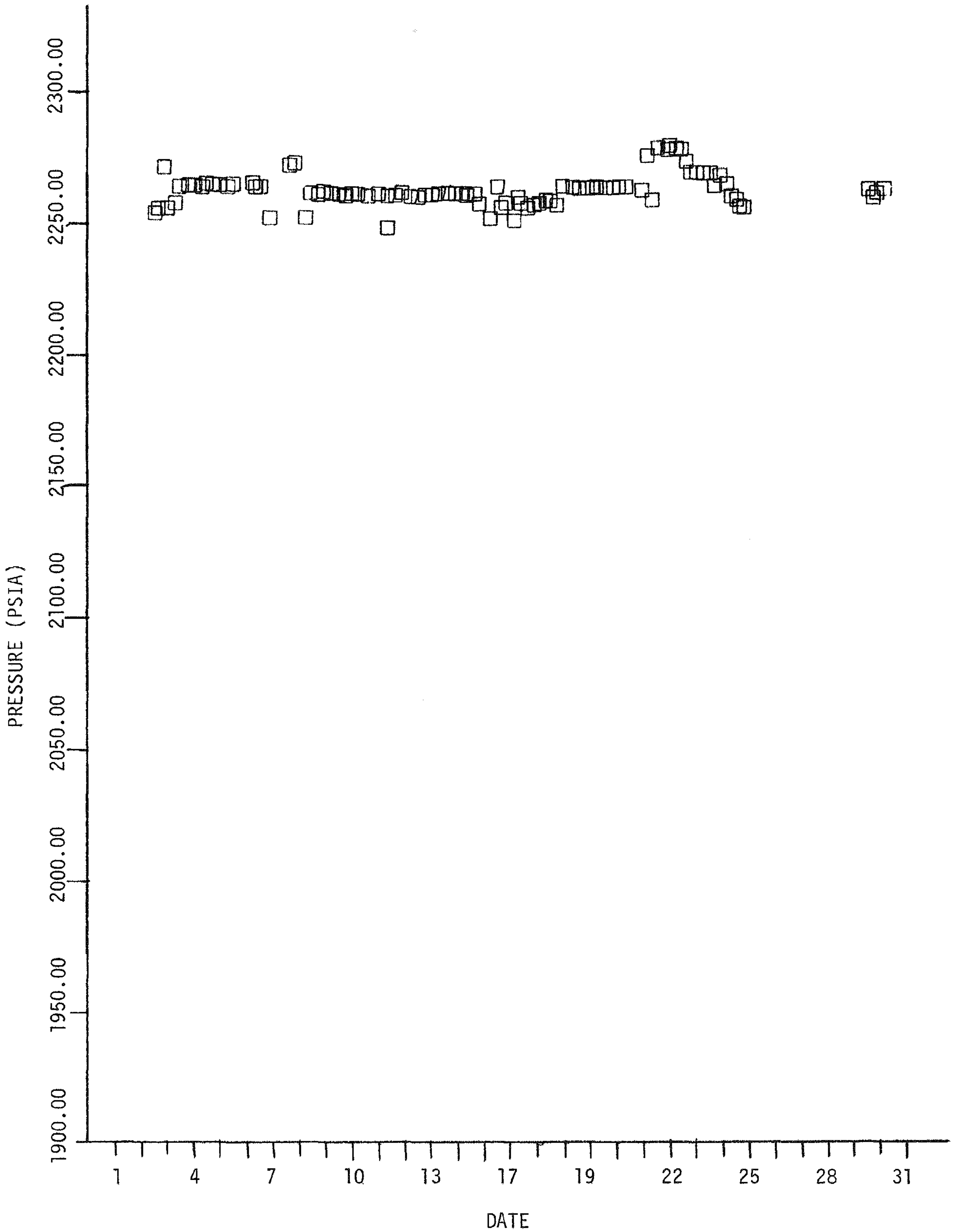


Figure 4-55. Pressurizer Pressure - December 1979

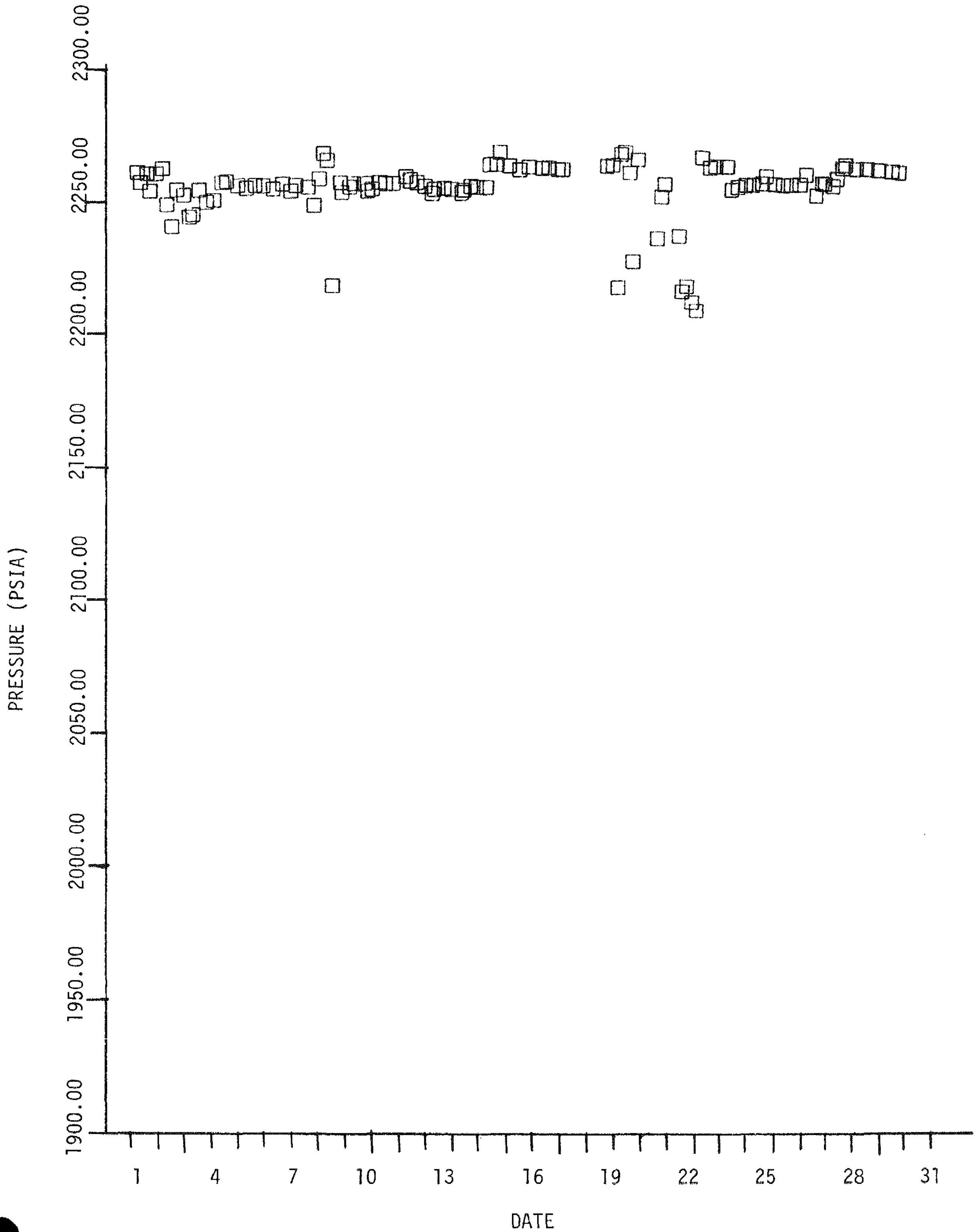


Figure 4-56. Pressurizer Pressure - January 1980

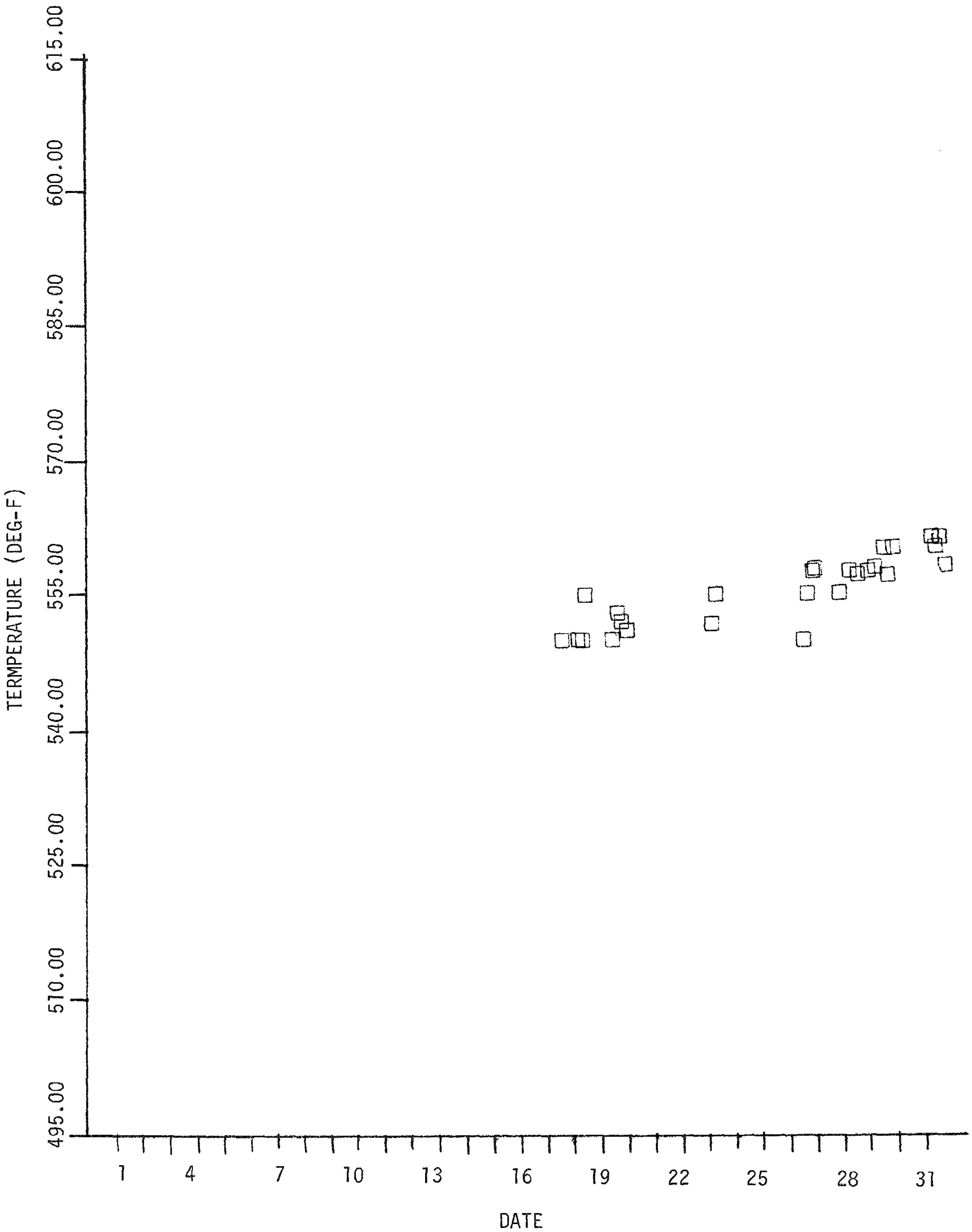


Figure 4-57. Hot Leg Temperature - December 1978

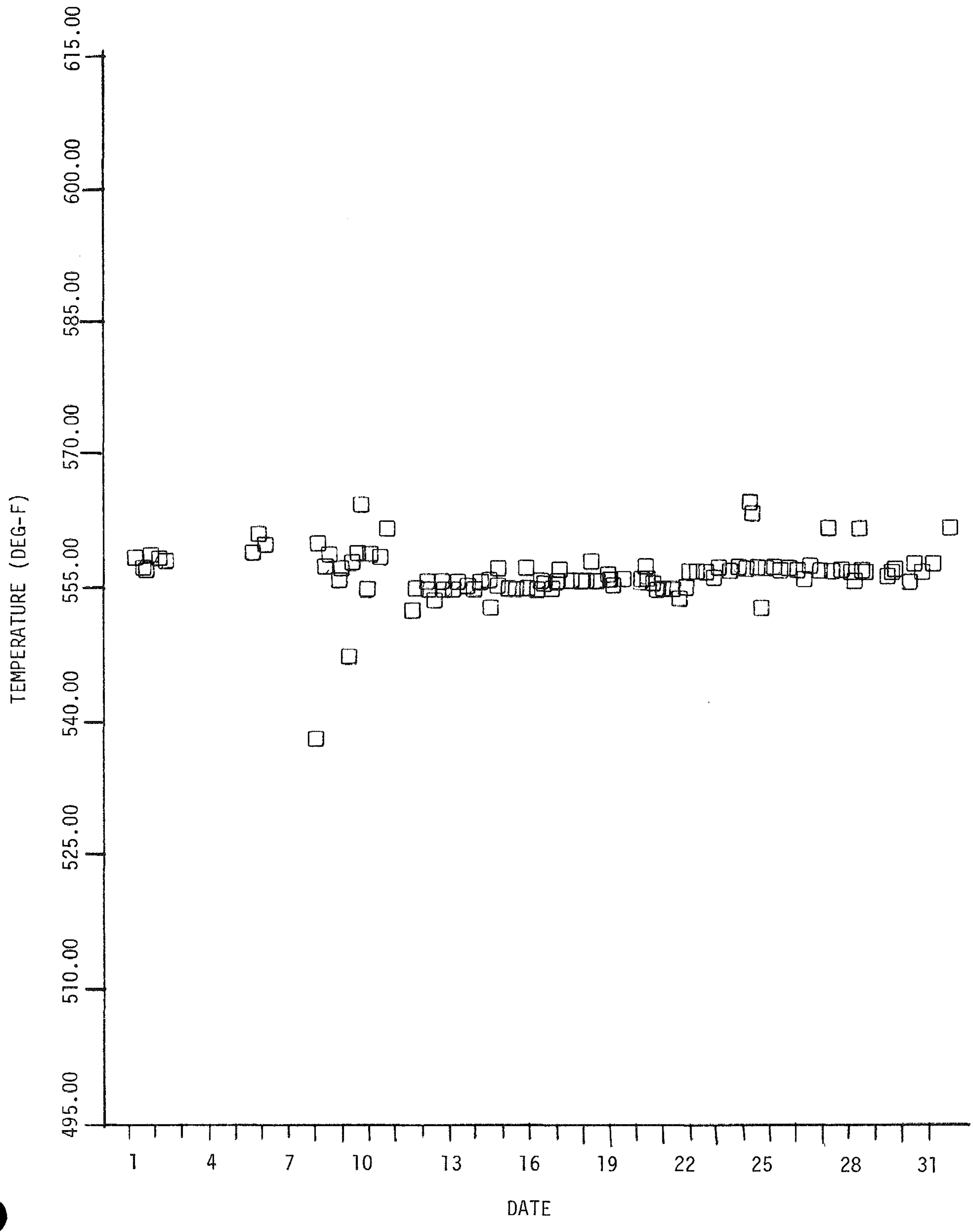


Figure 4-58. Hot Leg Temperature - January 1979

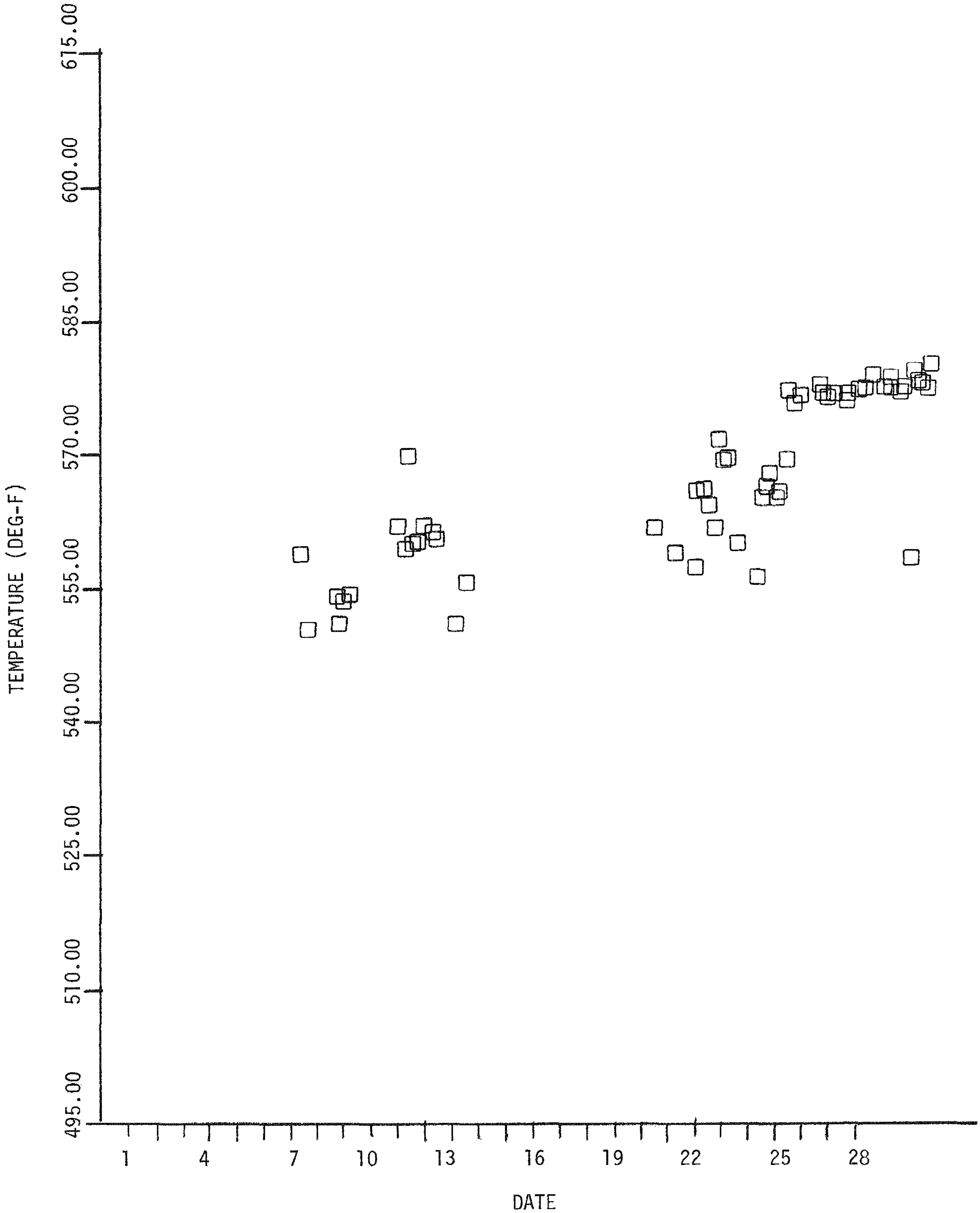


Figure 4-59. Hot Leg Temperature - June 1979

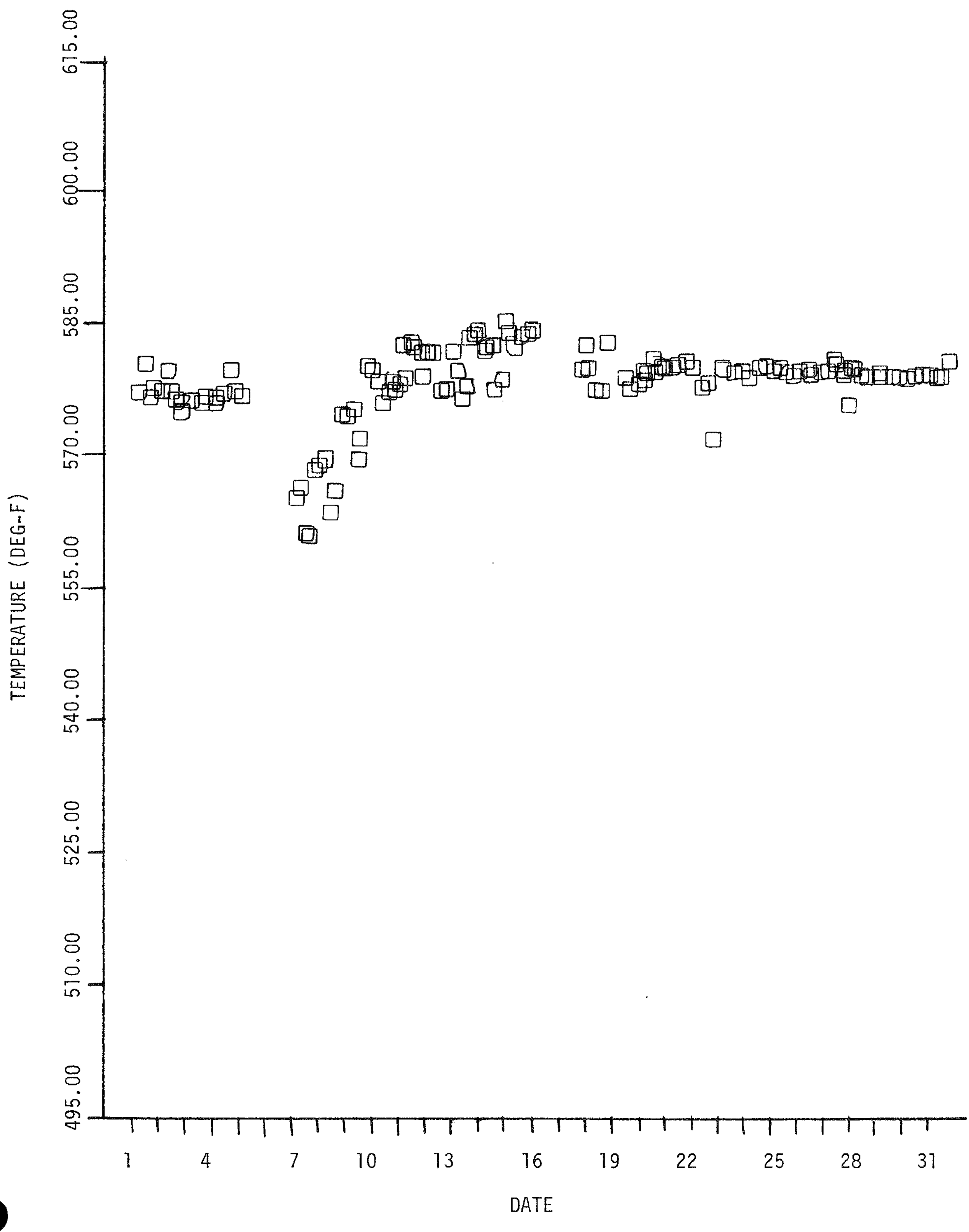


Figure 4-60. Hot Leg Temperature - July 1979

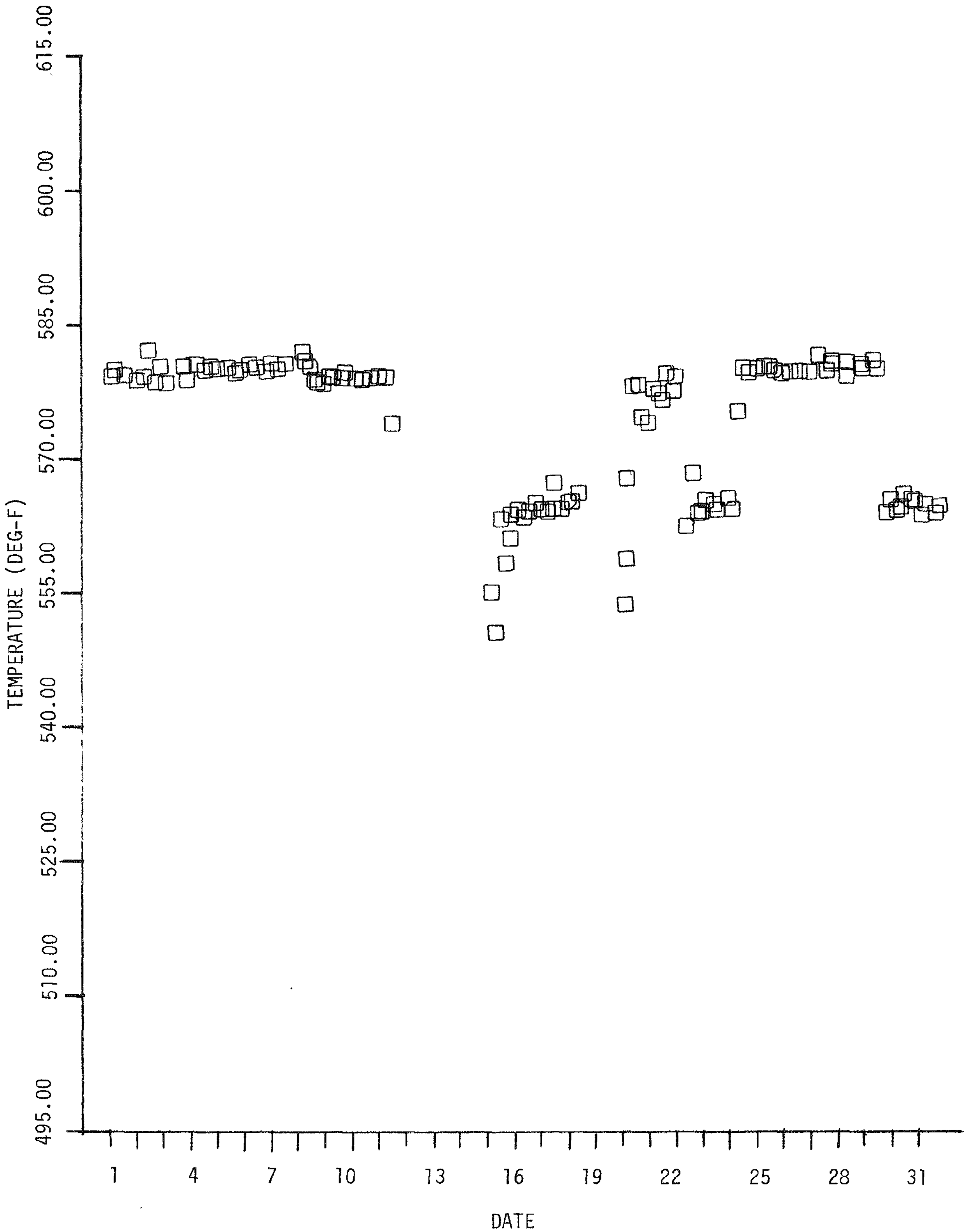


Figure 4-61. Hot Leg Temperature - August 1979

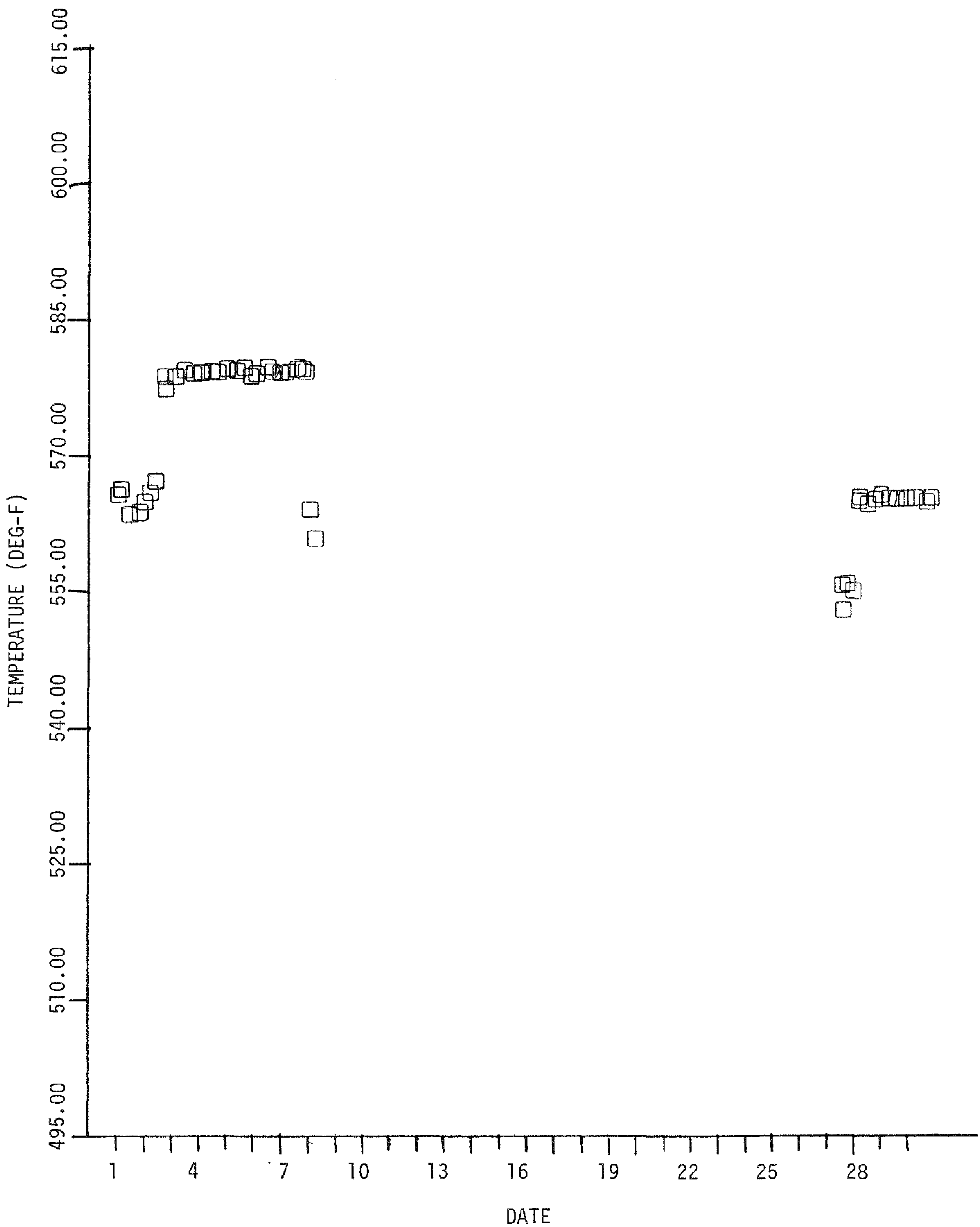


Figure 4-62. Hot Leg Temperature - September 1979

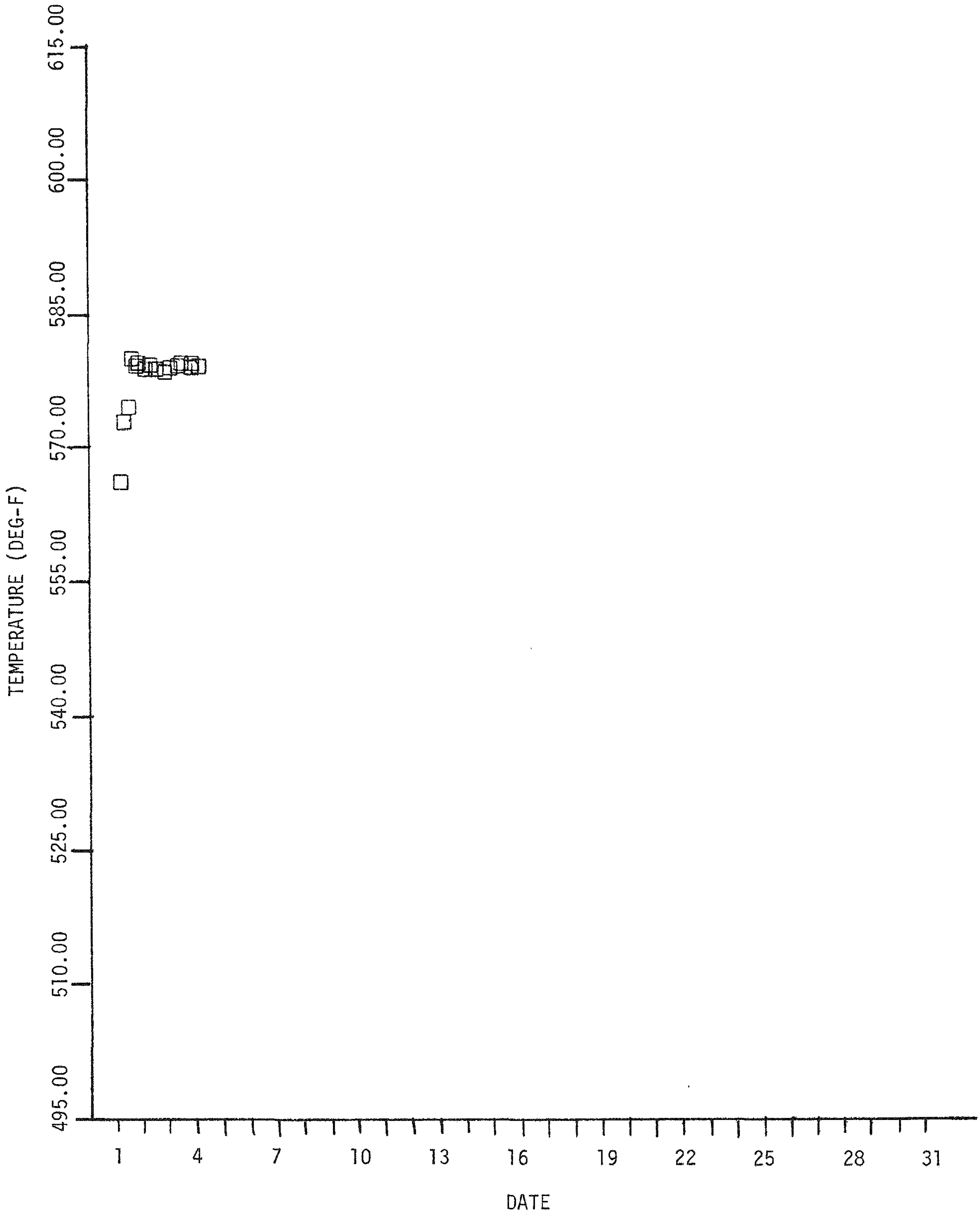


Figure 4-63. Hot Leg Temperature - October 1979

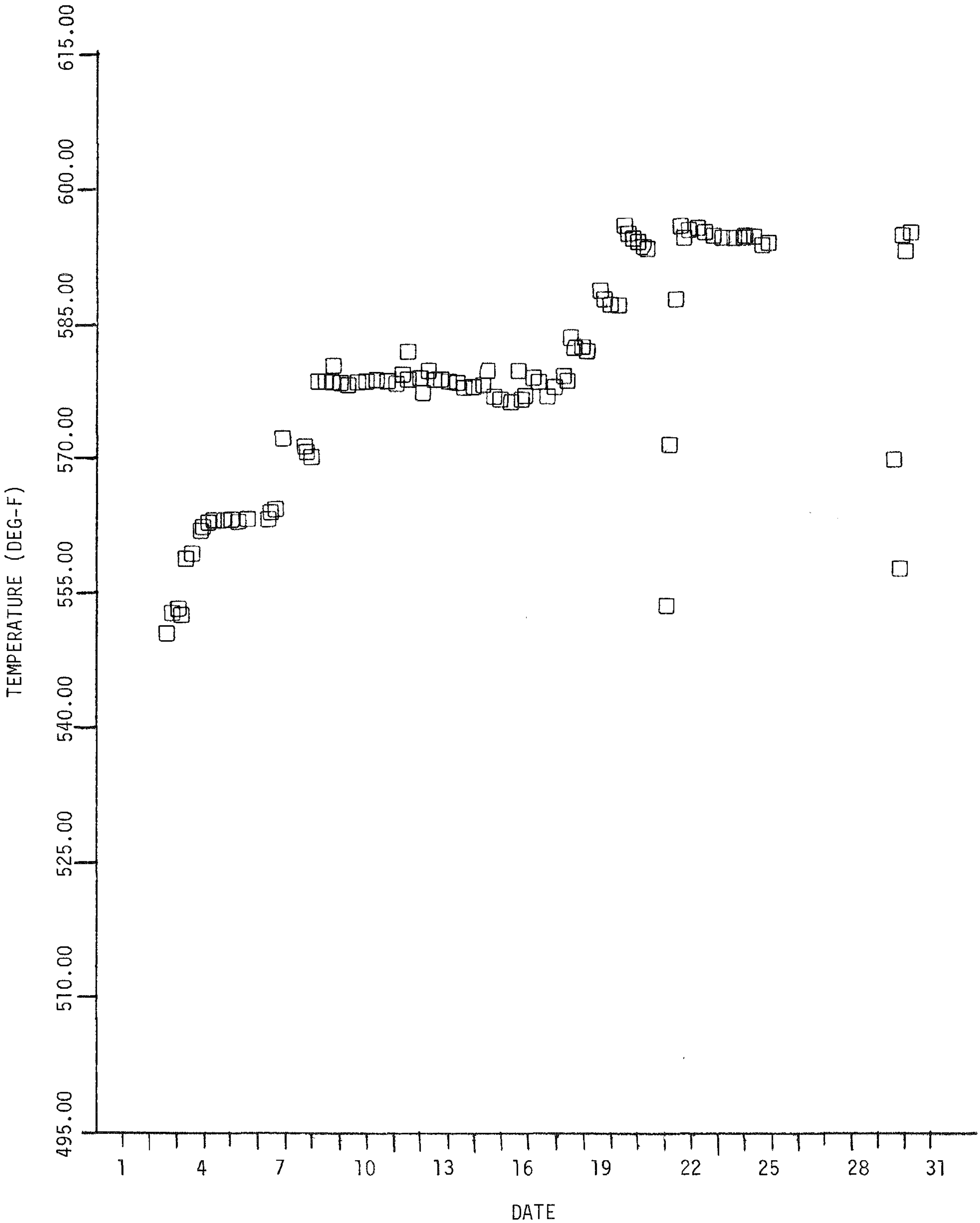


Figure 4-64. Hot Leg Temperature - December 1979

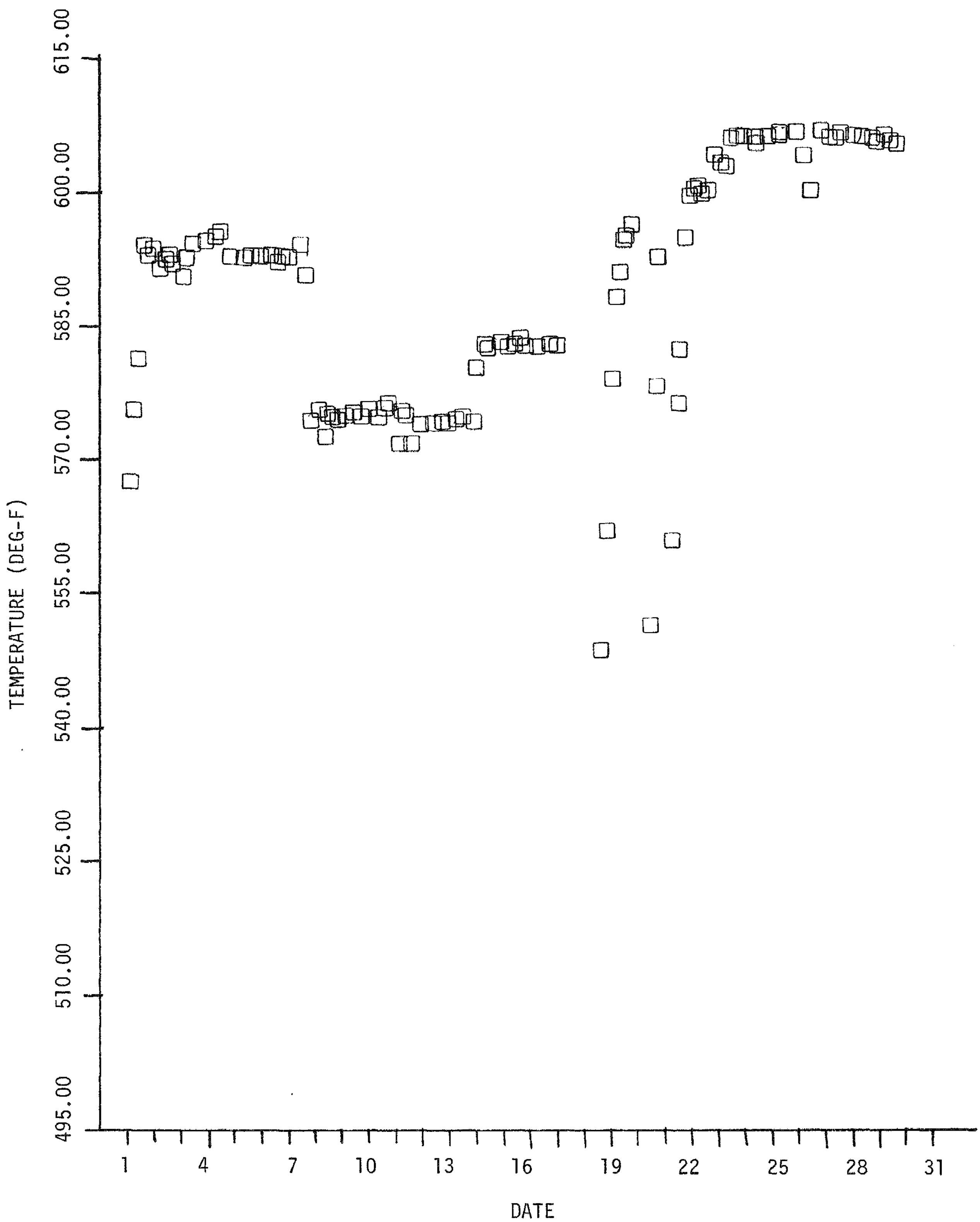


Figure 4-65. Hot Leg Temperature - January 1980

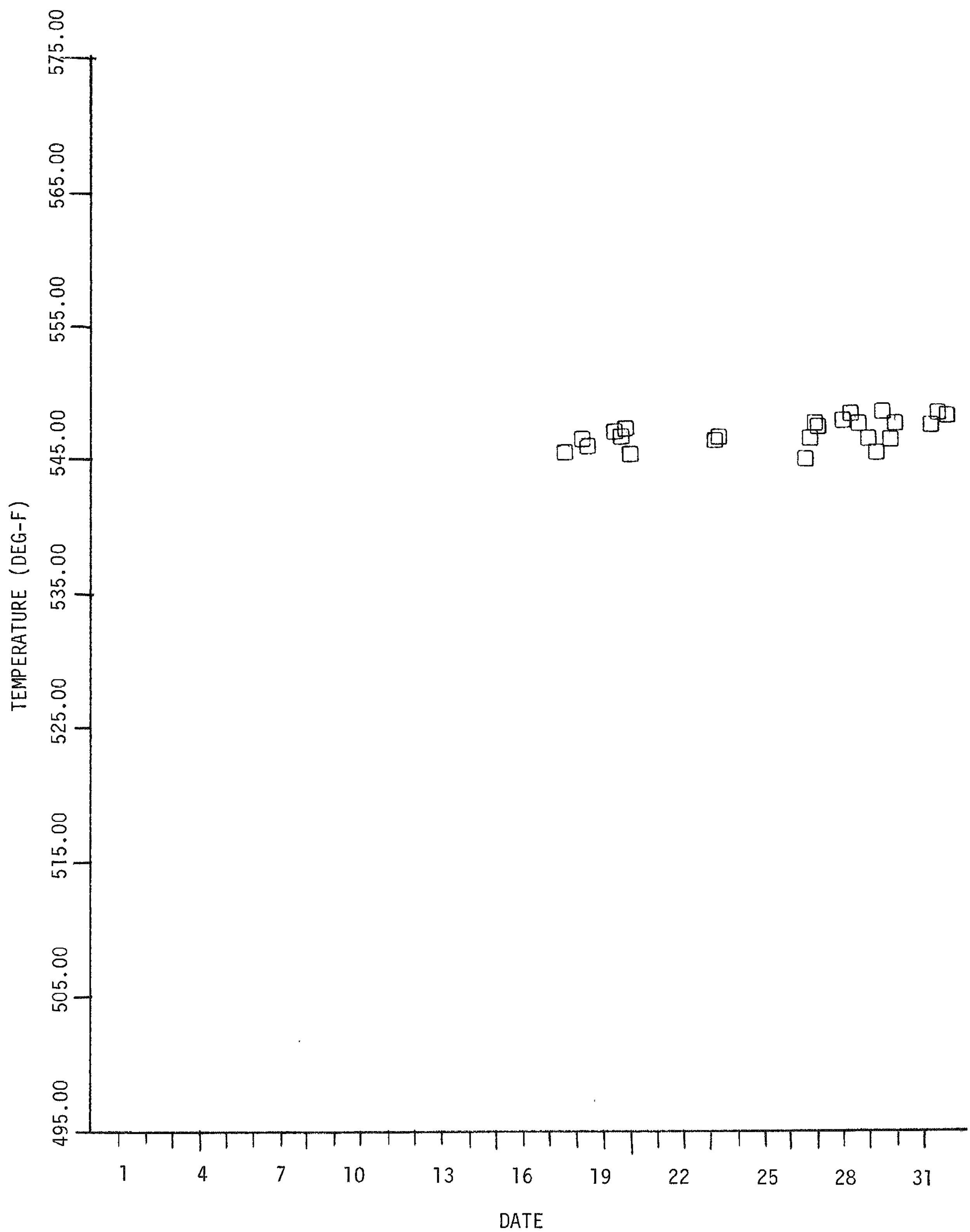


Figure 4-66. Cold Leg Temperature - December 1978

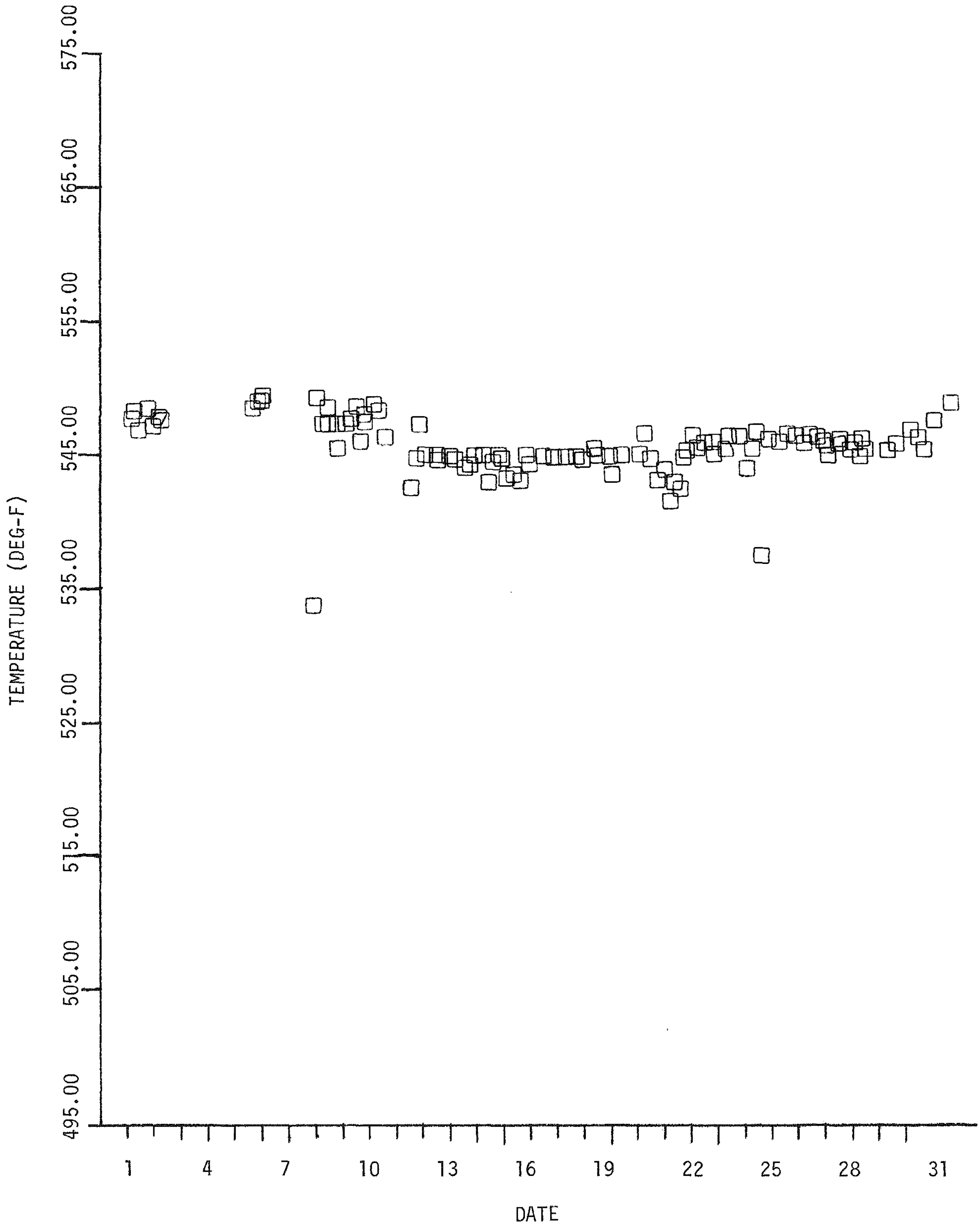


Figure 4-67. Cold Leg Temperature - January 1979

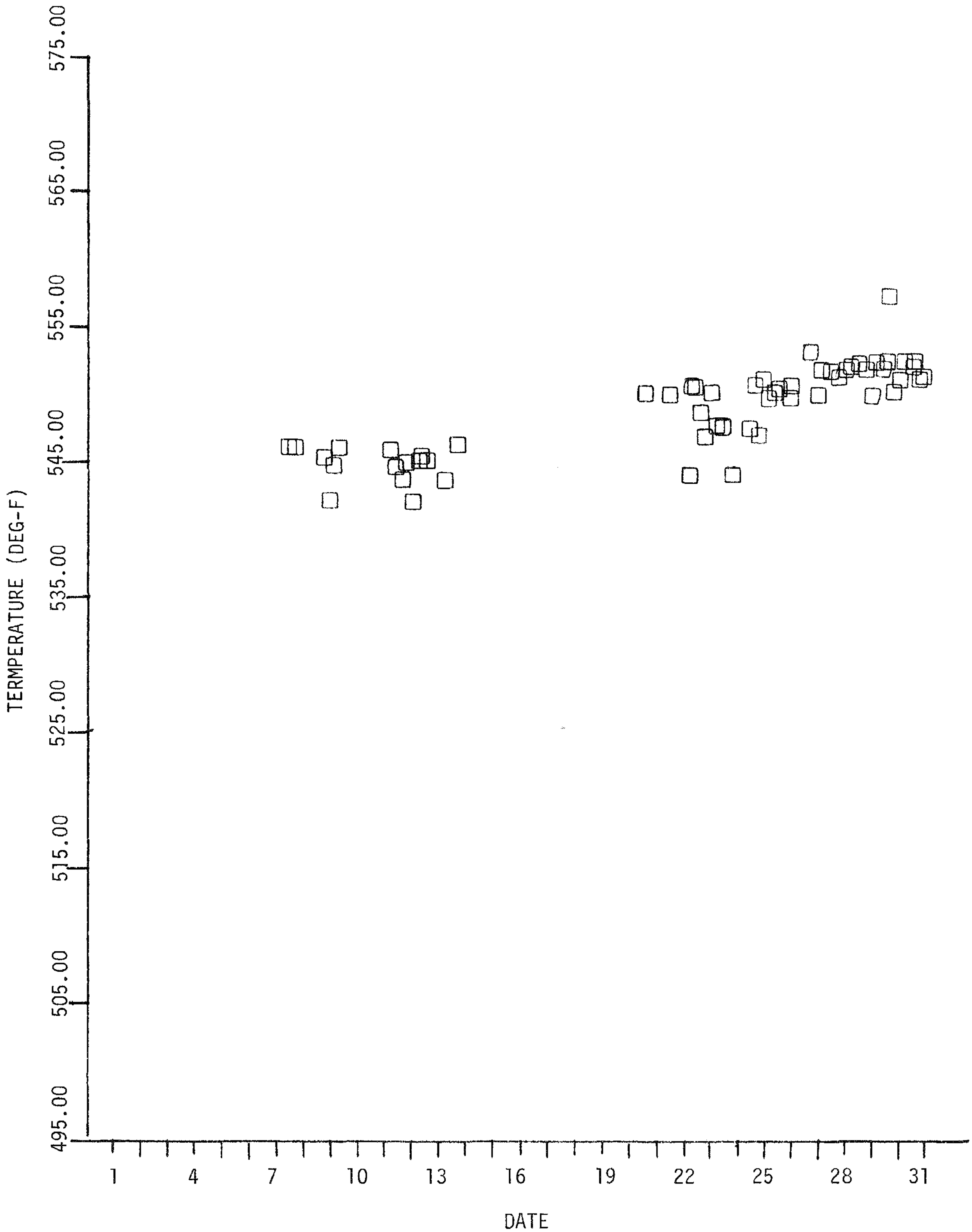


Figure 4-68. Cold Leg Temperature - June 1979

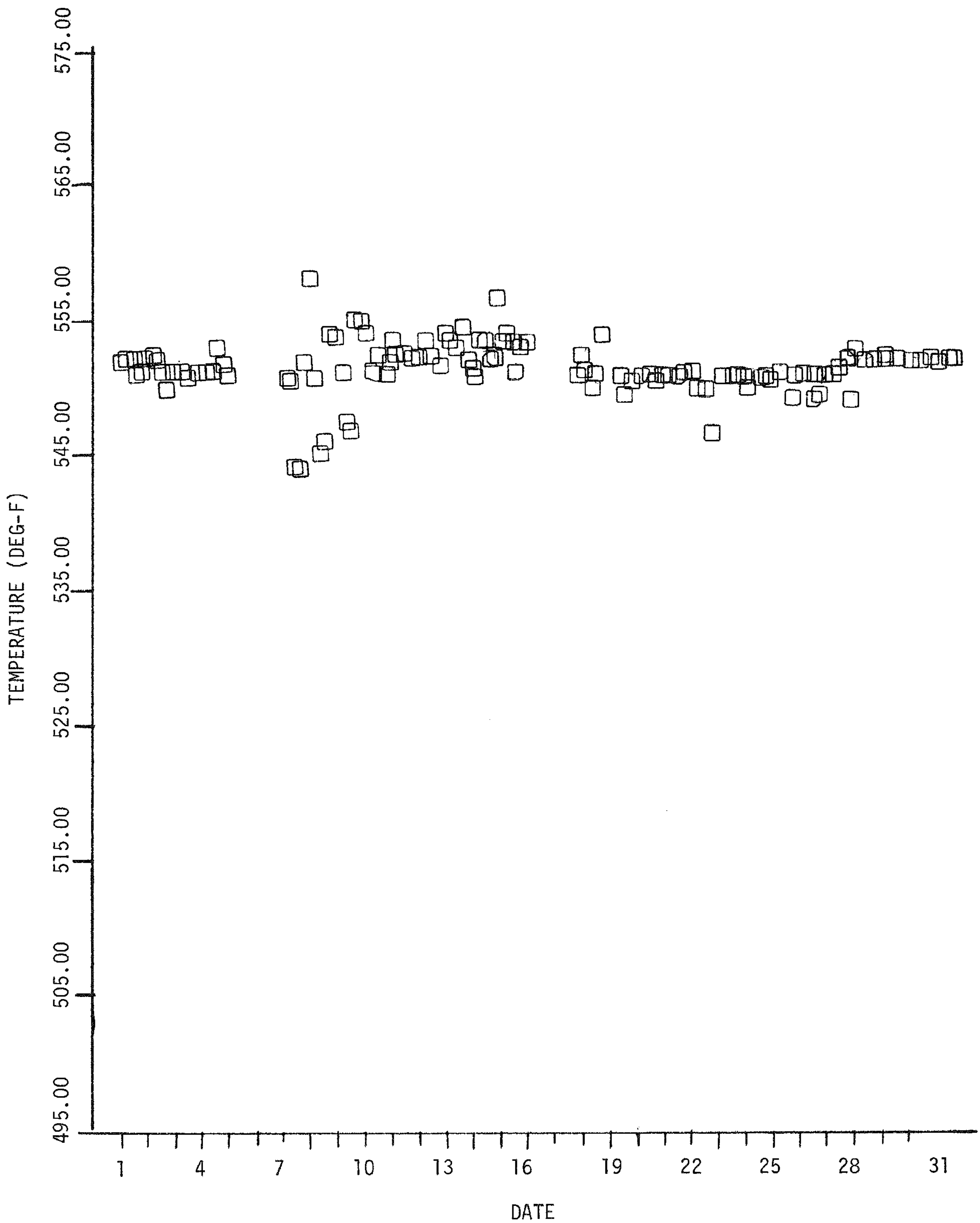


Figure 4-69. Cold Leg Temperature - July 1979

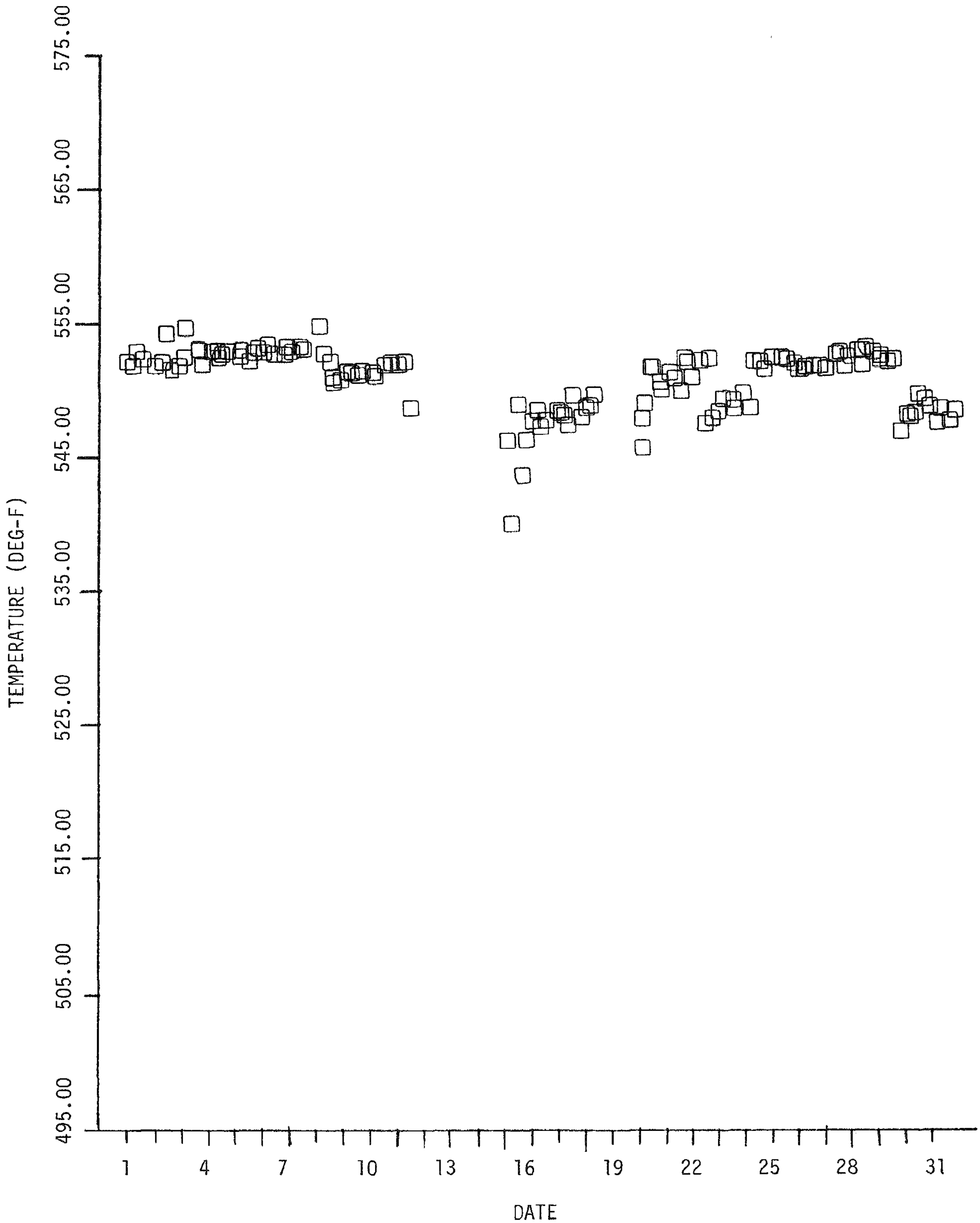


Figure 4-70. Cold Leg Temperature - August 1979

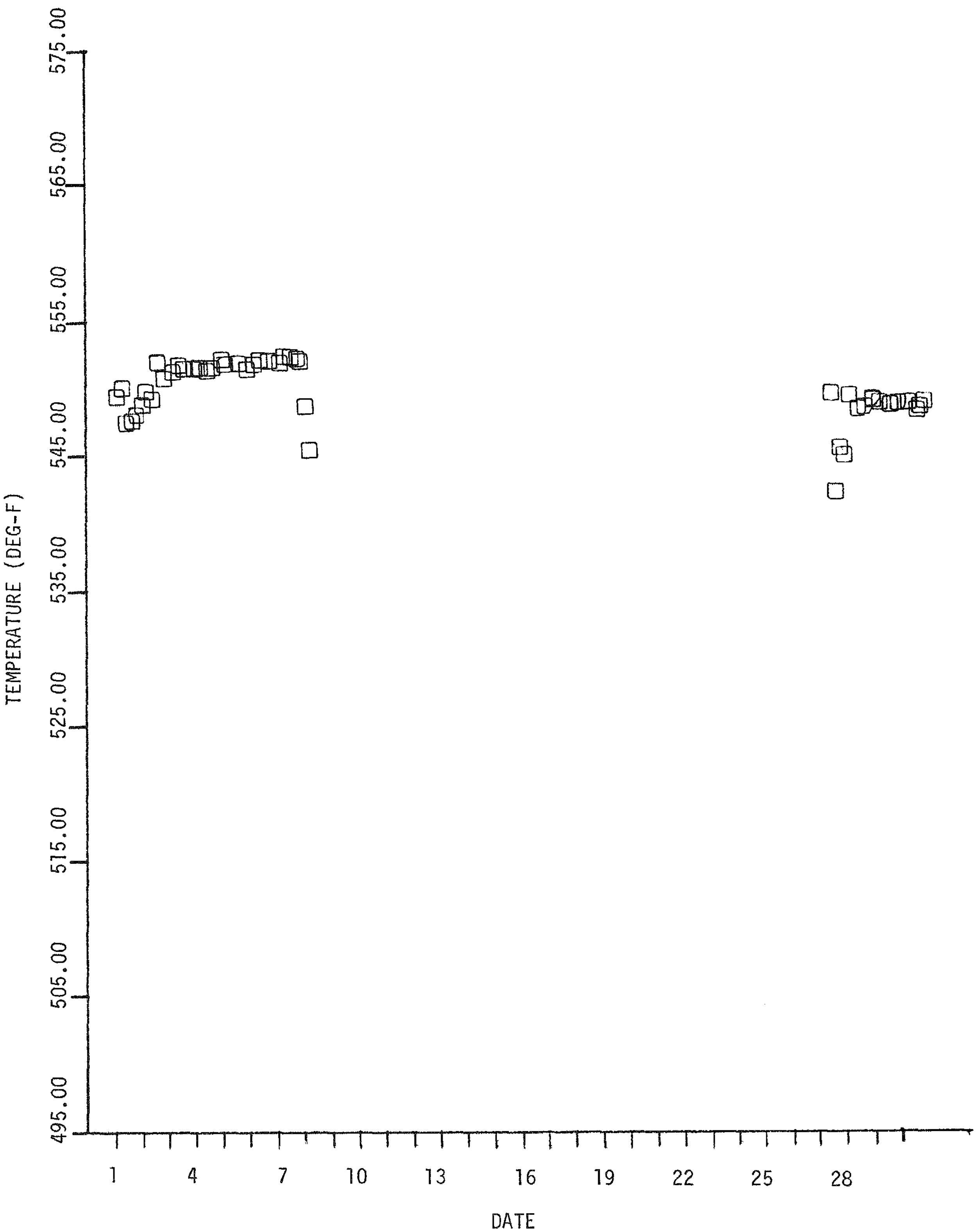


Figure 4-71. Cold Leg Temperature - September 1979

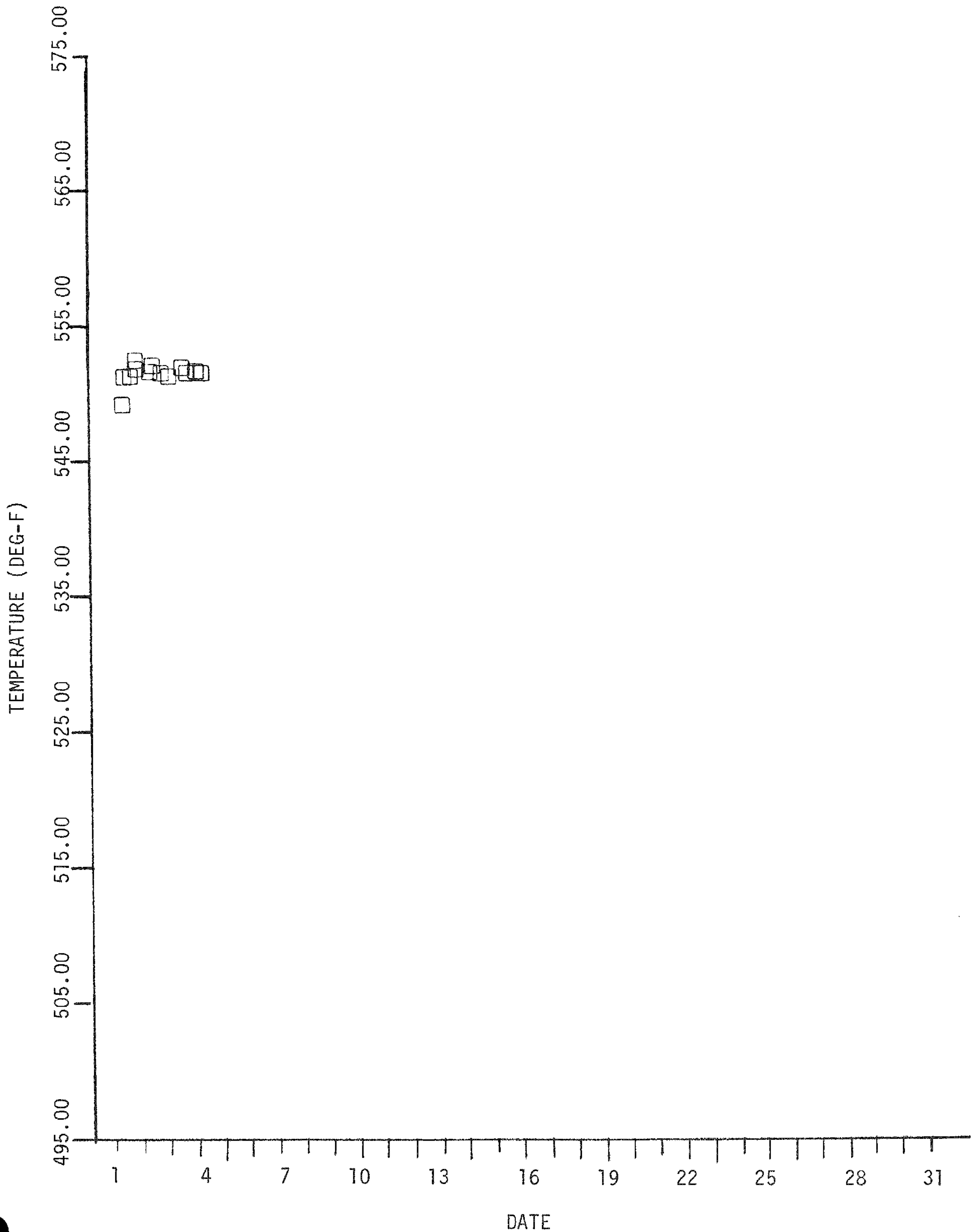


Figure 4-72. Cold Leg Temperature - October 1979

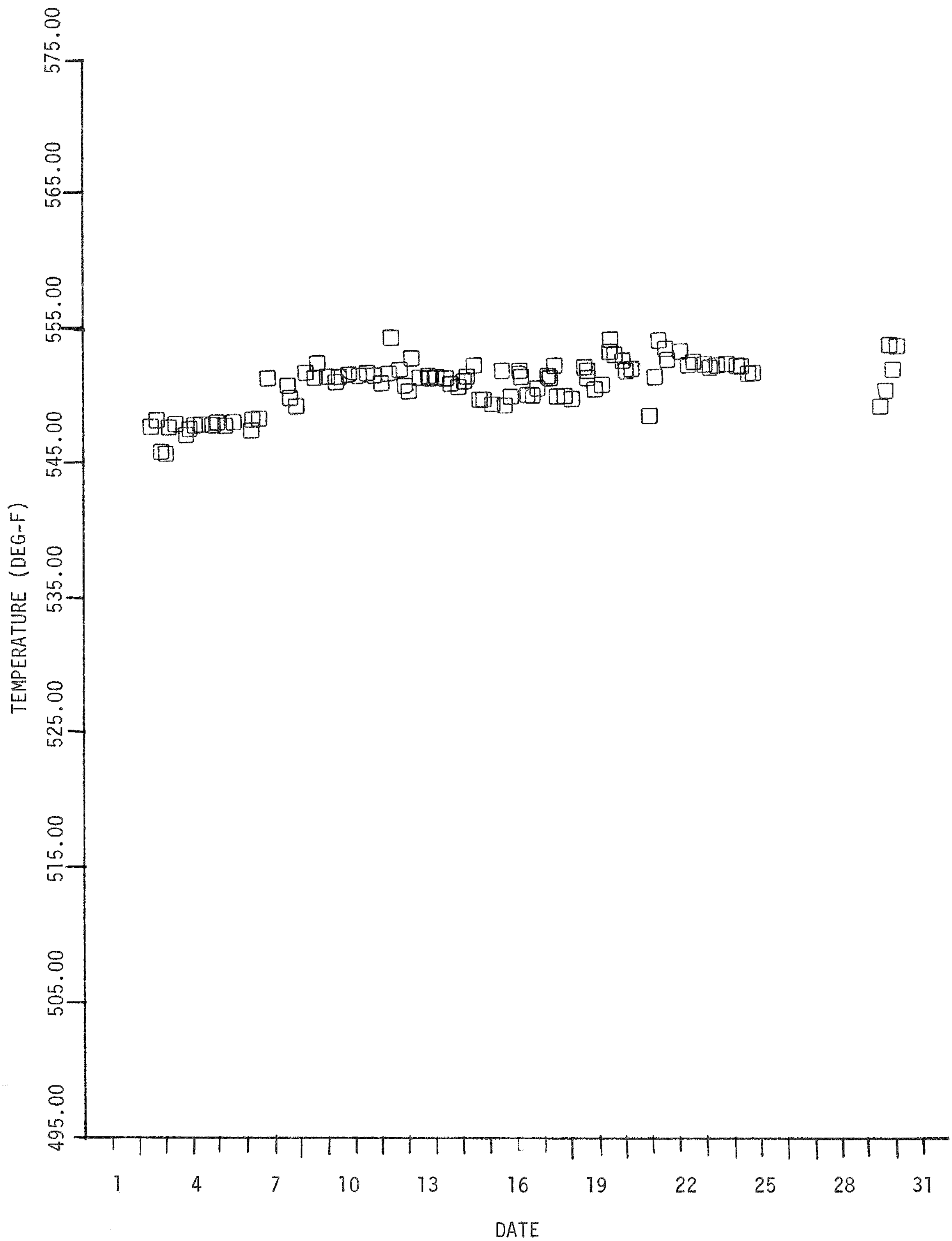


Figure 4-73. Cold Leg Temperature - December 1979

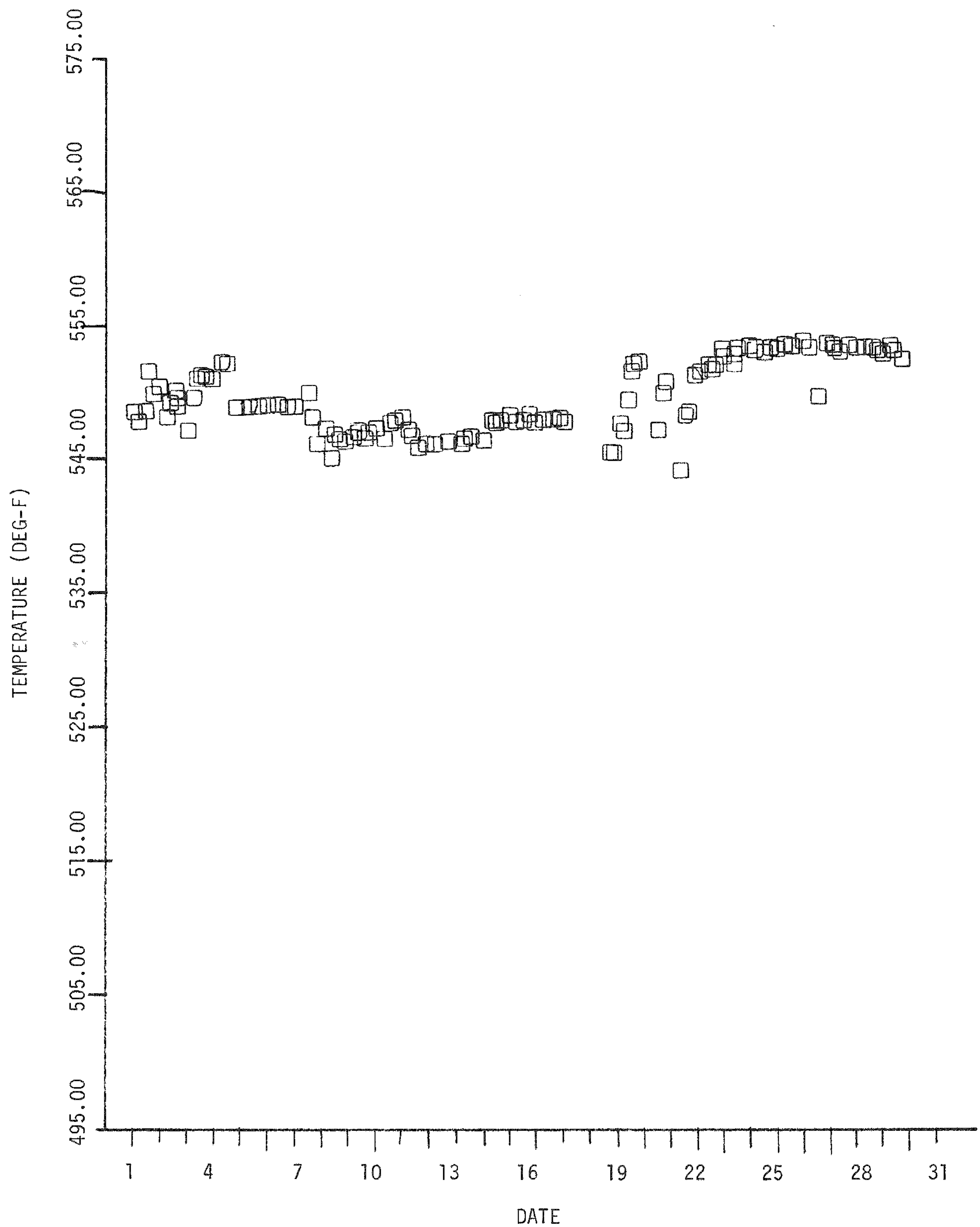


Figure 4-74. Cold Leg Temperature - January 1980

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 2.1985 -.0092 .8643	8 - 00	9 - 02 2.5299 -.0115 .9946	10 - 00	11 - 03 2.5454 -.0040 1.0007	12 - 00	13 - 04 1.9950 -.0105 .7843	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 2.5718 -.0092 1.0110	28 - 00	29 - 06 2.6160 -.0179 1.0284	30 - 00	31 - 07 2.8376 -.0187 1.1155	32 - 00	33 - 08 2.6585 -.0365 1.0451	34 - 00	35 - 09 2.5500 -.0242 1.0025	36 - 00	37 - 10 2.5487 -.0189 1.0020	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 1.4255 .0153 .5604	53 - 00	54 - 12 2.6190 -.0034 1.0296	55 - 00	56 - 13 2.7436 -.0148 1.0786	57 - 00	58 - 14 2.9157 -.0320 1.1462	59 - 00	60 - 15 2.8368 -.0226 1.1152	61 - 00	62 - 16 2.8095 -.0124 1.1045	63 - 00	64 - 17 2.6701 -.0031 1.0497	65 - 00	66 - 00
67 - 00	68 - 18 2.6916 -.0006 1.0582	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 2.4394 -.0133 .9590	81 - 00
82 - 00	83 - 00	84 - 20 2.7092 -.0199 1.0651	85 - 00	86 - 21 2.9030 -.0391 1.1412	87 - 00	88 - 22 2.9215 -.0142 1.1485	89 - 00	90 - 23 2.9697 -.0281 1.1675	91 - 00	92 - 24 2.8060 -.0145 1.1031	93 - 00	94 - 25 2.6686 -.0111 1.0491	95 - 00	96 - 00
97 - 00	98 - 26 2.4508 -.0062 .9635	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 2.4942 .0171 .9805	111-00
112-00	113-00	114-28 2.6051 -.0136 1.0242	115-00	116-29 2.7758 -.0063 1.0912	117-00	118-30 2.8799 -.0156 1.1322	119-00	120-31 2.7731 -.0207 1.0902	121-00	122-32 2.6533 -.0100 1.0431	123-00	124-33 2.5555 -.0086 1.0046	125-00	126-34 1.5942 -.0132 .6267
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 2.5959 -.0231 1.0205	142-00	143-36 2.6250 -.0178 1.0320	144-00	145-37 2.7780 -.0233 1.0921	146-00	147-38 2.7925 -.0135 1.0978	148-00	149-39 2.6410 -.0212 1.0382	150-00	151-40 2.4882 .0032 .9782	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 2.0721 -.0514 .8146	166-00	167-42 2.6138 .0260 1.0276	168-00	169-43 2.4873 -.0229 .9778	170-00	171-44 2.0708 -.0457 .8141	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-75. Full Core Power Distribution
60% Power, 12/30/78, 1:02

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1-00	2-00	3-00	4-00	5-00					
			6-00	7-01 2.6171 -.0095 .8158	8-00	9-02 3.2147 -.0110 1.0021	10-00	11-03 3.1503 -.0197 .9820	12-00	13-04 2.5294 -.0059 .7884	14-00			
		15-00	16-00	17-00	18-00	19-00	20-00	21-00	22-00	23-00	24-00	25-00		
	26-00	27-05 3.2661 -.0132 1.0181	28-00	29-06 3.3132 -.0170 1.0328	30-00	31-07 3.5978 -.0127 1.1215	32-00	33-08 3.4729 -.0148 1.0825	34-00	35-09 3.2282 -.0094 1.0062	36-00	37-10 3.2556 -.0121 1.0148	38-00	
	39-00	40-00	41-00	42-00	43-00	44-00	45-00	46-00	47-00	48-00	49-00	50-00	51-00	
52-11 1.9243 .0035 .5998	53-00	54-12 3.3018 -.0001 1.0292	55-00	56-13 3.3478 .0274 1.0435	57-00	58-14 3.6104 -.0082 1.1254	59-00	60-15 3.6114 -.0167 1.1257	61-00	62-16 3.5874 -.0092 1.1182	63-00	64-17 3.3194 -.0167 1.0347	65-00	66-00
67-00	68-18 3.1556 .0016 .9836	69-00	70-00	71-00	72-00	73-00	74-00	75-00	76-00	77-00	78-00	79-00	80-19 3.1090 -.0101 .9691	81-00
82-00	83-00	84-20 3.4602 -.0094 1.0786	85-00	86-21 3.6000 -.0139 1.1222	87-00	88-22 3.7202 -.0076 1.1596	89-00	90-23 3.6888 -.0057 1.1498	91-00	92-24 3.5788 -.0035 1.1156	93-00	94-25 3.3384 -.0061 1.0406	95-00	96-00
97-00	98-26 3.1180 .0001 .9719	99-00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 3.1447 .0072 .9802	111-00
112-00	113-00	114-28 3.2698 -.0122 1.0192	115-00	116-29 3.5362 -.0010 1.1023	117-00	118-30 3.6560 -.0146 1.1396	119-00	120-31 3.5341 -.0140 1.1016	121-00	122-32 3.4424 .0028 1.0730	123-00	124-33 3.2555 -.0039 1.0148	125-00	126-34 2.0476 -.0027 .6383
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 3.2839 -.0199 1.0236	142-00	143-36 3.3061 -.0122 1.0305	144-00	145-37 3.4989 -.0206 1.0906	146-00	147-38 3.5729 -.0060 1.1137	148-00	149-39 3.3201 -.0066 1.0349	150-00	151-40 3.1763 .0090 .9901	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 2.5793 -.0319 .8040	166-00	167-42 3.2042 -.0199 .9988	168-00	169-43 3.1650 -.0136 .9866	170-00	171-44 2.6312 -.0144 .8202	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-76. Full Core Power Distribution
20.2% Power, 1/16/79, 12:09

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 2.5103 -.0464 .7974	8 - 00	9 - 02 3.1062 -.0327 .9866	10 - 00	11 - 03 3.1257 -.0366 .9929	12 - 00	13 - 04 2.4708 -.0351 .7848	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 3.1712 -.0354 1.0073	28 - 00	29 - 06 3.3240 -0.434 1.0558	30 - 00	31 - 07 3.4976 -.0353 1.1110	32 - 00	33 - 08 3.4054 -.0429 1.0817	34 - 00	35 - 09 3.2838 -.0400 1.0431	36 - 00	37 - 10 3.1597 -.0425 1.0036	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 1.9378 -.0337 .6155	53 - 00	54 - 12 3.1934 -.0250 1.0143	55 - 00	56 - 13 3.5220 -.0260 1.1187	57 - 00	58 - 14 3.4980 -.0355 1.1111	59 - 00	60 - 15 3.4740 -.0373 1.1035	61 - 00	62 - 16 3.4879 -.0332 1.1079	63 - 00	64 - 17 3.2169 -.0394 1.0218	65 - 00	66 - 00
67 - 00	68 - 18 3.0826 -.0185 .9792	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 3.0022 -.0358 .9536	81 - 00
82 - 00	83 - 00	84 - 20 3.3430 -.0360 1.0619	85 - 00	86 - 21 3.5084 -.0311 1.1144	87 - 00	88 - 22 3.6370 -.0348 1.1552	89 - 00	90 - 23 3.5697 -.0337 1.1339	91 - 00	92 - 24 3.4735 -.0290 1.1033	93 - 00	94 - 25 3.3165 -.0264 1.0535	95 - 00	96 - 00
97 - 00	98 - 26 3.0697 -.0381 .9750	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 3.0226 -.0224 .9601	111-00
112-00	113-00	114-28 3.2250 -.0288 1.0244	115-00	116-29 3.4365 -.0308 1.0916	117-00	118-30 3.5562 -.0359 1.1296	119-00	120-31 3.5178 -.0369 1.1174	121-00	122-32 3.4078 -.0372 1.0825	123-00	124-33 3.1712 -.0284 1.0073	125-00	126-34 1.9701 -.0279 .6258
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 3.1724 -.0457 1.0077	142-00	143-36 3.3748 -.0398 1.0720	144-00	145-37 3.5219 -.0413 1.1187	146-00	147-38 3.4596 -.0326 1.0989	148-00	149-39 3.3178 -.0350 1.0539	150-00	151-40 3.0860 -.0209 .9802	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 2.5786 -.0647 .8191	166-00	167-42 3.2089 -.0170 1.0193	168-00	169-43 3.0753 -.0382 .9768	170-00	171-44 2.5349 -.0368 .8052	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-77. Full Core Power Distribution
19.8% Power, 1/27/79, 3:35

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1-00	2-00	3-00	4-00	5-00					
			6-00	7-01 2.4810 -.0063 .8111	8-00	9-02 3.0298 -.0047 .9906	10-00	11-03 3.0478 -.0110 .9965	12-00	13-04 2.3954 -.0063 .7832	14-00			
		15-00	16-00	17-00	18-00	19-00	20-00	21-00	22-00	23-00	24-00	25-00		
	26-00	27-05 3.0515 -.0079 .9977	28-00	29-06 3.2258 -.0155 1.0547	30-00	31-07 3.4055 -.0124 1.1134	32-00	33-08 3.3255 -.0194 1.0873	34-00	35-09 3.1992 -.0093 1.0460	36-00	37-10 3.0556 -.0128 .9990	38-00	
	39-00	40-00	41-00	42-00	43-00	44-00	45-00	46-00	47-00	48-00	49-00	50-00	51-00	
52-11 1.8568 -.0096 .6071	53-00	54-12 3.1034 .0023 1.0146	55-00	56-13 3.4266 .0010 1.1190	57-00	58-14 3.4369 -.0104 1.1237	59-00	60-15 3.4312 -.0157 1.1218	61-00	62-16 3.4017 -.0042 1.1122	63-00	64-17 3.1389 -.0149 1.0263	65-00	66-00
67-00	68-18 3.0044 .0080 .9823	69-00	70-00	71-00	72-00	73-00	74-00	75-00	76-00	77-00	78-00	79-00	80-19 2.9201 -.0097 .9547	81-00
82-00	83-00	84-20 3.2566 -.0102 1.0647	85-00	86-21 3.4408 -.0077 1.1250	87-00	88-22 3.5227 -.0093 1.1517	89-00	90-23 3.4892 -.0038 1.1408	91-00	92-24 3.3758 -.0023 1.1037	93-00	94-25 3.2316 -.0039 1.0566	95-00	96-00
97-00	98-26 2.9228 .0029 .9556	99-00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 2.9281 -.0007 .9573	111-00
112-00	113-00	114-28 3.1538 -.0017 1.0311	115-00	116-29 3.3452 -.0014 1.0937	117-00	118-30 3.4627 -.0119 1.1321	119-00	120-31 3.4188 -.0105 1.1178	121-00	122-32 3.3100 -.0103 1.0822	123-00	124-33 3.0753 -.0077 1.0054	125-00	126-34 1.8789 .0017 0.6143
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 3.0737 -.0177 1.0049	142-00	143-36 3.2637 -.0128 1.0671	144-00	145-37 3.4264 -.0158 1.1202	146-00	147-38 3.3605 -.0106 1.0987	148-00	149-39 3.2138 -.0086 1.0507	150-00	151-40 2.9735 .0070 .9722	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 2.4908 -.0320 .8144	166-00	167-42 3.0427 .0038 .9948	168-00	169-43 2.9859 -.0143 .9762	170-00	171-44 2.4729 -.0088 .8085	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-78. Full Core Power Distribution
19.2% Power, 6/12/79, 2:32

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 5.9828 .0071 .7781	8 - 00	9 - 02 7.4055 .0063 .9631	10 - 00	11 - 03 7.4565 .0038 .9697	12 - 00	13 - 04 5.9274 .0106 .7709	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 7.4201 .0103 .9650	28 - 00	29 - 06 8.1262 .0012 1.0568	30 - 00	31 - 07 8.6415 .0031 1.1238	32 - 00	33 - 08 8.4734 -.0017 1.1020	34 - 00	35 - 09 8.0301 .0032 1.0443	36 - 00	37 - 10 7.5205 .0081 .9781	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 4.5246 .0185 .5884	53 - 00	54 - 12 7.7796 .0170 1.0118	55 - 00	56 - 13 8.7896 .0144 1.1431	57 - 00	58 - 14 8.9071 .0031 1.1584	59 - 00	60 - 15 8.9446 -.0034 1.1633	61 - 00	62 - 16 8.7070 .0097 1.1324	63 - 00	64 - 17 7.8601 .0023 1.0222	65 - 00	66 - 00
67 - 00	68 - 18 7.3709 .0222 .9586	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 7.1919 .0099 .9353	81 - 00
82 - 00	83 - 00	84 - 20 8.1605 .0043 1.0613	85 - 00	86 - 21 8.8130 .0042 1.1461	87 - 00	88 - 22 9.2938 .0097 1.2087	89 - 00	90 - 23 9.1048 .0079 1.1841	91 - 00	92 - 24 8.7812 .0113 1.1420	93 - 00	94 - 25 8.1090 .0073 1.0546	95 - 00	96 - 00
97 - 00	98 - 26 7.2442 .0139 .9421	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 7.2301 .0186 .9403	111-00
112-00	113-00	114-28 7.8261 .0086 1.0178	115-00	116-29 8.5737 .0097 1.1150	117-00	118-30 8.9749 .0027 1.1672	119-00	120-31 8.8486 .0029 1.1508	121-00	122-32 8.4676 .0044 1.1012	123-00	124-33 7.6752 .0132 .9982	125-00	126-34 4.6060 .0191 .5990
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 7.5355 -.0031 .9800	142-00	143-36 8.1496 .0026 1.0599	144-00	145-37 8.7046 -.0044 1.1321	146-00	147-38 8.5530 .0072 1.1123	148-00	149-39 8.0495 .0089 1.0469	150-00	151-40 7.2980 .0186 .9491	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 6.0559 -.0039 .7876	166-00	167-42 7.4458 .0220 .9683	168-00	169-43 7.3131 .0059 .9511	170-00	171-44 5.9819 .0042 .7780	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-79. Full Core Power Distribution
48.3% Power, 6/28/79, 21:01

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 6.2008 .0080 .7724	8 - 00	9 - 02 7.7251 .0118 .9623	10 - 00	11 - 03 7.7343 .0049 .9634	12 - 00	13 - 04 6.1636 .0114 .7678	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 7.7230 .0092 .9620	28 - 00	29 - 06 8.4966 .0011 1.0584	30 - 00	31 - 07 9.0517 .0037 1.1275	32 - 00	33 - 08 8.8891 .0001 1.1073	34 - 00	35 - 09 8.4021 .0056 1.0466	36 - 00	37 - 10 7.7776 .0098 .9688	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 4.6827 .0176 .5833	53 - 00	54 - 12 8.1428 .0170 1.0143	55 - 00	56 - 13 9.2380 .0150 1.1507	57 - 00	58 - 14 9.3614 .0046 1.1661	59 - 00	60 - 15 9.4371 -.0015 1.1755	61 - 00	62 - 16 9.1287 .0103 1.1371	63 - 00	64 - 17 8.2041 .0030 1.0219	65 - 00	66 - 00
67 - 00	68 - 18 7.6511 .0232 .9531	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 7.4709 .0116 .9306	81 - 00
82 - 00	83 - 00	84 - 20 8.5143 .0044 1.0606	85 - 00	86 - 21 9.2456 .0008 1.1517	87 - 00	88 - 22 9.7968 .0108 1.2203	89 - 00	90 - 23 9.5739 .0081 1.1926	91 - 00	92 - 24 9.2243 .0145 1.1490	93 - 00	94 - 25 8.4727 .0101 1.0554	95 - 00	96 - 00
97 - 00	98 - 26 7.5403 .0141 .9393	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 7.5069 .0199 .9351	111-00
112-00	113-00	114-28 8.1749 .0092 1.0183	115-00	116-29 8.9911 .0118 1.1200	117-00	118-30 9.4318 .0038 1.1749	119-00	120-31 9.2978 .0031 1.1582	121-00	122-32 8.8904 .0052 1.1074	123-00	124-33 8.0264 .0141 .9998	125-00	126-34 4.7564 .0173 .5925
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 7.8239 -.0024 .9746	142-00	143-36 8.5268 .0039 1.0621	144-00	145-37 9.1115 -.0050 1.1350	146-00	147-38 8.9676 .0100 1.1170	148-00	149-39 8.4195 .0109 1.0488	150-00	151-40 7.5876 .0167 .9451	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 6.2982 -.0010 .7845	166-00	167-42 7.7310 .0218 .9630	168-00	169-43 7.5923 .0065 .9457	170-00	171-44 6.2373 .0006 .7769	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-80. Full Core Power Distribution
50.4% Power, 7/22/79, 3:03

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 6.2470 .0034 .7693	8 - 00	9 - 02 7.7284 .0060 .9518	10 - 00	11 - 03 7.7657 .0016 .9564	12 - 00	13 - 04 6.1956 .0092 .7630	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 7.7741 .0072 .9574	28 - 00	29 - 06 8.5999 -.0013 1.0591	30 - 00	31 - 07 9.1757 .0022 1.1300	32 - 00	33 - 08 9.0206 -.0041 1.1109	34 - 00	35 - 09 8.5035 .0034 1.0472	36 - 00	37 - 10 7.8361 .0081 .9650	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 4.5605 .0475 .5616	53 - 00	54 - 12 8.2314 .0143 1.0137	55 - 00	56 - 13 9.3915 .0136 1.1566	57 - 00	58 - 14 9.5552 .0019 1.1768	59 - 00	60 - 15 9.6152 -.0036 1.1841	61 - 00	62 - 16 9.2983 .0089 1.1451	63 - 00	64 - 17 8.3538 .0037 1.0288	65 - 00	66 - 00
67 - 00	68 - 18 7.7039 .0217 .9488	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 7.6105 .0185 .9373	81 - 00
82 - 00	83 - 00	84 - 20 8.5948 .0007 1.0585	85 - 00	86 - 21 9.4242 -.0012 1.1606	87 - 00	88 - 22 10.0030 .0068 1.2319	89 - 00	90 - 23 9.7737 .0070 1.2037	91 - 00	92 - 24 9.3966 .0131 1.1572	93 - 00	94 - 25 8.6188 .0109 1.0614	95 - 00	96 - 00
97 - 00	98 - 26 7.5553 .0095 .9305	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 7.6136 .0228 .9376	111-00
112-00	113-00	114-28 8.2751 .0064 1.0191	115-00	116-29 9.1327 .0098 1.1247	117-00	118-30 9.5979 .0019 1.1820	119-00	120-31 9.4778 .0011 1.1672	121-00	122-32 9.0482 .0032 1.1143	123-00	124-33 8.1597 .0135 1.0049	125-00	126-34 4.7752 .0193 .5881
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 7.8614 -.0053 .9682	142-00	143-36 8.6309 .0012 1.0629	144-00	145-37 9.2487 -.0071 1.1390	146-00	147-38 9.0958 .0064 1.1202	148-00	149-39 8.5390 .0082 1.0516	150-00	151-40 7.6423 .0118 .9412	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 6.4180 -.0045 .7904	166-00	167-42 7.7672 .0199 .9566	168-00	169-43 7.6146 .0035 .9378	170-00	171-44 6.2517 .0028 .7699	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-81. Full Core Power Distribution
51.1% Power, 8/26/79, 9:44

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 6.2018 .0054 .7739	8 - 00	9 - 02 7.6305 .0088 .9522	10 - 00	11 - 03 7.6554 .0034 .9553	12 - 00	13 - 04 6.1302 .0089 .7649	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 7.6938 .0065 .9600	28 - 00	29 - 06 8.4977 -.0013 1.0604	30 - 00	31 - 07 9.0701 .0039 1.1318	32 - 00	33 - 08 8.8950 -.0016 1.1099	34 - 00	35 - 09 8.4071 .0032 1.0491	36 - 00	37 - 10 7.7392 .0090 .9657	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 4.6764 .0172 .5835	53 - 00	54 - 12 8.1368 .0168 1.0153	55 - 00	56 - 13 9.2738 .0143 1.1572	57 - 00	58 - 14 9.4118 .0043 1.1744	59 - 00	60 - 15 9.4761 -.0019 1.1824	61 - 00	62 - 16 9.1882 .0104 1.1465	63 - 00	64 - 17 8.2829 .0041 1.0336	65 - 00	66 - 00
67 - 00	68 - 18 7.6157 .0202 .9503	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 7.5089 .0178 .9370	81 - 00
82 - 00	83 - 00	84 - 20 8.4232 -.0010 1.0511	85 - 00	86 - 21 9.2978 -.0001 1.1602	87 - 00	88 - 22 9.8185 .0104 1.2252	89 - 00	90 - 23 9.6374 .0089 1.2026	91 - 00	92 - 24 9.2710 .0132 1.1569	93 - 00	94 - 25 8.4486 .0094 1.0542	95 - 00	96 - 00
97 - 00	98 - 26 7.4728 .0107 .9325	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 7.5240 .0238 .9389	111-00
112-00	113-00	114-28 8.1981 .0070 1.0230	115-00	116-29 9.0112 .0112 1.1244	117-00	118-30 9.4611 .0037 1.1806	119-00	120-31 9.3452 .0043 1.1661	121-00	122-32 8.9280 .0047 1.1141	123-00	124-33 8.0766 .0146 1.0078	125-00	126-34 4.7119 .0211 .5080
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 7.7851 -.0034 .9714	142-00	143-36 8.5348 .0024 1.0650	144-00	145-37 9.1464 -.0068 1.1413	146-00	147-38 8.9831 .0078 1.1209	148-00	149-39 8.4480 .0095 1.0542	150-00	151-40 7.5733 .0145 .9450	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 6.3662 -.0042 .7944	166-00	167-42 7.6687 .0215 .9569	168-00	169-43 7.5223 .0049 .9387	170-00	171-44 6.2009 .0038 .7738	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4.82. Full Core Power Distribution
50.4% Power, 10/4/79, 2:22

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 6.2749 .0051 .7889	8 - 00	9 - 02 7.5974 .0081 .9552	10 - 00	11 - 03 7.6134 .0021 .9572	12 - 00	13 - 04 6.1200 .0102 .7695	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 7.6771 -.0051 .9652	28 - 00	29 - 06 8.4452 -.0013 1.0618	30 - 00	31 - 07 9.0028 .0007 1.1319	32 - 00	33 - 08 8.8527 -.0016 1.1130	34 - 00	35 - 09 8.3952 .0060 1.0555	36 - 00	37 - 10 7.7517 .0097 .9746	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 4.6336 .0096 .5826	53 - 00	54 - 12 8.1118 .0145 1.0199	55 - 00	56 - 13 9.0326 .0057 1.1357	57 - 00	58 - 14 9.2067 .0023 1.1575	59 - 00	60 - 15 9.4477 -.0025 1.1878	61 - 00	62 - 16 9.0581 .0105 1.1389	63 - 00	64 - 17 8.2133 .0054 1.0326	65 - 00	66 - 00
67 - 00	68 - 18 7.4168 .0126 .9325	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 7.4929 .0172 .9421	81 - 00
82 - 00	83 - 00	84 - 20 8.2352 -.0047 1.0354	85 - 00	86 - 21 9.1592 -.0001 1.1516	87 - 00	88 - 22 9.8095 .0083 1.2333	89 - 00	90 - 23 9.4828 .0080 1.1923	91 - 00	92 - 24 9.2496 .0124 1.1629	93 - 00	94 - 25 8.4532 .0127 1.0628	95 - 00	96 - 00
97 - 00	98 - 26 7.4191 .0125 .9328	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 7.4994 .0220 .9429	111-00
112-00	113-00	114-28 8.1451 .0063 1.0241	115-00	116-29 8.9367 .0098 1.1236	117-00	118-30 9.2980 .0044 1.1690	119-00	120-31 9.2663 .0018 1.1650	121-00	122-32 8.8968 .0028 1.1186	123-00	124-33 8.0444 .0137 1.0114	125-00	126-34 4.6868 .0246 .5893
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 7.7324 -.0053 .9722	142-00	143-36 8.4112 .0017 1.0575	144-00	145-37 9.1250 -.0077 1.1473	146-00	147-38 8.8737 .0080 1.1157	148-00	149-39 8.4440 .0079 1.0616	150-00	151-40 7.5433 .0150 .9484	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 6.2925 -.0054 .7911	166-00	167-42 7.6560 .0186 .9626	168-00	169-43 7.4939 .0039 .9422	170-00	171-44 6.1971 .0037 .7792	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-83. Full Core Power Distribution
50.0% Power, 12/10/79, 0:05

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 9.7095 .0079 .7904	8 - 00	9 - 02 11.7117 .0129 .9534	10 - 00	11 - 03 11.6779 .0080 .9506	12 - 00	13 - 04 9.4433 .0132 .7687	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 11.7540 .0100 .9568	28 - 00	29 - 06 13.0760 .0023 1.0644	30 - 00	31 - 07 13.9167 .0062 1.1329	32 - 00	33 - 08 13.7226 .0021 1.1171	34 - 00	35 - 09 12.9991 .0087 1.0582	36 - 00	37 - 10 11.9532 .0175 .9730	38 - 00	
	39 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 7.1425 .0144 .5814	53 - 00	54 - 12 12.5349 .0192 1.0204	55 - 00	56 - 13 13.9632 .0072 1.1367	57 - 00	58 - 14 14.2235 .0046 1.1579	59 - 00	60 - 15 14.5049 .0075 1.1808	61-00	62 - 16 14.0198 .0123 1.1413	63 - 00	64 - 17 12.7106 .0092 1.0347	65 - 00	66 - 00
67 00	68 - 18 11.4926 .0104 .9356	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 11.5449 .0213 .9398	81 - 00
82 - 00	83 - 00	84 - 20 12.7081 -.0035 1.0345	85 - 00	86 - 21 14.2120 .0040 1.1569	87 - 00	88 - 22 15.1514 .0100 1.2334	89 - 00	90 - 23 14.6816 .0083 1.1951	91 - 00	92 - 24 14.3100 .0145 1.1649	93 - 00	94 - 25 13.0434 .0174 1.0618	95 - 00	96 - 00
97 - 00	98 - 26 11.4628 .0172 .9331	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 11.5411 .0197 .9395	111-00
112-00	113-00	114-28 12.6228 .0091 1.0276	115-00	116-29 13.8897 .0119 1.1307	117-00	118-30 14.3939 .0067 1.1717	119-00	120-31 14.3471 .0046 1.1679	121-00	122-32 13.7965 .0054 1.1231	123-00	124-33 12.4319 .0195 1.0120	125-00	126-34 7.2527 .0261 .5904
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 11.9986 .0009 .9767	142-00	143-36 13.0316 .0050 1.0608	144-00	145-37 14.1897 -.0051 1.1551	146-00	147-38 13.7526 .0118 1.1195	148-00	149-39 13.0586 .0133 1.0630	150-00	151-40 11.6343 .0180 .9471	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 9.6176 .0000 .7829	166-00	167-42 11.8131 .0239 .9616	168-00	169-43 11.5504 .0105 .9403	170-00	171-44 9.5938 .0095 .7810	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-84. Full Core Power Distribution
77.2% Power, 12/20/79, 11:39

FORMAT:

Box Number - Instrument Number
Integrated Assembly Power, MWTH
Assembly Axial Shape Index, SIU
Assembly Relative Power Fraction

					1 - 00	2 - 00	3 - 00	4 - 00	5 - 00					
			6 - 00	7 - 01 12.6819 .0211 .8008	8 - 00	9 - 02 15.0352 .0262 .9494	10 - 00	11 - 03 15.0360 .0219 .9495	12 - 00	13 - 04 12.2437 .0268 .7731	14 - 00			
		15 - 00	16 - 00	17 - 00	18 - 00	19 - 00	20 - 00	21 - 00	22 - 00	23 - 00	24 - 00	25 - 00		
	26 - 00	27 - 05 15.1971 .0220 .9596	28 - 00	29 - 06 16.8863 .0146 1.0663	30 - 00	31 - 07 18.0486 .0195 1.1397	32 - 00	33 - 08 17.6681 .0138 1.1157	34 - 00	35 - 09 16.8044 .0186 1.0611	36 - 00	37 - 10 15.4948 .0293 .9784	38 - 00	
	39 - 00	40 - 00	41 - 00	42 - 00	43 - 00	44 - 00	45 - 00	46 - 00	47 - 00	48 - 00	49 - 00	50 - 00	51 - 00	
52 - 11 9.2085 .0250 .5815	53 - 00	54 - 12 16.2458 .0299 1.0259	55 - 00	56 - 13 17.8771 .0165 1.1289	57 - 00	58 - 14 18.2456 .0144 1.1521	59 - 00	60 - 15 18.7115 .0187 1.1816	61 - 00	62 - 16 18.1752 .0207 1.1477	63 - 00	64 - 17 16.4269 .0200 1.0373	65 - 00	66 - 00
67 - 00	68 - 18 14.7779 .0193 .9332	69 - 00	70 - 00	71 - 00	72 - 00	73 - 00	74 - 00	75 - 00	76 - 00	77 - 00	78 - 00	79 - 00	80 - 19 14.8035 .0336 .9348	81 - 00
82 - 00	83 - 00	84 - 20 16.3936 .0070 1.0352	85 - 00	86 - 21 18.2956 .0167 1.1553	87 - 00	88 - 22 19.5713 .0192 1.2359	89 - 00	90 - 23 18.8684 .0169 1.1915	91 - 00	92 - 24 18.4977 .0231 1.1681	93 - 00	94 - 25 16.7275 .0268 1.0563	95 - 00	96 - 00
97 - 00	98 - 26 14.7754 .0302 .9330	99 - 00	100-00	101-00	102-00	103-00	104-00	105-00	106-00	107-00	108-00	109-00	110-27 14.8822 .0402 .9398	111-00
112-00	113-00	114-28 16.3869 .0219 1.0348	115-00	116-29 18.0944 .0212 1.1426	117-00	118-30 18.6106 .0164 1.1752	119-00	120-31 18.4610 .0138 1.1657	121-00	122-32 17.7412 .0175 1.1203	123-00	124-33 16.0766 .0278 1.0152	125-00	126-34 9.4187 .0404 .5948
	127-00	128-00	129-00	130-00	131-00	132-00	133-00	134-00	135-00	136-00	137-00	138-00	139-00	
	140-00	141-35 15.6166 .0146 .9861	142-00	143-36 16.7705 .0159 1.0590	144-00	145-37 18.3213 .0063 1.1569	146-00	147-38 17.8331 .0237 1.1261	148-00	149-39 16.8808 .0259 1.0660	150-00	151-40 15.0651 .0318 .9513	152-00	
		153-00	154-00	155-00	156-00	157-00	158-00	159-00	160-00	161-00	162-00	163-00		
			164-00	165-41 12.4299 .0099 .7849	166-00	167-42 15.2698 .0391 .9642	168-00	169-43 14.8755 .0239 .9393	170-00	171-44 12.4875 .0242 .7885	172-00			
					173-00	174-00	175-00	176-00	177-00					

Figure 4-85. Full Core Power Distribution
99.6% Power, 1/25/80, 22:12

REFERENCES

1. N. H. Larsen, "Core Design and Operating Data for Cycles 1 and 2 of Peach Bottom 2," EPRI-NP-563, Electric Power Research Institute, Palo Alto, California (1978).

2. L. A. Carmichael, R. O. Niemi, "Transient and Stability Tests at Peach Bottom Atomic Power Station Unit 2 at End of Cycle 2," EPRI-NP-564, Electric Power Research Institute, Palo Alto, California (1978).

3. RETRAN-A Program for One-Dimensional Transient Thermal-Hydraulic Analysis of Complex Fluid Flow Systems, EPRI NP-408, Electric Power Research Institute, Palo Alto, California, December 1978.

4. NSSS Transient Tests at ANO-2, EPRI NP-1708, Electric Power Research Institute, Palo Alto, California (1981).

5. Reactor Transient Tests at ANO-2, EPRI NP-1709, Electric Power Research Institute, Palo Alto, California (1981).

Appendix A

LIST OF ACRONYMS AND SYMBOLS

ANO-2	Arkansas Nuclear One - Unit 2
AMI	Automatic Motion Inhibit
A/S	Air Supply
AWP	Automatic Withdrawal Prohibit
BFWV	Bypass Feedwater Valve
CEDMCS	Control Element Drive Mechanism Control System
E/P	Electro-Pneumatic Converter
FWCS	Feedwater Control System
FWF	Feedwater Flow
M/A	Manual/Automatic
MCB	Main Control Board
MCS	Master Control Station
MFWV	Main Feedwater Valve
NSSS	Nuclear Steam Supply System
P_{COND}	Condenser Pressure
P_P	Pressurizer Pressure
P_S	Steam Header Pressure
P_{SEC}	Steam Generator Pressure
P_{TFS}	Turbine First Stage Pressure
P_{DP}	Differential Pump Pressure
PID	Proportional plus Integral plus Differential
PLCS	Pressurizer Level Control System
PPCS	Pressurizer Pressure Control System
PSSD	Pump Speed Setpoint Demand
QO	Quick Open
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RRS	Reactor Regulating System
S	LaPlace Transform Operator
SDBCS	Steam Dump and Bypass Control System
SG	Steam Generator
T_{AVG}^{Low}	Low Average Core Temperature
T_C	Cold Leg Temperature

T_H	Hot Leg Temperature
V_{DEMAND}	Valve Position Demand Signal
W_S	Steam Generator Steam Flow
$\emptyset_N$	Reactor Power
	AND gate
	OR gate
⊠	NOT gate

APPENDIX B

HEAT BALANCE AND NSSS CALORIMETRIC POWER CALCULATIONS

NSSS calorimetric power calculations provide an accurate determination of core thermal power and are used to specify the core average power history and fuel burnup. Detailed heat balance calculations were performed during the initial power ascension at the 20%, 50%, 80% and 100% power plateaus by means of a secondary system heat balance. The following information details NSSS calorimetric calculations performed at ANO-2 during July (50% power plateau) and December (80% power plateau), 1979. The information provided in this appendix augments the operating history and state point data.

Energy inputs from the pressurizer heaters and reactor coolant pumps as well as energy losses through RCS components are determined during the Post Core Hot Functional testing (prior to the initial power ascension). These parameters are assumed constant for each calorimetric calculation since they have only a small effect on the overall heat balance.

In order to make an accurate determination of the heat generated (power generated) by the steam generators, data were recorded every ten minutes for three hours. These data were then averaged and used in a heat balance around the steam generators.

NSSS CALORIMETRIC AT 50% POWER, JULY 13, 1979

Initial Conditions

1. RCS T-average constant at 564.7^{o}F

2. Pressurizer level constant at 47.3%

3. RCS pressure constant at 2251.7 psia

4. Secondary steam header pressure constant at 950.5 psia

5. Steam temperature constant at 538.9^{o}F

Data Collection

The following data were recorded every ten minutes for three hours. Average values (used in the calculation) are presented below.

		SG-A	SG-B
1.	Steam generator pressure	961.61 psia	968.45 psia
2.	Feedwater pressure	977.08 psia	964.20 psia
3.	Feedwater temperature	387.65°F	387.52°F
4.	Feedwater flow, W_F	2947.70 klbm/hr	3041.13 klbm/hr
5.	Blowdown flow, W_B	203.377 GPM	213.271 GPM
6.	Blowdown pressure	970.0 psia	919.8 psia

Assumptions

		SG-A	SG-B
1.	Main steam enthalpy, h_s, assumed to be dry saturated steam	1194.4 $\frac{BTU}{lb}$	1194.2 $\frac{BTU}{lb}$
2.	Blowdown enthalpy, h_B, assumed to be a saturated liquid	536.3 $\frac{BTU}{lb}$	536.6 $\frac{BTU}{lb}$
3.	Feedwater enthalpy, h_F, assumed to be a compressed liquid	362.01 $\frac{BTU}{lb}$	362.01 $\frac{BTU}{lb}$
4.	Specific volume of blowdown liquid, V_B, assumed to be a saturated liquid	0.02145 $\frac{ft^3}{lb}$	0.02147 $\frac{ft^3}{lb}$

5. Heat loss through pressurizer = 1.04×10^6 BTU/hr
6. Heat loss through RCS piping - 2.76×10^6 BTU/hr
7. Heat loss through other NSSS components = 3.09×10^6 BTU/hr
8. Heat input from reactor coolant pumps = 5.62×10^7 BTU/hr
9. Heat input from pressurizer heaters = 1.09×10^6 BTU/hr

Assumptions 5 through 9 were determined during the Post Core Hot Functional testing and are assumed to remain constant.

Calculations

1. Steam generator A power

$$B_{SGA} = (W_{FA} - W_{BA}) * h_{SA} + (W_{BA} * h_{BA}) - (W_{FA} * h_{FA})$$

where:

W_{FA} = Feedwater flow to steam generator A, lbs/hr
W_{BA} = Blowdown flow from steam generator A, lbs/hr
h_{SA} = Main steam enthalpy in steam generator A, BTU/lb
h_{BA} = Blowdown enthalpy in steam generator A, BTU/lb
h_{FA} = Feedwater enthalpy in steam generator A, BTU/lb

$$B_{SGA} = (2,974,700 - 76,050) * 1194.4 + (76,050 * 536.3) - (2,974,700 * 362.01)$$

$$B_{SGA} = 2.426 \times 10^9 \text{ BTU/hr}$$

2. Steam generator B power

$$B_{SGB} = (W_{FB} - W_{BB}) * h_{SB} + (W_{BB} * h_{BB}) - (W_{FB} * h_{FB})$$

where:

W_{FB} = Feedwater flow to steam generator B, lbs/hr
W_{BB} = Blowdown flow from steam generator B, lbs/hr
h_{SB} = Main steam enthalpy in steam generator B, BTU/lb
h_{BB} = Blowdown enthalpy in steam generator B, BTU/lb
h_{FB} = Feedwater enthalpy in steam generator B, BTU/lb

$$B_{SGB} = (3,041,300 - 79,690) * 1194.2 + (79,690 * 536.6) - (3,041,300 * 362.01)$$

$$B_{SGB} = 2.479 \times 10^9 \text{ BTU/hr}$$

3. Total steam generator power

$$B_{SG} = B_{SGA} + B_{SGB} = (2.426 + 2.479) \times 10^9 \text{ BTU/hr}$$

$$B_{SG} = 4.905 \times 10^9 \text{ BTU/hr}$$

4. Energy losses (see assumptions 5 through 7)

$$B_{loss} = B_P + B_{RCS} + B_{NSSS}$$

where:

B_P = Energy loss through the pressurizer walls
B_{RCS} = Energy loss through the RCS piping
B_{NSSS} = Energy loss through other NSSS components

$$B_{loss} = (1.04 + 2.76 + 3.09) \times 10^6 \text{ BTU/hr}$$

$$B_{loss} = 6.98 \times 10^6 \text{ BTU/hr}$$

5. Energy inputs (see assumptions 8 and 9)

$$B_{in} = B_{RCP} + B_{PH}$$

where:

B_{RCP} = Energy input from reactor coolant pumps
B_{PH} = Energy inputs from pressurizer heaters

$$B_{in} = 5.62 \times 10^7 \frac{\text{BTU}}{\text{hr}} + 1.09 \times 10^6 \frac{\text{BTU}}{\text{hr}}$$

$$B_{in} = 5.729 \times 10^7 \text{ BTU/hr}$$

6. Total calorimetric power

$$B_{tot} = B_{SG} + B_{in} - B_{loss}$$

$$B_{tot} = 4.905 \times 10^9 \frac{BTU}{hr} + 5.729 \times 10^7 \frac{BTU}{hr} - 6.89 \times 10^6 \frac{BTU}{hr}$$

$$B_{tot} = 4.955 \times 10^9 \frac{BTU}{hr}$$

7. Full power core heat rate

$$B_{core} = (2.815 \text{ Mw}) (3.412 \times 10^6 \frac{BTU/hr}{Mw})$$

$$B_{core} = 9.605 \times 10^9 \text{ BTU/hr}$$

8. Secondary calorimetric power

$$B_{cal} = \frac{4.955 \times 10^9 \frac{BTU}{hr}}{9.605 \times 10^9 \frac{BTU}{hr}} * 100\%$$

$$B_{cal} = 51.59\%$$

NSSS CALORIMETRIC AT 80% POWER, DECEMBER 9, 1979

Initial Conditions

1. RCS T-average constant at 573.2°F
2. Pressurizer level constant at 46%
3. RCS pressure constant at 2260 psia
4. Secondary steam header pressure constant at 912 psia
5. Steam temperature constant at 532.5°F

Data Collection

The following data were collected every ten minutes for three hous. Average values (used in the calculation) are presented below.

		SG-A	SG-B
1.	Steam generator pressure	936.77 psia	939.93 psia
2.	Feedwater pressure	958.79 psia	945.25 psia
3.	Feedwater temperature	426.82°F	427.62°F
4.	Feedwater flow, W_F	4800.52 klbm/hr	4842.87 klbm/hr
5.	Blowdown flow, W_B	178.20 GPM	184.00 GPM
6.	Blowdown pressure	900 psia	962 psia

Assumptions

		SG-A	SG-B
1.	Main steam enthalpy, h_s, assumed to be dry saturated steam	1195.45 $\frac{BTU}{lb}$	1195.36 $\frac{BTU}{lb}$
2.	Blowdown enthalpy, h_B, assumed to be a saturated liquid	531.32 $\frac{BTU}{lb}$	531.79 $\frac{BTU}{lb}$
3.	Feedwater enthalpy, h_F, assumed to be a compressed liquid	407.02 $\frac{BTU}{lb}$	408.08 $\frac{BTU}{lb}$
4.	Specific volume of blowdown liquid, V_B, assumed to be a saturated liquid	0.021333 $\frac{ft^3}{lb}$	0.021343 $\frac{ft^3}{lb}$

5. Heat loss through pressurizer = 1.04×10^6 BTU/hr
6. Heat loss through RCS piping = 2.76×10^6 BTU/hr
7. Heat loss through other NSSS components = 3.09×10^6 BTU/hr
8. Heat input from reactor coolant pumps = 5.62×10^6 BTU/hr
9. Heat input from pressurizer heaters = 1.09×10^6 BTU/hr

Assumptions 5 through 9 were determined during the Post Core Hot Functional testing and are assumed to remain constant.

Calculations

1. Steam generator A power

$$B_{SGA} = (W_{FA} - W_{BA}) * h_{SA} + (W_{BA} * h_{BA}) - (W_{FA} * h_{FA})$$

where:

W_{FA} = Feedwater flow rate to steam generator A, lbs/hr
W_{BA} = Blowdown flow rate from steam generator A, lbs/hr
h_{SA} = Main steam enthalpy in steam generator A, BTU/lb
h_{BA} = Blowdown enthalpy in steam generator A, BTU/lb
h_{FA} = Feedwater enthalpy in steam generator A, BTU/lb

B_{SGA} = (4,800,520 - 67,008) * 1195.45 + (67,008 * 531.32) - 4,800,520 * 407.02)

$B_{SGA} = 3.740 \times 10^9$ BTU/hr

2. Steam generator B power

$$B_{SGB} = (W_{FB} - W_{BB}) * h_{SB} + (W_{BB} * h_{BB}) - (W_{FB} * h_{FB})$$

where:

W_{FB} = Feedwater flow rate to steam generator B, lbs/hr
W_{BB} = Blowdown flow rate from steam generator B, lbs/hr
h_{SB} = Main steam enthalpy in steam generator B, BTU/lb
h_{BB} = Blowdown enthalpy from steam generator B, BTU/lb
h_{FB} = Feedwater enthalpy in steam generator B, BTU/lb

B_{SGB} = (4,842,870 - 69,158) * 1195.36 + (69,158 * 531.79) - (4,842,570 * 408.08)

$B_{SGB} = 3.767 \times 10^9$ BTU/hr

3. Total steam generator power

$$B_{SG} = B_{SGA} + B_{SGB} = (3.740 + 3.767) \times 10^9 \frac{BTU}{hr}$$

$B_{SG} = 7.507 \times 10^9$ BTU/hr

4. Energy losses (see assumptions 5 through 7)

$$B_{loss} = B_P + B_{RCS} + B_{NSSS}$$

where:

B_P = Energy loss through pressurizer walls
B_{RCS} = Energy loss through RCS piping
B_{NSSS} = Energy loss through other NSSS components

$$B_{loss} = (1.04 + 2.76 + 3.09) \times 10^9 \text{ BTU/hr}$$

$$B_{loss} = 6.89 \times 10^9 \text{ BTU/hr}$$

5. Energy inputs

$$B_{in} = B_{RCP} + B_{PH}$$

where:

B_{RCP} = Energy input from reactor coolant pumps
B_{PH} = Energy input from pressurizer heaters

$$B_{in} = 5.62 \times 10^7 \text{ BTU/hr} + 1.09 \times 10^6 \text{ BTU/hr}$$

$$B_{in} = 5.729 \times 10^7 \text{ BTU/hr}$$

6. Total calorimetric power

$$B_{tot} = B_{SG} + G_{in} - B_{loss}$$

$$B_{tot} = (7.507 \times 10^9 + 5.729 \times 10^7 - 6.89 \times 10^6) \text{ BTU/hr}$$

$$B_{tot} = 7.557 \times 10^9 \text{ BTU/hr}$$

7. Full power core heat rate

$$B_{core} = (2815\ Mw)\ (3.412 \times 10^{6}\ \frac{BTU/hr}{Mw})$$

$$B_{core} = 9.605 \times 10^{9}\ BTU/hr$$

8. Secondary calorimetric power

$$B_{cal} = \frac{7.557 \times 10^{9}\ \frac{BTU}{hr}}{9.605 \times 10^{9}\ \frac{BTU}{hr}} * 100\%$$

$$B_{cal} = 78.68\%$$