FIGURES

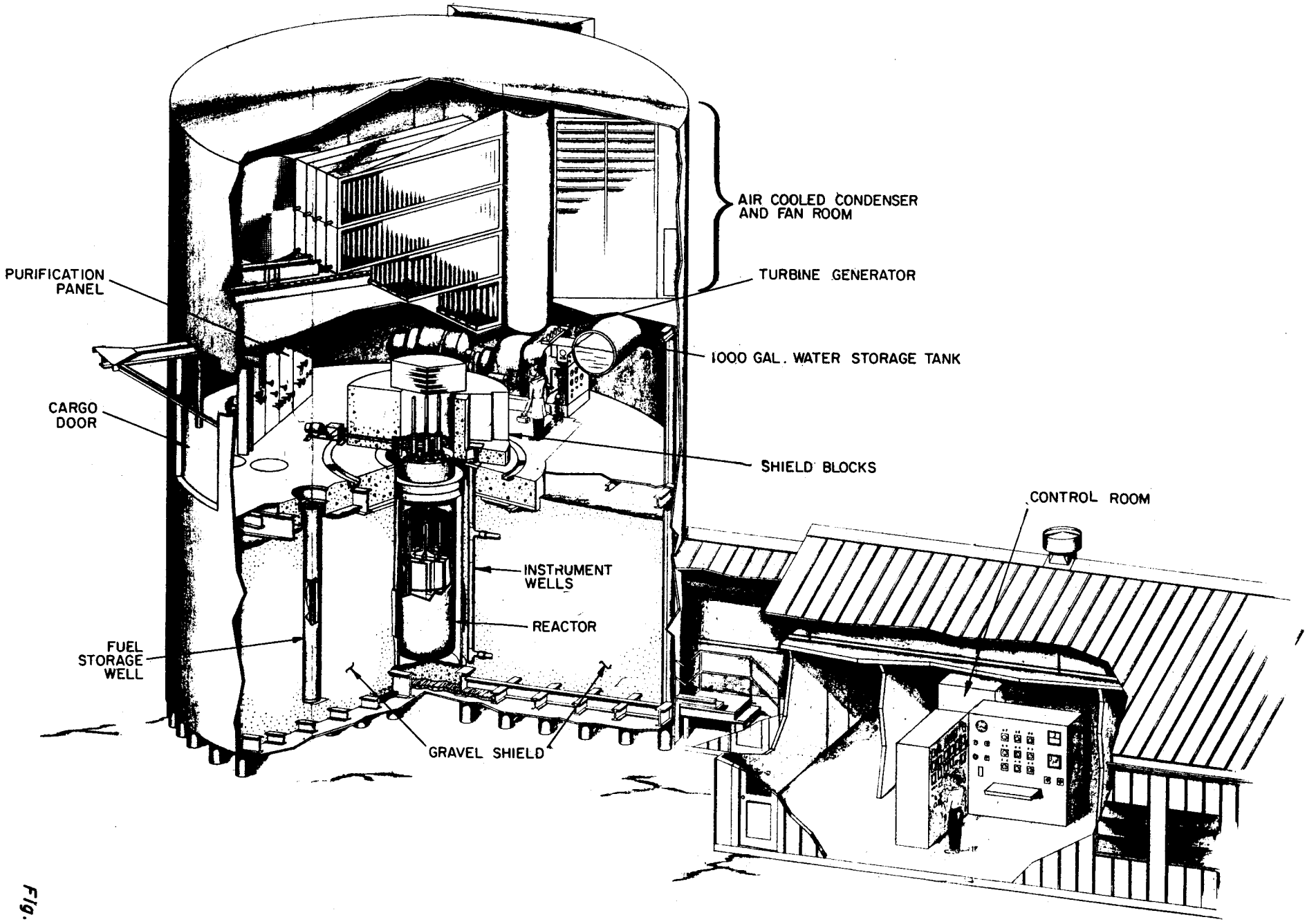
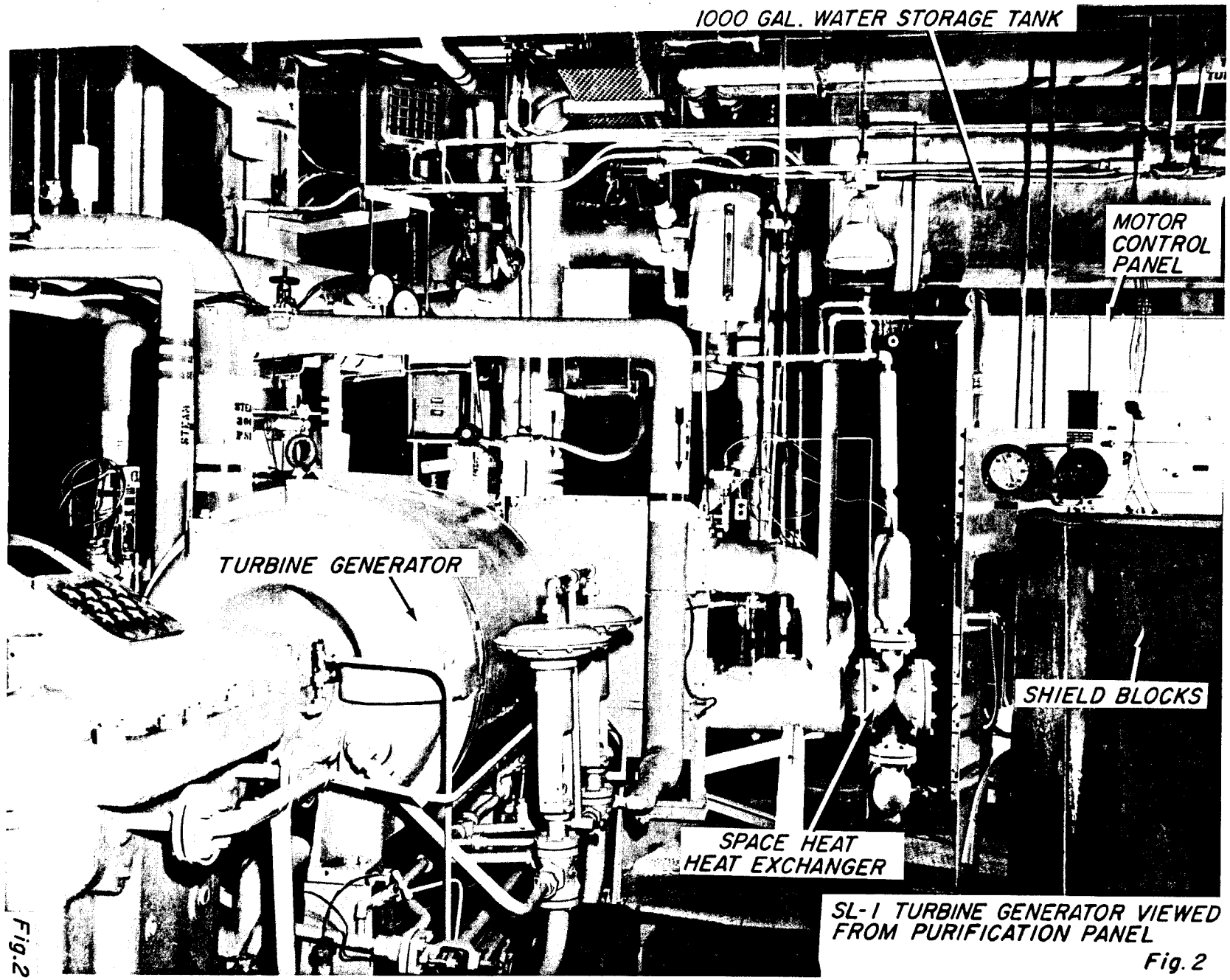


Fig. 1

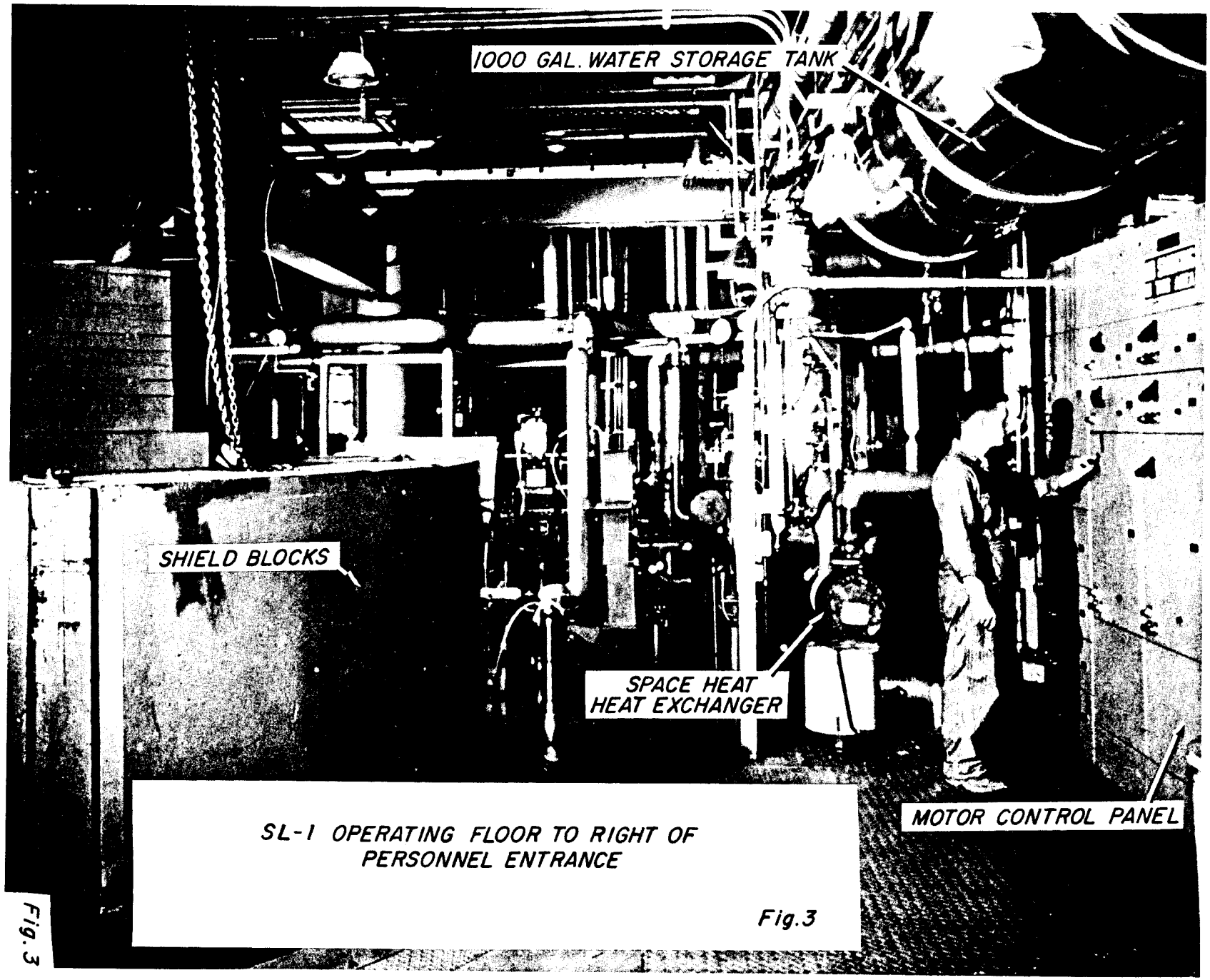
SL-1 PLANT PERSPECTIVE



SL-1 TURBINE GENERATOR VIEWED FROM PURIFICATION PANEL

Fig. 2

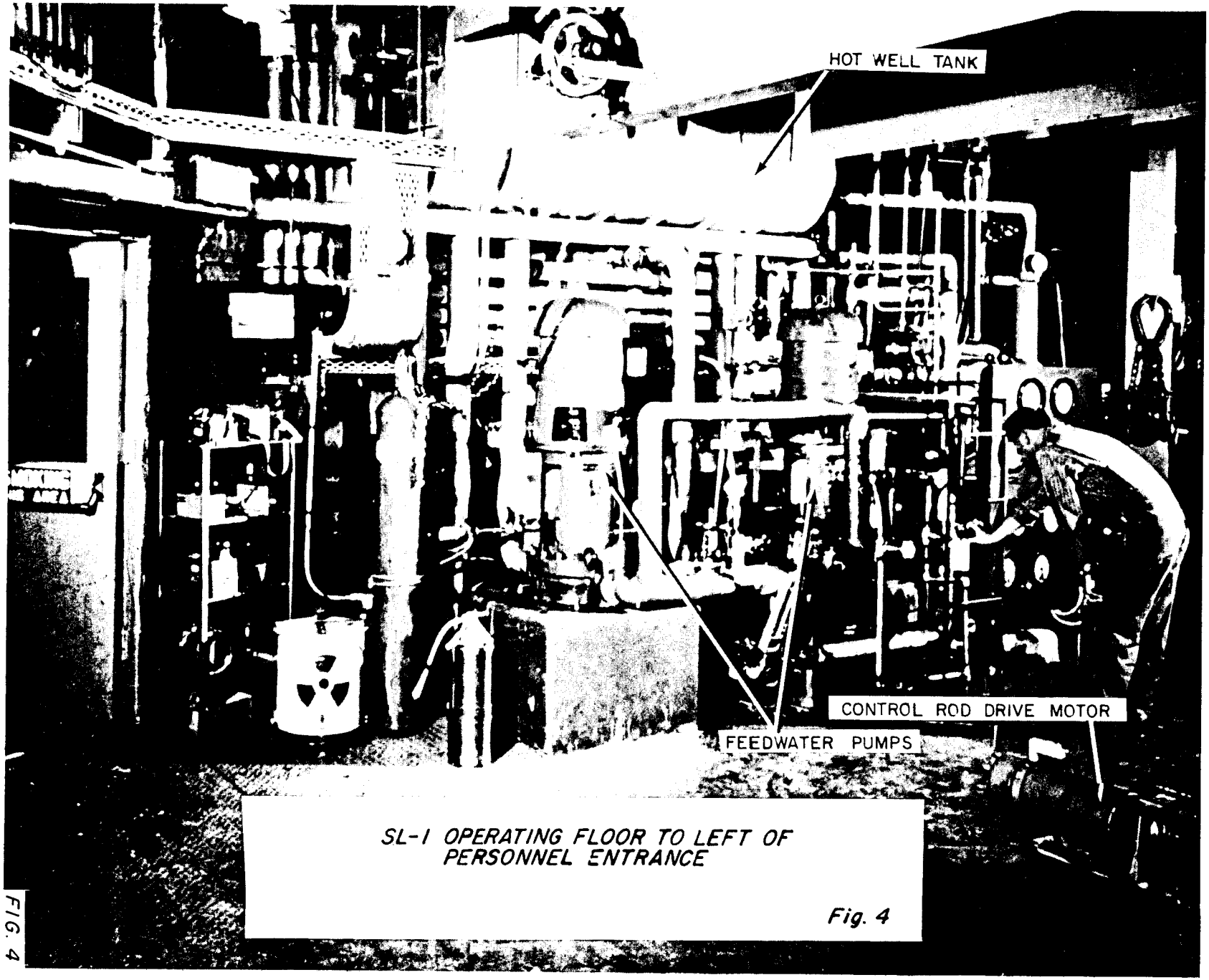
Fig.2



SL-1 OPERATING FLOOR TO RIGHT OF PERSONNEL ENTRANCE

Fig.3

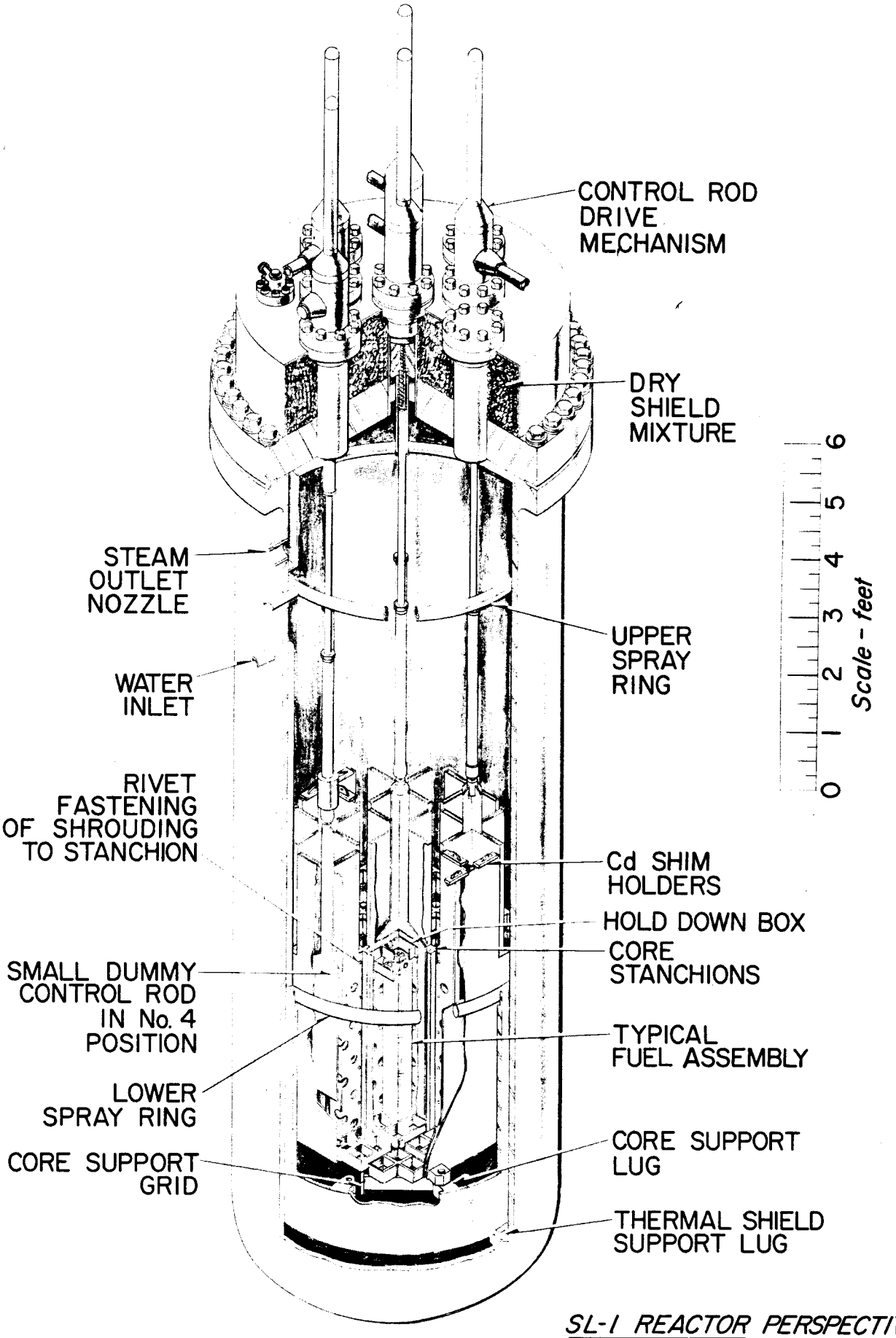
Fig. 3



SL-1 OPERATING FLOOR TO LEFT OF PERSONNEL ENTRANCE

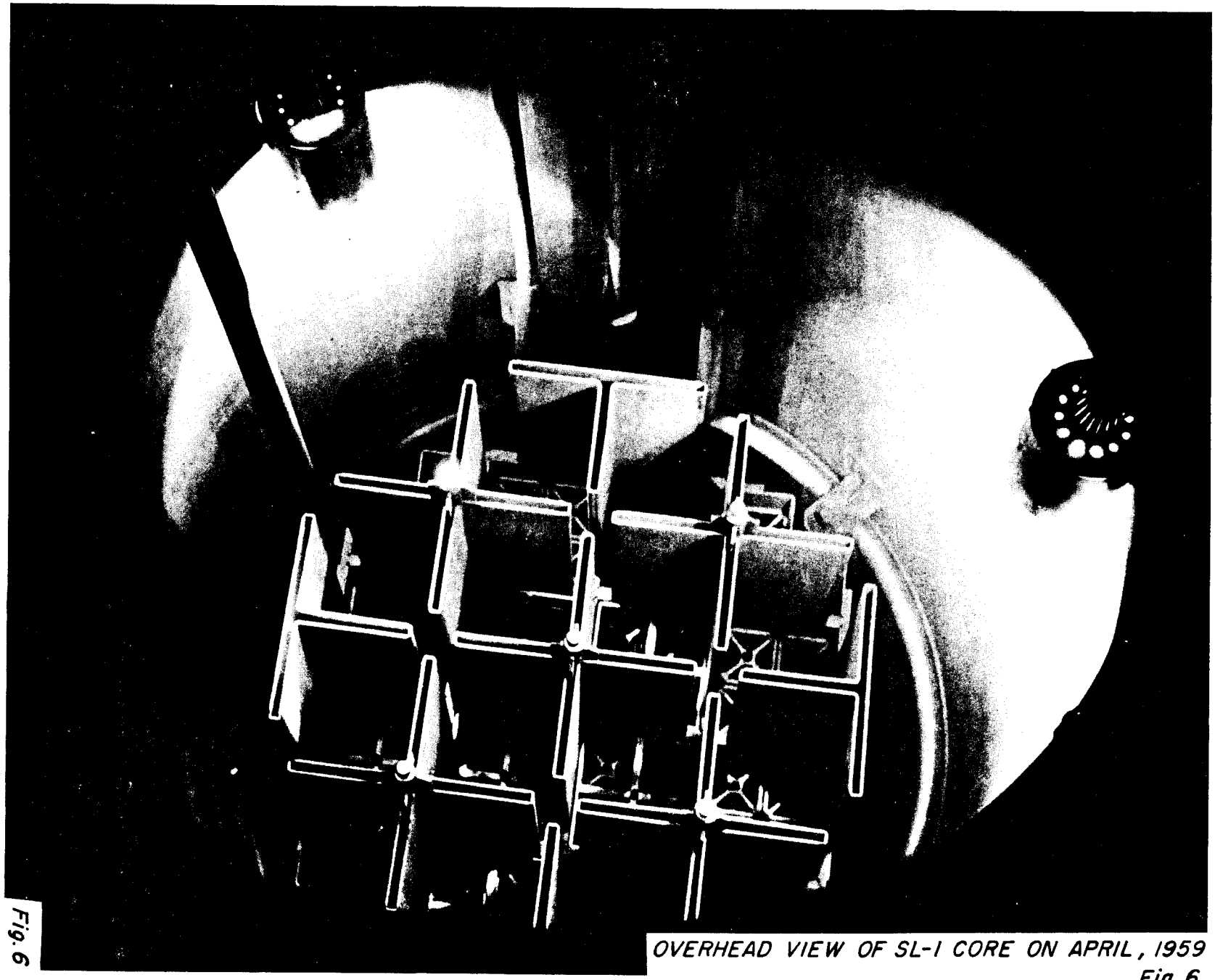
Fig. 4

FIG. 4



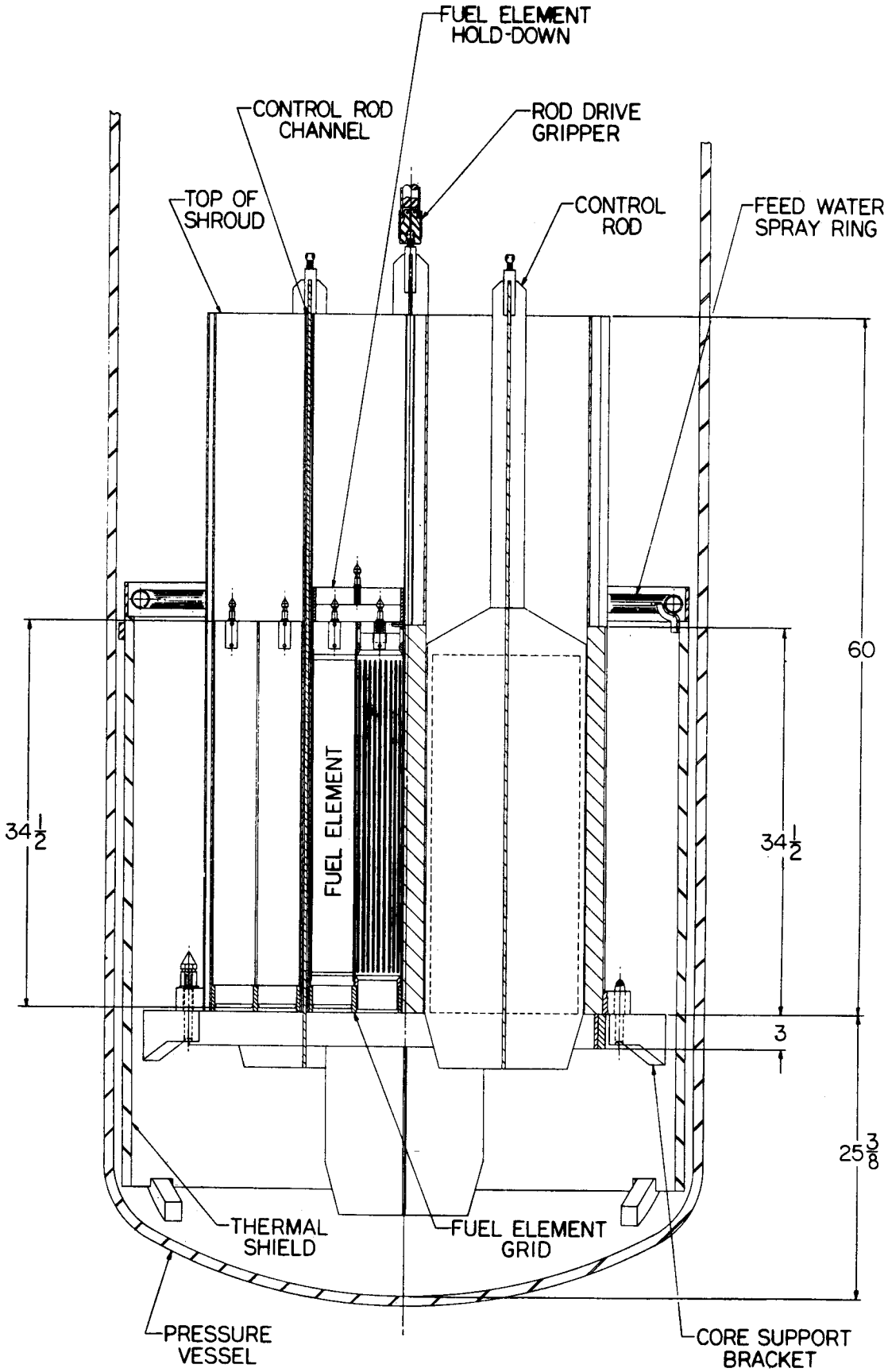
SL-1 REACTOR PERSPECTIVE

Fig. 5



OVERHEAD VIEW OF SL-1 CORE ON APRIL, 1959
Fig. 6

Fig. 6

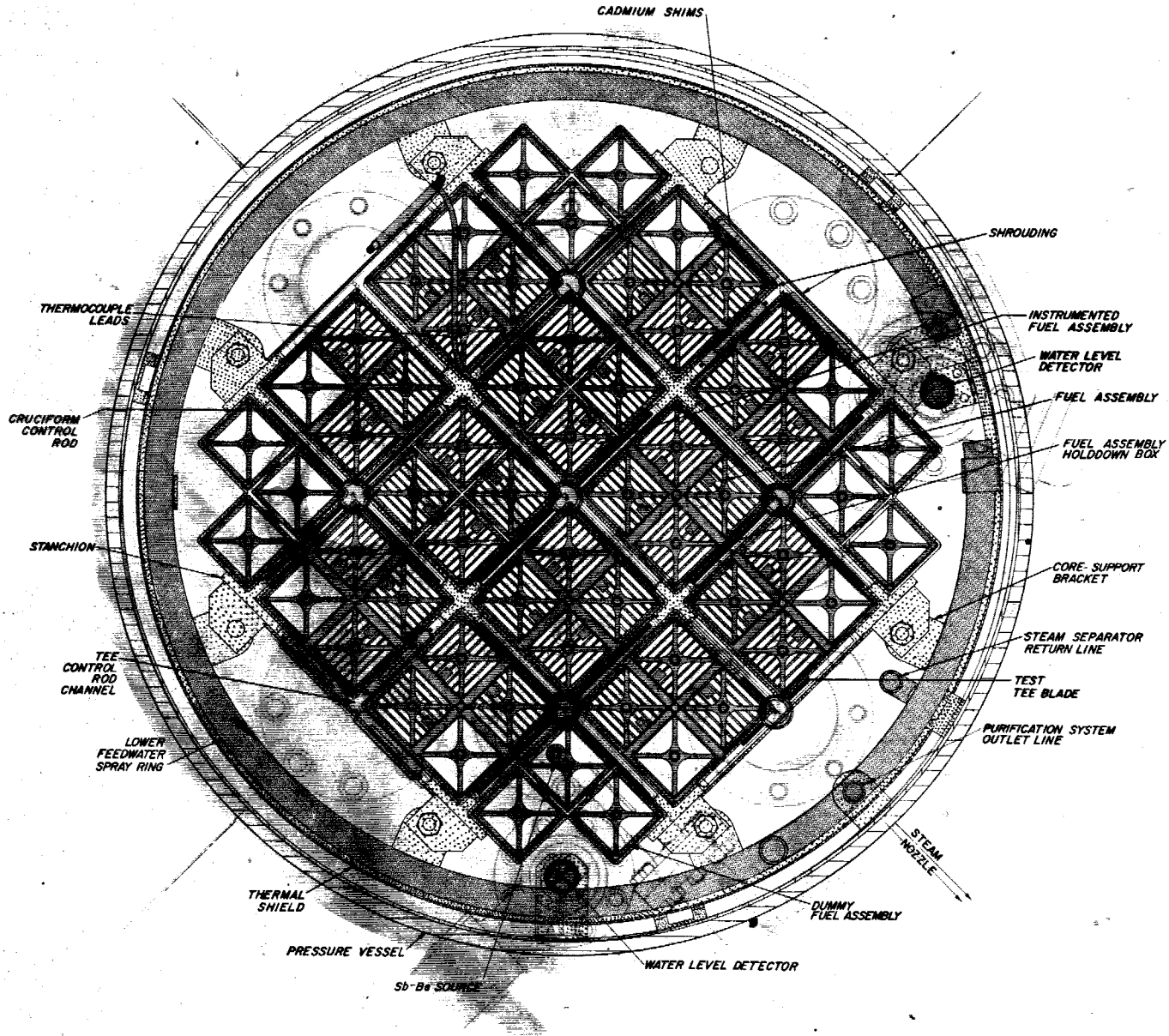


SL-1 REACTOR VERTICAL CROSS SECTION

Fig. 7

KEY:

- NON REMOVABLE CORE STRUCTURE
- LOWER SPRAY RING AND PIPING
- REMOVABLE CORE COMPONENTS AND INSTRUMENT

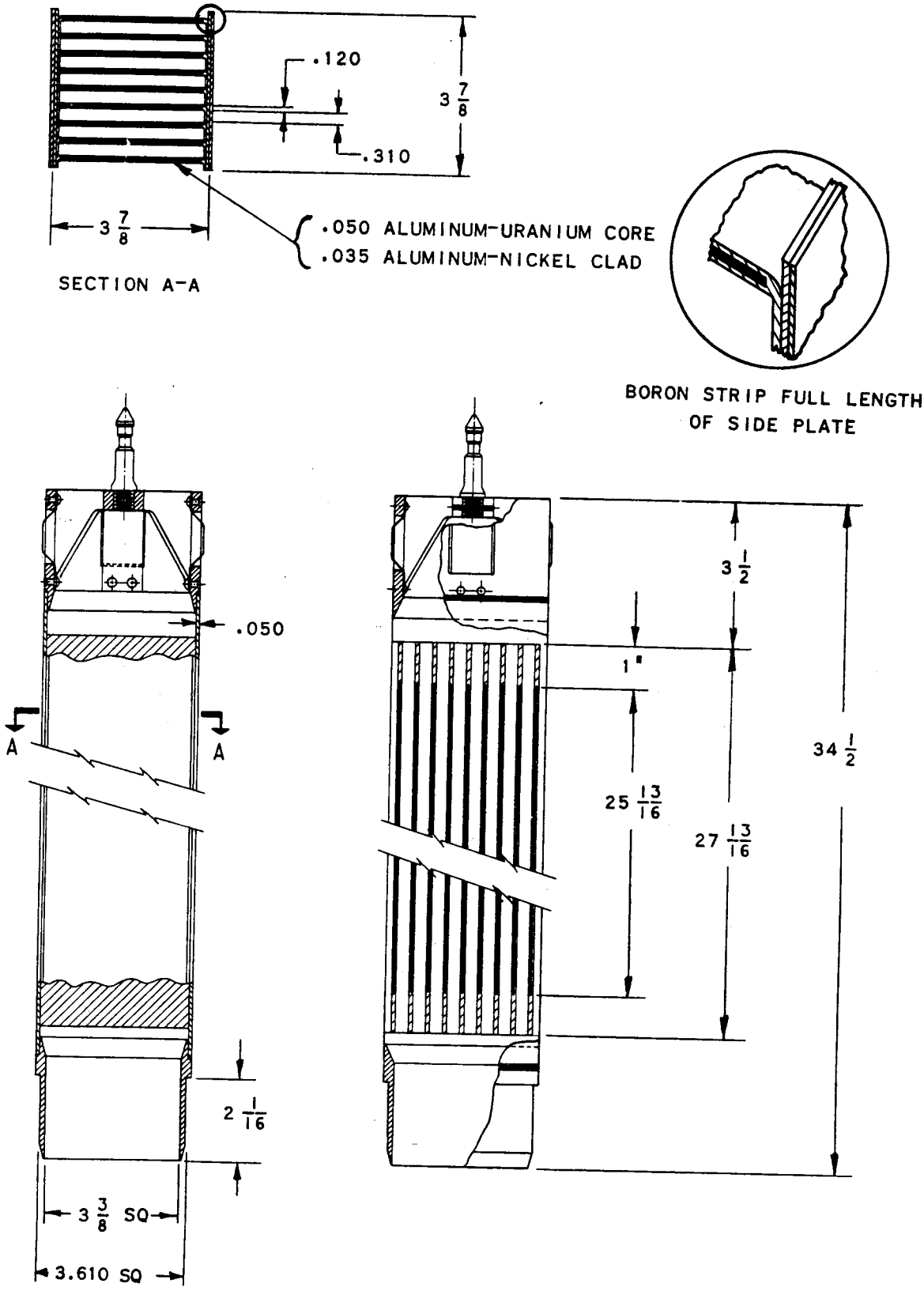


CONTROL RODS AND CADMIUM SHIMS

REACTOR VESSEL HEAD PHANTOM VIEW
WITH PORTS UNCOVERED BY EXCURSION
SHOWN OPEN

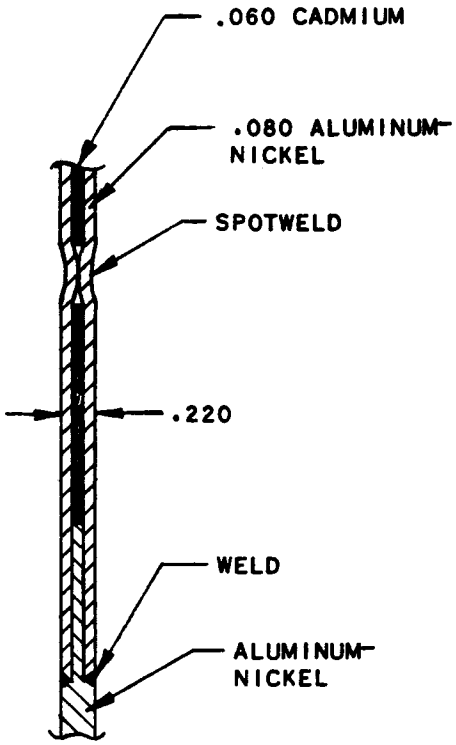
SL-1 CORE
AS OF JAN. 3, 1961

Fig. 8

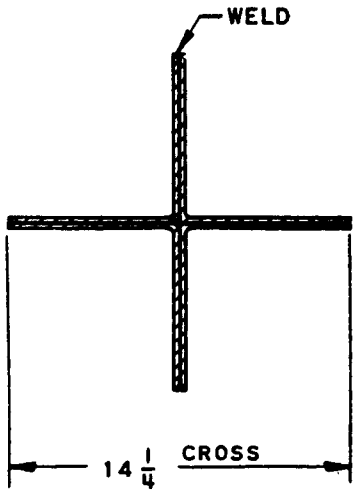


reprinted from ANL-5744 (Fig. 9)

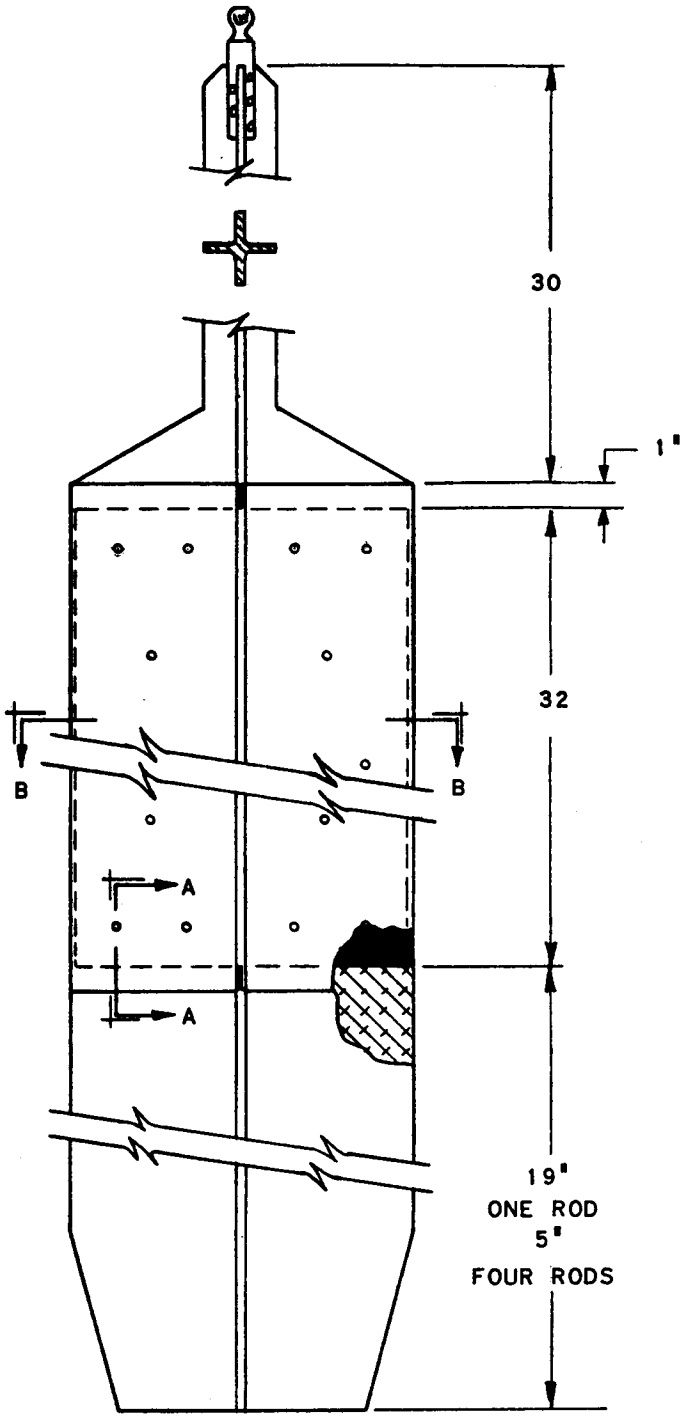
SL-1 FUEL ASSEMBLY
Fig. 9



SECTION A-A

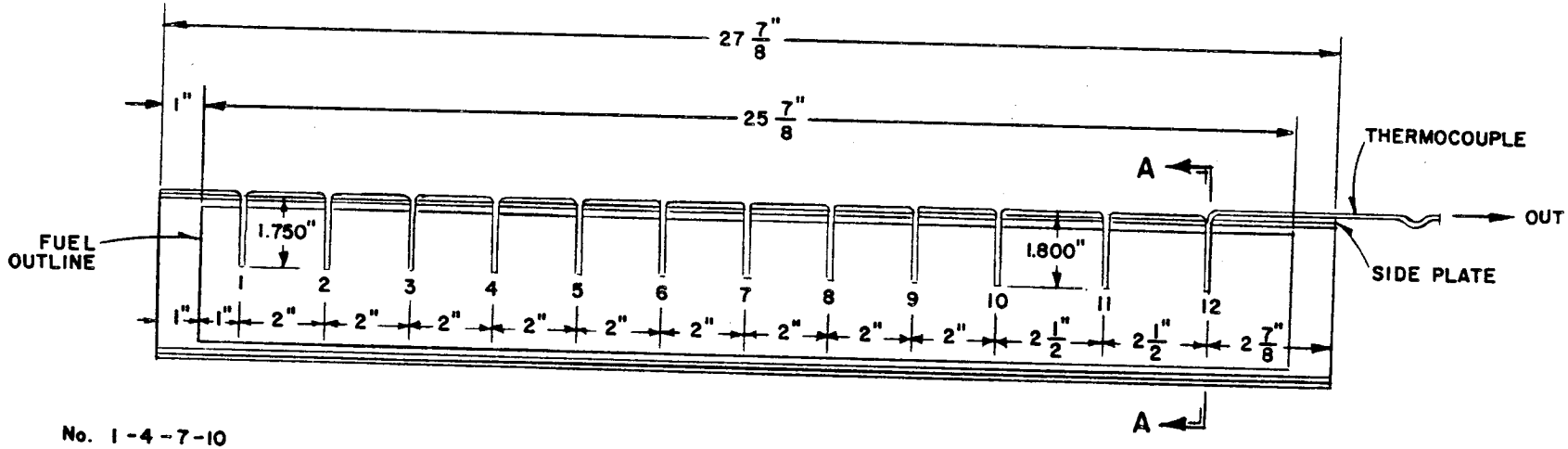


SECTION B-B



reprinted from ANL-5744 (Fig. 10)

SL-1 CRUCIFORM CONTROL ROD
Fig. 10



No. 1-4-7-10

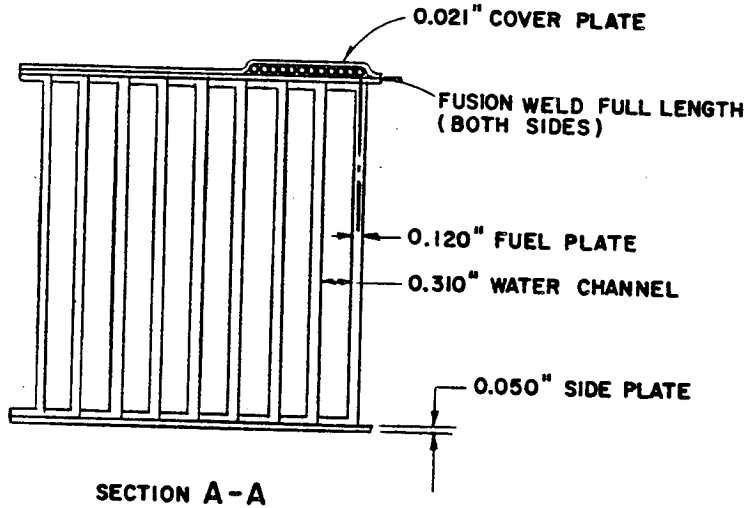
No. 2-5-8-11 BRAZED

No. 3-6-9-12 PEENED

NOTE:

1 - CENTER DRILL 0.125" RADIUS

2 - DRILL 0.067 - 0.068 DIA. - 1.80" DEEP FROM SIDE PLATE SURFACE

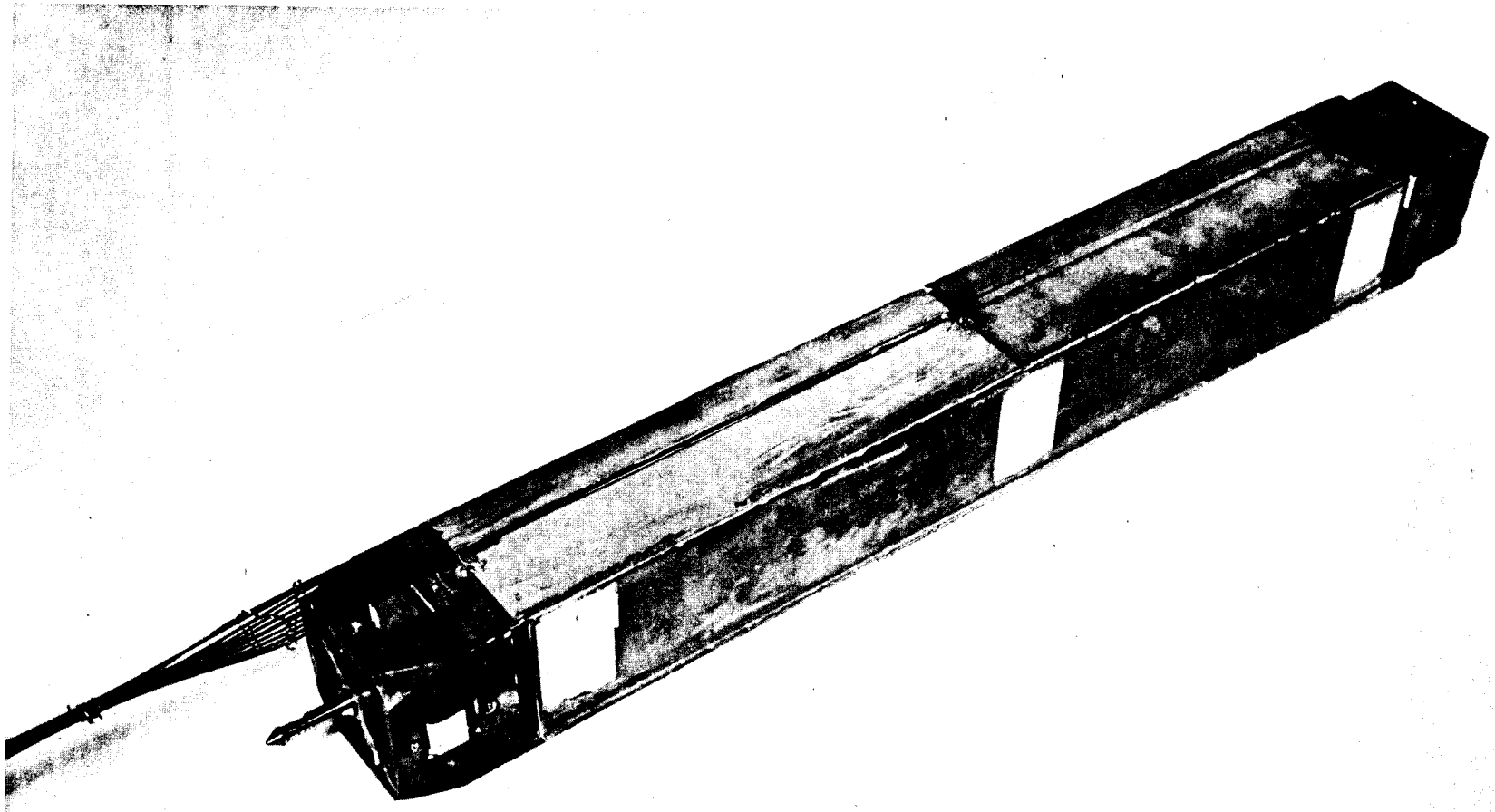


SECTION A-A

Fig. 11

THERMOCOUPLE LOCATION
SL-1 INSTRUMENTED FUEL ASSEMBLY

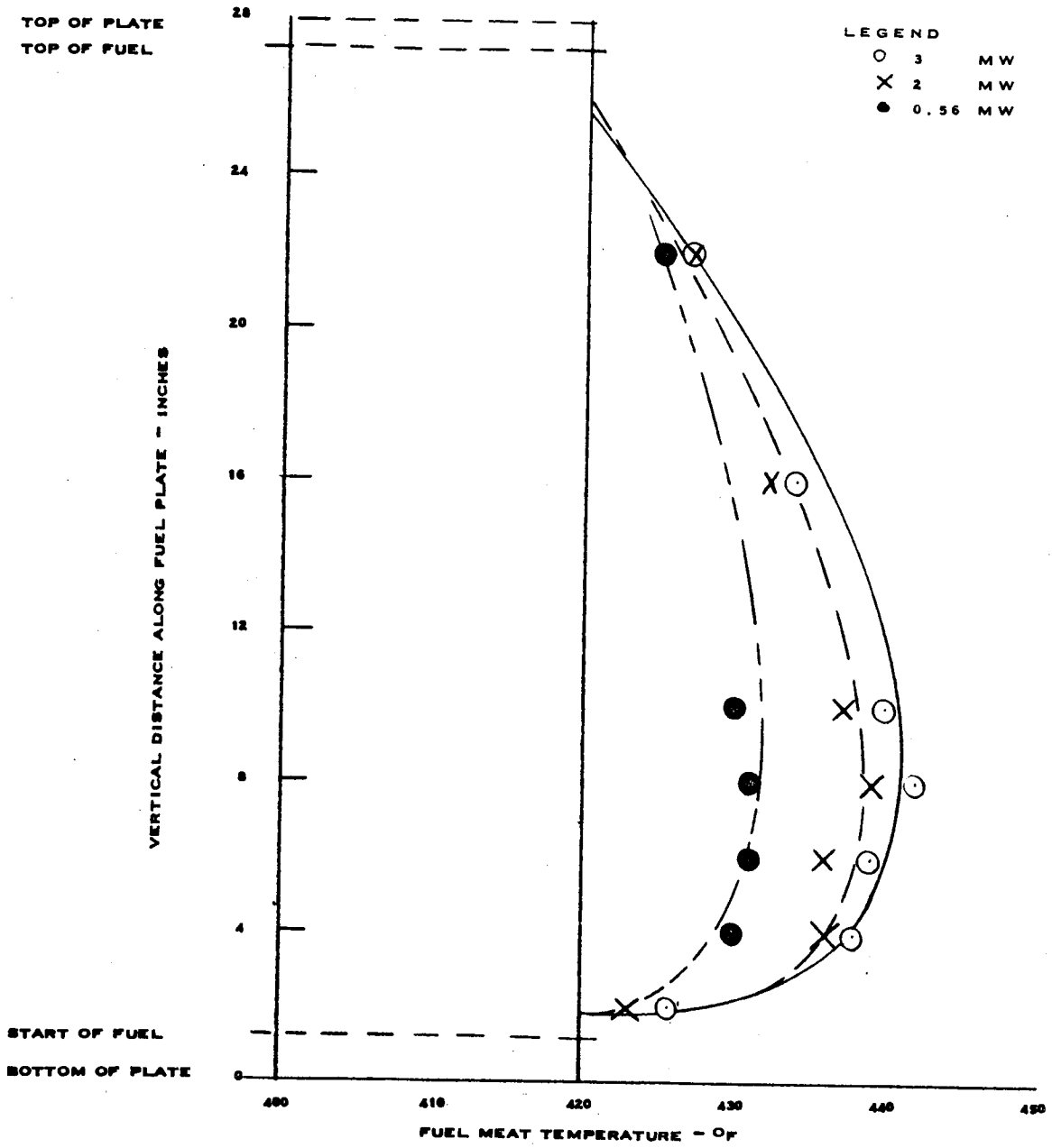
Fig.11



SL-I CORE I INSTRUMENTED
FUEL ASSEMBLY

Fig. 12

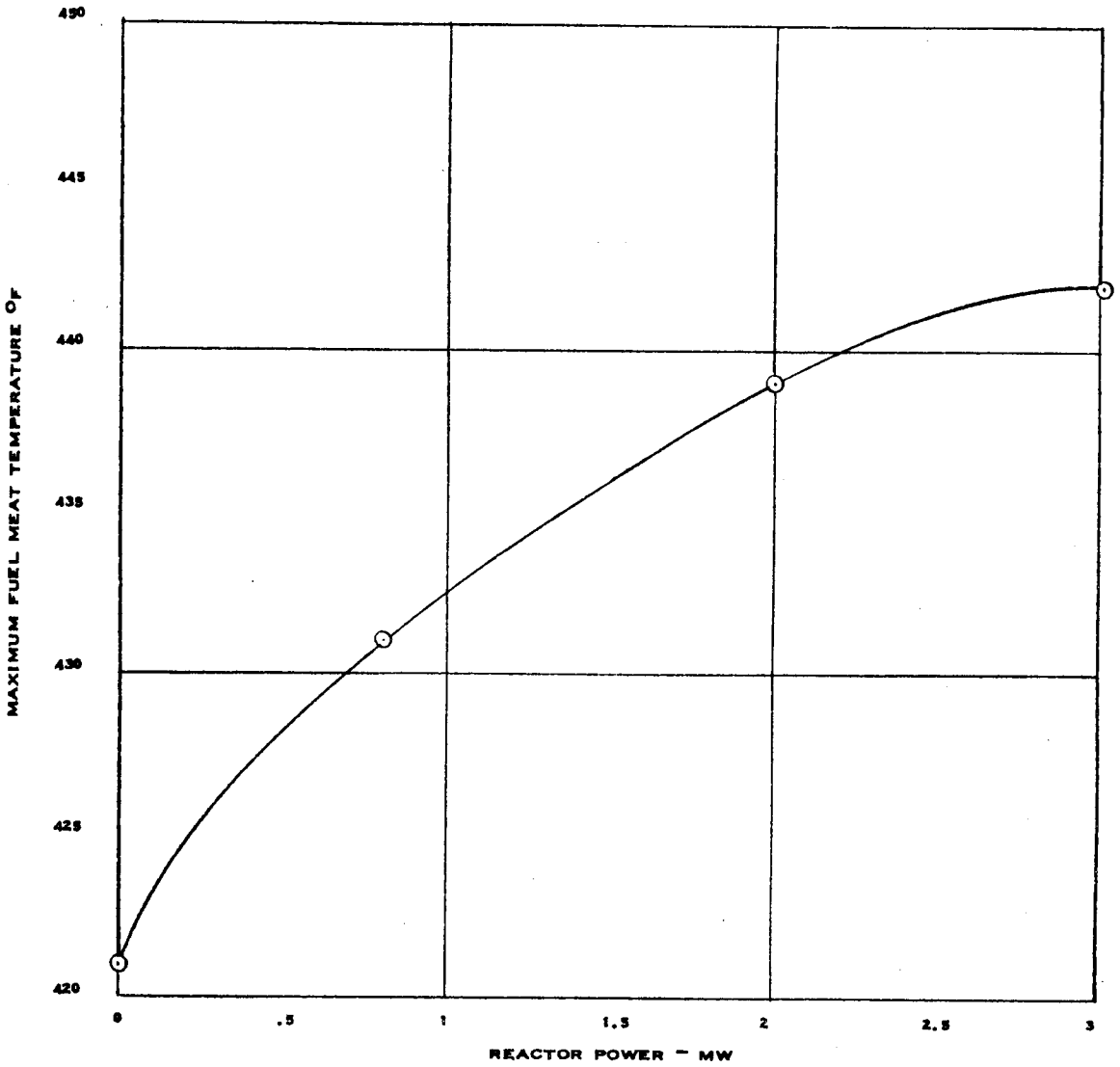
Fig. 12



INSTRUMENTED FUEL ASSEMBLY PLATE TEMPERATURES

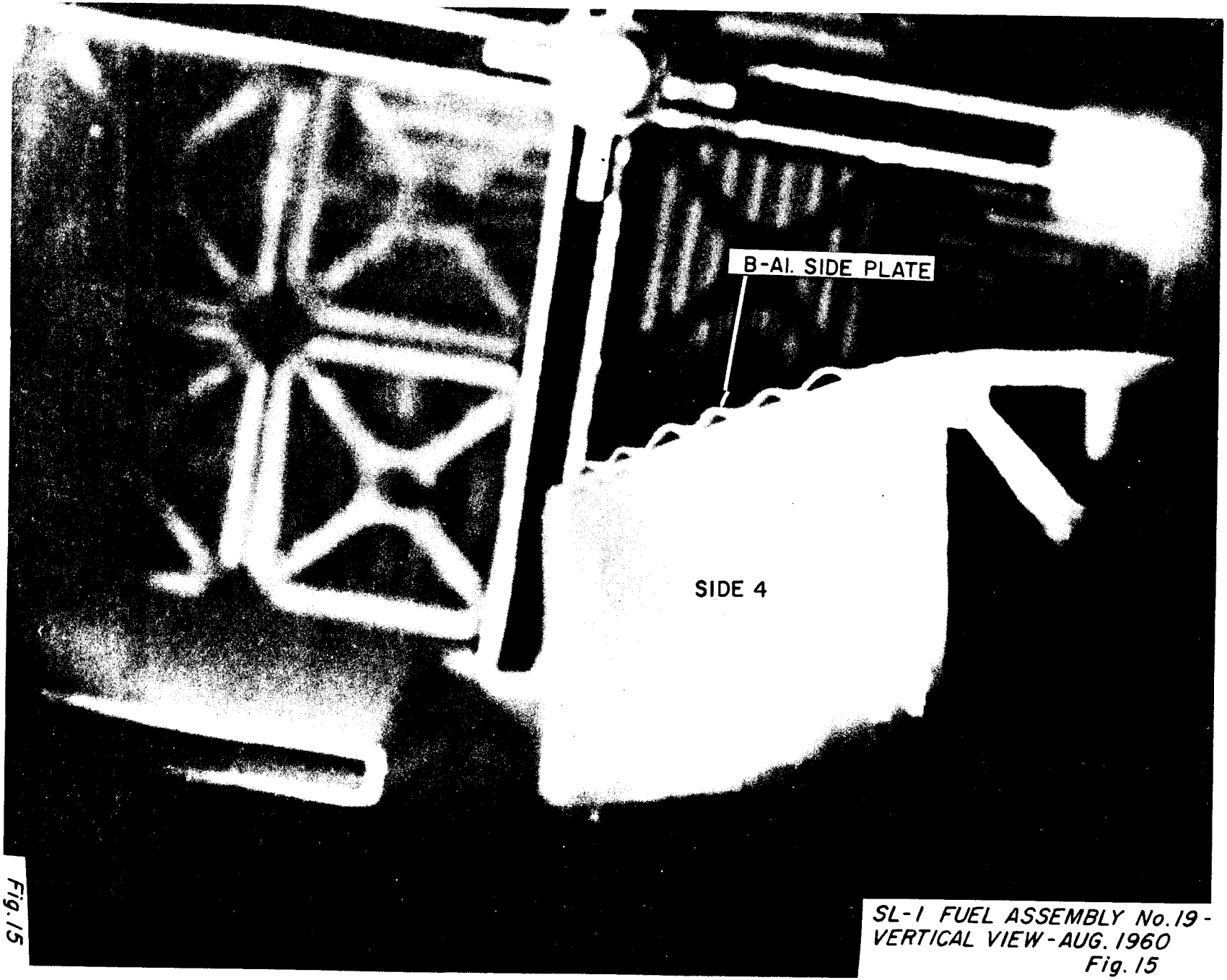
REACTOR AT 3MW

Fig. 13



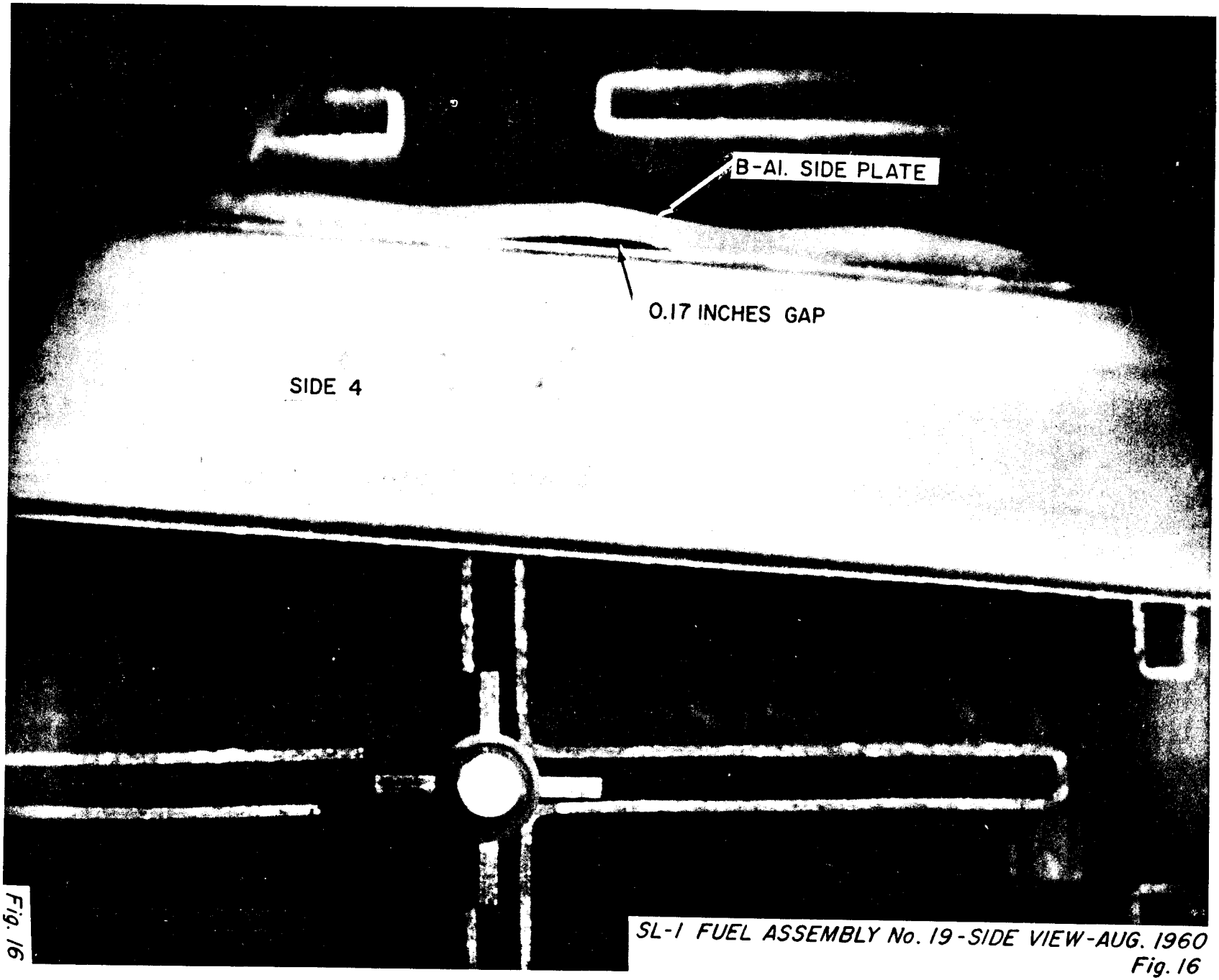
THE EFFECT OF REACTOR POWER ON SL-1 MAXIMUM FUEL PLATE TEMPERATURE

Fig. 14



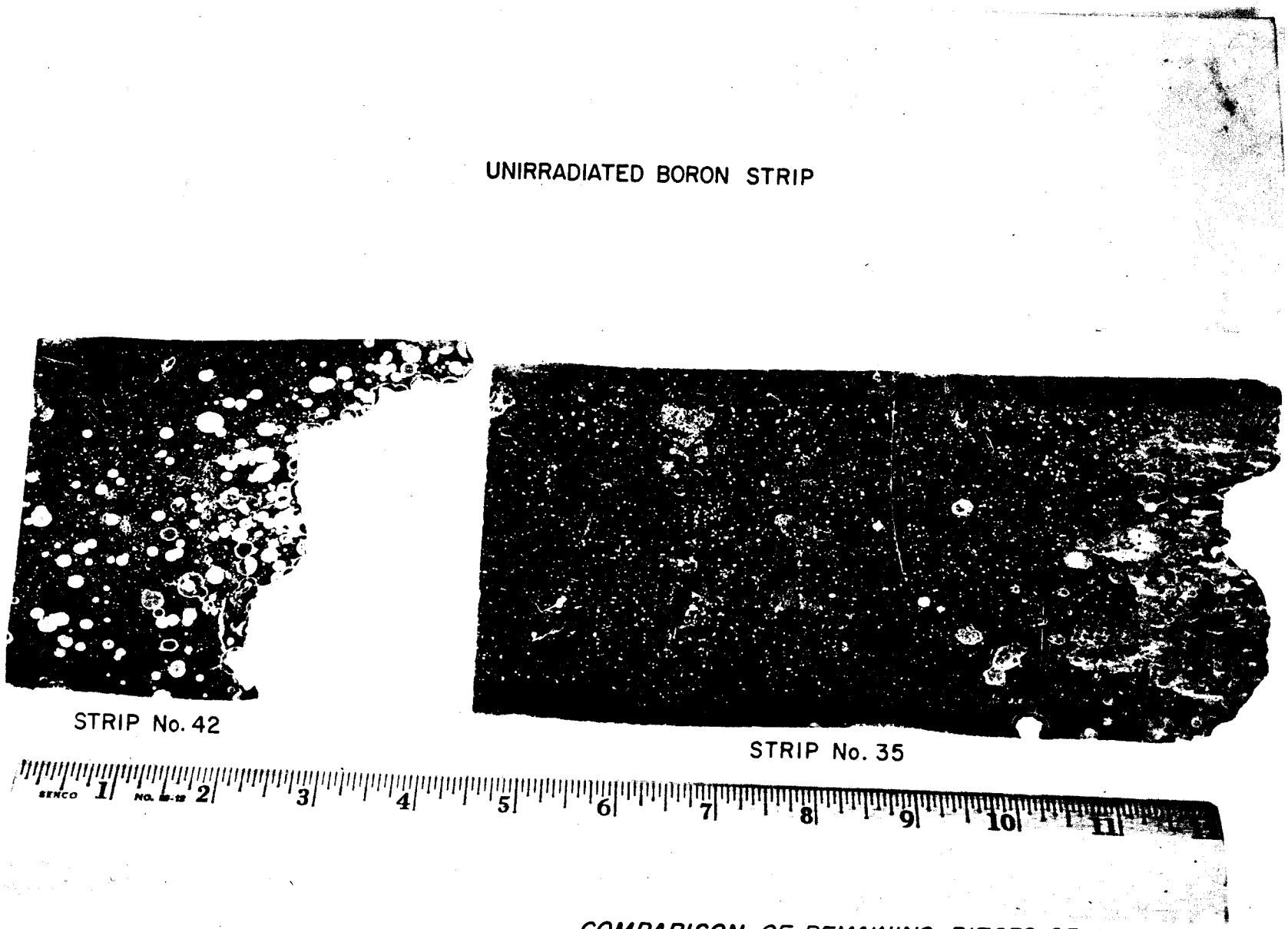
SL-1 FUEL ASSEMBLY No. 19 -
VERTICAL VIEW - AUG. 1960
Fig. 15

Fig. 15



SL-1 FUEL ASSEMBLY No. 19 - SIDE VIEW - AUG. 1960
Fig. 16

Fig. 16



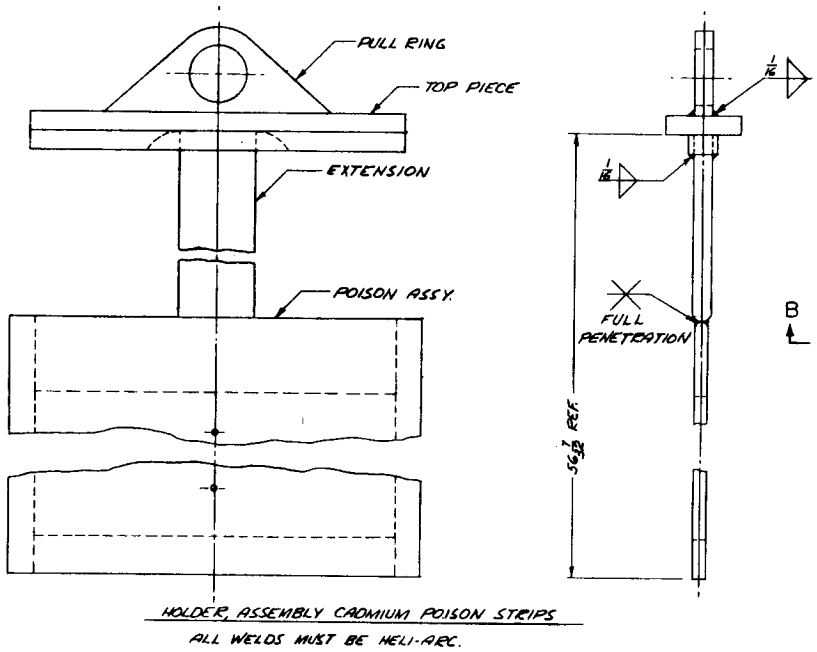
COMPARISON OF REMAINING PIECES OF ALUMINUM-BORON STRIPS WITH UNIRRADIATED STRIP

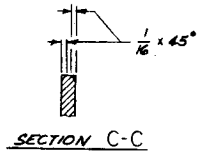
Fig. 17

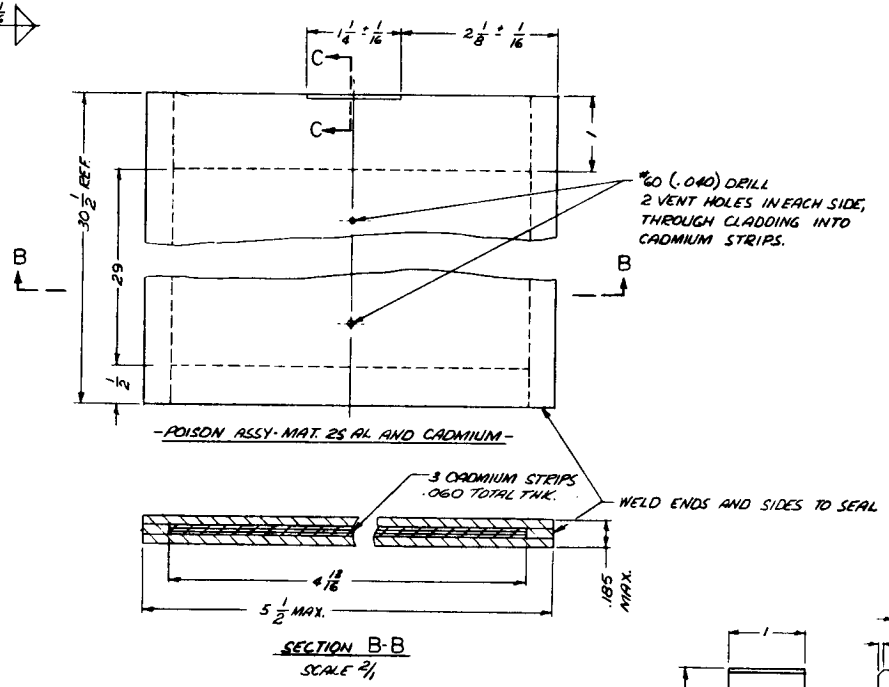
Fig. 17

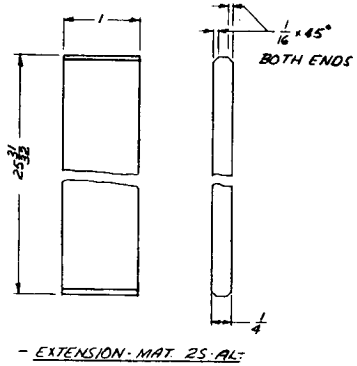
DEBRIS RECOVERED FROM BOTTOM OF SL-1 REACTOR VESSEL
Fig. 18

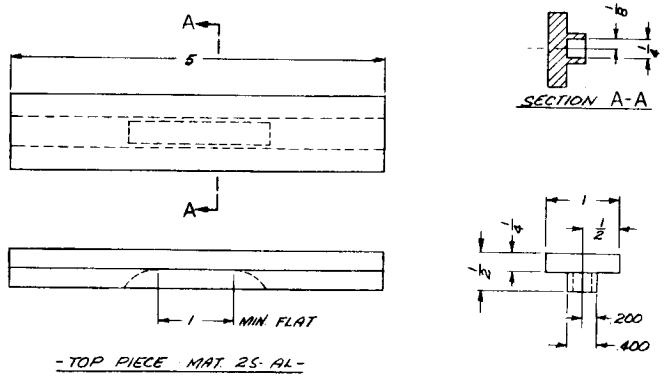
Fig 18

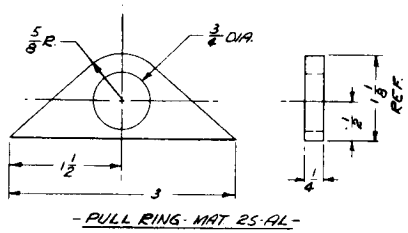




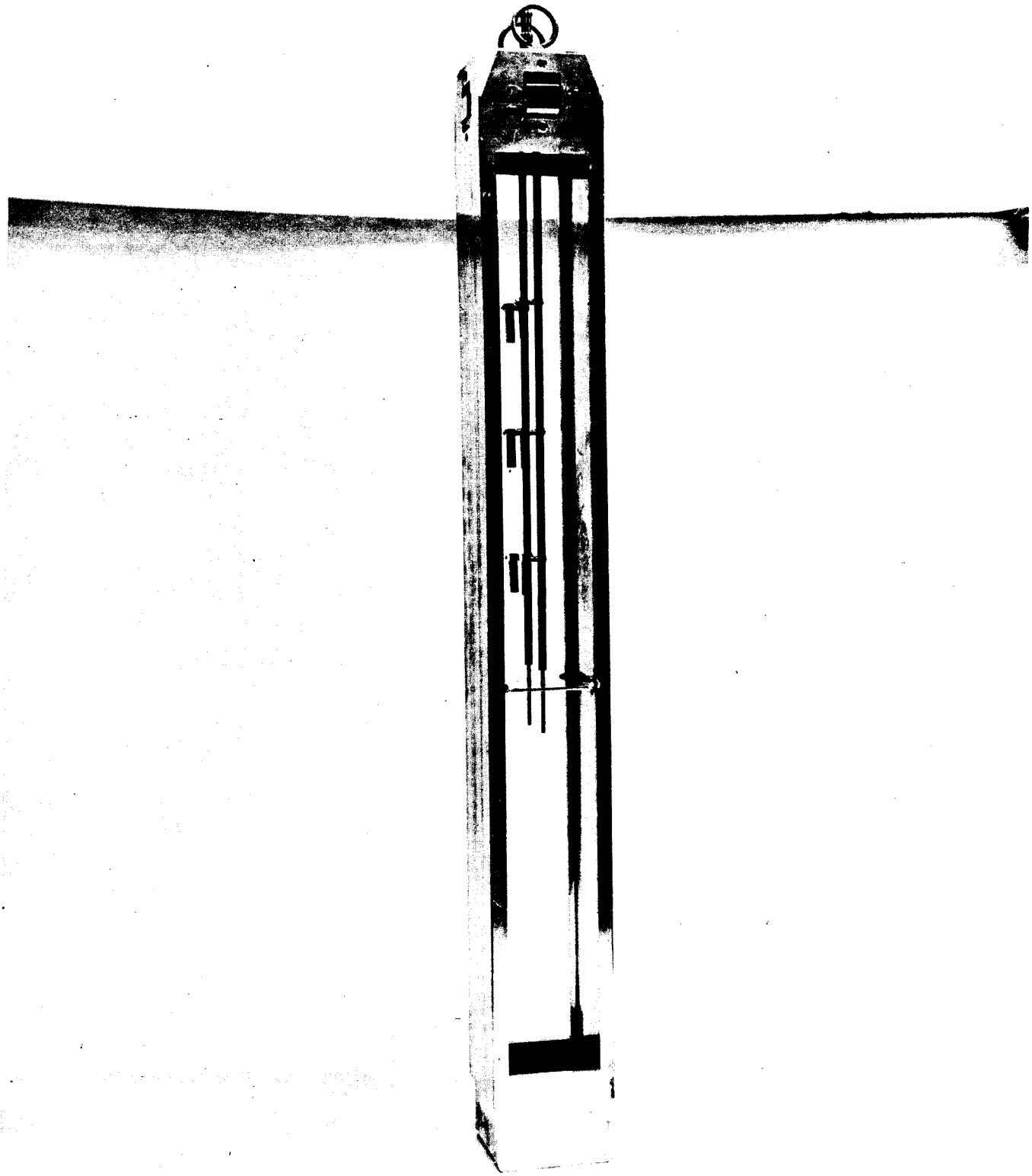






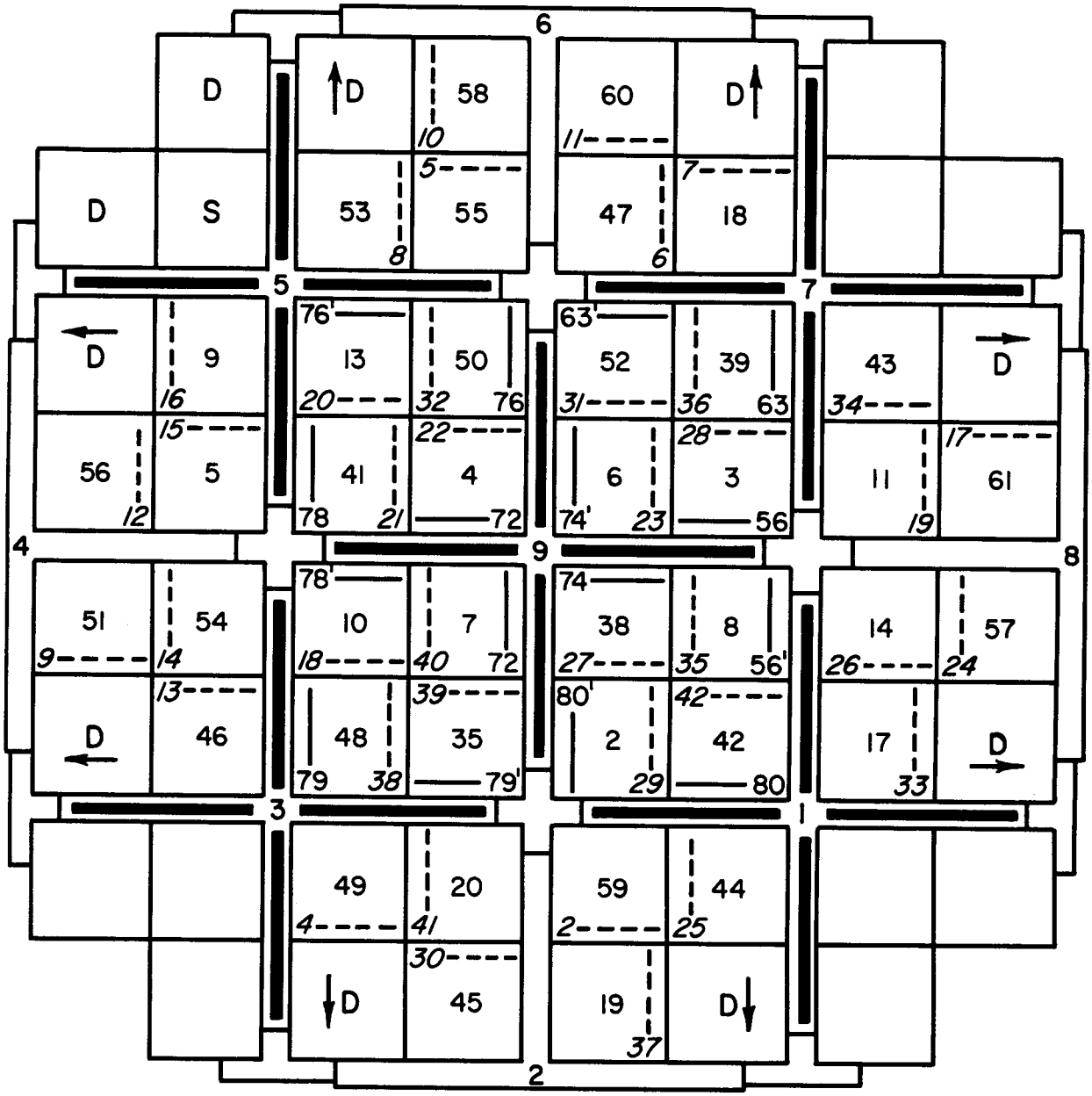


CADMIUM SHIMS - AS BUILT
Fig. 19



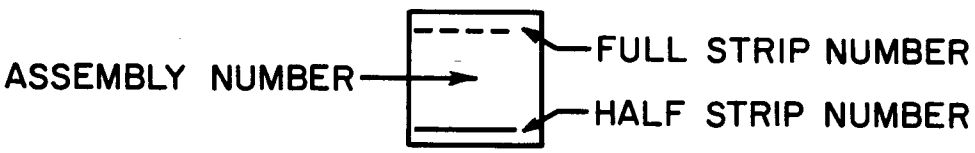
SILVER-INDIUM-CADMIUM CORROSION TEST ASSEMBLY FOR SL-1

Fig. 20



KEY:

FULL STRIP OF BORON - DASH LINE
HALF STRIP OF BORON - SOLID LINE
D - DUMMY ELEMENT
S - SOURCE



The position of the full and dotted lines indicate the orientation of the assembly and the position of the boron within a cell of four assemblies.

The direction of the side plates of the dummy elements are shown by an arrow.

SL-1 LOADING FOR 40 ELEMENT CORE

FIG. 21

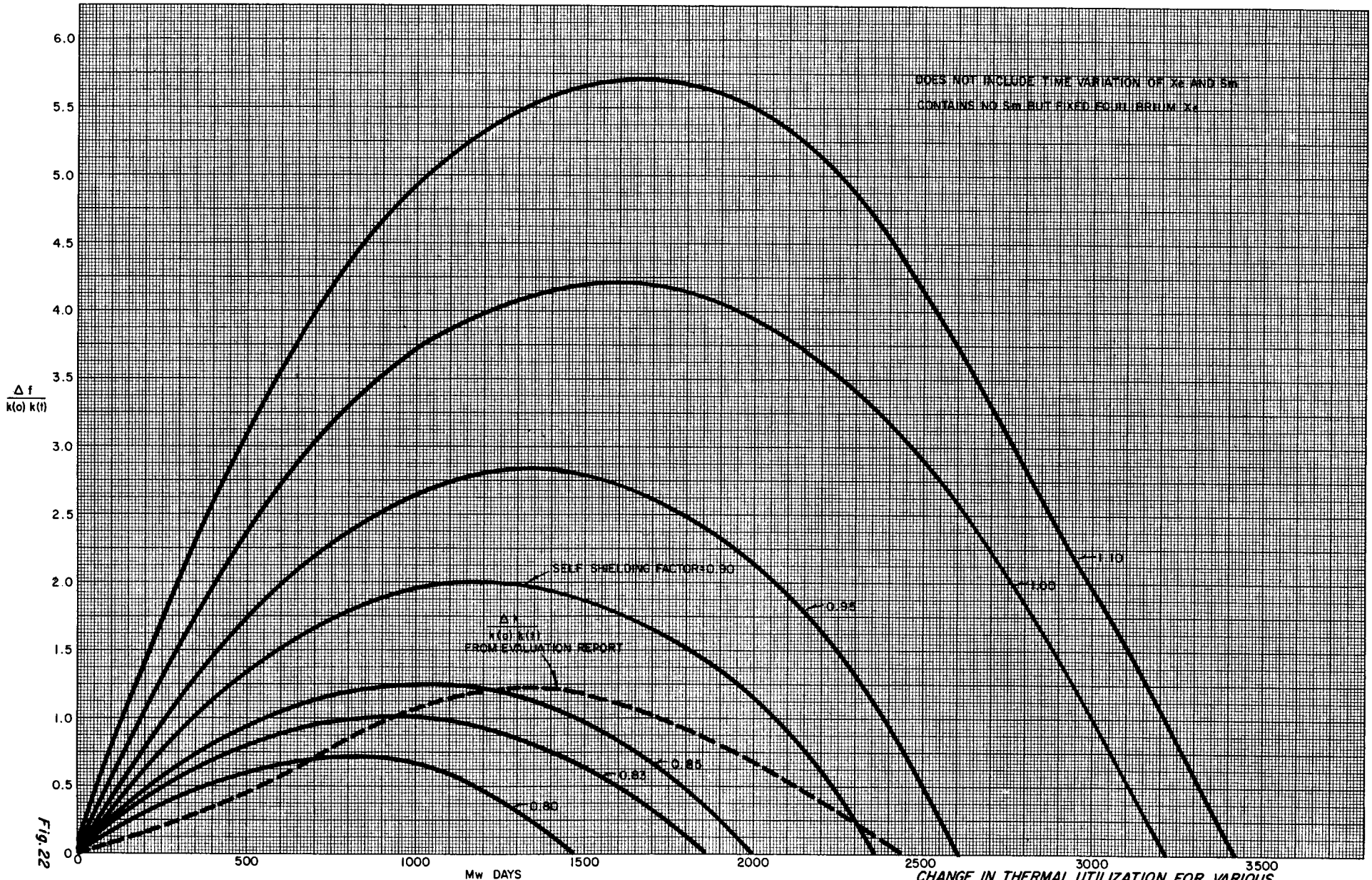
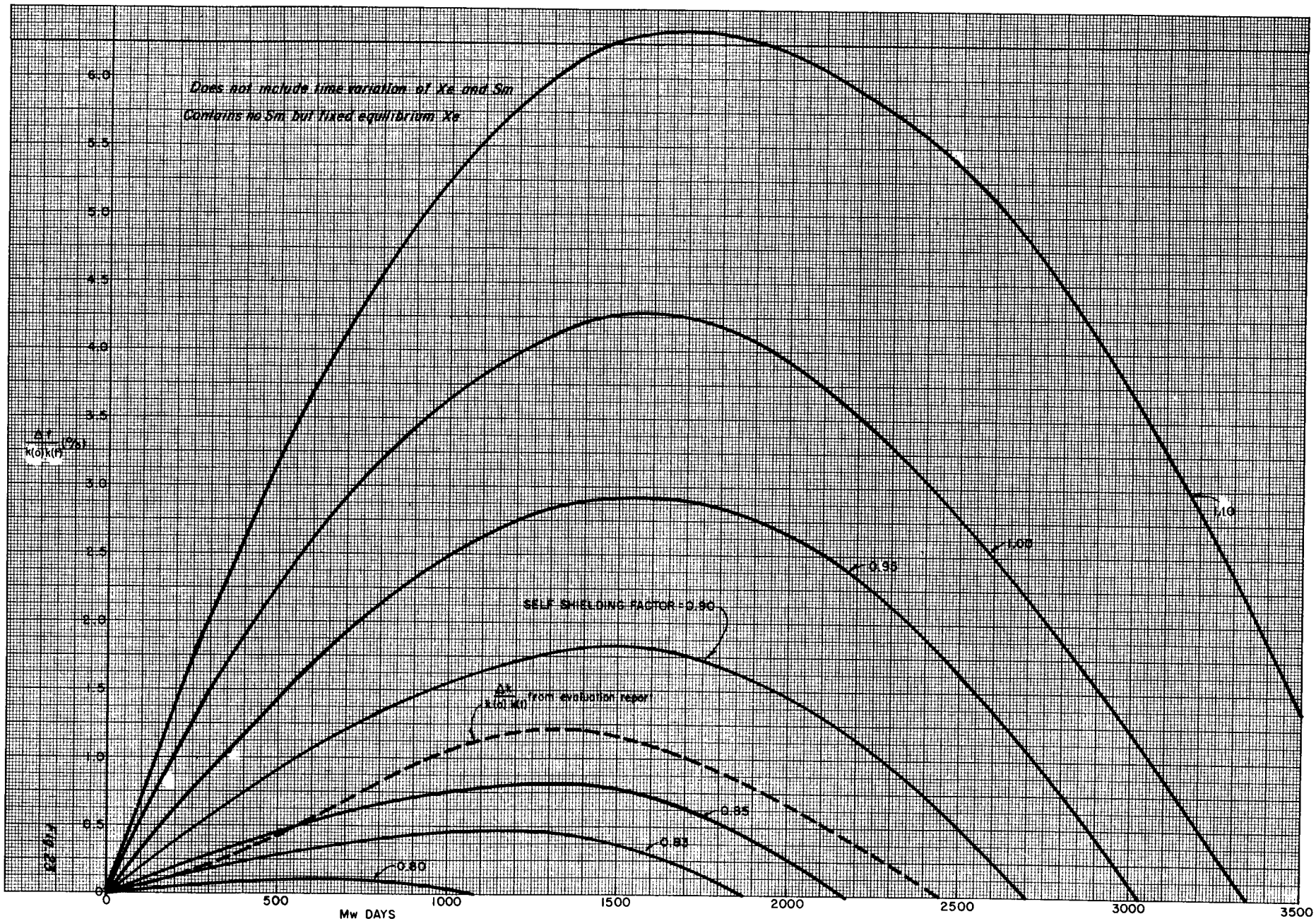


Fig.22

CHANGE IN THERMAL UTILIZATION FOR VARIOUS TIME INDEPENDENT BORON SELF SHIELDING FACTORS (RELATIVE TO URANIUM)

Fig.22



CHANGE IN THERMAL UTILIZATION FOR VARIOUS TIME DEPENDENT BORON SELF SHIELDING FACTORS
(RELATIVE TO URANIUM)

Fig. 23

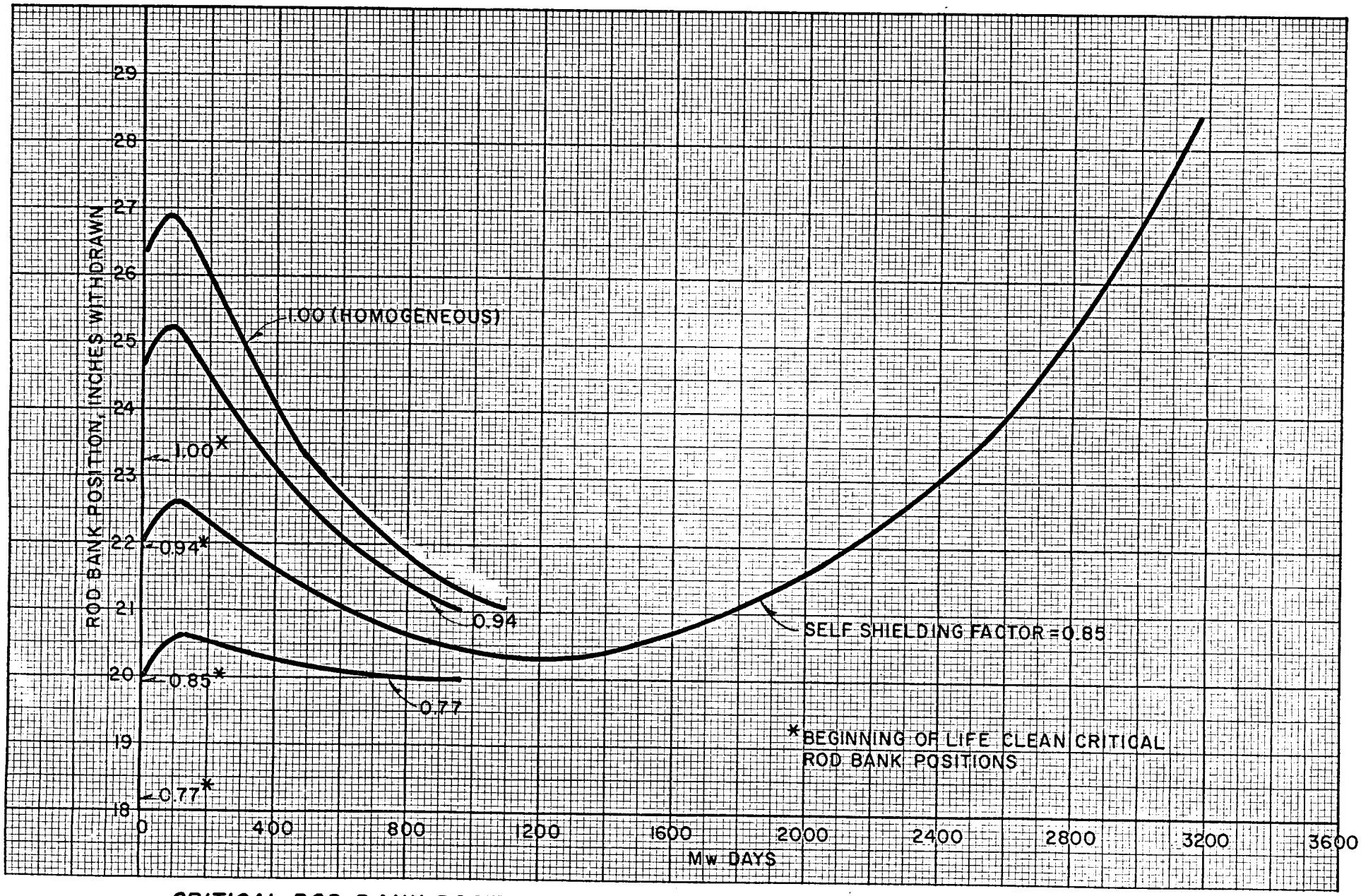
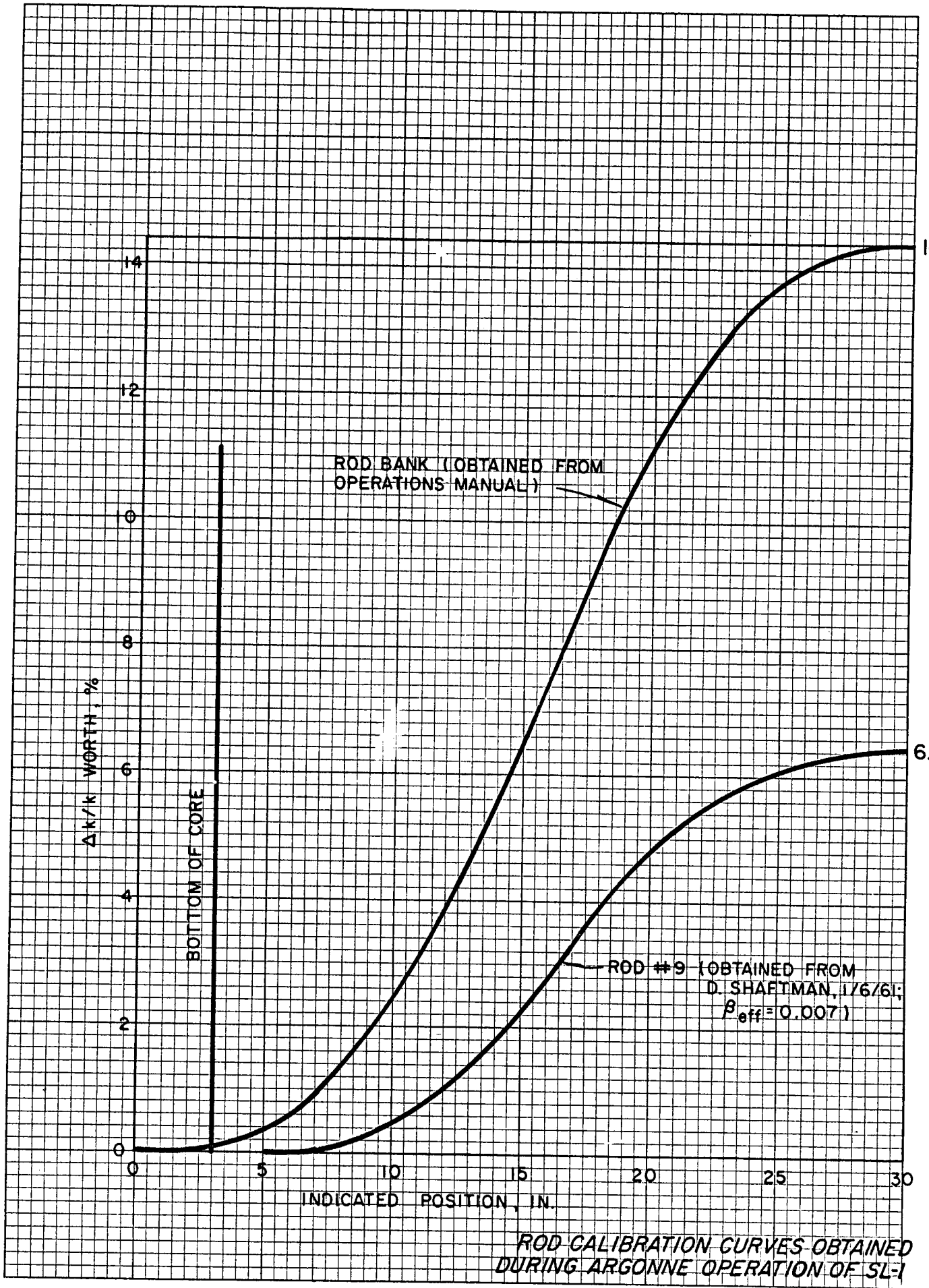


Fig. 24

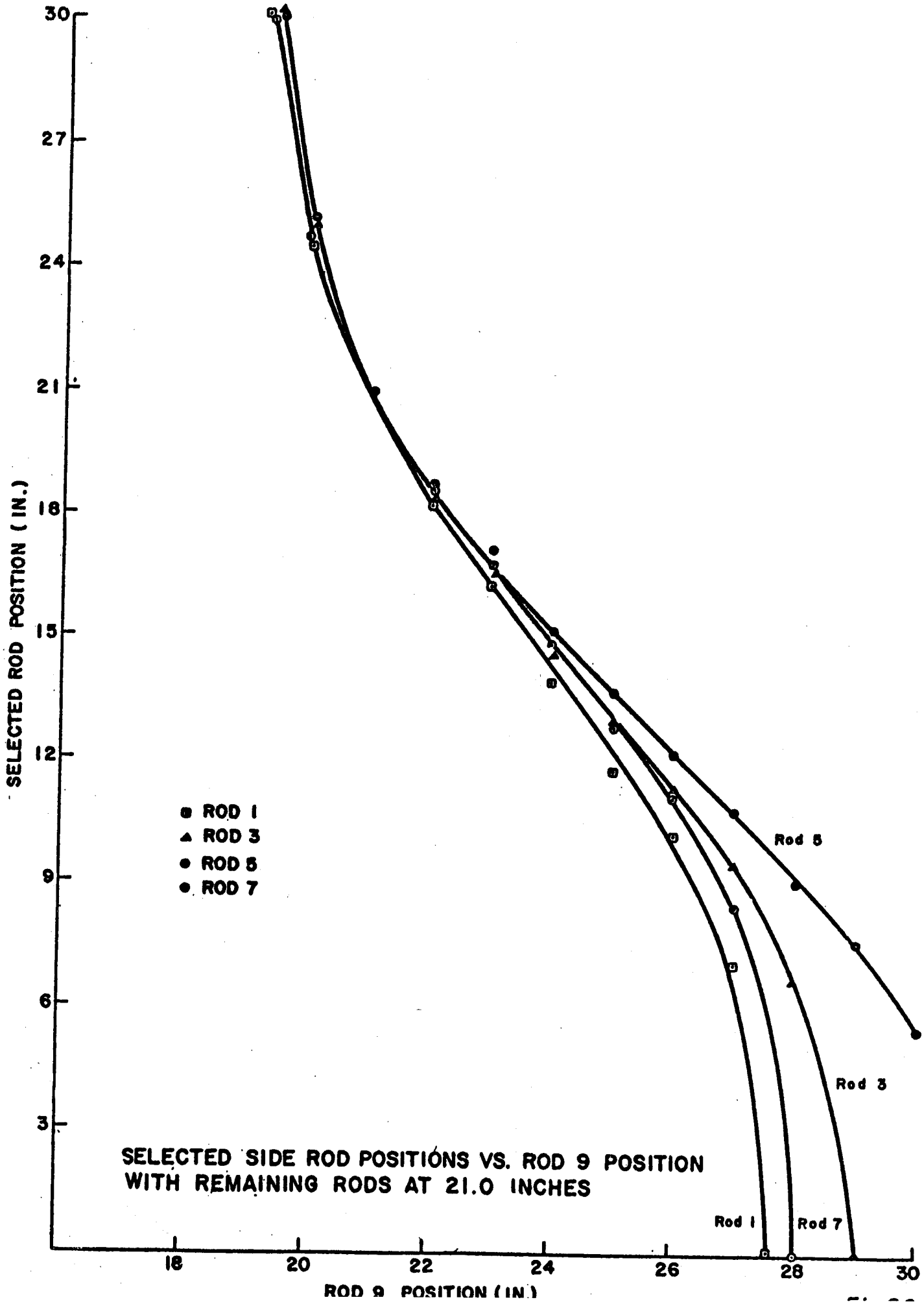
CRITICAL ROD BANK POSITION FOR VARIOUS TIME INDEPENDENT *SELF SHIELDING FACTORS (RELATIVE TO URANIUM) (ONE DIMENSIONAL WINDOW SHADE TECHNIQUE)*

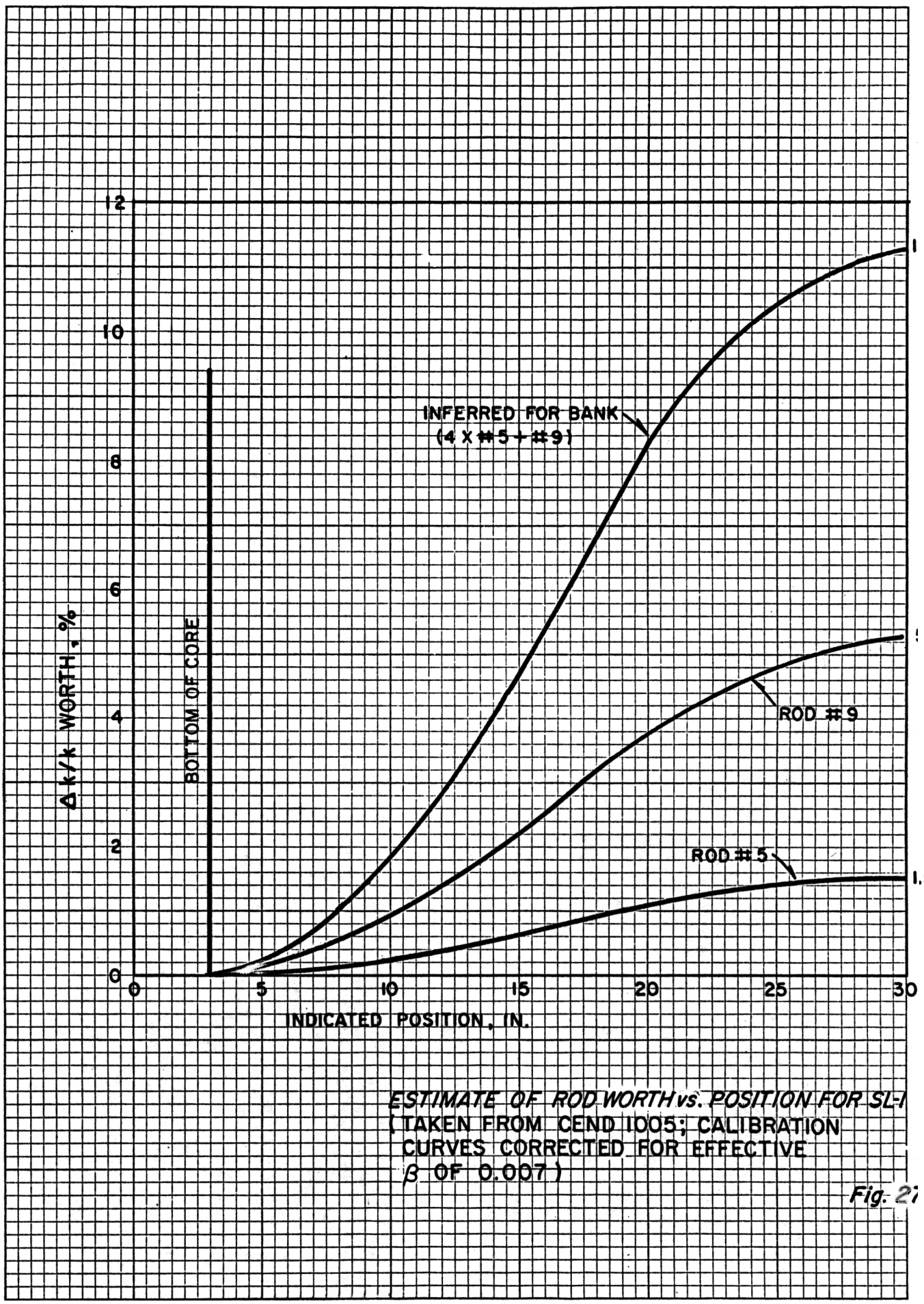
Fig. 24



ROD CALIBRATION CURVES OBTAINED DURING ARGONNE OPERATION OF SL-1

Fig. 25


30
27
24
21
18
15
12
9
6
3
SELECTED ROD POSITION (IN.)
ROD 1
ROD 3
ROD 5
ROD 7
Rod 5
Rod 3
Rod 1
Rod 7
SELECTED SIDE ROD POSITIONS VS. ROD 9 POSITION
WITH REMAINING RODS AT 21.0 INCHES
18
20
22
24
26
28
30
ROD 9 POSITION (IN.)



ESTIMATE OF ROD WORTH vs. POSITION FOR SL-1
(TAKEN FROM CEND 1005; CALIBRATION CURVES CORRECTED FOR EFFECTIVE β OF 0.007)

Fig. 27

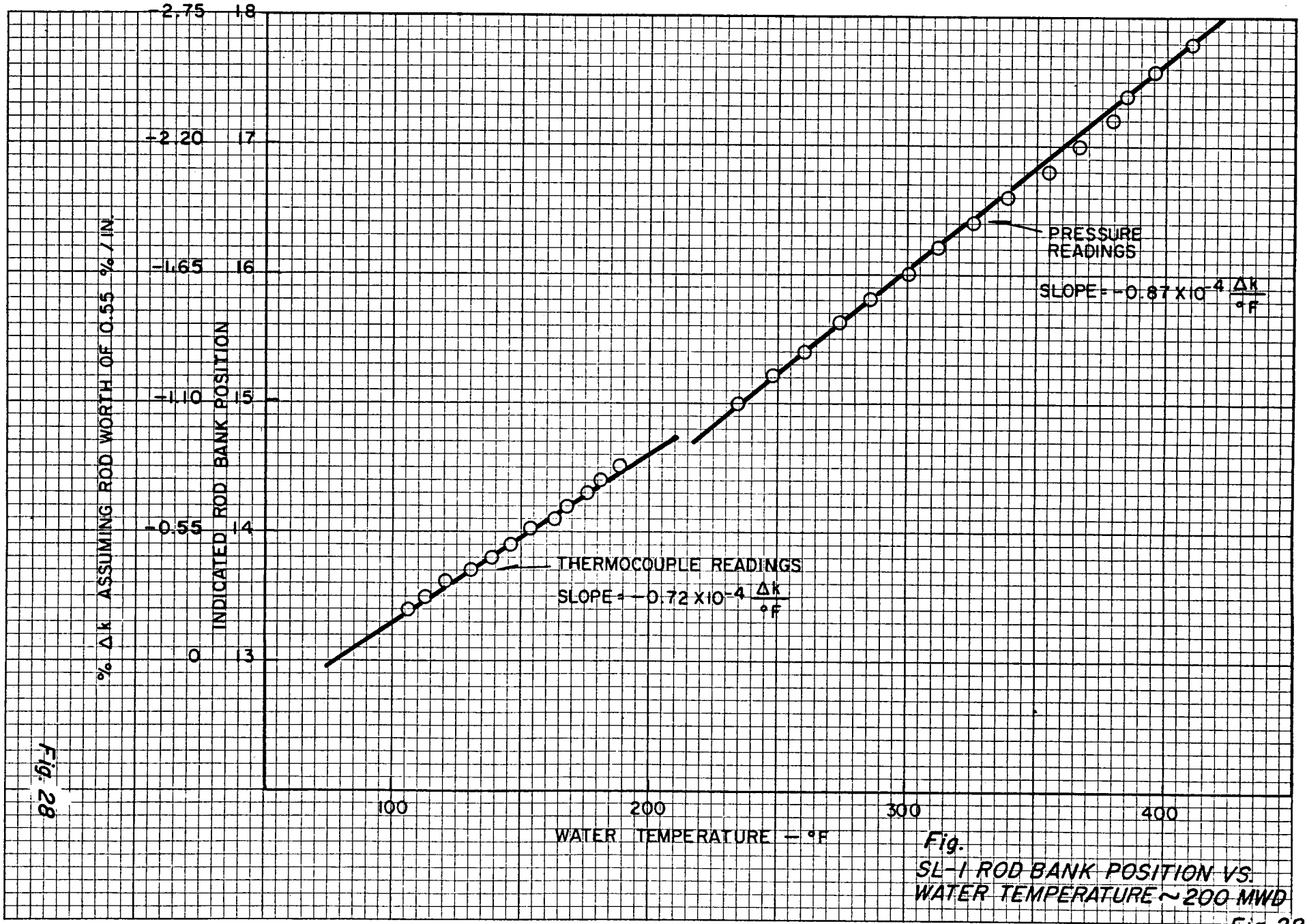
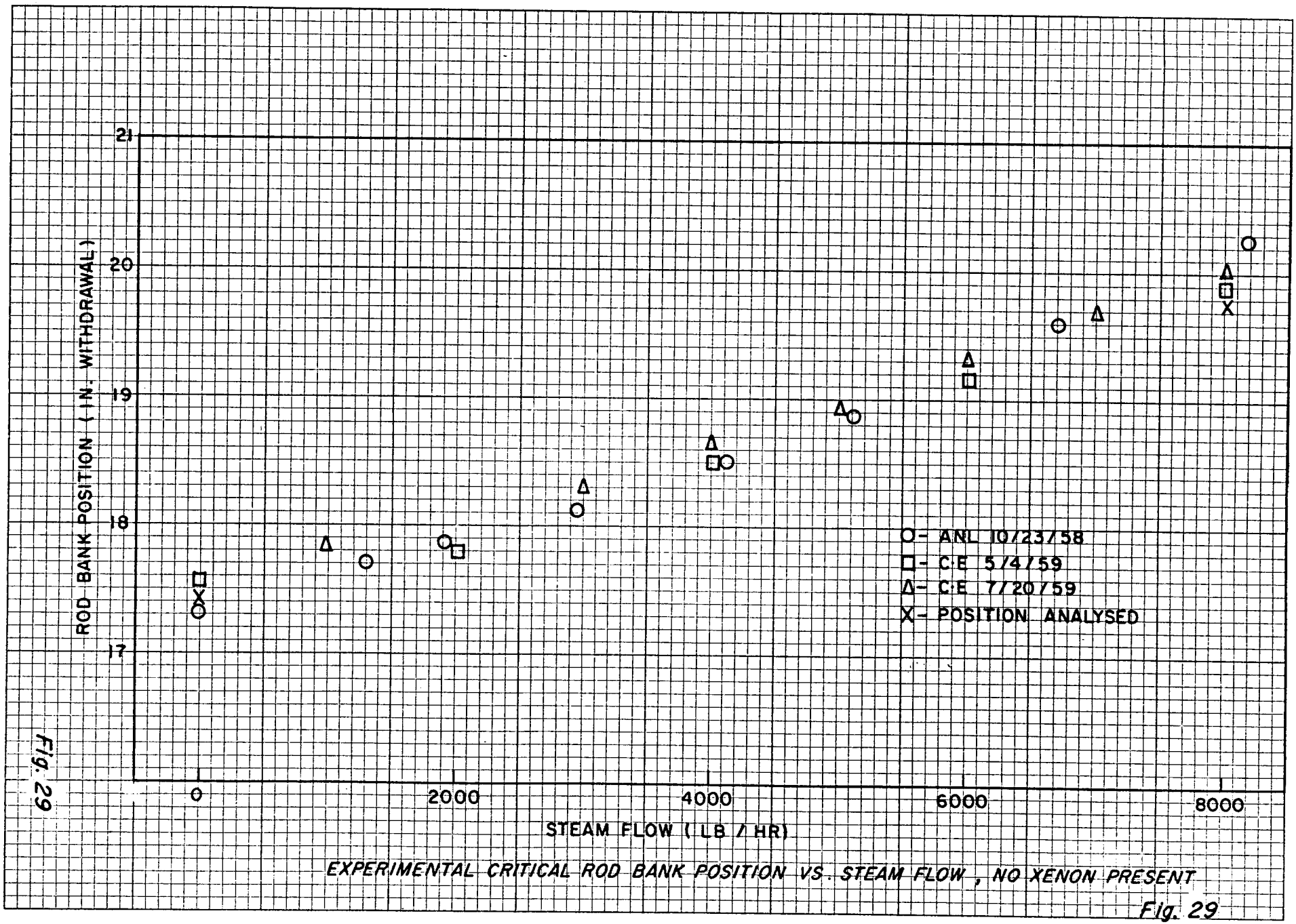


Fig. 28

Fig.
SL-1 ROD BANK POSITION VS.
WATER TEMPERATURE ~ 200 MWD

Fig. 28



EXPERIMENTAL CRITICAL ROD BANK POSITION VS. STEAM FLOW , NO XENON PRESENT

Fig. 29

Fig. 29

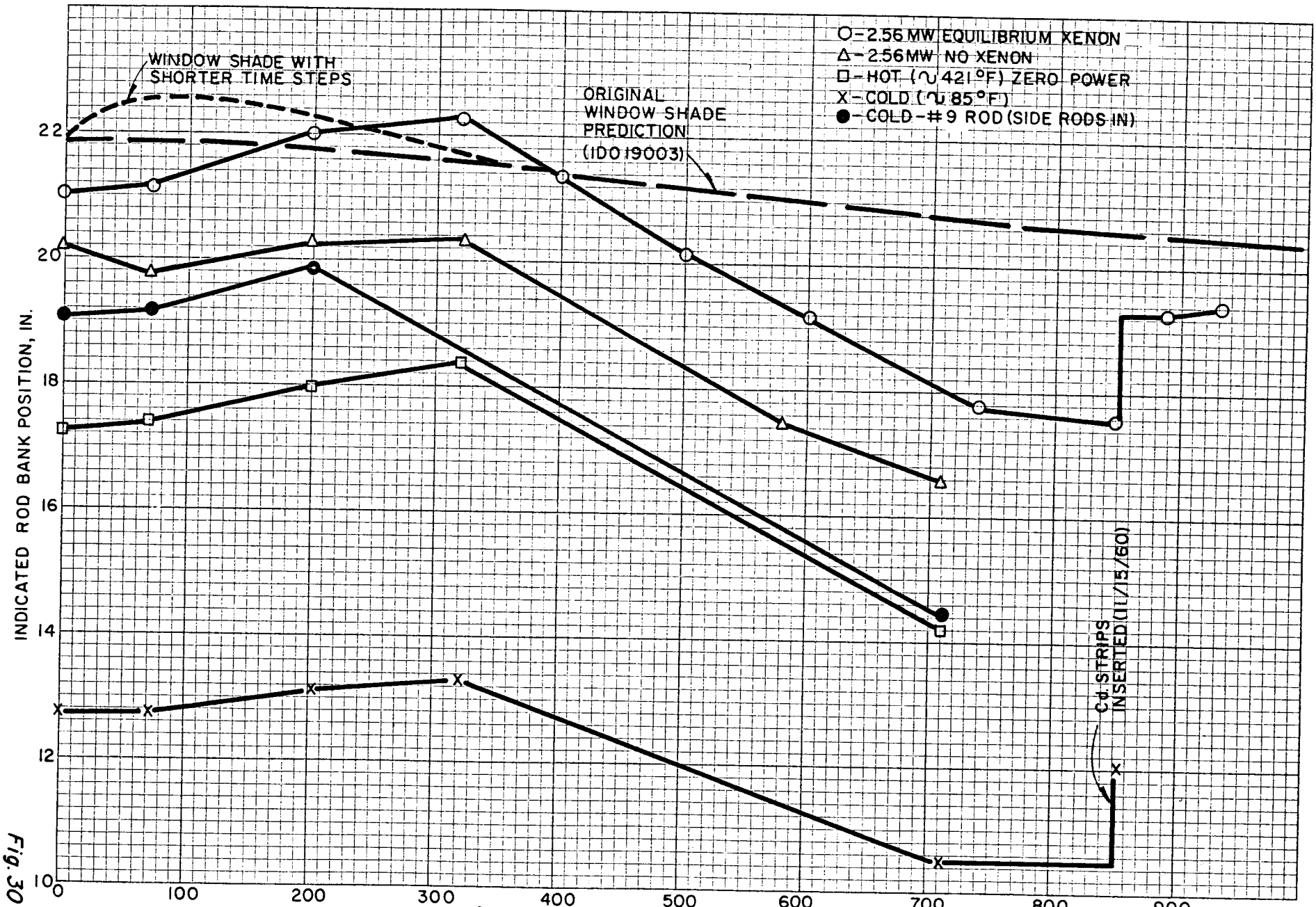
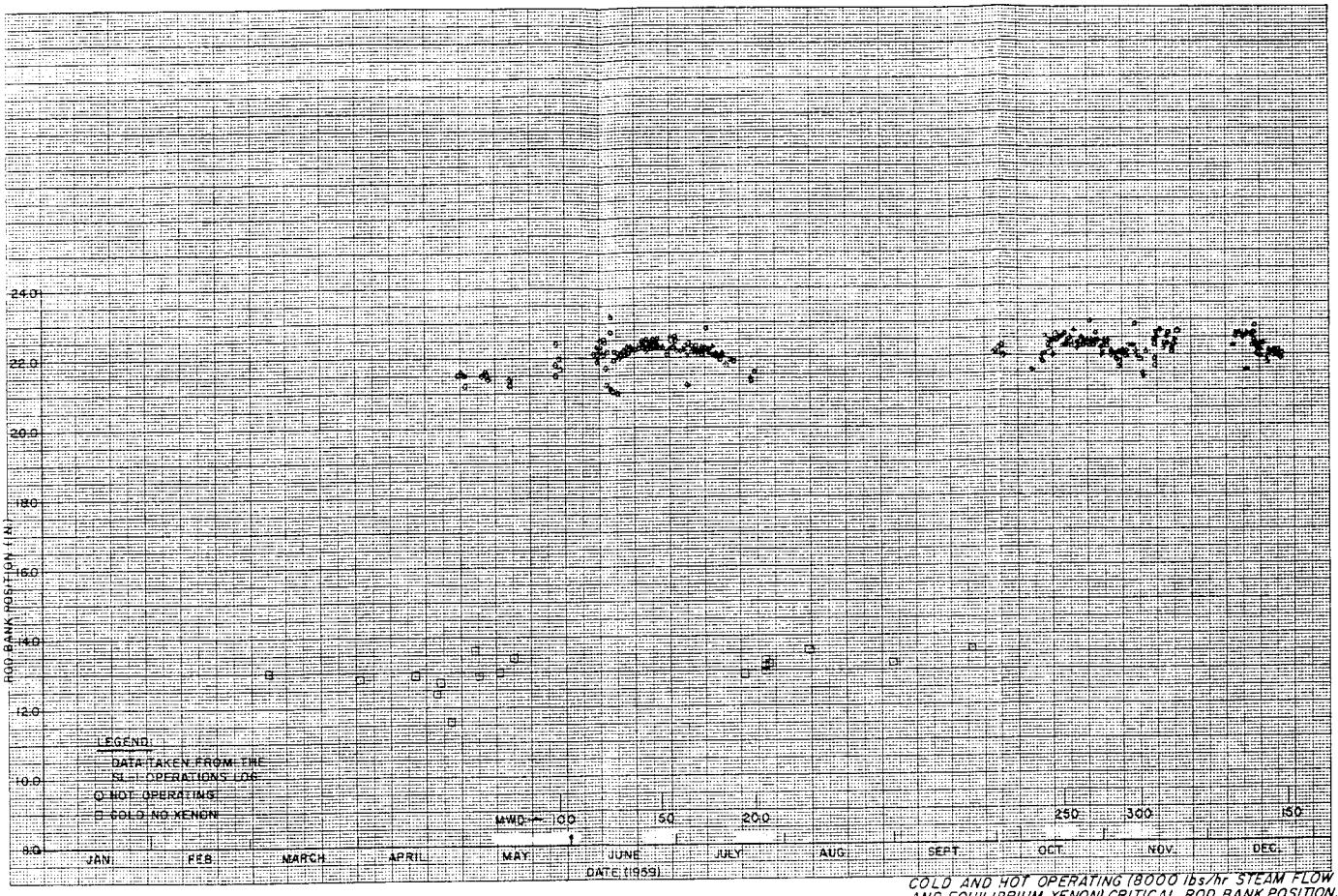


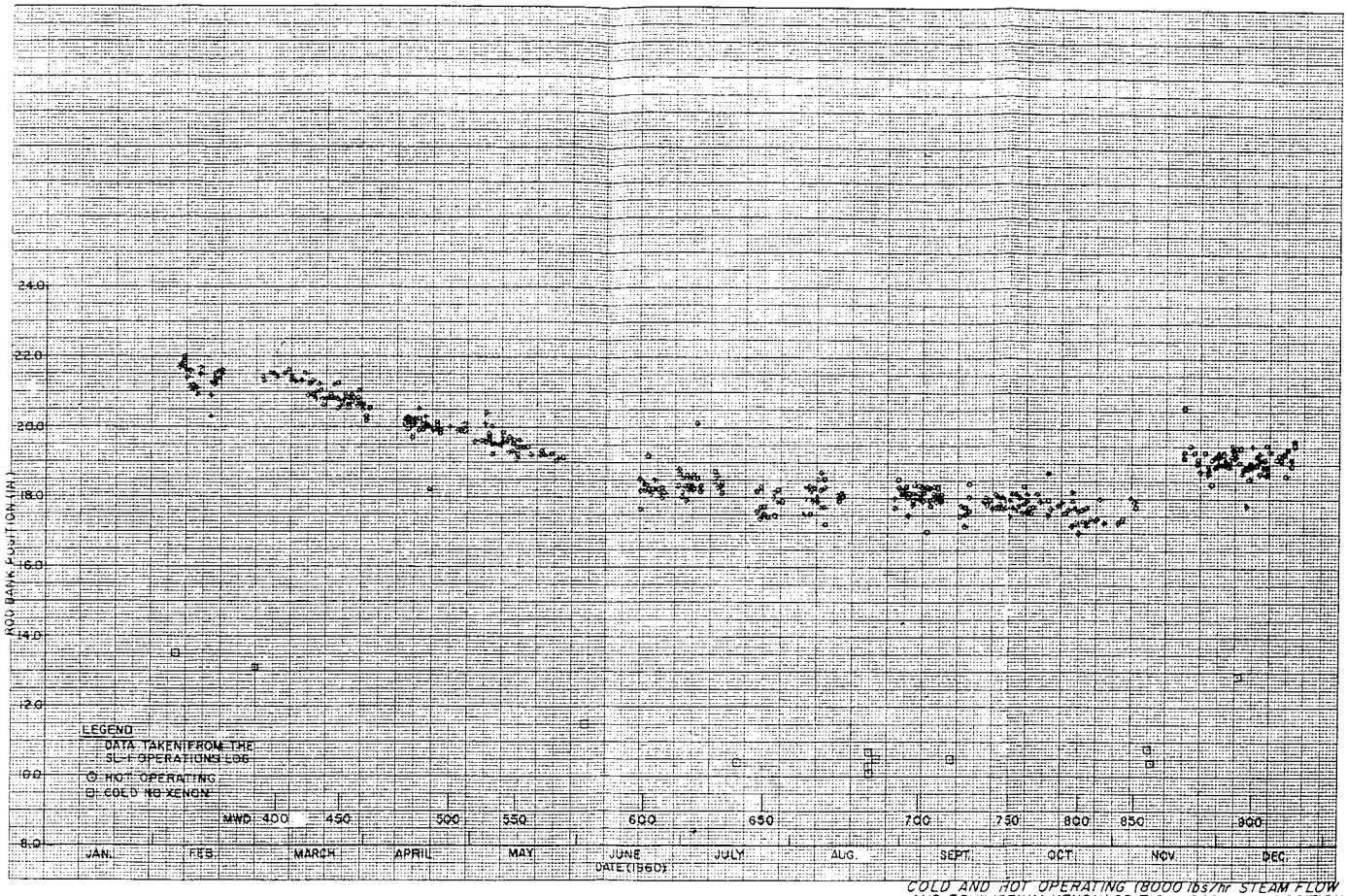
Fig. 30

SL-1 ROD BANK POSITION VS. CORE LIFE
(PHYSICS TEST DATA)

Fig. 30

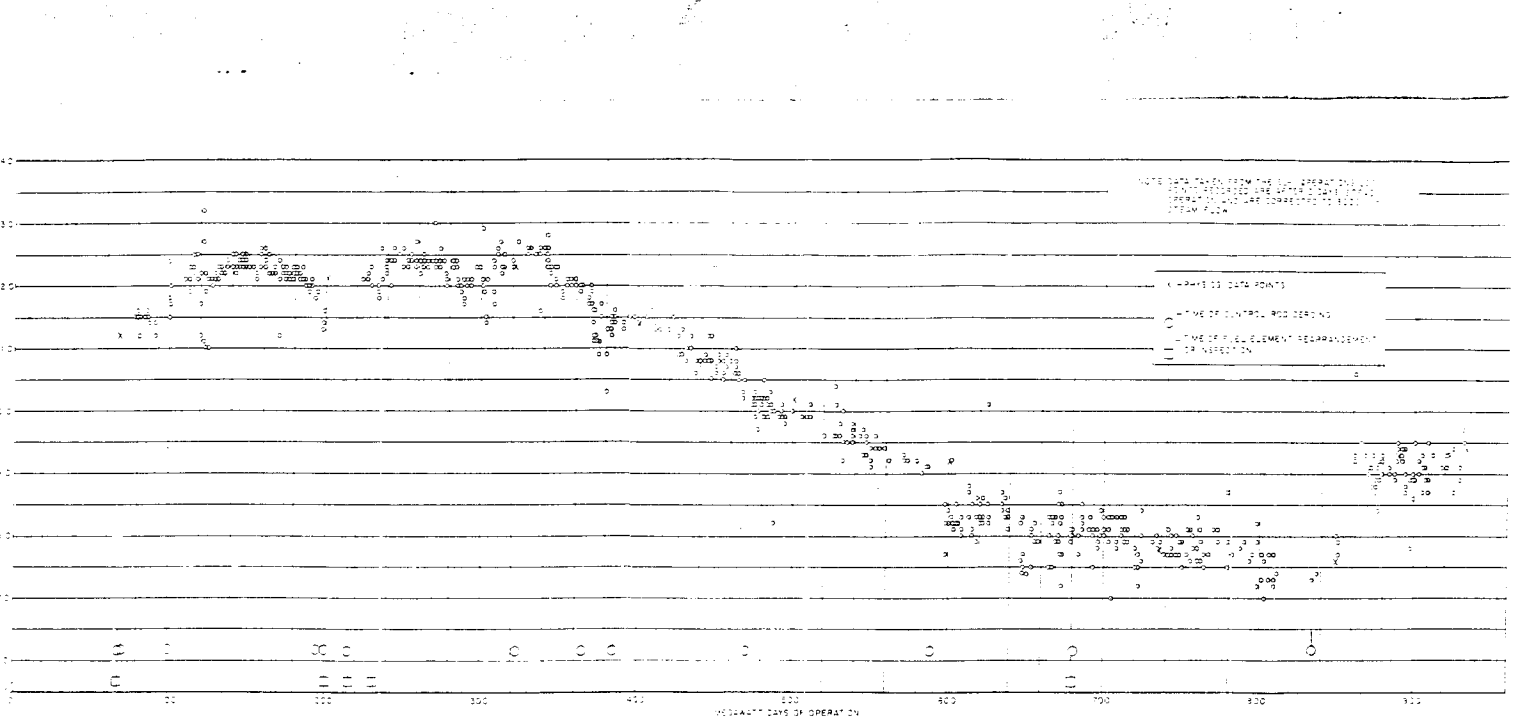


COLD AND HOT OPERATING (80000 lbs/hr STEAM FLOW AND EQUILIBRIUM XENON) CRITICAL ROD BANK POSITIONS IN SL-1 vs. CALENDAR TIME FOR 1959 Fig. 31



COLD AND HOT OPERATING (8000 lbs/hr STEAM FLOW AND EQUILIBRIUM XENON) CRITICAL ROD BANK POSITIONS IN SL-1 vs. CALENDAR TIME FOR 1960

Fig. 32



HOT OPERATING 1800 lbs/hr STEAM FLOW AND EQUILIBRIUM XENON CRITICAL ROD BANK POSITIONS IN SL-1 VS. MEGAWATT DAYS OF OPERATION

Fig. 33

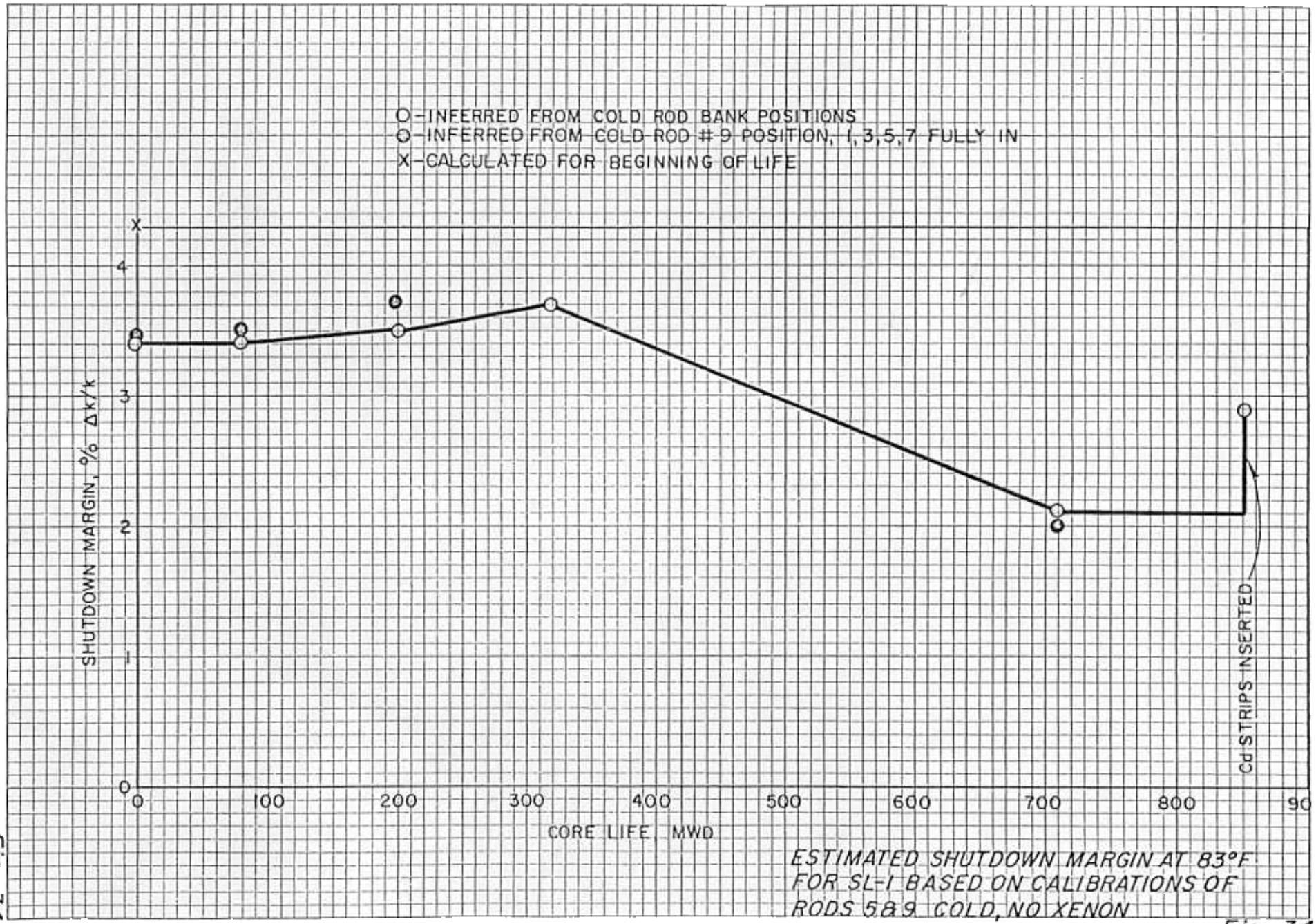
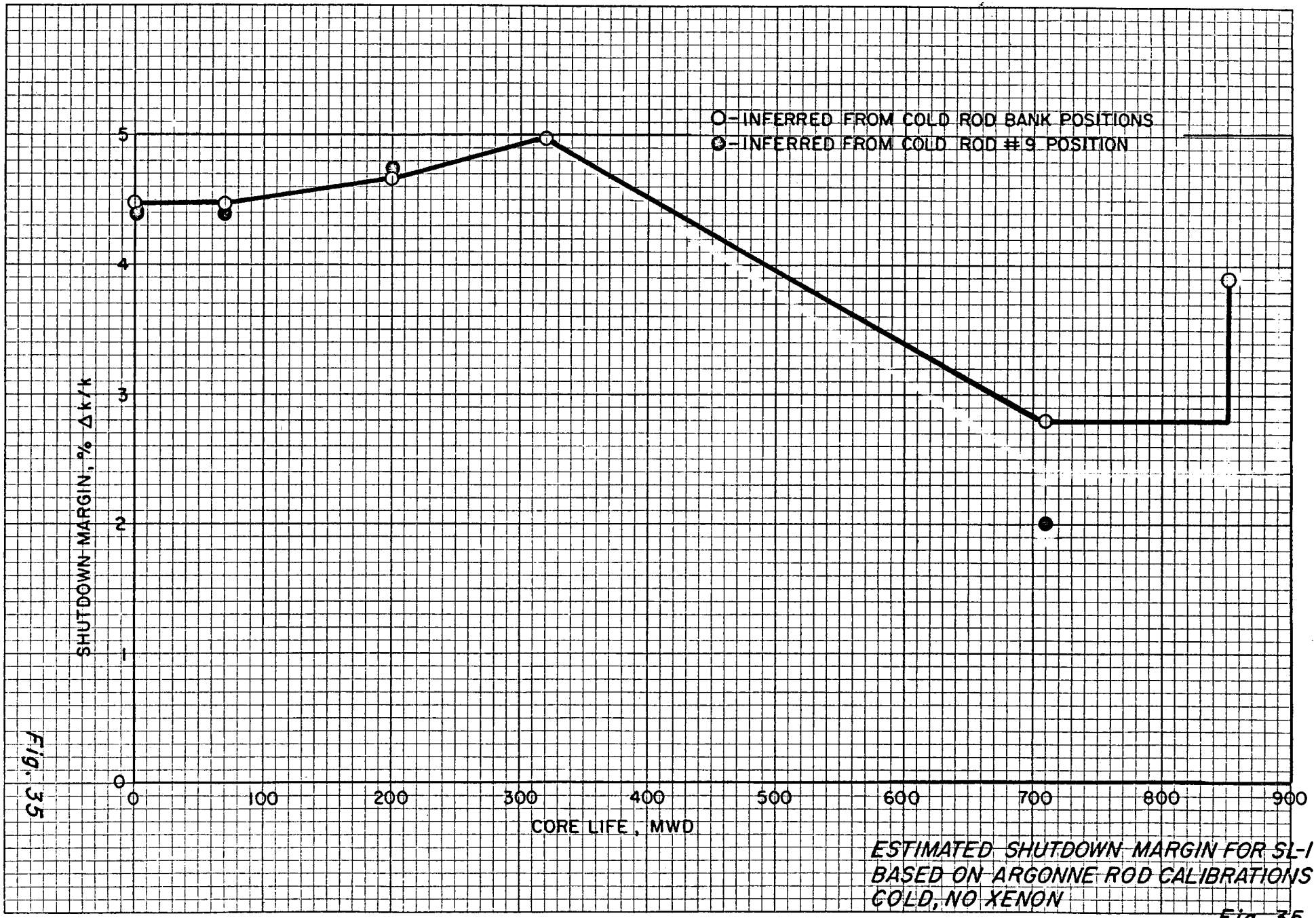

O-INFERRED FROM COLD ROD BANK POSITIONS
O-INFERRED FROM COLD ROD #9 POSITION, 1,3,5,7 FULLY IN
X-CALCULATED FOR BEGINNING OF LIFE
SHUTDOWN MARGIN, % Δk/k
X
4
3
2
1
0
0
100
200
300
400
500
600
700
800
90
CORE LIFE MWD
Cd STRIPS INSERTED
ESTIMATED SHUTDOWN MARGIN AT 83°F
FOR SL-1 BASED ON CALIBRATIONS OF
RODS 5&9 COLD, NO XENON

Fig 34

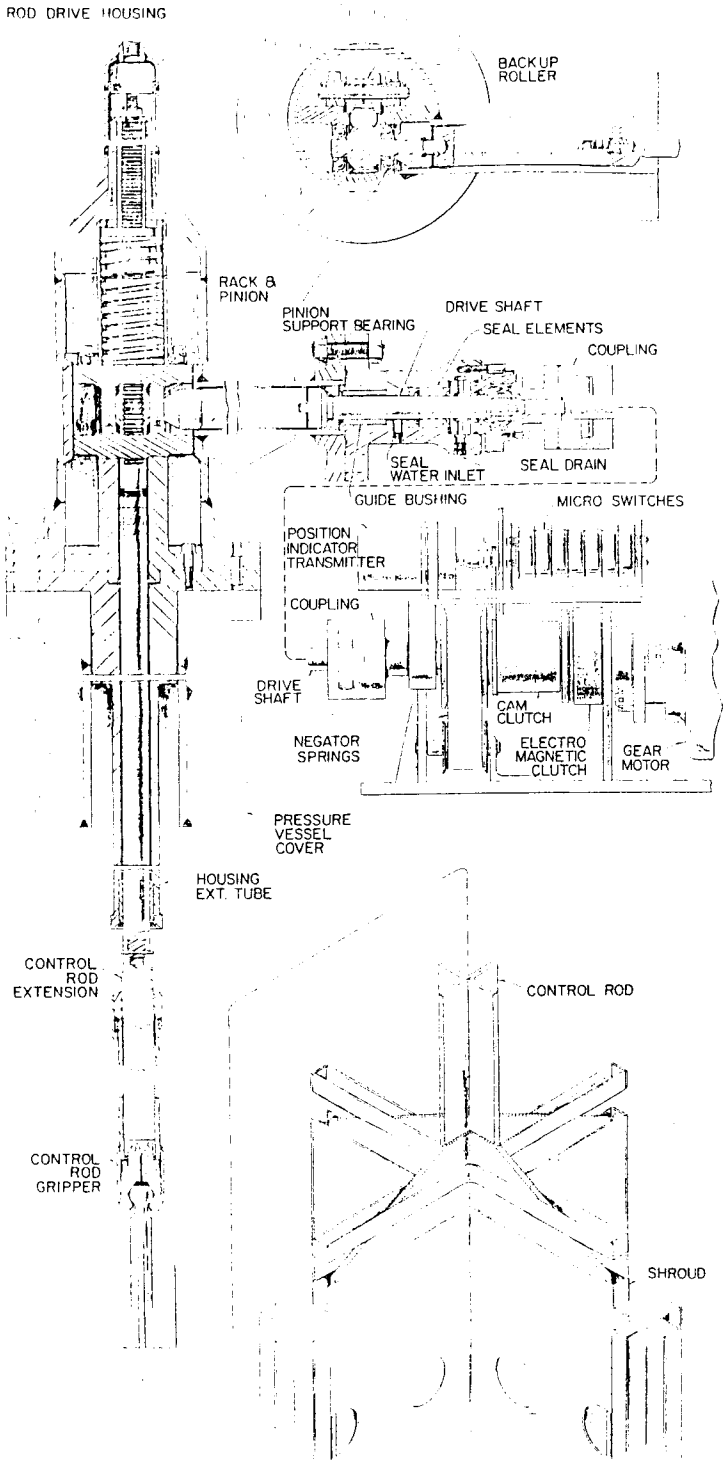
Fig 34



ESTIMATED SHUTDOWN MARGIN FOR SL-1
BASED ON ARGONNE ROD CALIBRATIONS
COLD, NO XENON

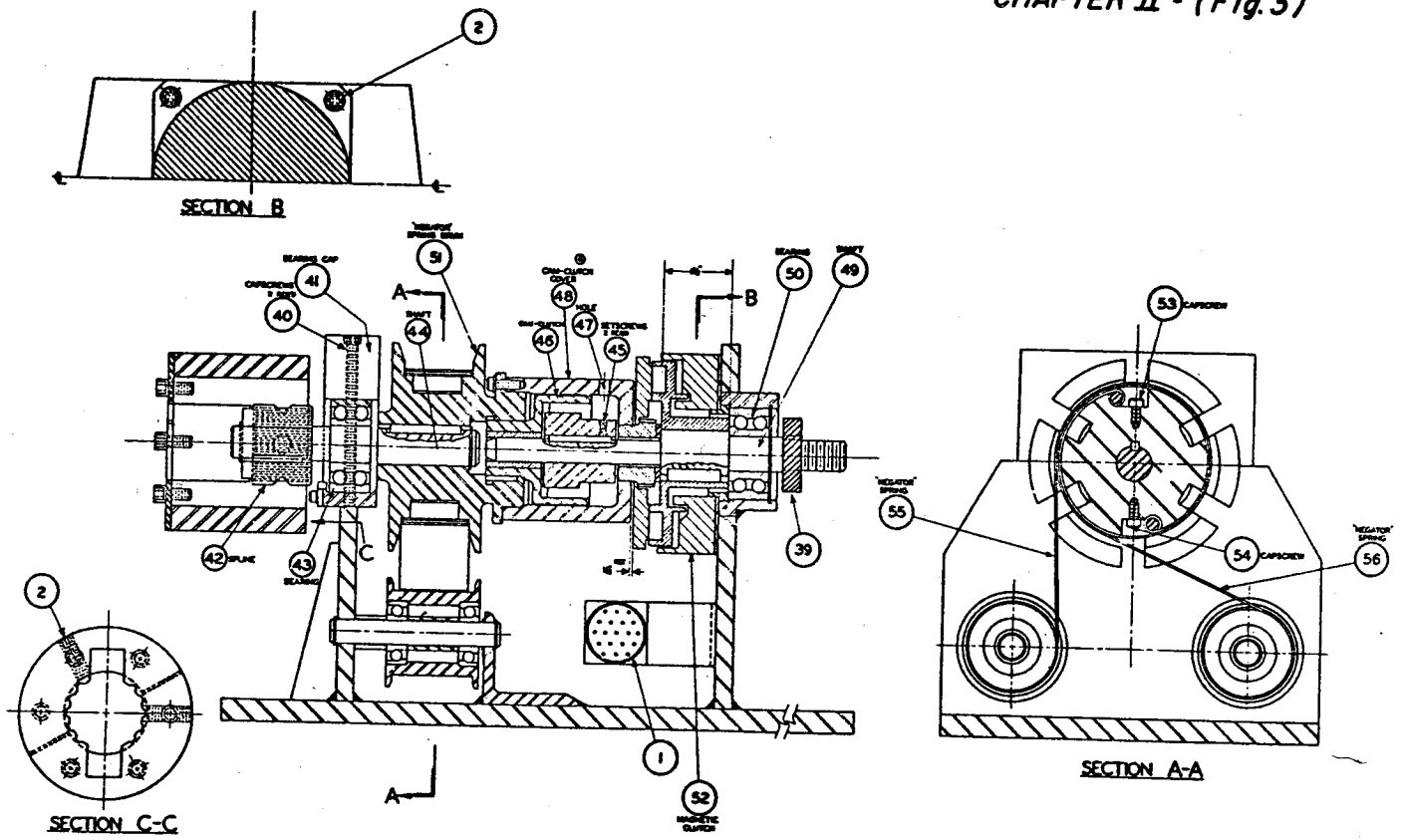
Fig. 35

Fig. 35



SL-1 CONTROL ROD DRIVE MECHANISM
Fig 36

Reprinted from - NUCLEAR POWER PLANT OPERATORS MANUAL - CHAPTER II - (Fig. 3)



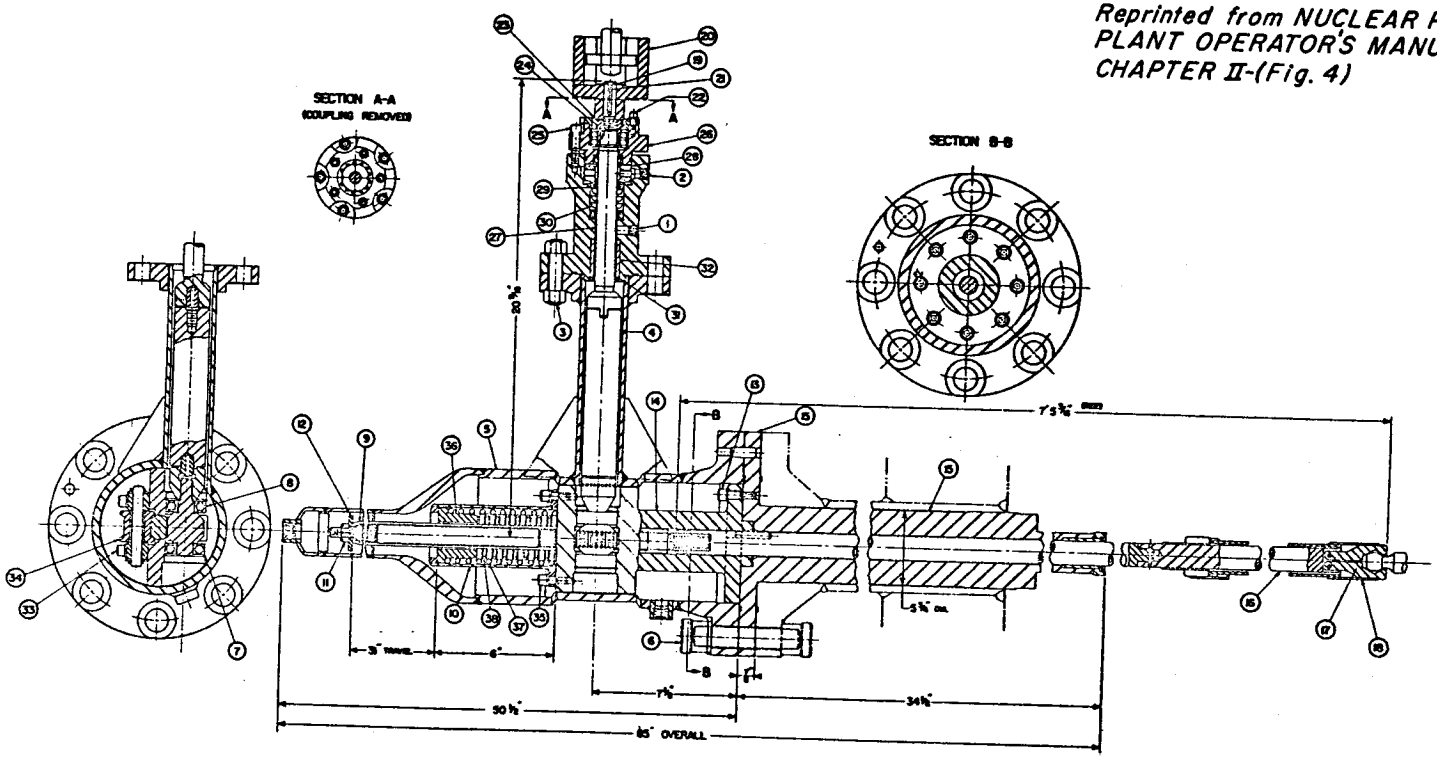
1. Electrical connection
2. Set Screws
39. Change gear
40. Socket head cap screws
41. Bearing cap
42. Spline
43. Bearing
44. Shaft assembly
45. Set screws
46. Cam clutch
47. Hole
48. Clutch cover
49. Drive shaft
50. Bearing
51. Negator spring drum
52. Magnetic clutch
53. Socket head screws
54. Socket head screws
55. Negator spring
56. Negator spring

SL-1 CONTROL ROD DRIVE CLUTCH ASSEMBLY
Fig. 37

Fig. 37

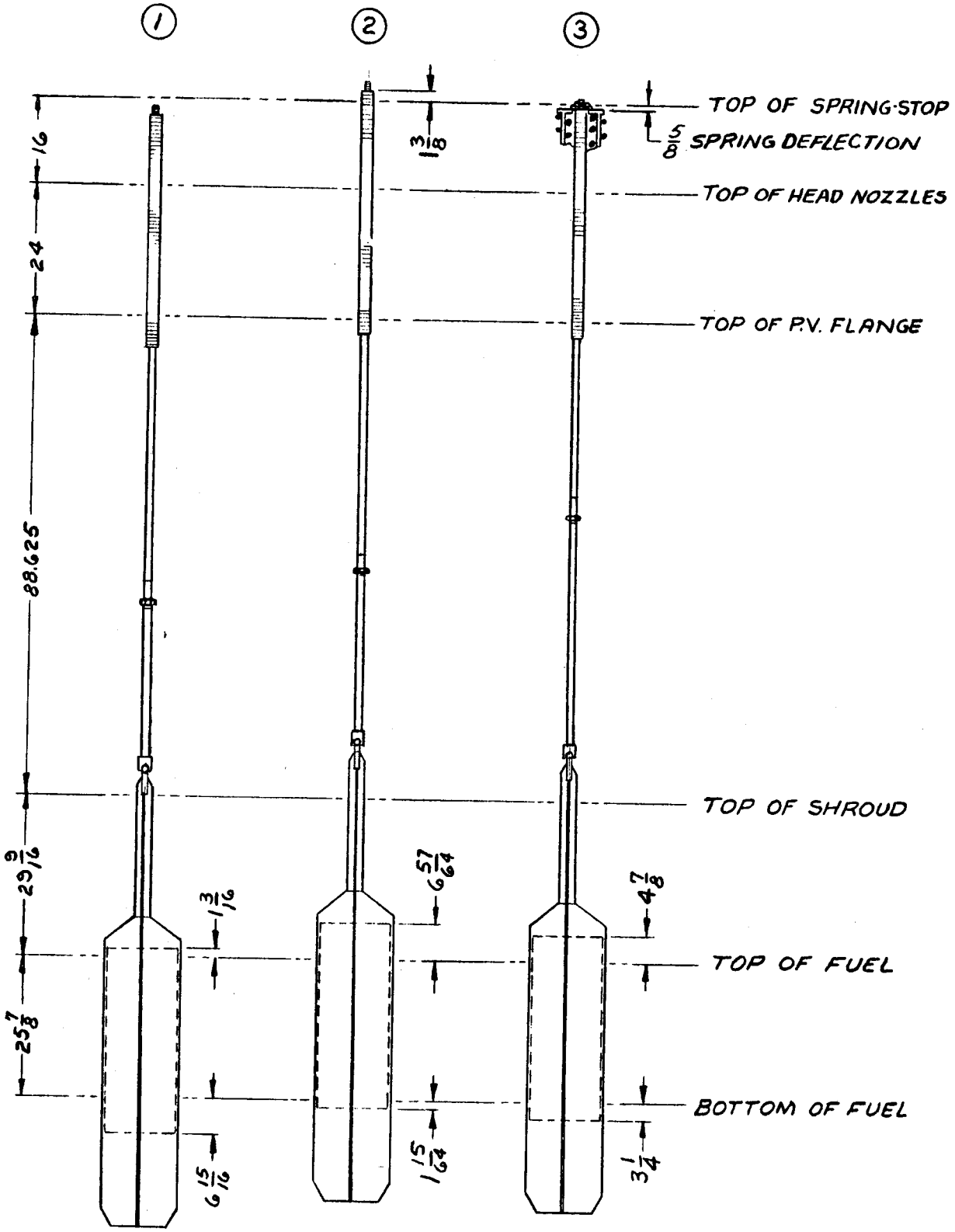
CONTROL ROD DRIVE

Reprinted from NUCLEAR POWER PLANT OPERATOR'S MANUAL, CHAPTER II-(Fig. 4)



1. SEAL COOLING WATER INLET
2. SEAL COOLING WATER OUTLET
3. TIE ROD STUD
4. PINION SHAFT EXTENSION
5. THIMBLE
6. —
7. RETAINING RING 2 REQ'D WALDES-TRUARK CAT. NO. 5000-206W
8. BEARING TYPE 3304 STELLITE BALLS & RACES SST RETAINERS, 2 REQ'D
9. RACK ANL DRG. NO. RE-I-6533-C 1 REQ'D
10. SPRING HOUSING 89-2-2029 1 REQ'D
11. NUT SLOTTED SST 1 REQ'D COTTER PIN SST 1 REQ'D ALCO CODE 2979002-032
12. STOP WASHER A9-13-2048 1 REQ'D
13. SOCKET HD. CAPSCREW 3/8-16UNC-2A x 1 3/4 LG. 17 REQ'D STAINLESS STEEL TYPE 303
14. SUPPORT 09-2-2023 1 REQ'D
15. HOUSING
16. EXTENSION ROD
17. SPLIT COUPLING
18. CONTROL ROD GRIPPER
19. SNAP RING, WALDES TRUARC 5000-62-5 1 REQ'D
20. COUPLING, DRIVEN ANL DWG. RE-I-2032-B 1 REQ'D
21. KEY 3/16 x 3/16 x 1/2 STD STL KEYSTOCK 1 REQ'D
22. CAPSCREW
23. BEARING RETAINER A9-11-2107 1 REQ'D
24. LOCKNUT BEARING A9-9-2106 LOCKWASHER A9-9-2027 1 EACH-8 REQ'D
25. SOCKET HEAD CAPSCREW
26. GLAND WATER SEAL CR 9-2206 1 REQ'D
27. SEAL SHAFT
28. SEAL, LANTERN ANL DWG. RE-I-6742-B 1 REQ'D
29. SEAL DIAPHRAGM ANL DWG. RE-I-6743-C 4 REQ'D
30. SEAL, FLOATING RING ANL DWG. RE-I-6744-C 5 REQ'D
31. RETAINING RING 1 REQ'D WALDES-TRUARC CAT. NO. 5000-150W
32. BUSHING, STELLITE 3/8 ANL DWG. RE-I-8782-A 1 REQ'D
33. CAPSCREWS, 4 REQ'D
34. ROLLER A9-12-2040 1 REQ'D
35. SOCKET HD. CAP SCR. 5/8-18 UNC-2A X 1" LG. SST 303-6 REQ'D
36. SEAT A9-12-2025 1 REQ'D
37. SPRING COMPRESSION A9-12-2024 1 REQ'D
38. SPRING COMPRESSION RE-I-6567-A 1 REQ'D

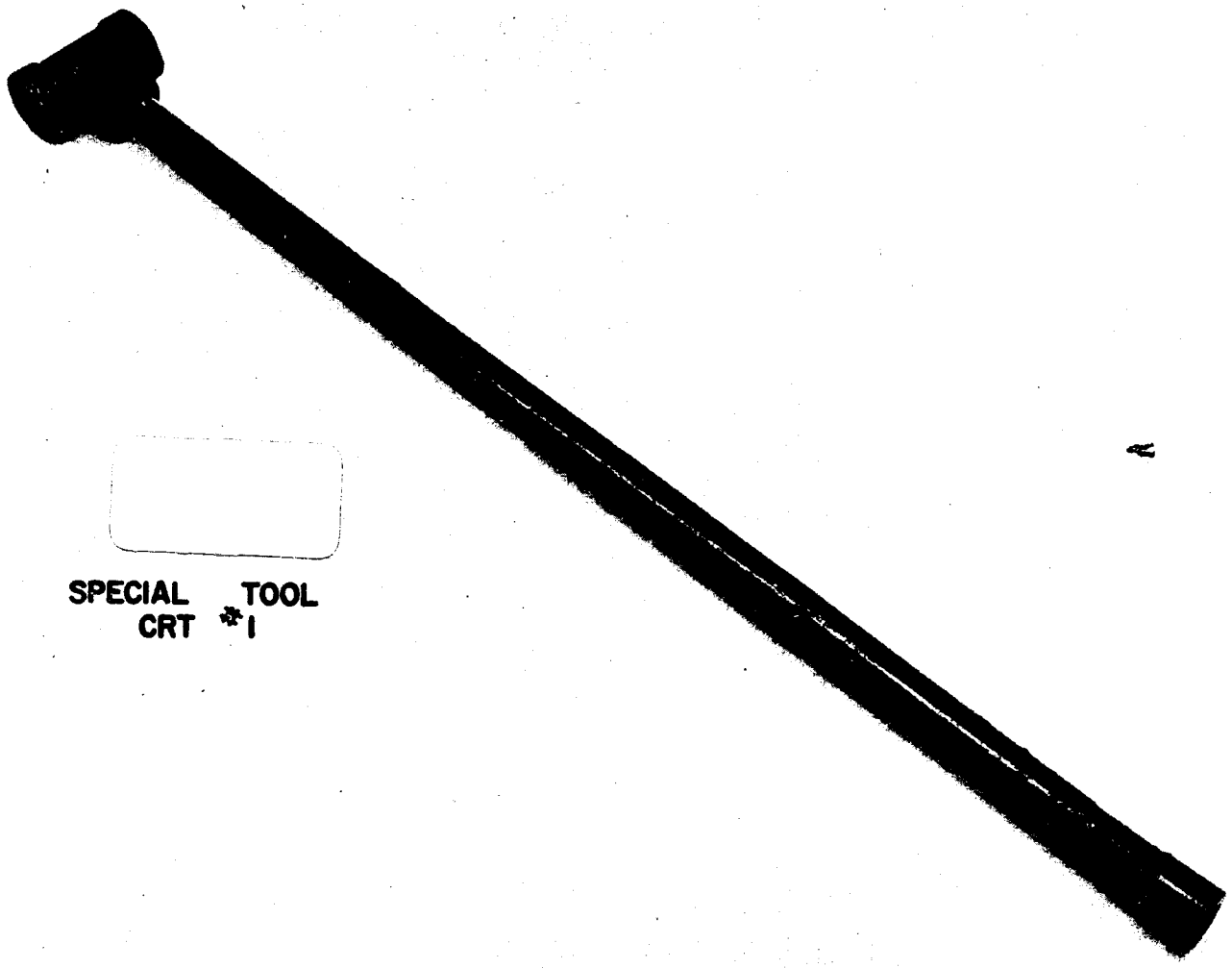
Fig. 39



(1) CONTROL ROD POSITION WITH SCRAM STOP WASHER AND NUT REMOVED.
(2) CONTROL ROD POSITION FOR INSTALLATION OF SCRAM STOP WASHER AND NUT.
(3) CONTROL ROD ZERO POSITION

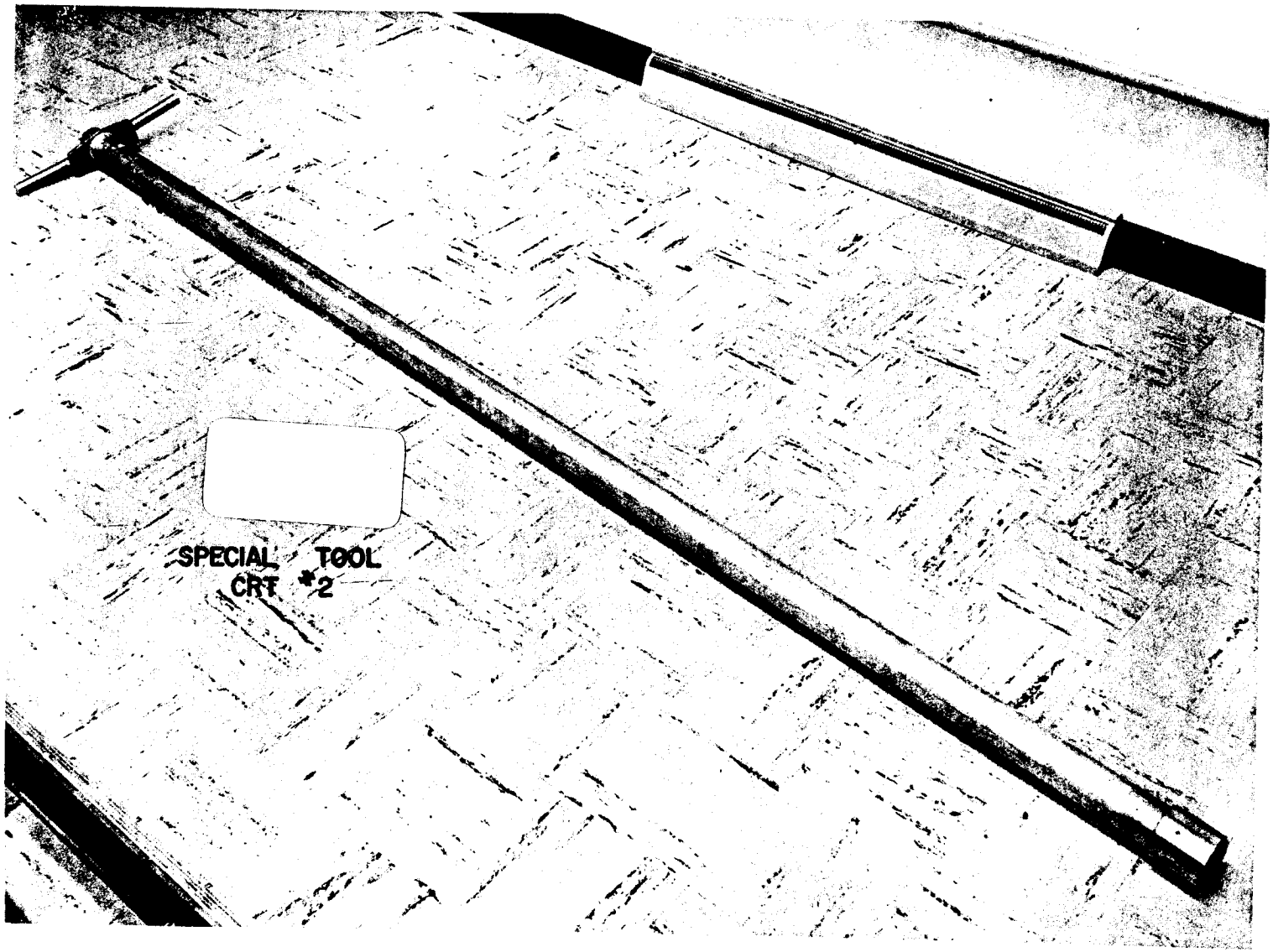
SL-1 CONTROL ROD CADMIUM OVERLAP OF ACTIVE CORE FOR VARIOUS CONDITIONS

Fig. 39



Reprinted from NUCLEAR POWER PLANT OPERATOR'S COURSE, CHAPTER II (Fig. 5)

Fig. 40

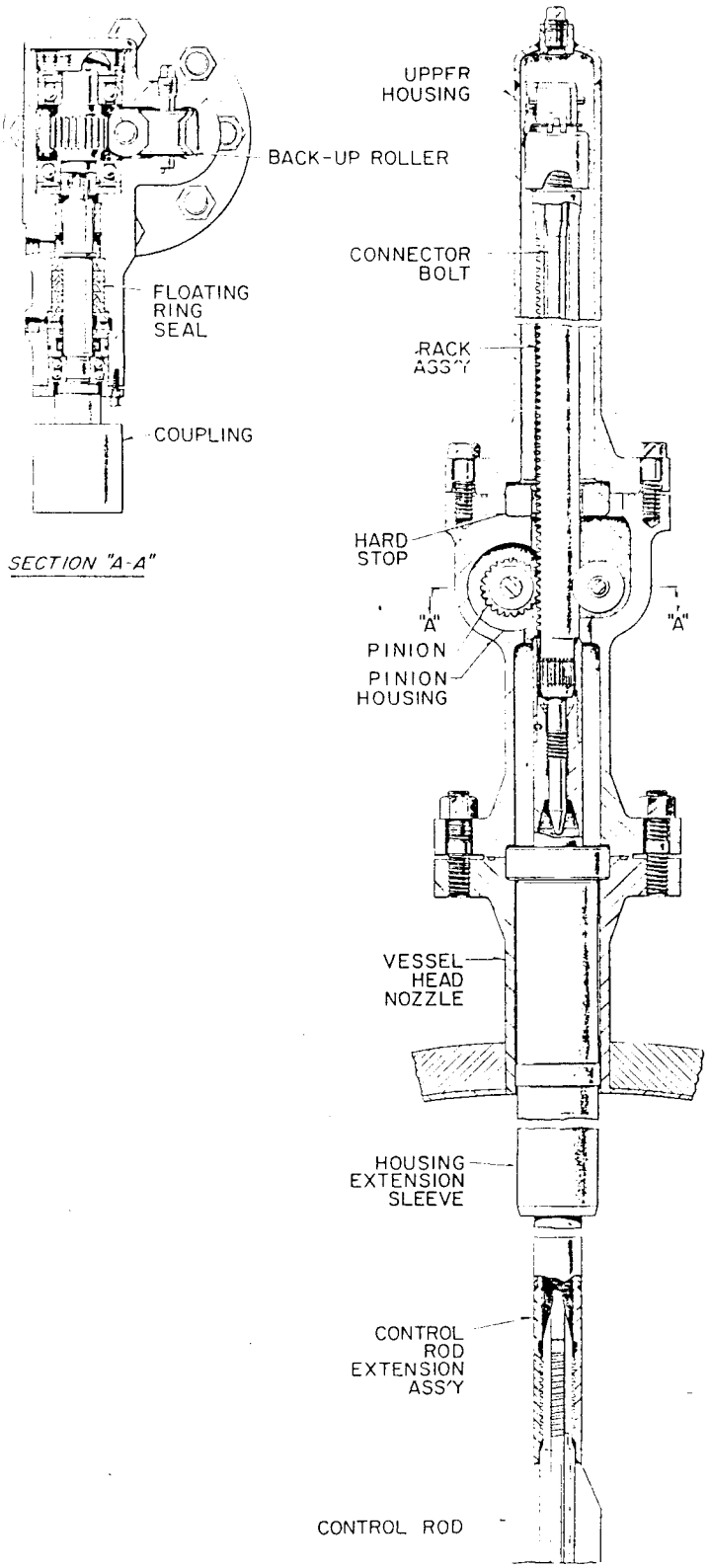


Reprinted from NUCLEAR POWER PLANT
OPERATOR'S COURSE, CHAPTER II (Fig.6)
Fig. 41

Fig. 41

Reprinted from NUCLEAR POWER PLANT OPERATOR'S COURSE, CHAPTER II (Fig. 7)

Fig. 42


UPPER HOUSING
BACK-UP ROLLER
CONNECTOR BOLT
FLOATING RING SEAL
RACK ASS'Y
COUPLING
HARD STOP
"A"
"A"
PINION
PINION HOUSING
VESSEL HEAD NOZZLE
HOUSING EXTENSION SLEEVE
CONTROL ROD EXTENSION ASS'Y
CONTROL ROD

SECTION "A-A"

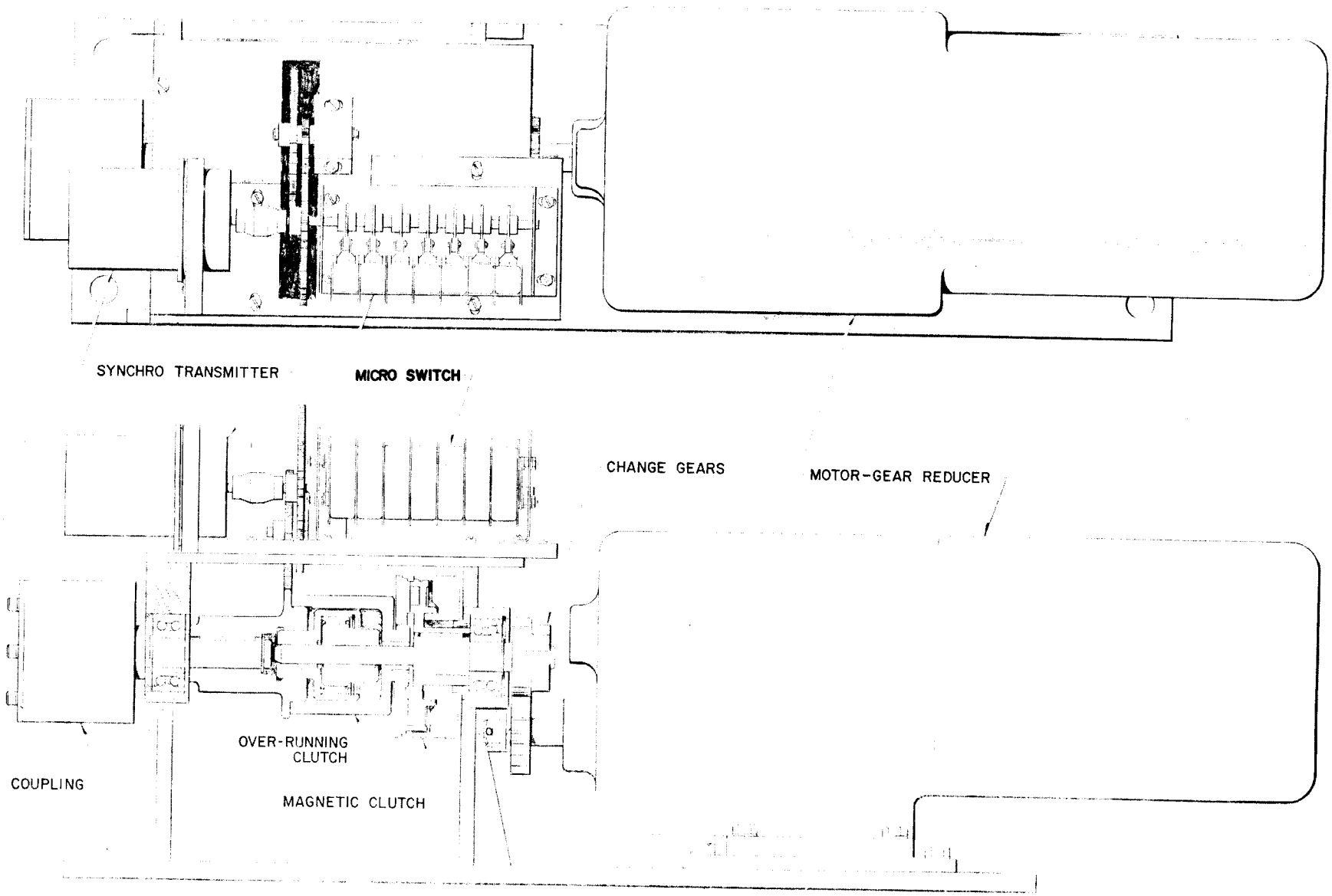
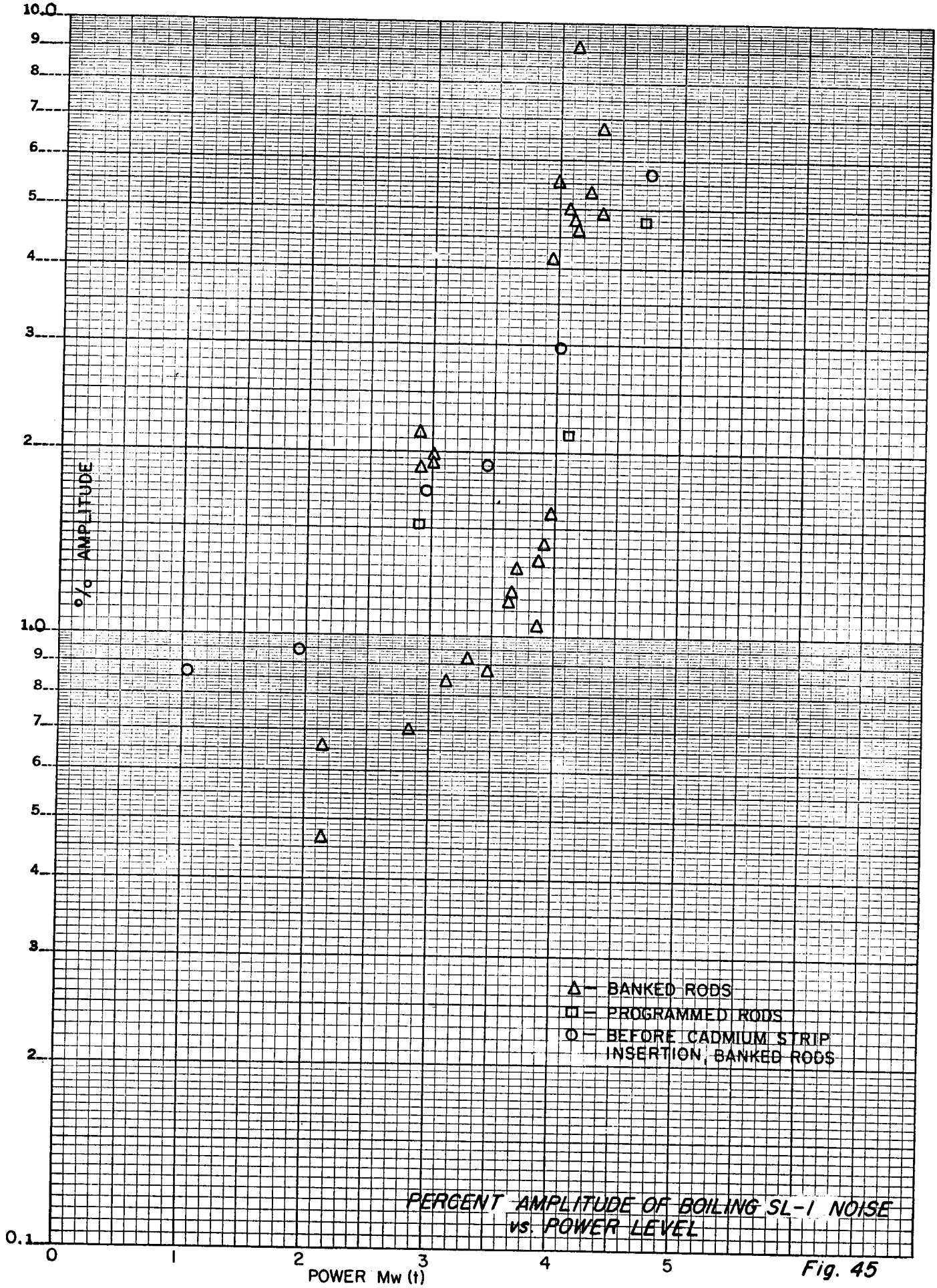


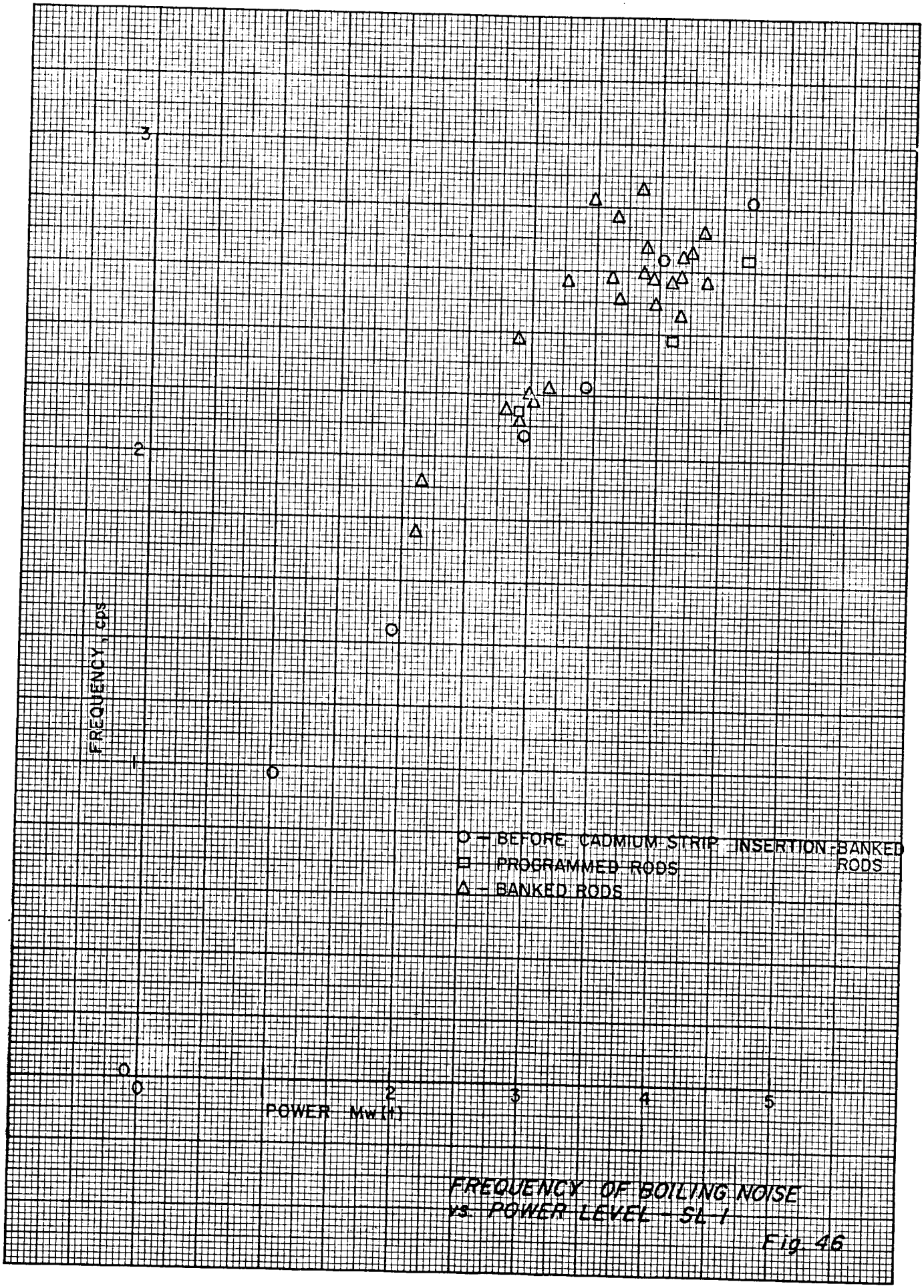
Fig. 44

PL CONTROL ROD DRIVE MECHANISM, DRIVE PACKAGE
Fig. 44



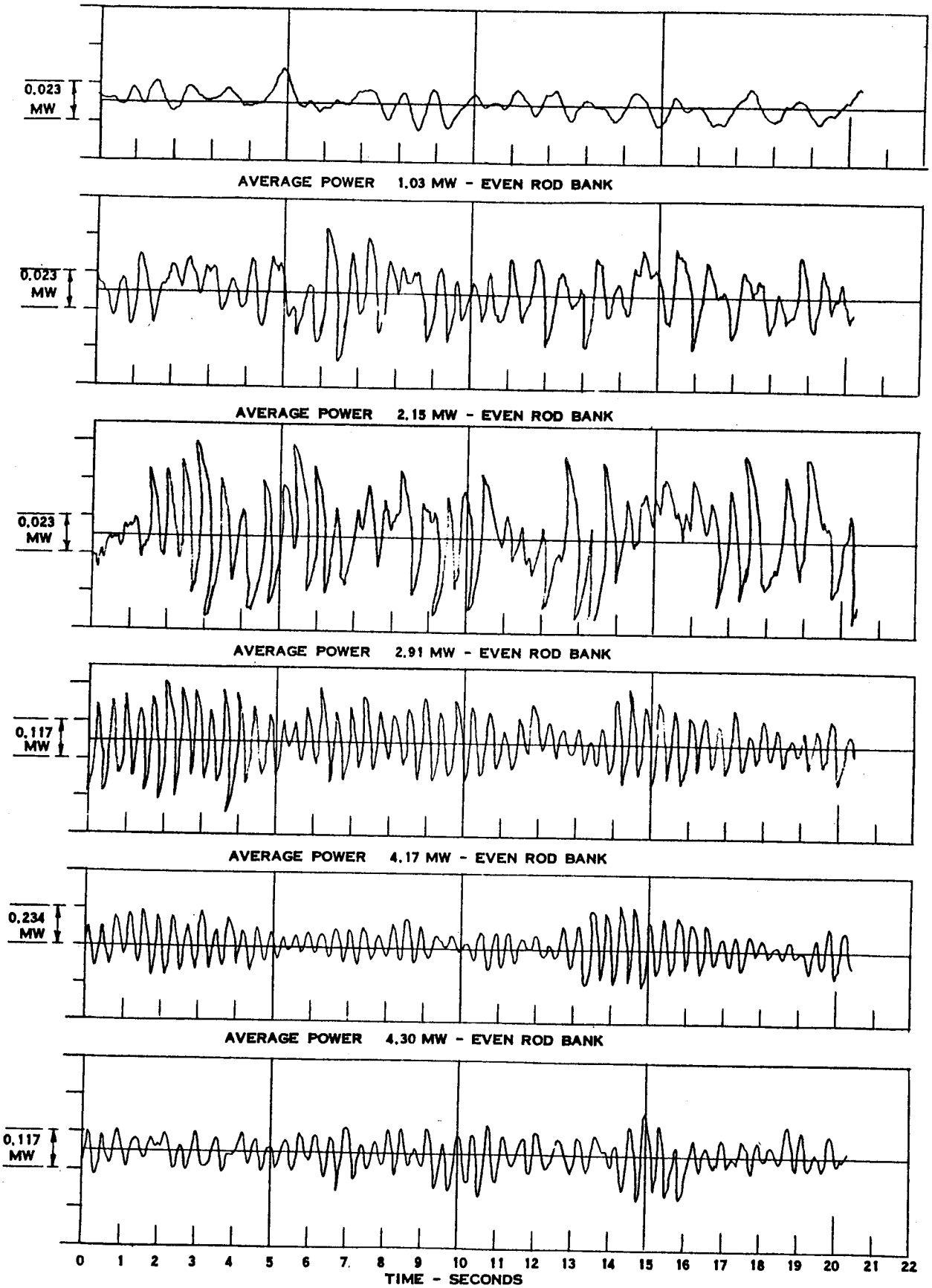
PERCENT AMPLITUDE OF BOILING SL-1 NOISE vs. POWER LEVEL

Fig. 45



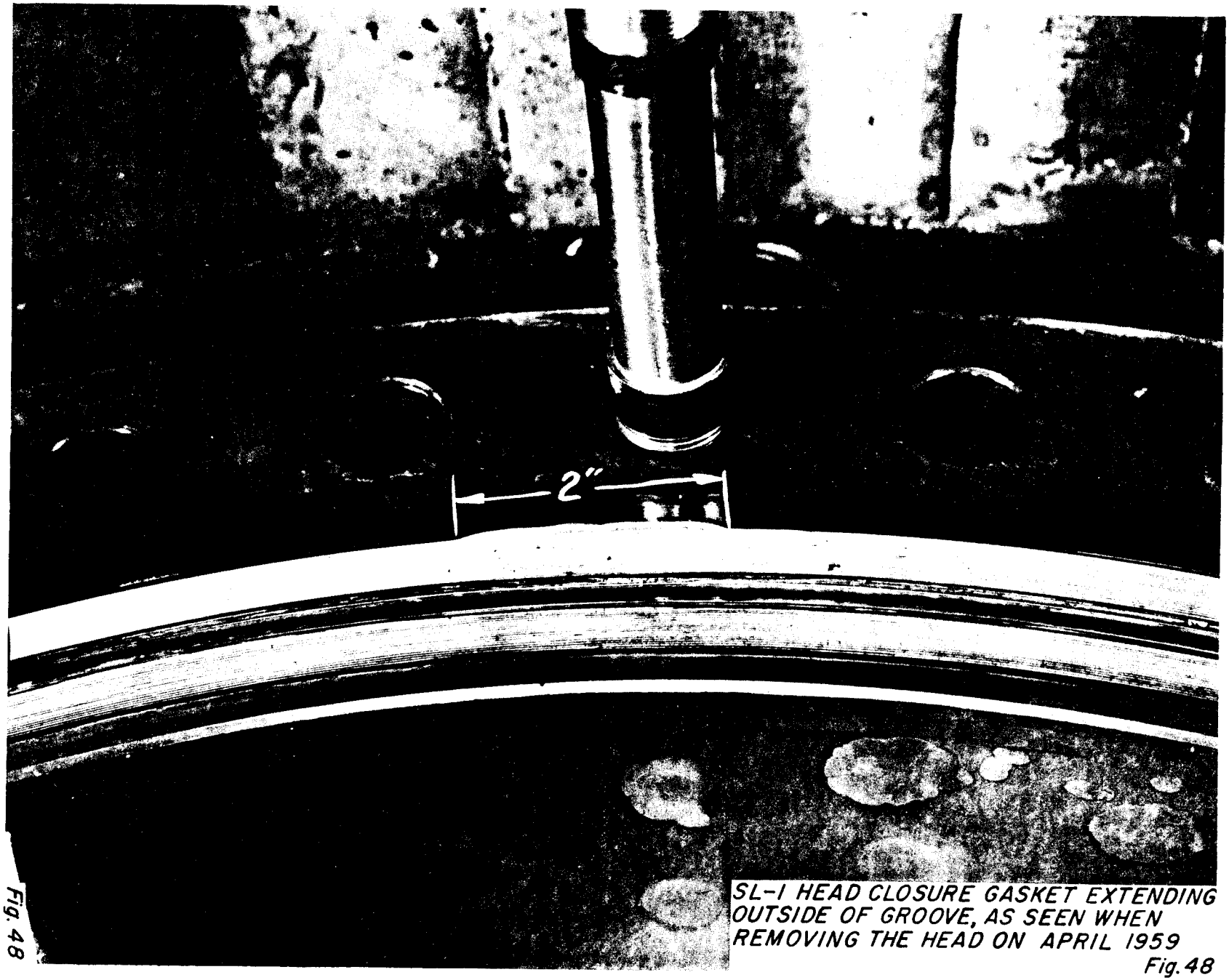
FREQUENCY OF BOILING NOISE VS. POWER LEVEL – SL-1

Fig 46



TYPICAL DATA
BOILING NOISE FROM 1 TO 4.7 MW
CD SHIMS IN T-ROD SLOTS - SL-1

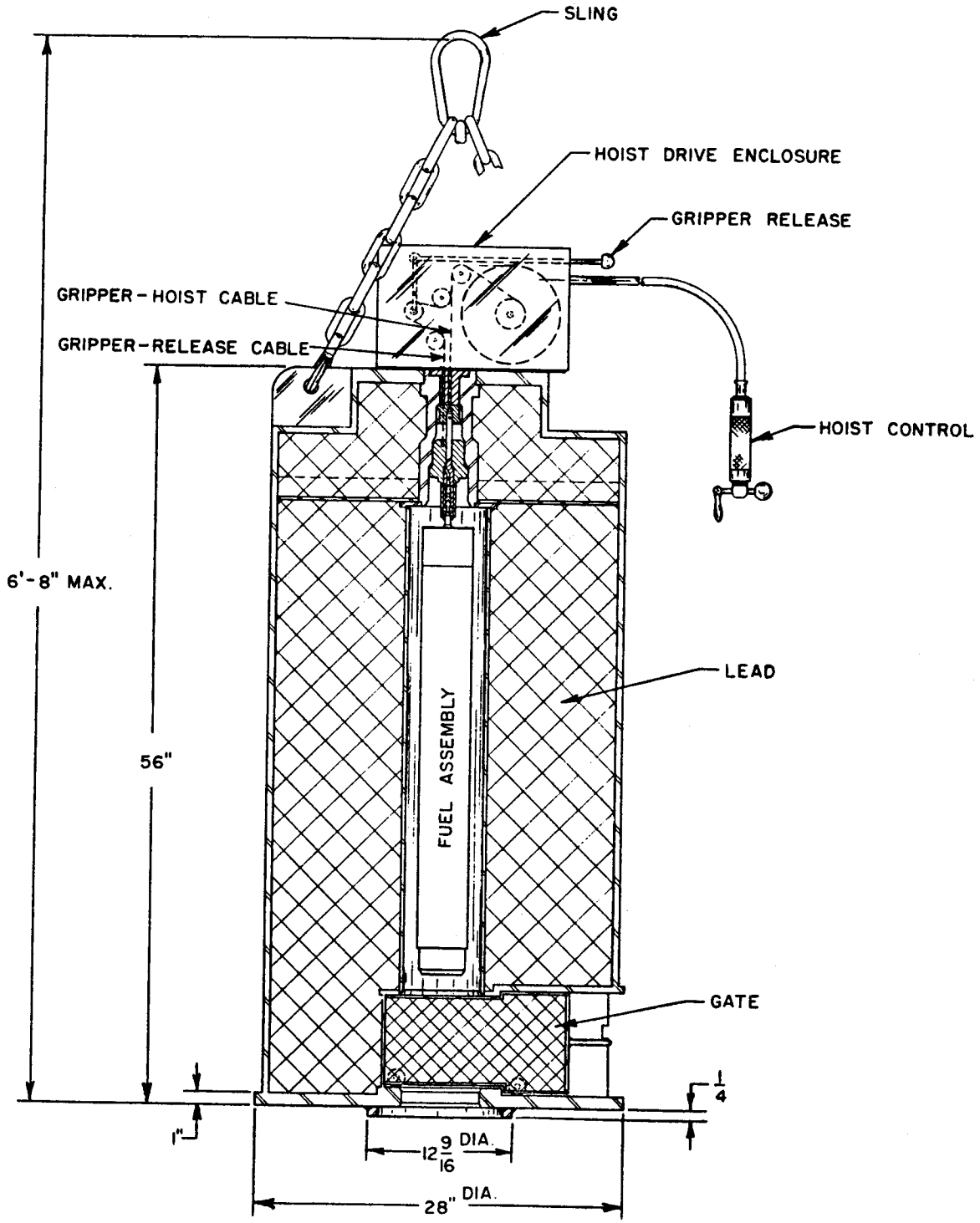
Fig. 47



SL-I HEAD CLOSURE GASKET EXTENDING OUTSIDE OF GROOVE, AS SEEN WHEN REMOVING THE HEAD ON APRIL 1959

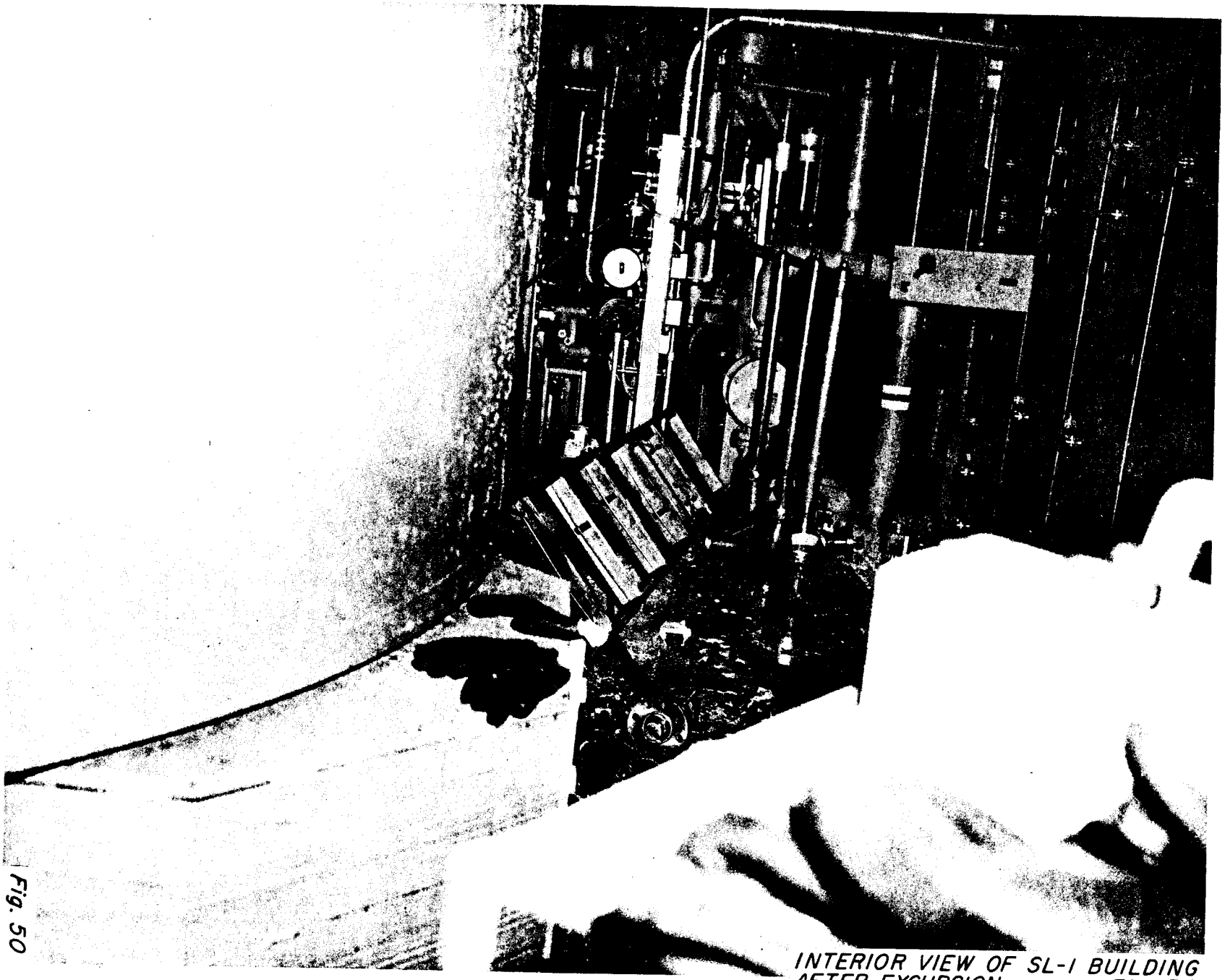
Fig. 48

Fig. 48



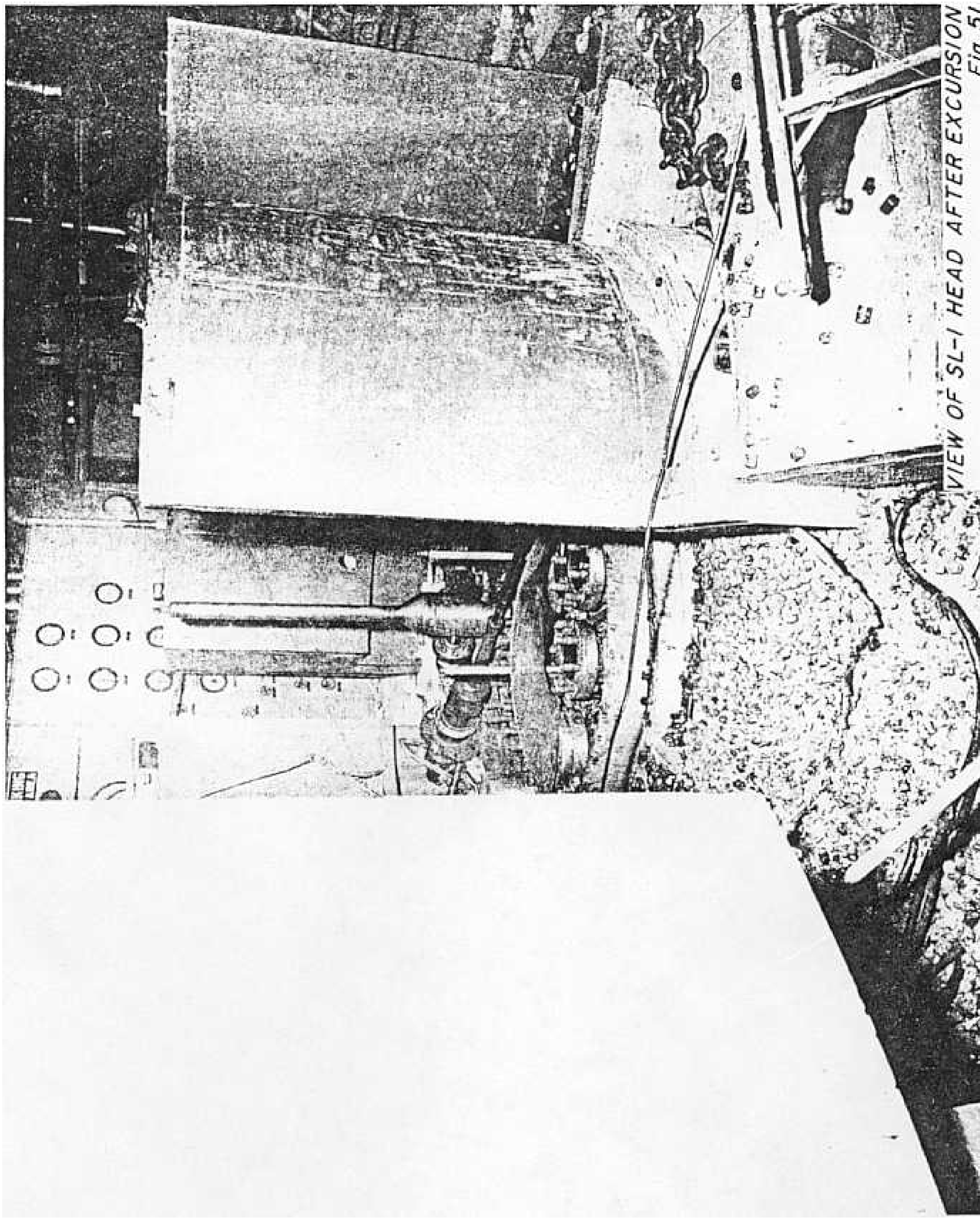
SL-1 FUEL ASSEMBLY COFFIN
Fig. 49

reprinted from ANL-6084 (Fig. 21)



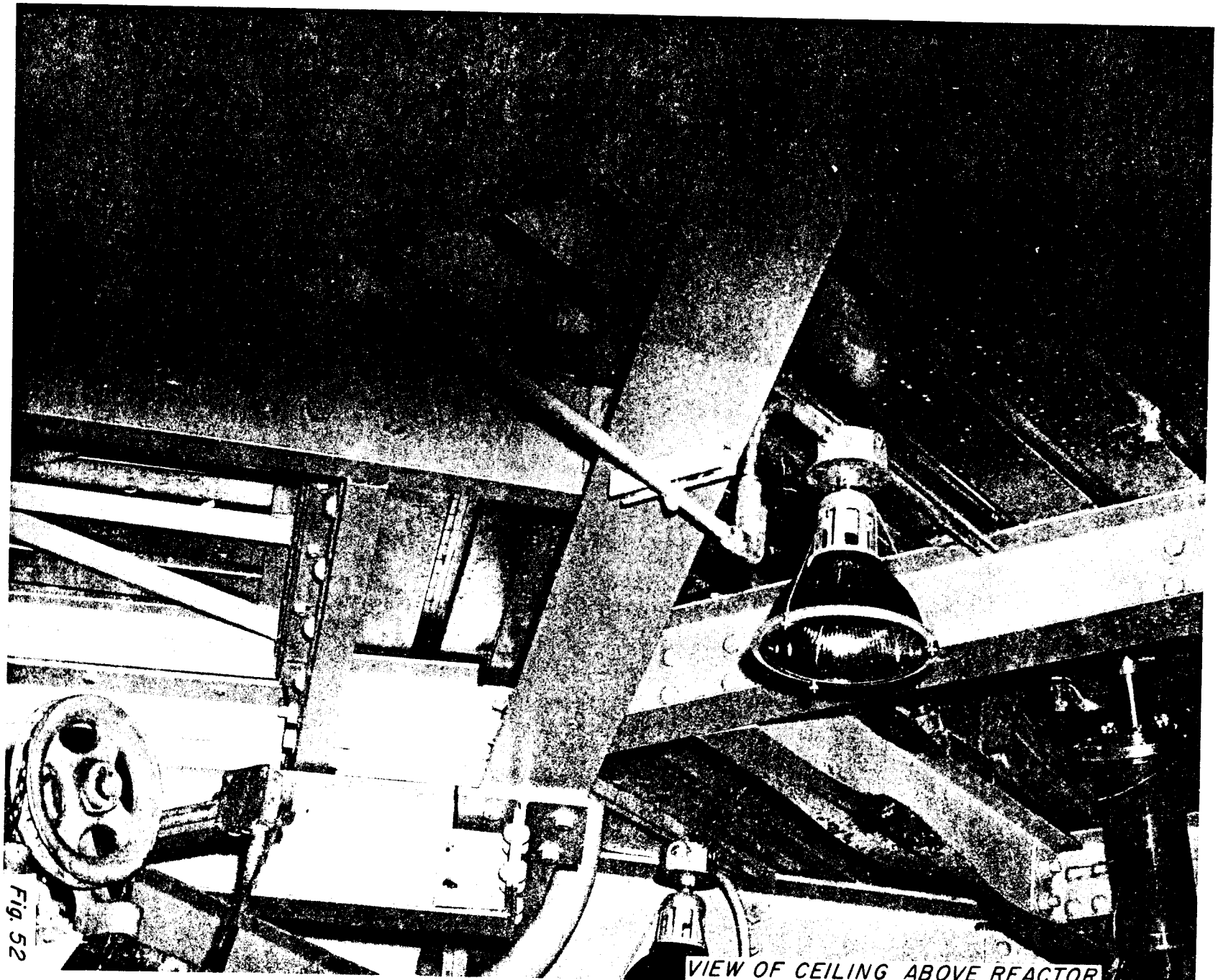
INTERIOR VIEW OF SL-1 BUILDING
AFTER EXCURSION
Fig. 50

Fig. 50



VIEW OF SL-1 HEAD AFTER EXCURSION
Fig. 51

Fig. 51



VIEW OF CEILING ABOVE REACTOR
SHOWING DAMAGE FROM MISSLES

Fig. 52

Fig. 52

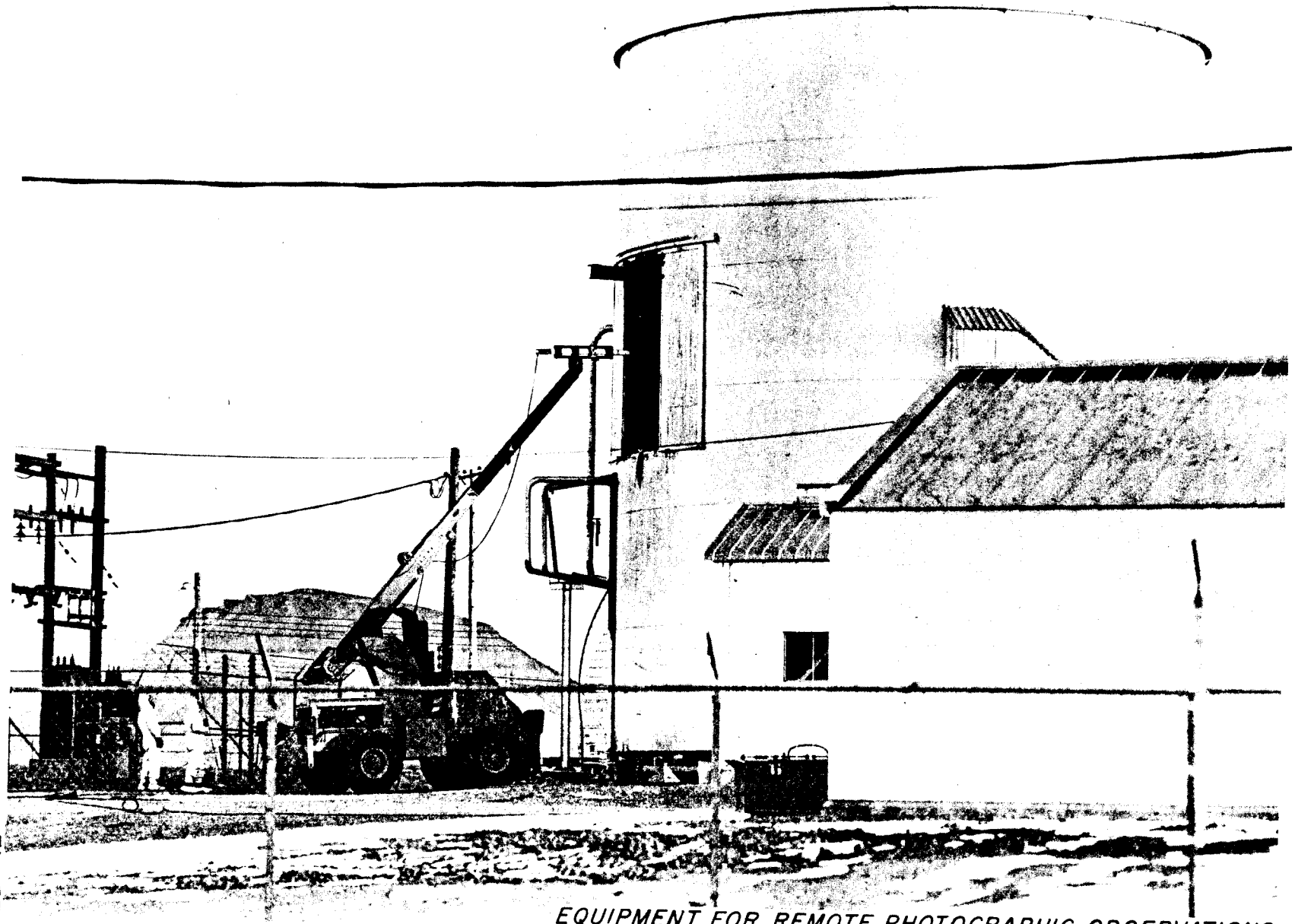
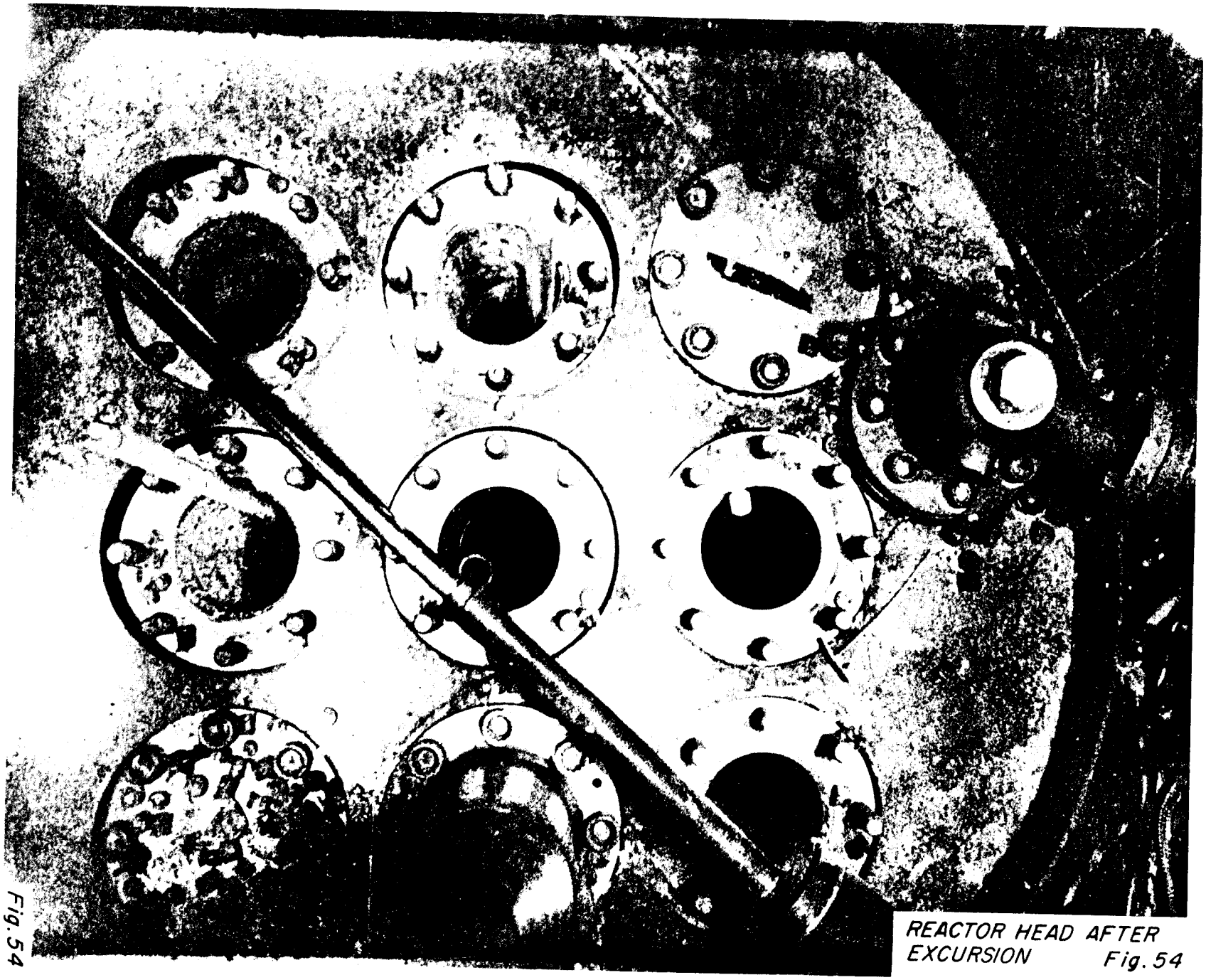


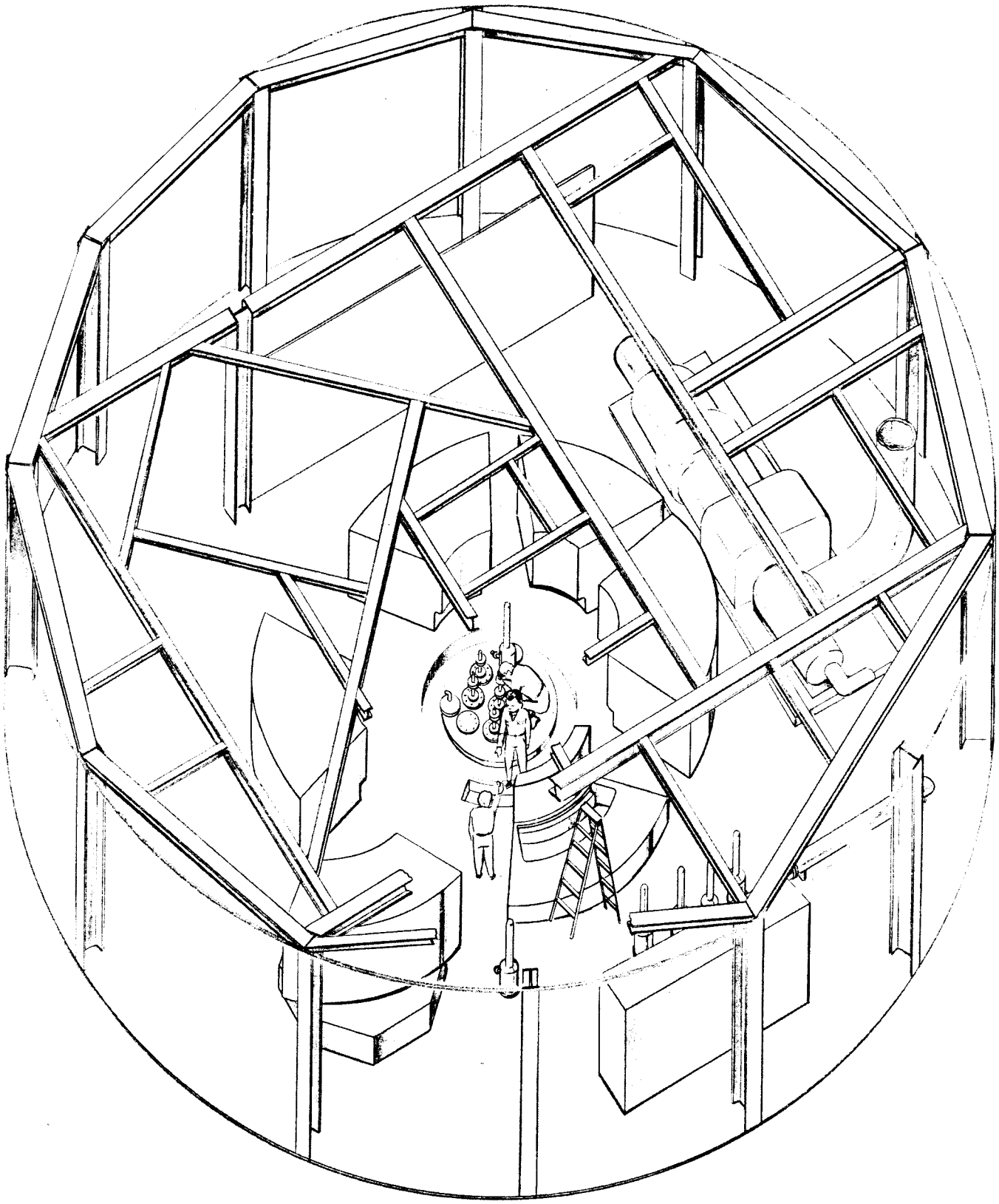
Fig. 53

EQUIPMENT FOR REMOTE PHOTOGRAPHIC OBSERVATIONS
Fig. 53



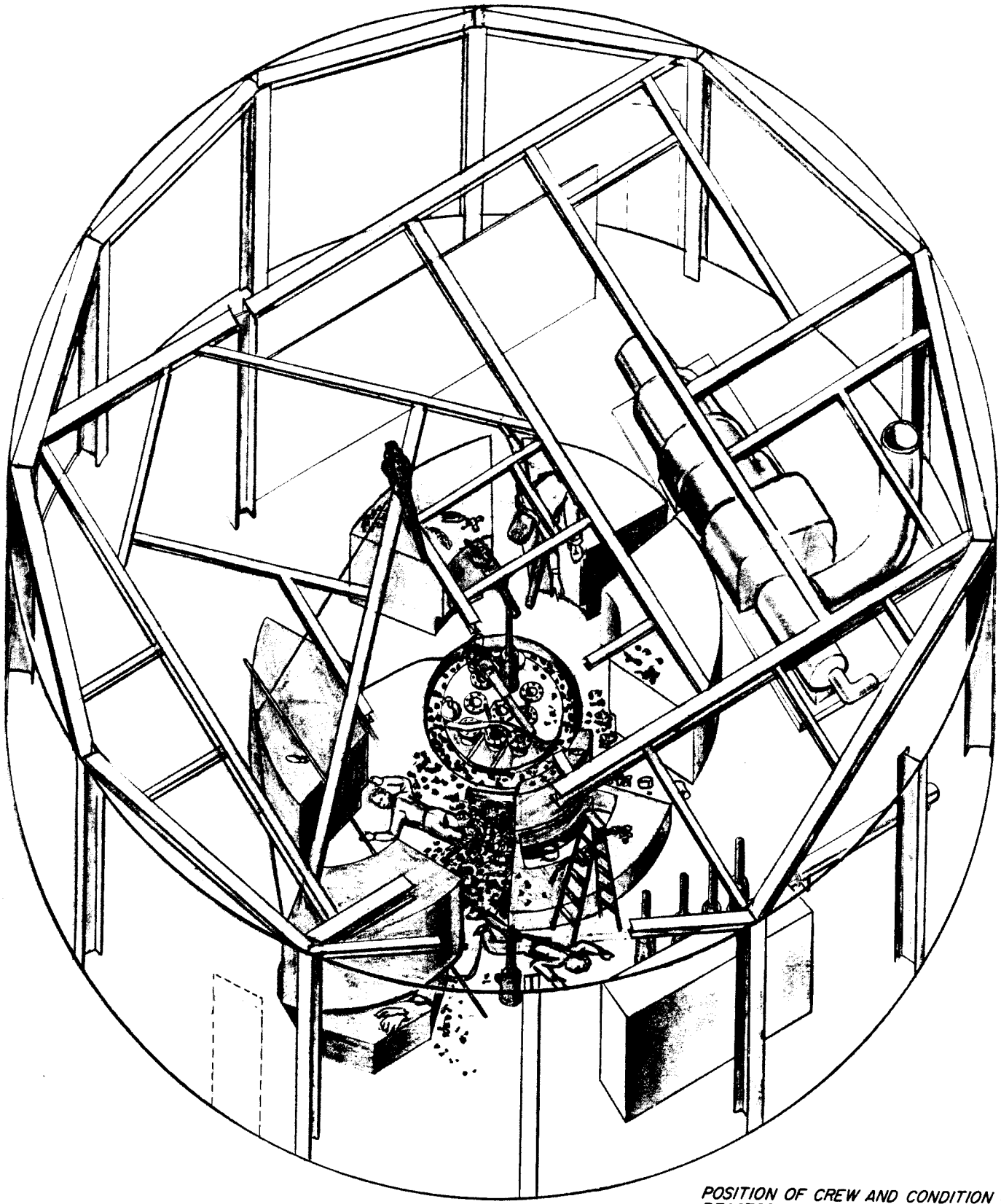
REACTOR HEAD AFTER EXCURSION Fig. 54

Fig. 54



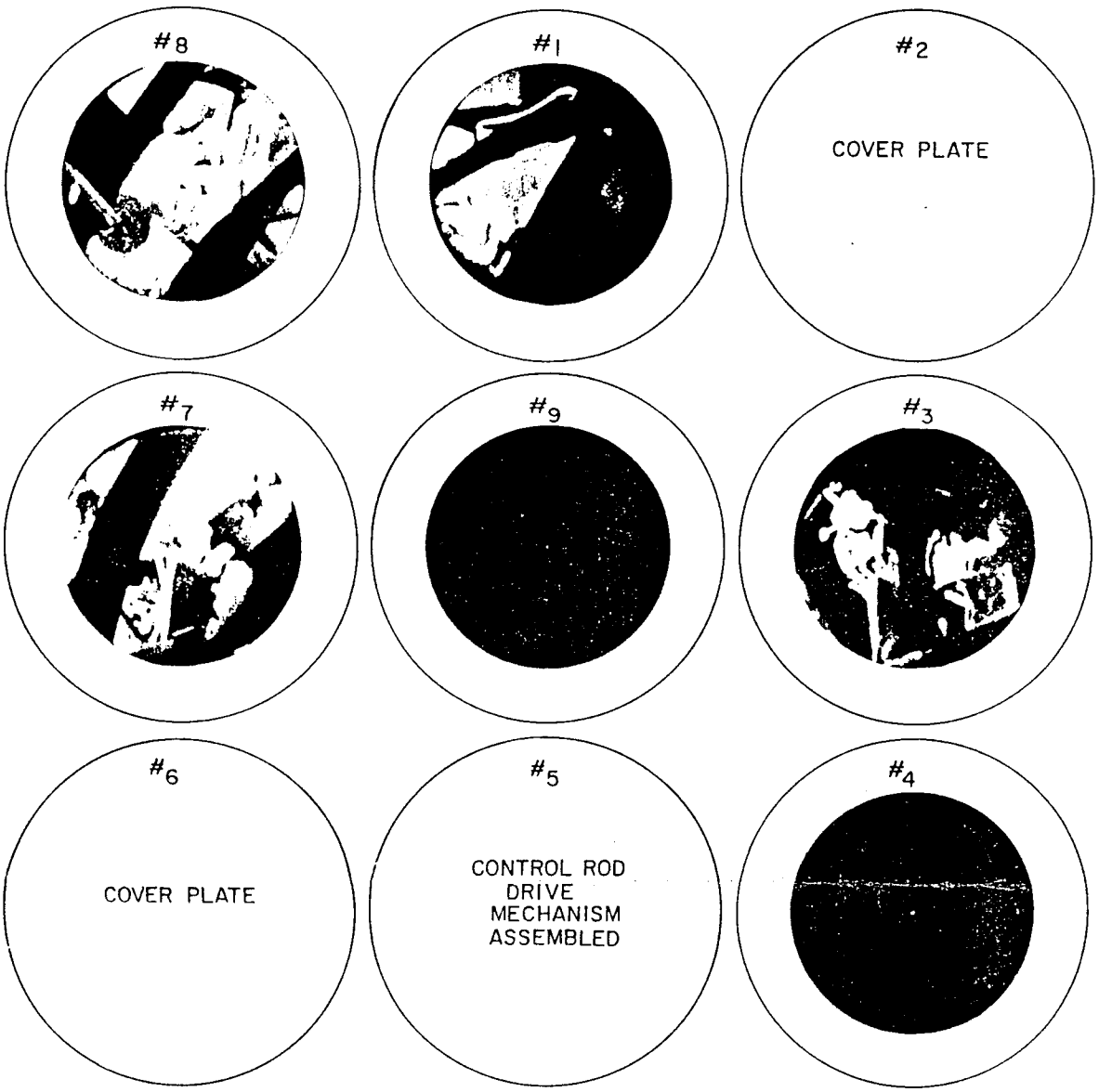
POSITION OF CREW AND CONDITION OF REACTOR HEAD JUST PRIOR TO INCIDENT

Fig.55



POSITION OF CREW AND CONDITION OF REACTOR HEAD JUST AFTER INCIDENT

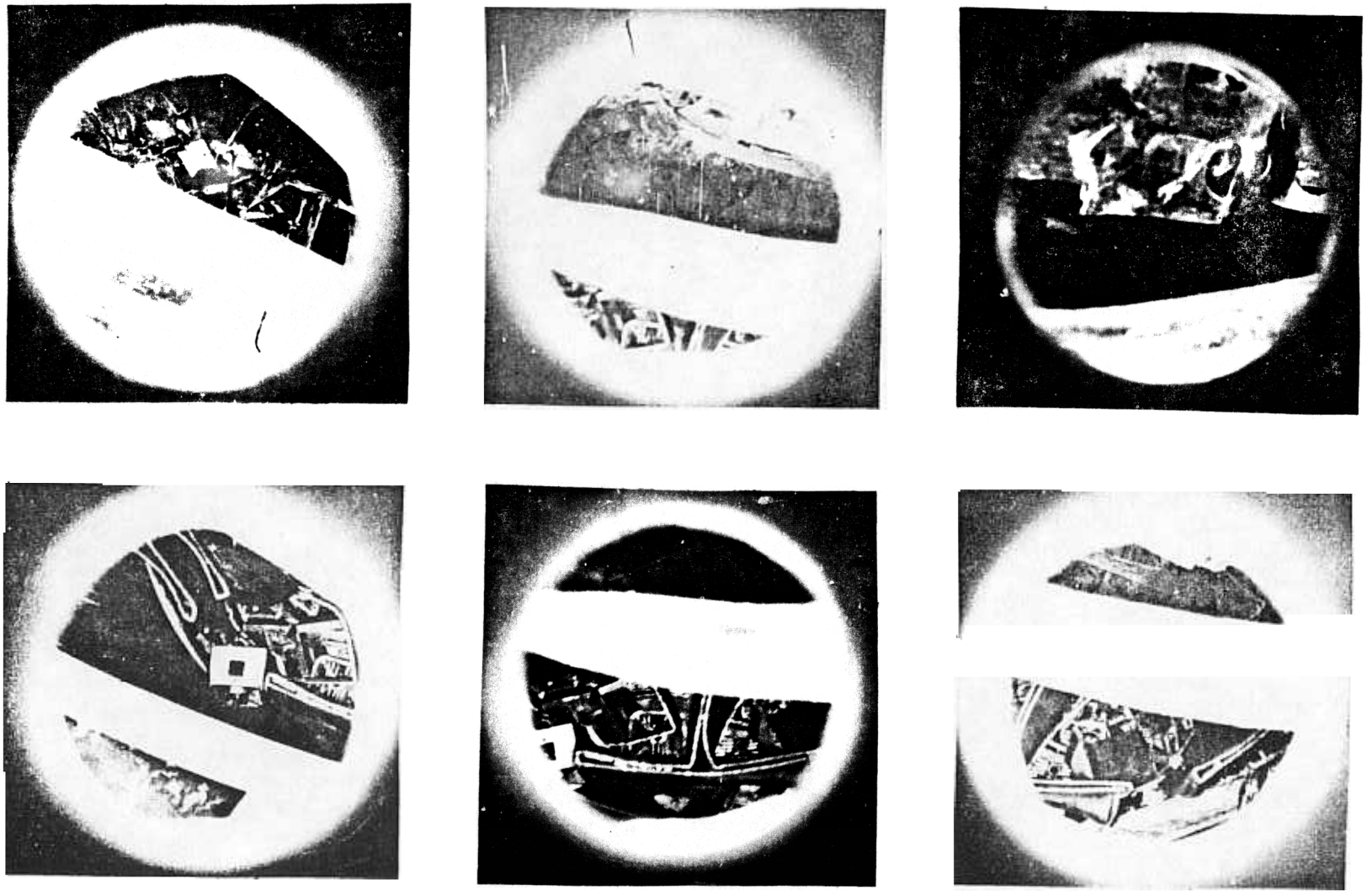
Fig. 56



TYPICAL FRAMES FROM MOTION PICTURE OBSERVATION THROUGH HEAD PORTS ON FEB. 22, 1961

Fig. 57

Fig 57



TYPICAL PICTURES FROM MINIATURE CAMERA ENTRY ON MAY 11, 1961

Fig. 58

Fig. 58

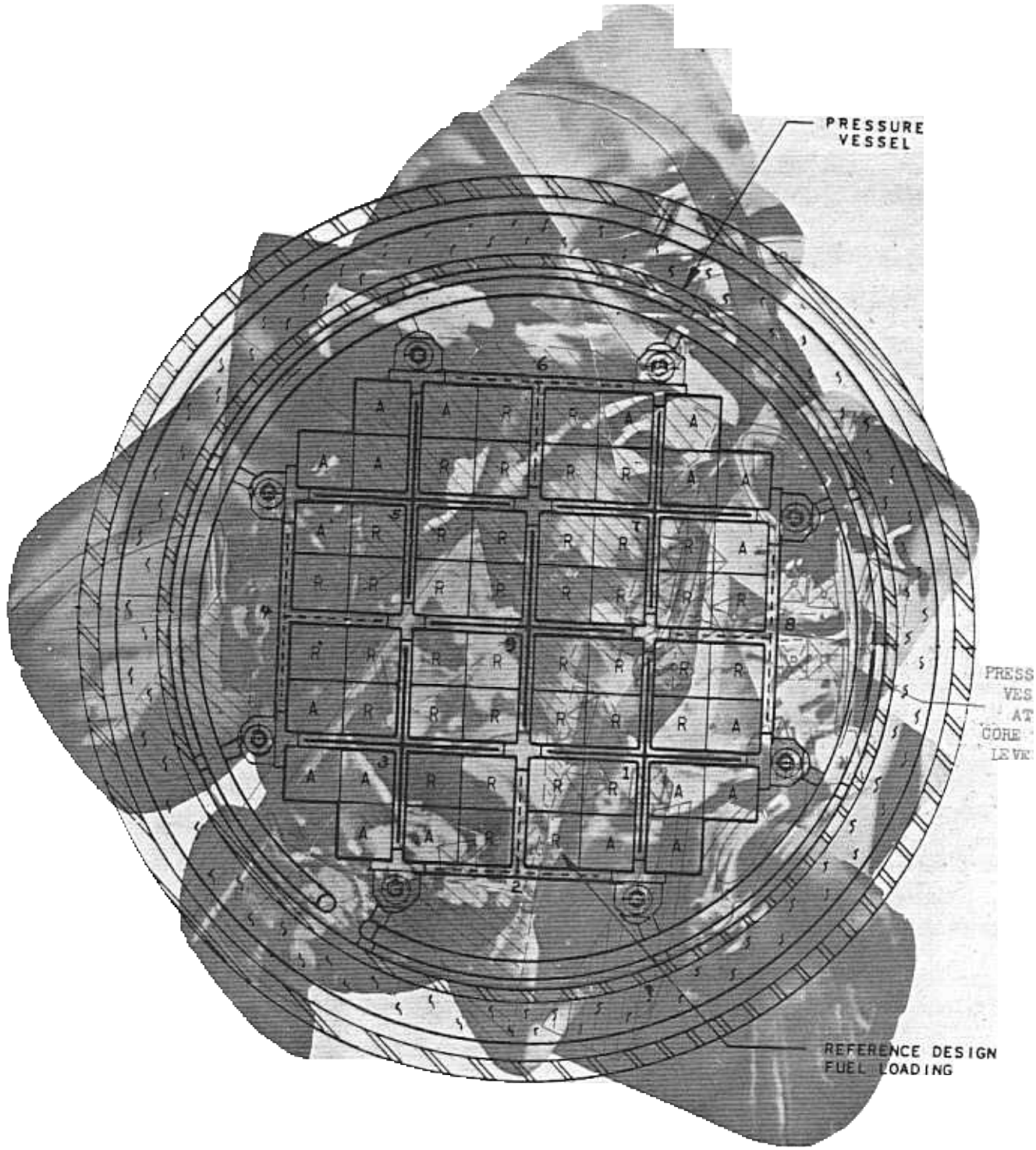
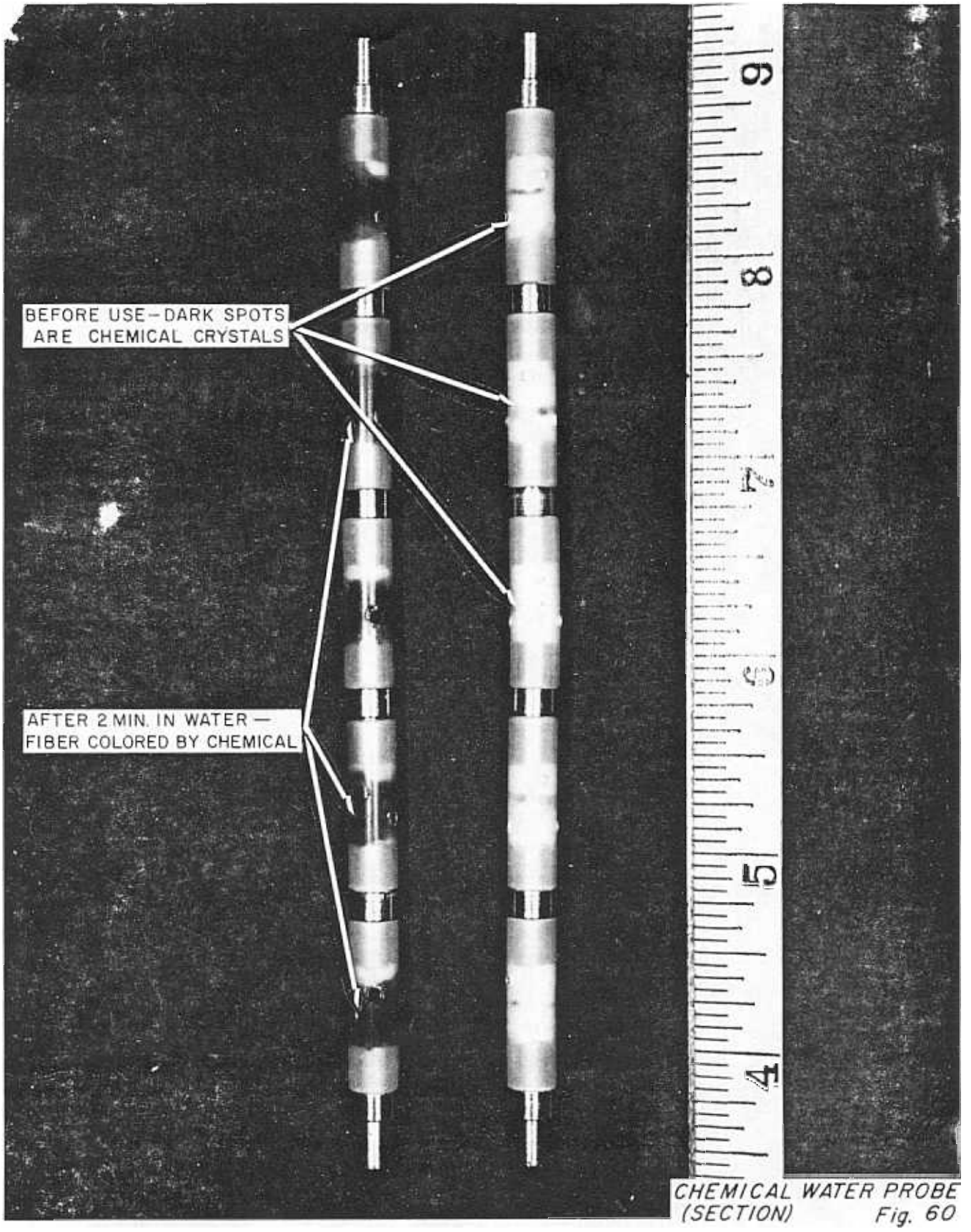
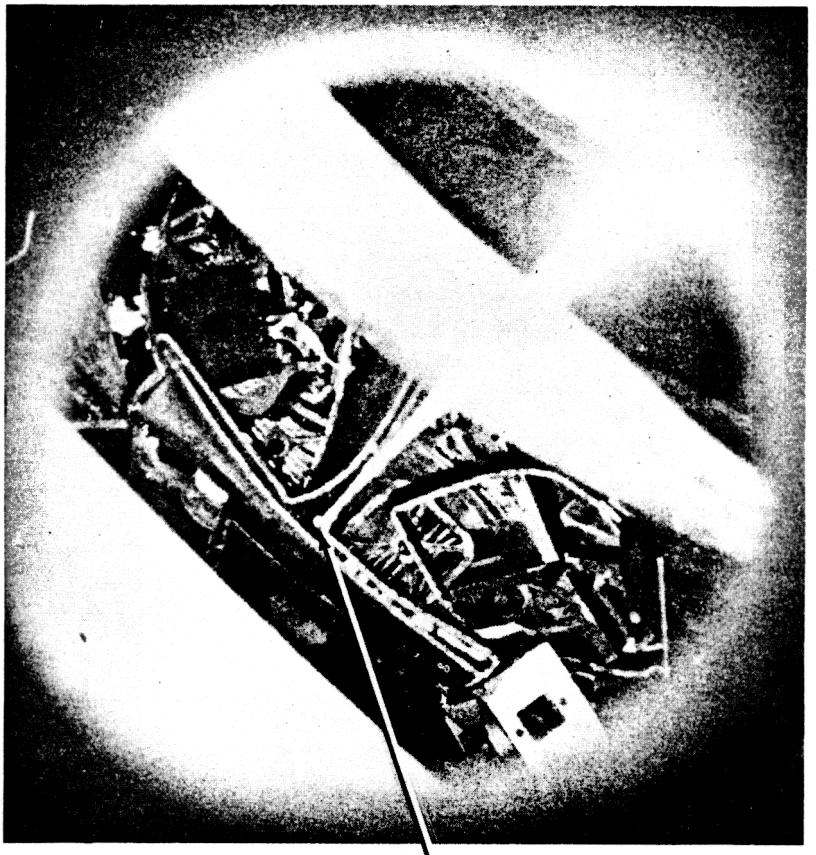


PHOTO-ANALYSIS OF VESSEL INTERIOR.
(REPRINTED FROM USNPIC REPORT N-PZII P.6)
Fig. 59



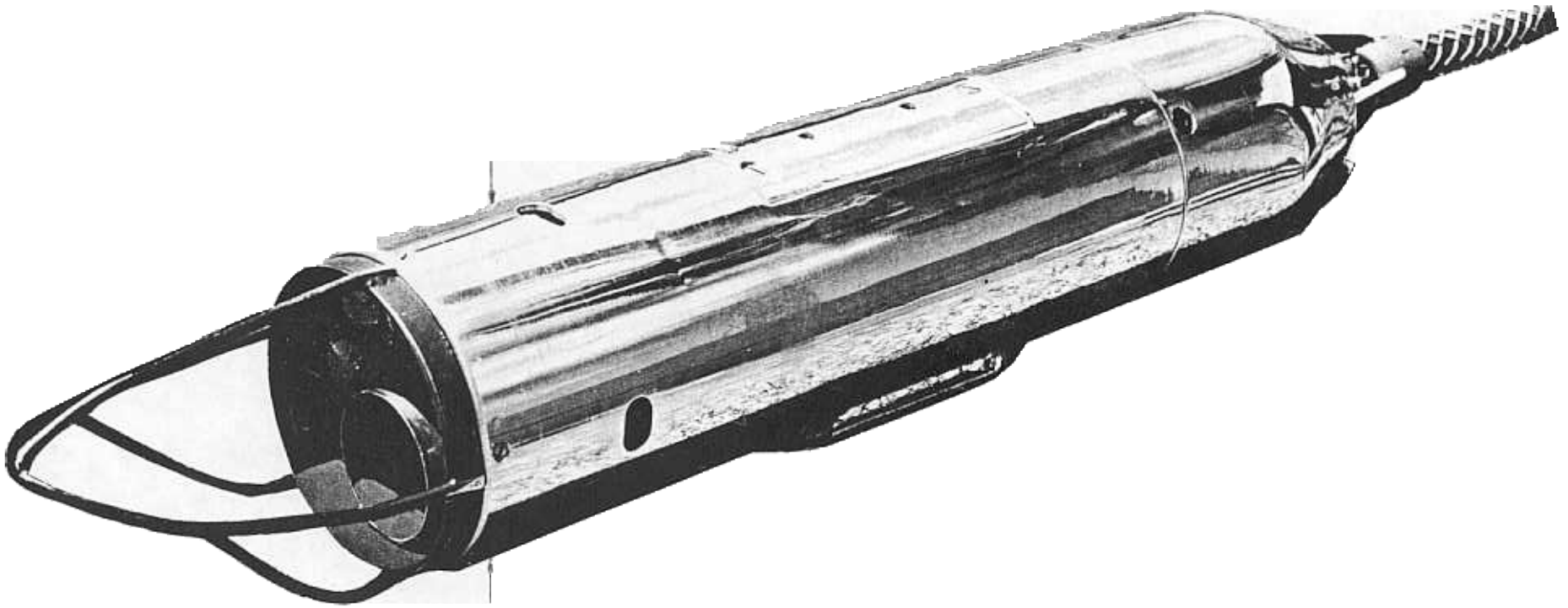
CHEMICAL WATER PROBE (SECTION) Fig. 60



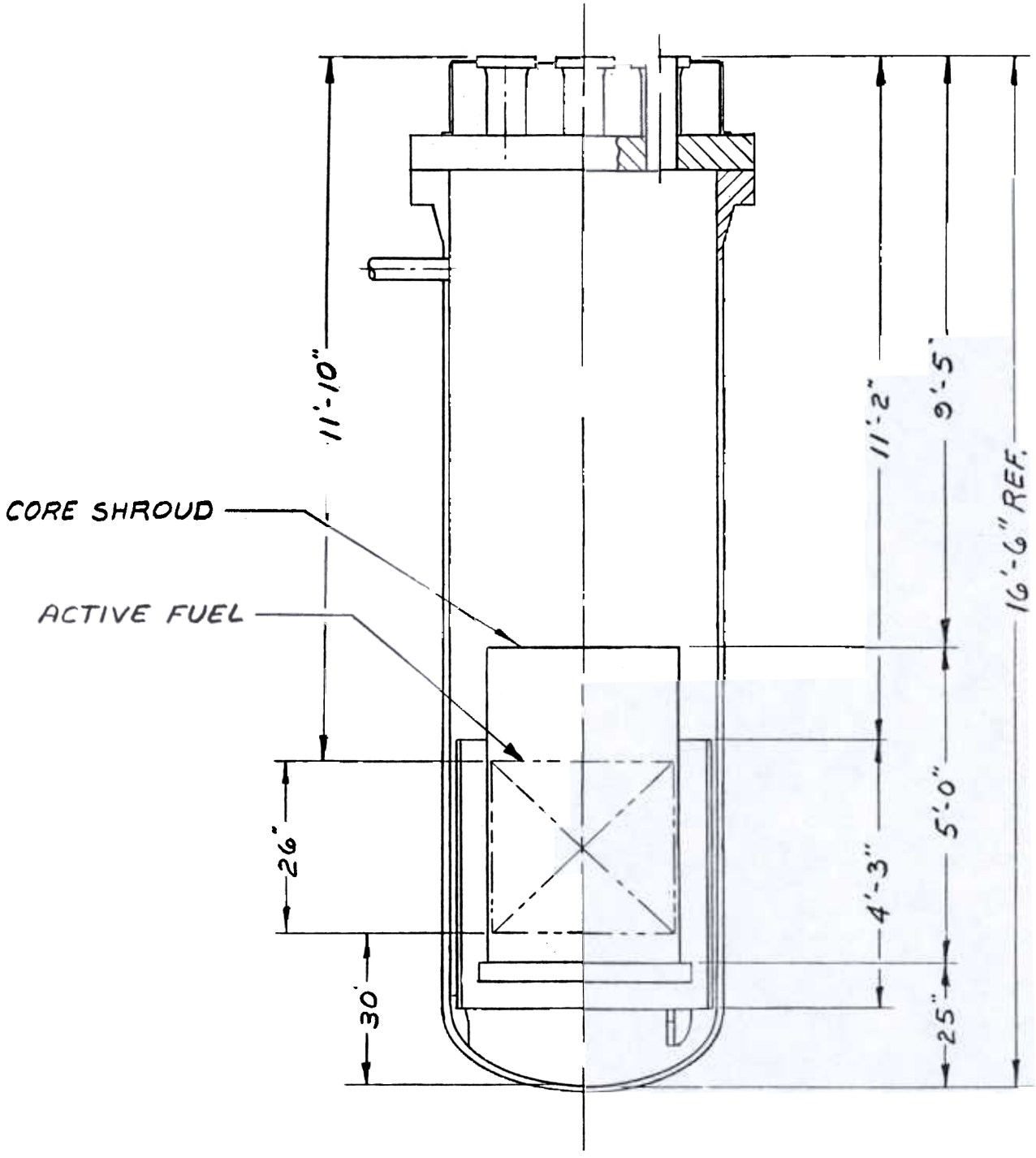
TOP END OF CHEMICAL WATER PROBE

MINIATURE CAMERA PHOTOGRAPH
THROUGH PORT No. 8

Fig. 61



REMOTELY CONTROLLED SHIELDED
MINIATURE CAMERA ASSEMBLY.
Fig. 62



WATER PROBE ENTRY
REFERENCE DIMENSIONS
Fig. 63

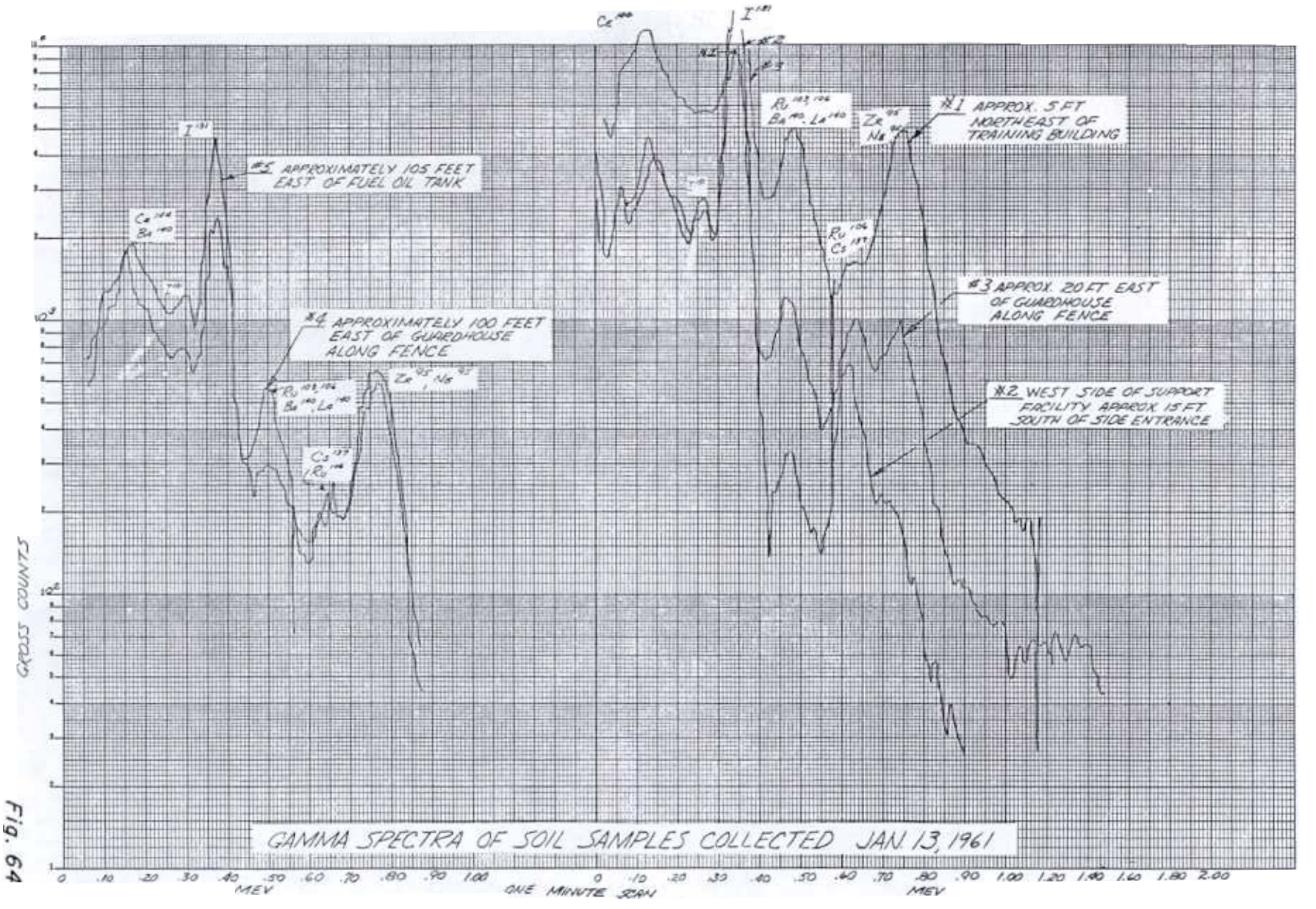
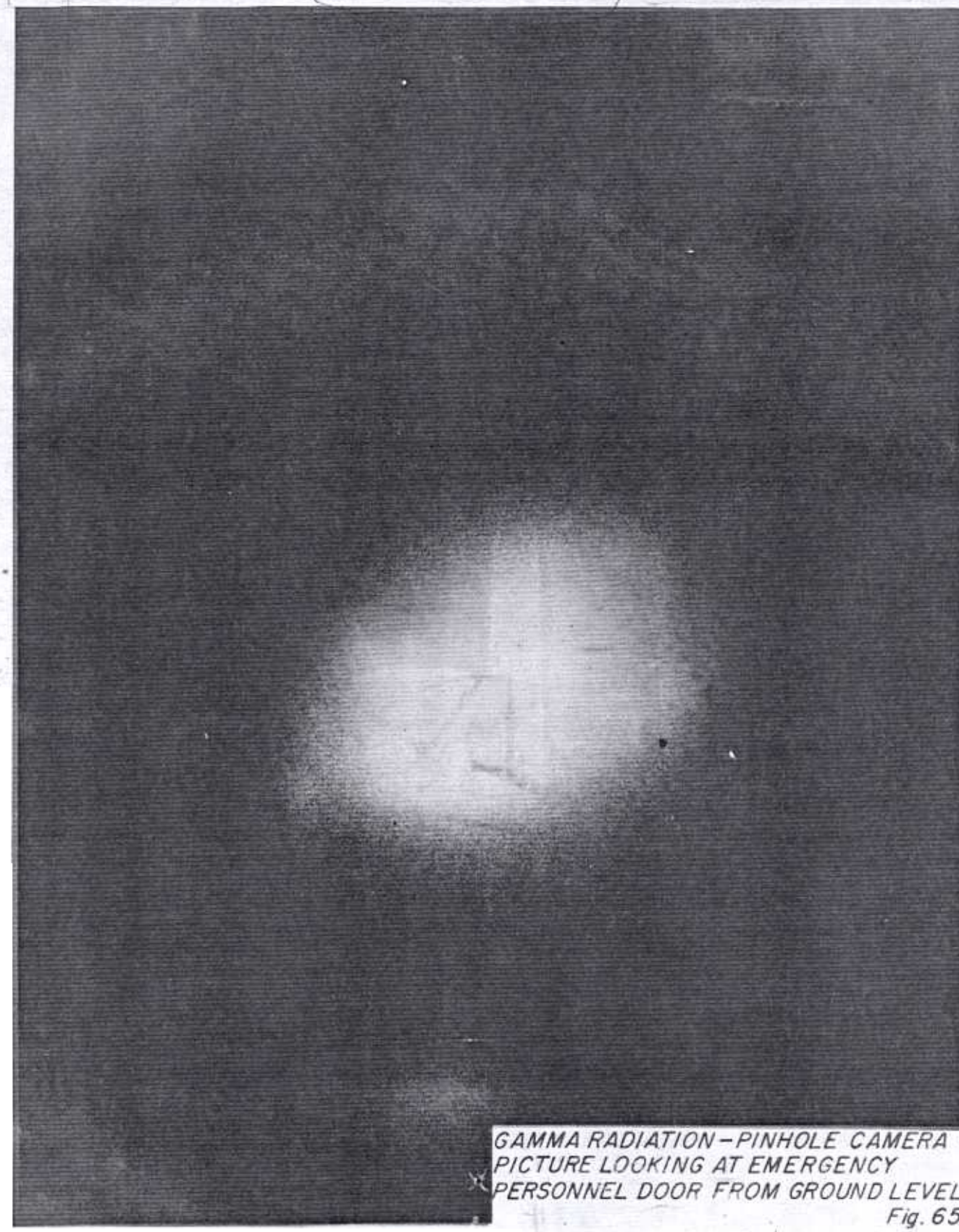
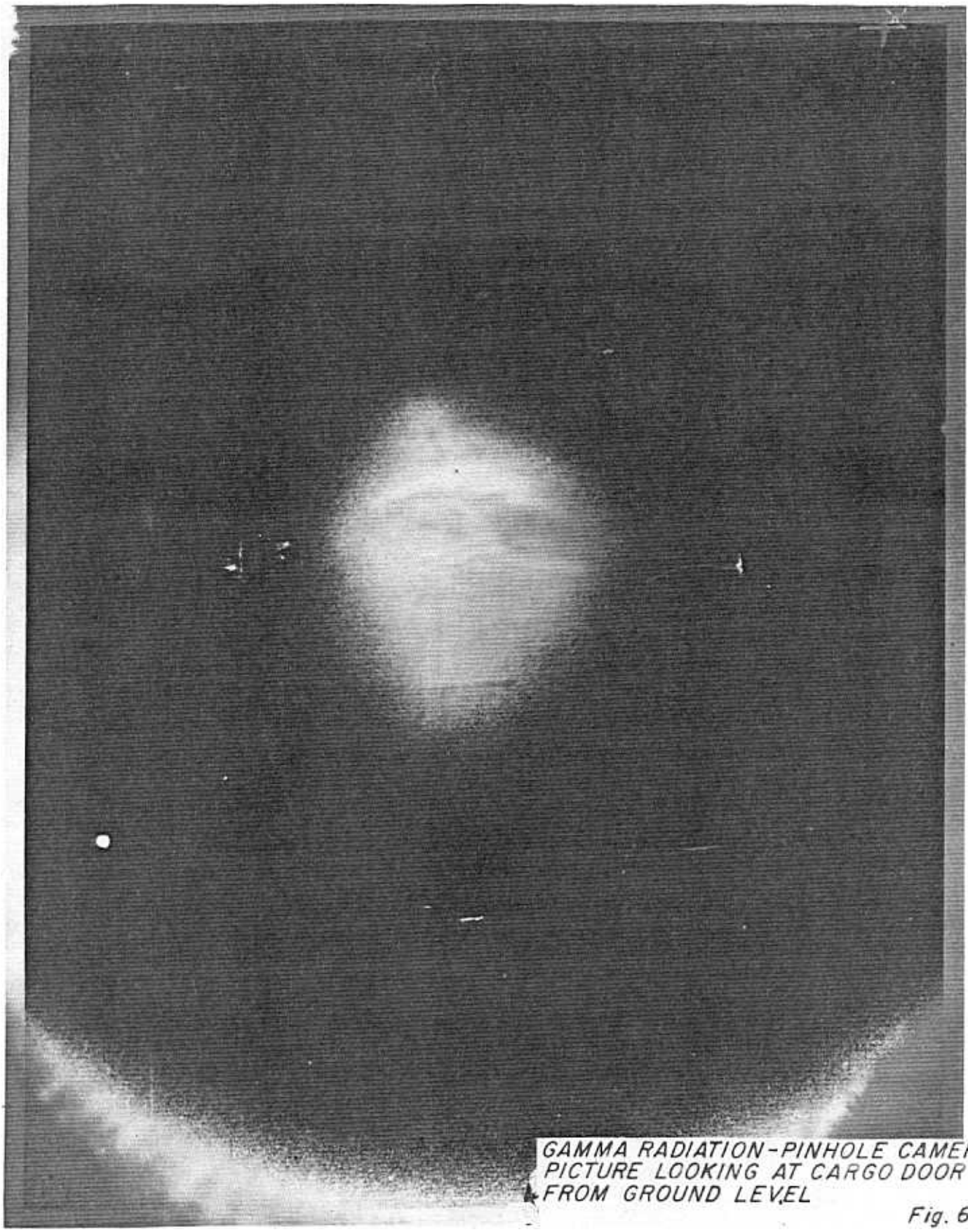

#5 APPROXIMATELY 105 FEET EAST OF FUEL OIL TANK
#4 APPROXIMATELY 100 FEET EAST OF GUARDHOUSE ALONG FENCE
#1 APPROX. 5 FT NORTHEAST OF TRAINING BUILDING
#3 APPROX. 20 FT EAST OF GUARDHOUSE ALONG FENCE
#2 WEST SIDE OF SUPPORT FACILITY APPROX. 15 FT SOUTH OF SIDE ENTRANCE
GAMMA SPECTRA OF SOIL SAMPLES COLLECTED JAN. 13, 1961
GROSS COUNTS
MEV
ONE MINUTE SCAN
MEV

Fig. 64

Fig. 64

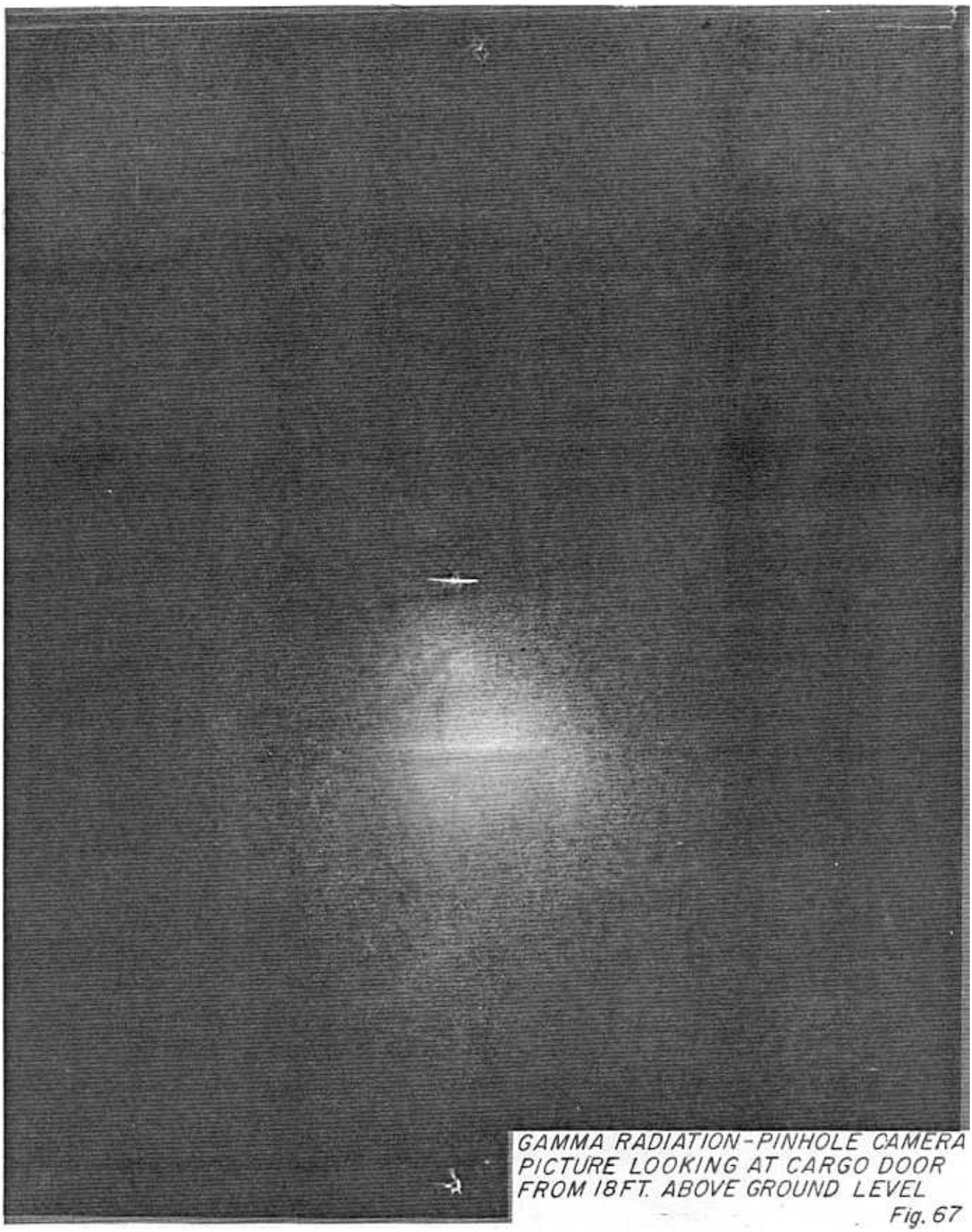


GAMMA RADIATION – PINHOLE CAMERA
PICTURE LOOKING AT EMERGENCY
PERSONNEL DOOR FROM GROUND LEVEL
Fig. 65



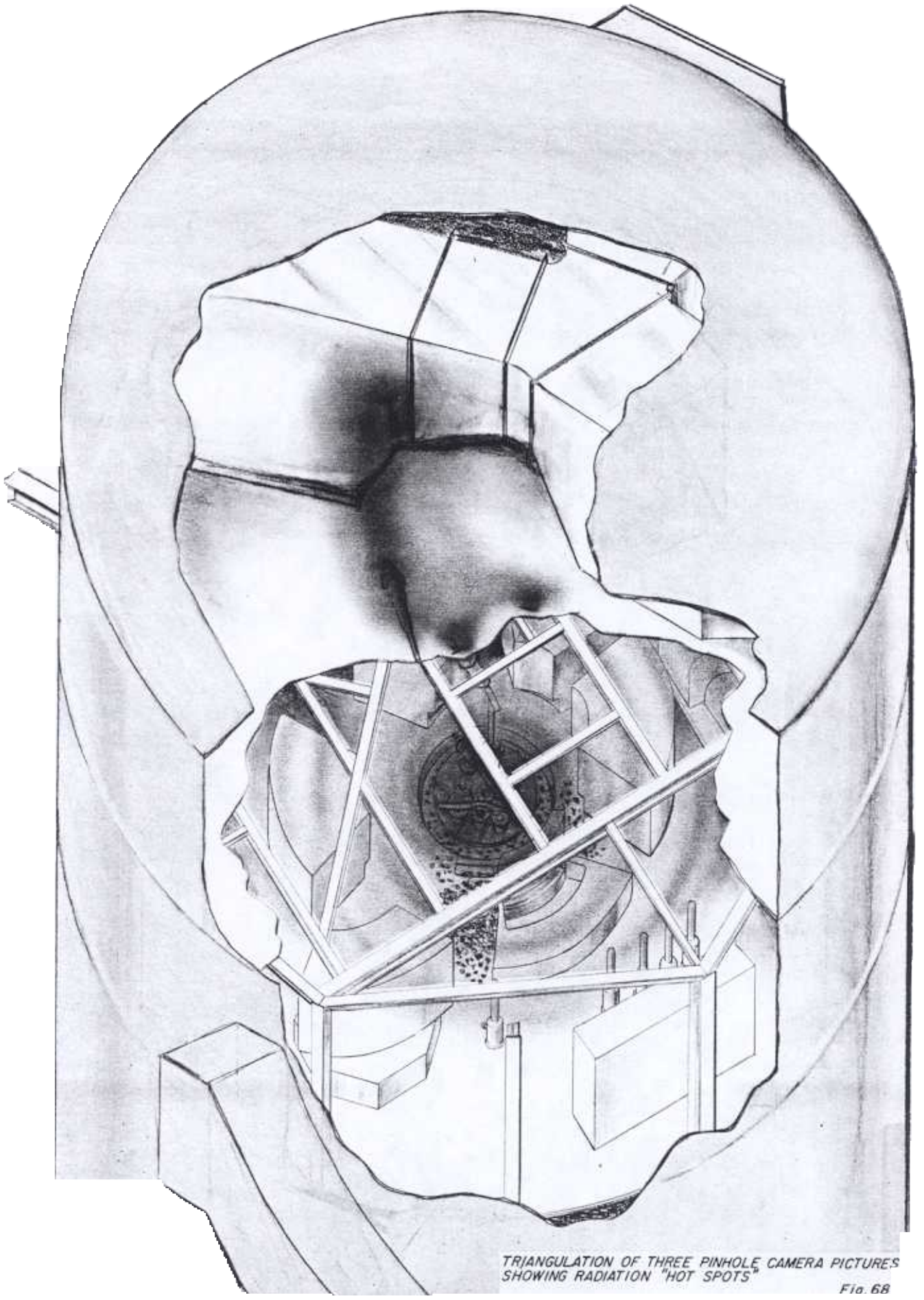
GAMMA RADIATION - PINHOLE CAMERA PICTURE LOOKING AT CARGO DOOR FROM GROUND LEVEL

Fig. 66



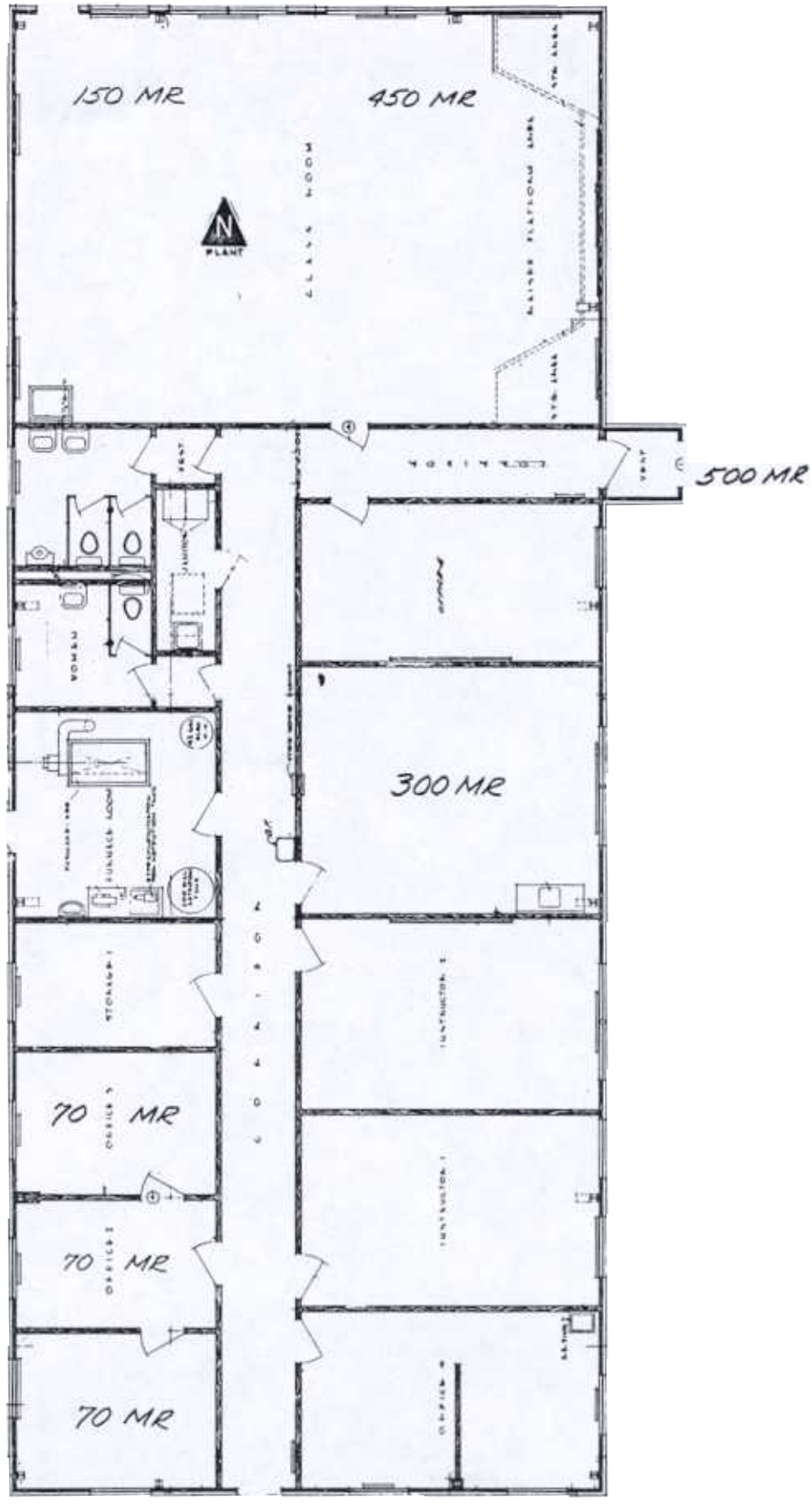
GAMMA RADIATION - PINHOLE CAMERA PICTURE LOOKING AT CARGO DOOR FROM 18FT. ABOVE GROUND LEVEL

Fig. 67



TRIANGULATION OF THREE PINHOLE CAMERA PICTURES SHOWING RADIATION "HOT SPOTS"

Fig. 68

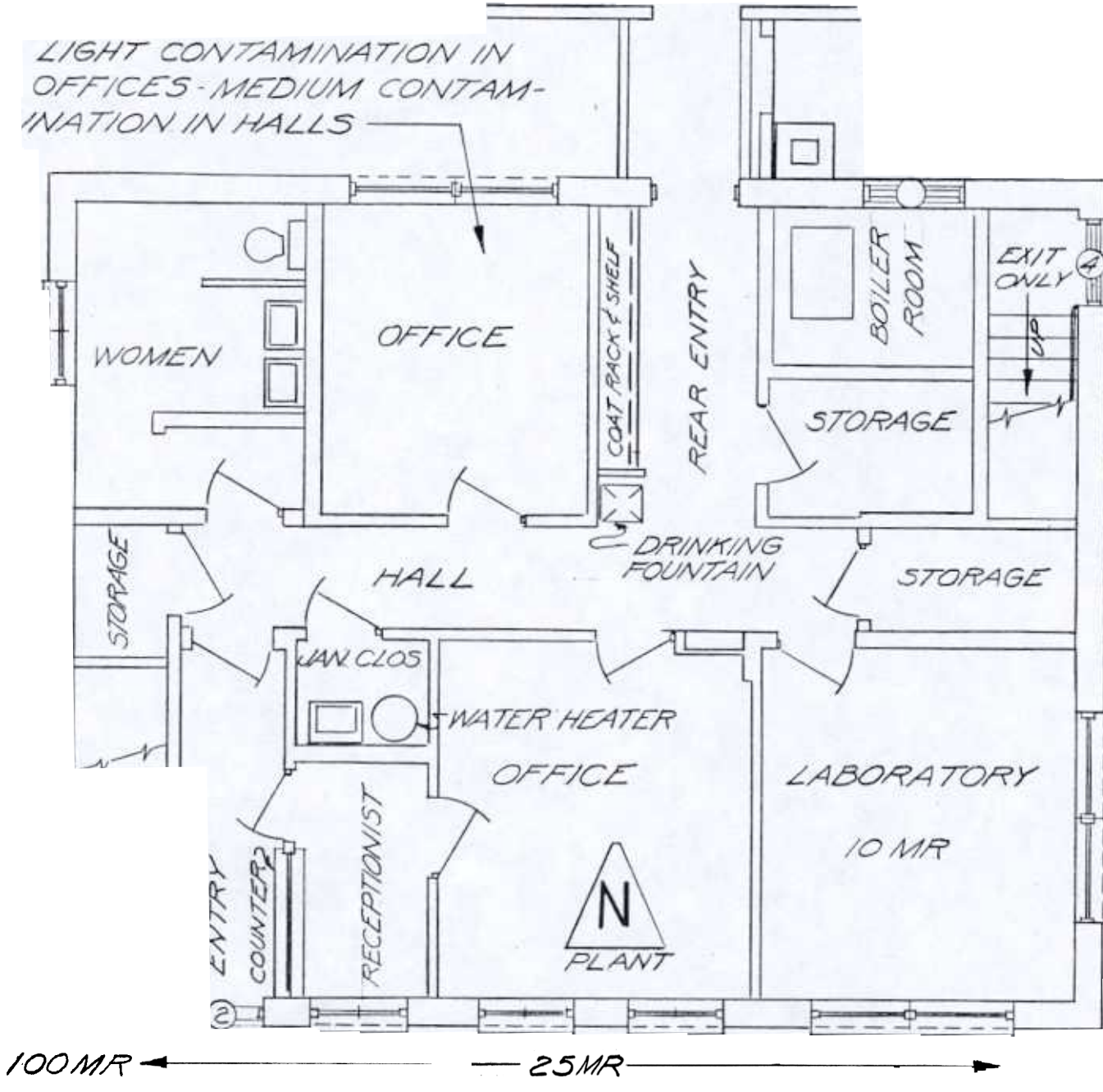


SURVEYED -
JAN. 10, 1961

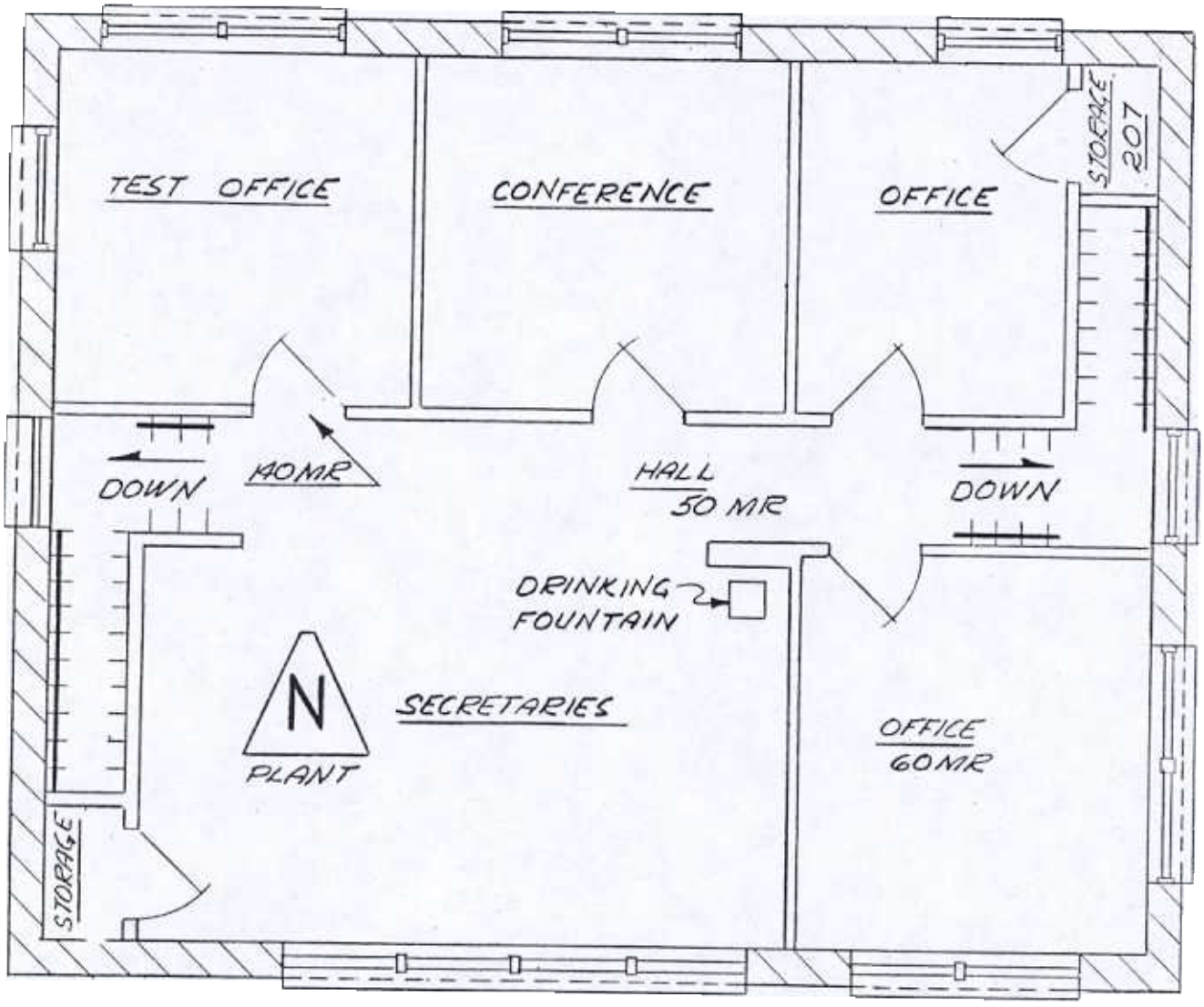
RADIATION SURVEY OF SL-1 MILITARY TRAINING BUILDING Fig. 69

SURVEYED - JAN. 11, 1961

SUPPORT FACILITY



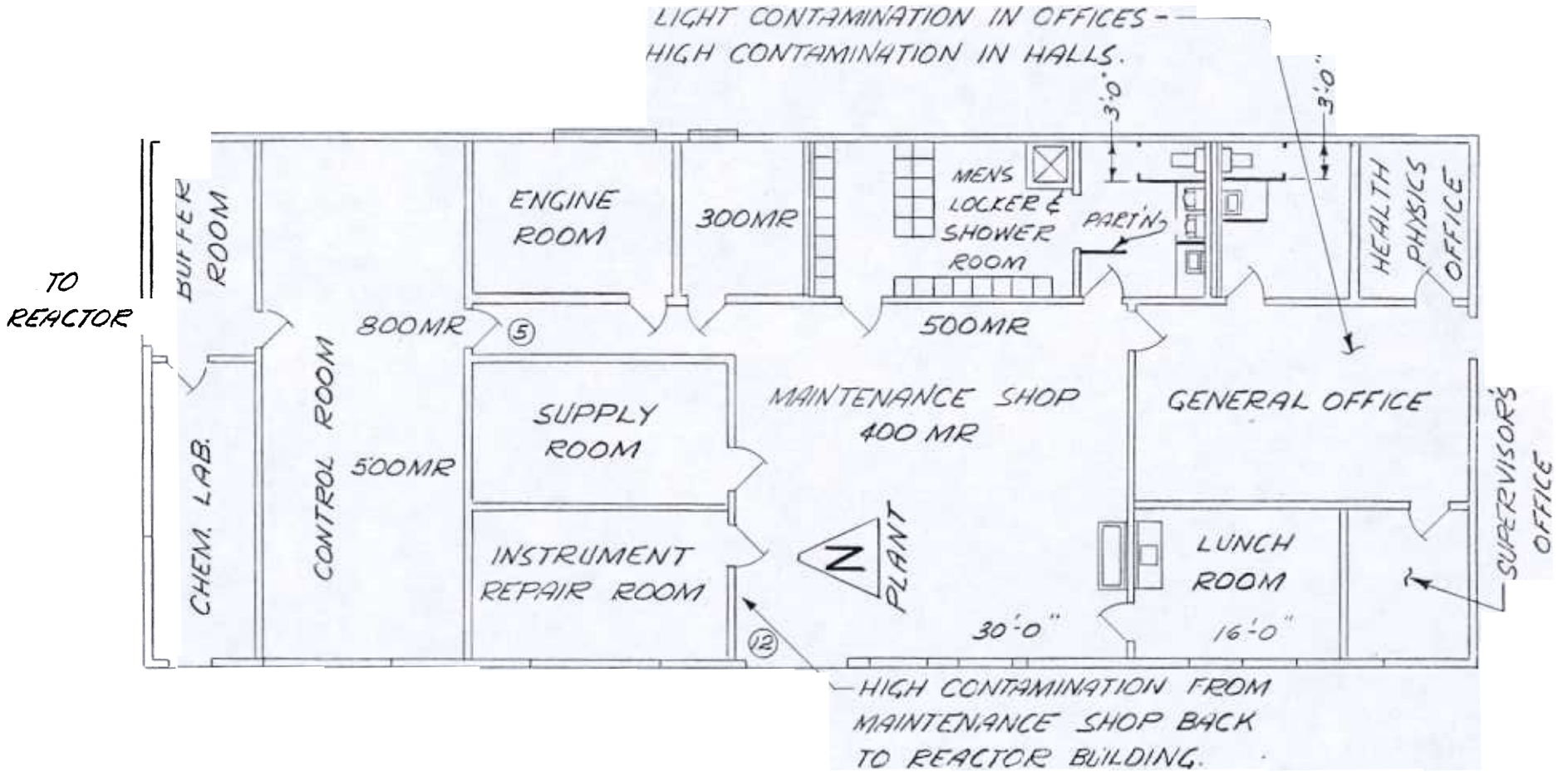
RADIATION SURVEY OF FIRST FLOOR-
SL-1 ADMINISTRATION BUILDING
Fig. 70



SURVEYED JAN 11, 1961

RADIATION SURVEY OF SECOND FLOOR-
SL-1 ADMINISTRATION BUILDING
Fig. 71

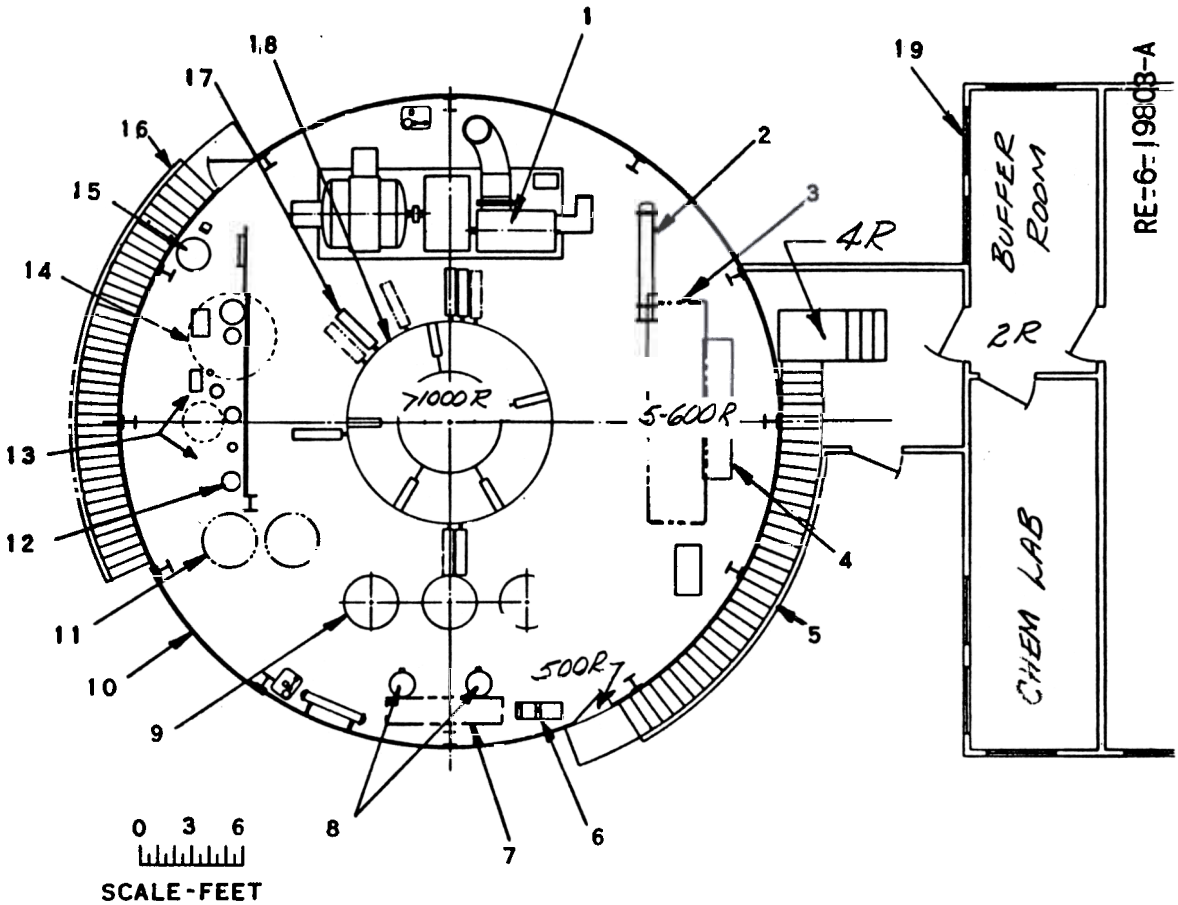
SURVEYED JAN. 11, 1961



RADIATION SURVEY OF SL-1 SUPPORT FACILITIES BUILDING

Fig. 72

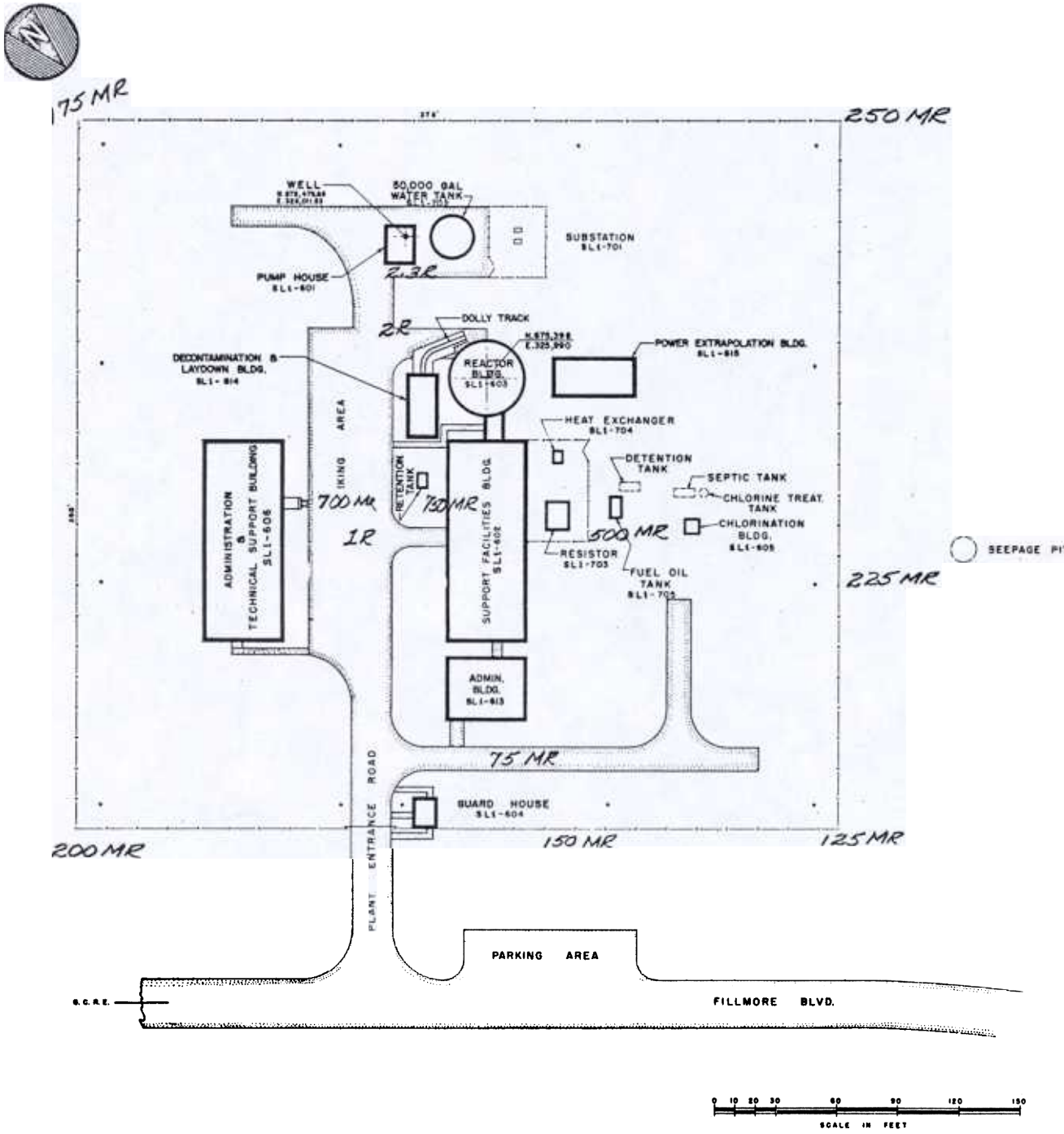
SURVEYED - JAN. 11, 1961



1. TURBINE-GENERATOR
2. HEAT EXCHANGER
3. WATER STORAGE TANK (OVERHEAD)
4. MOTOR CONTROL BOARD
5. COVERED STAIRWAY
6. CONDENSATE CIRCULATING PUMP
7. HOTWELL (OVERHEAD)
8. FEED WATER PUMPS
9. FUEL STORAGE WELLS
10. EQUIPMENT DOORS
11. WASTE STORAGE TANKS
12. FEED WATER LINE FILTER
13. PURIFICATION SYSTEM AREA
14. CONTAMINATED WATER STORAGE TANK
15. BORON STORAGE TANK
16. COVERED EMERGENCY STAIRWAY
17. CONTROL ROD DRIVE MOTORS
18. CONCRETE SHIELD
19. SUPPORT FACILITIES BUILDING (CONTROL ROOM LOCATION)

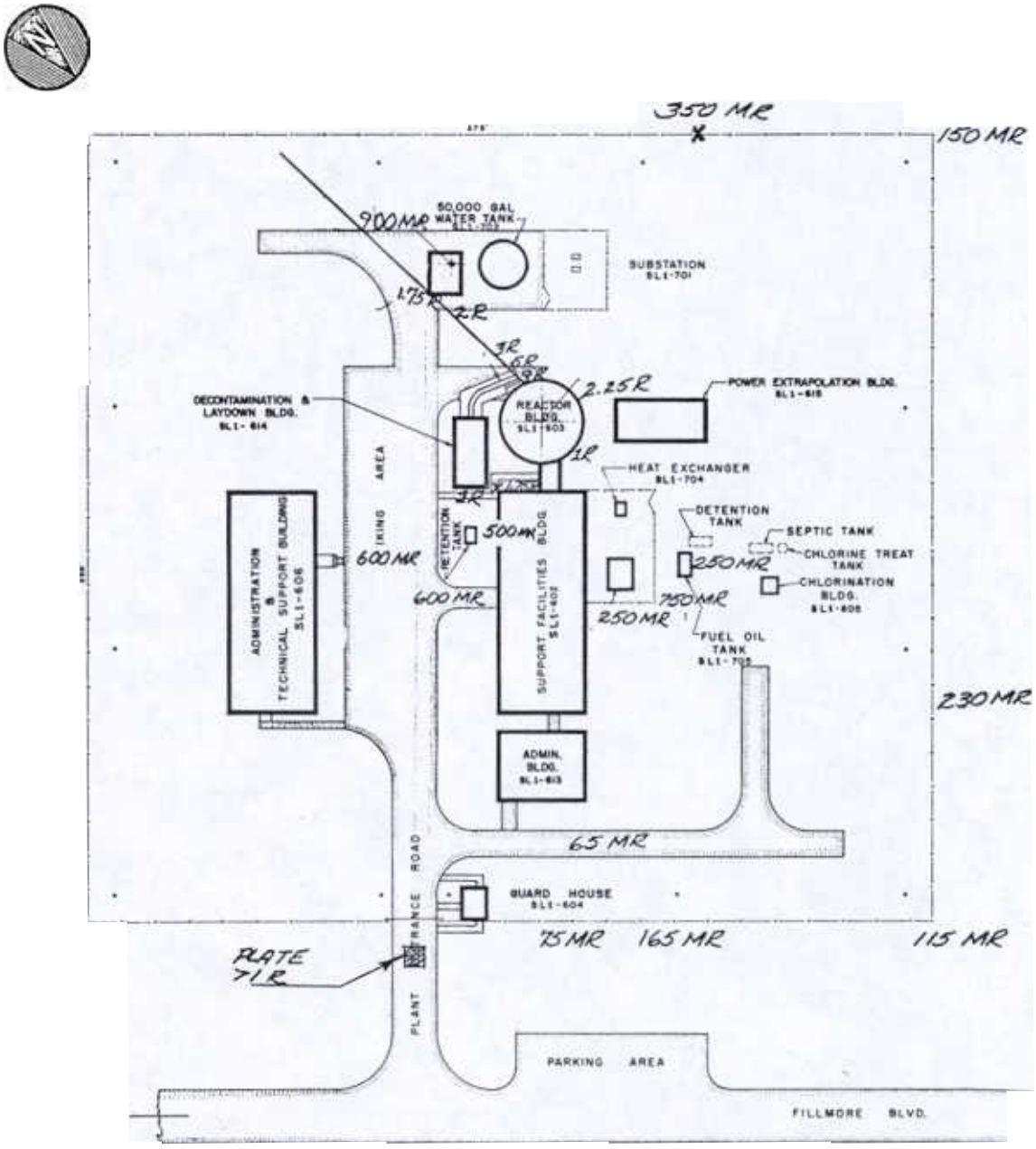
RADIATION SURVEY OF SL-1 OPERATING FLOOR

Fig. 73



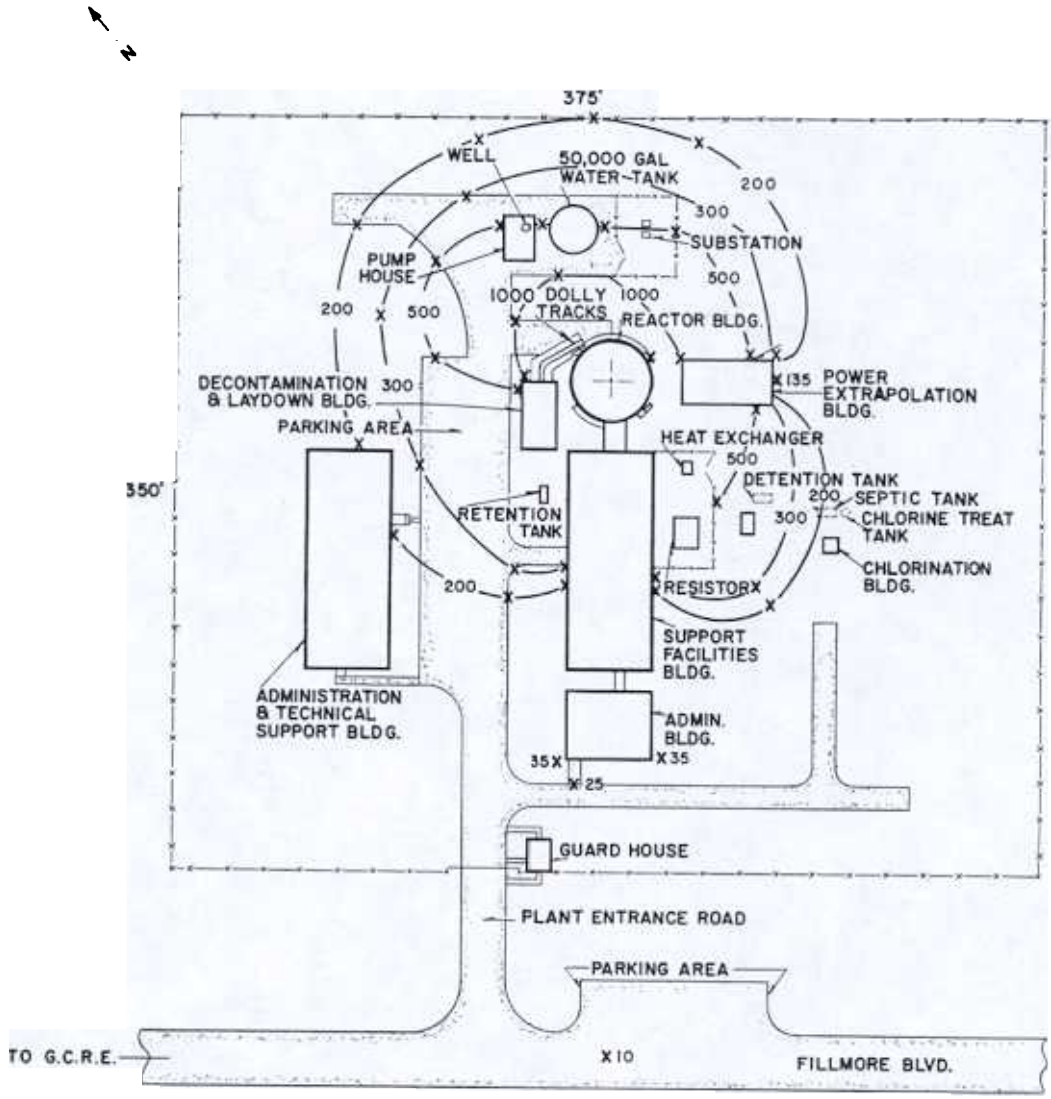
SL-1 SITE RADIATION SURVEY
SURVEYED—JAN. 13, 1961

Fig. 74



SL-I SITE RADIATION SURVEY
SURVEYED JAN 18, 1961

Fig. 75



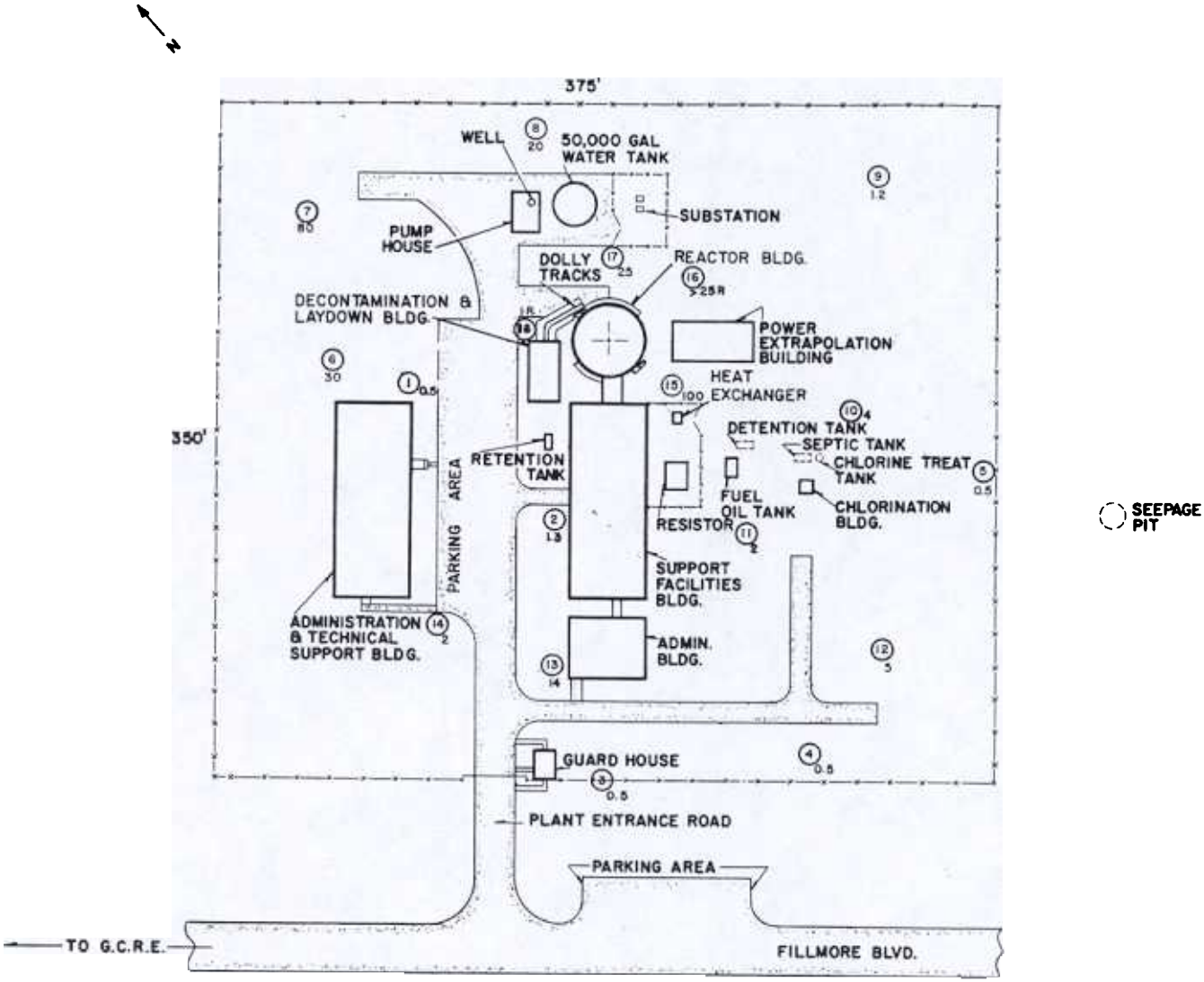
ALL READINGS IN MR/HR
INSTRUMENT— HR JUNO IDO HP 1887

0 10 20 30 40 70 100
SCALE IN FEET

SL-1 SITE ISODOSE PLOT

SURVEYED 6 MARCH 1961

Fig. 76



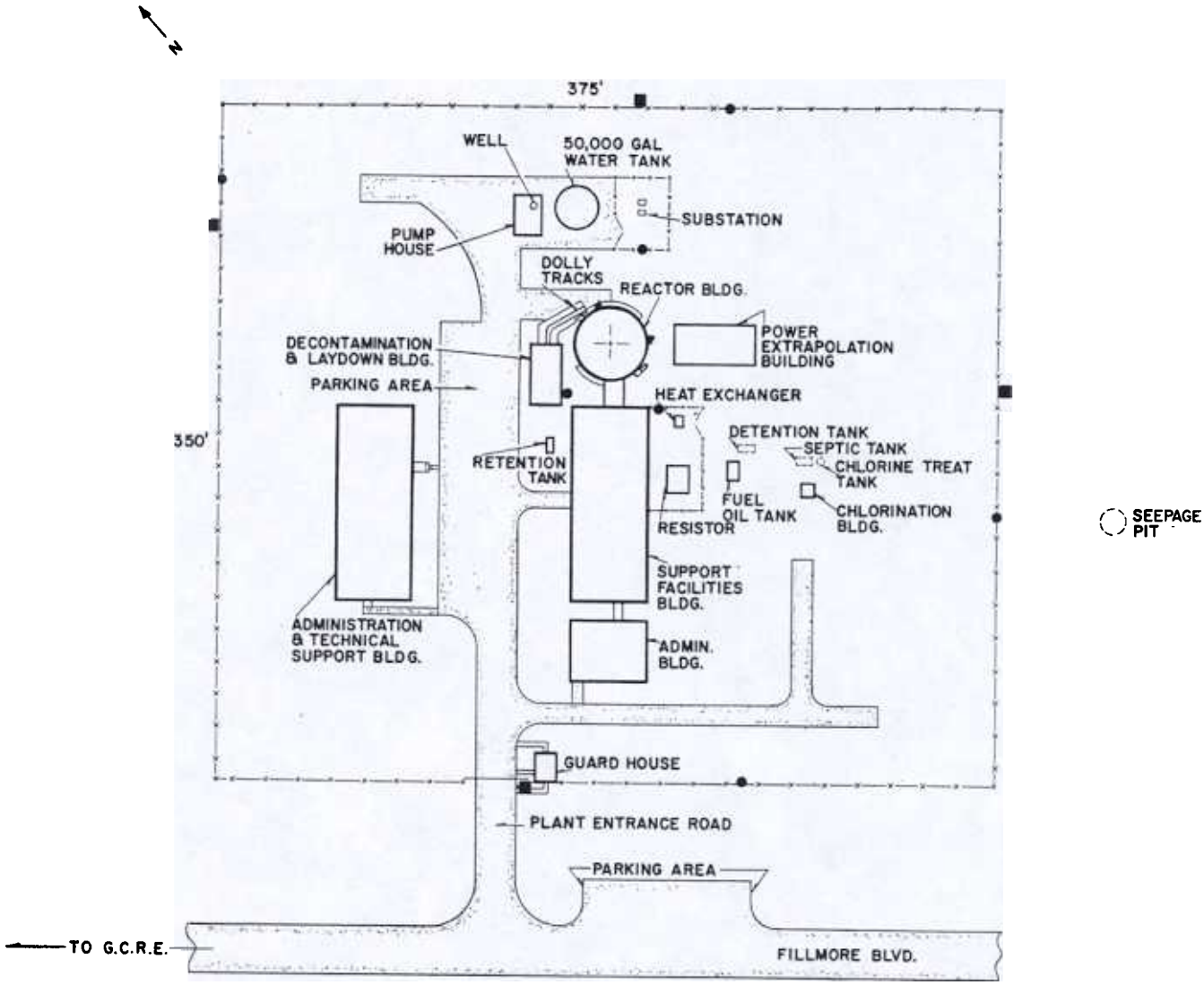
⊗ STATION IDENTIFICATION

UNLESS OTHERWISE INDICATED READINGS IN MREM/HR

SL-1 SITE

SOIL SAMPLE LOCATIONS

Fig. 77



LEGEND:

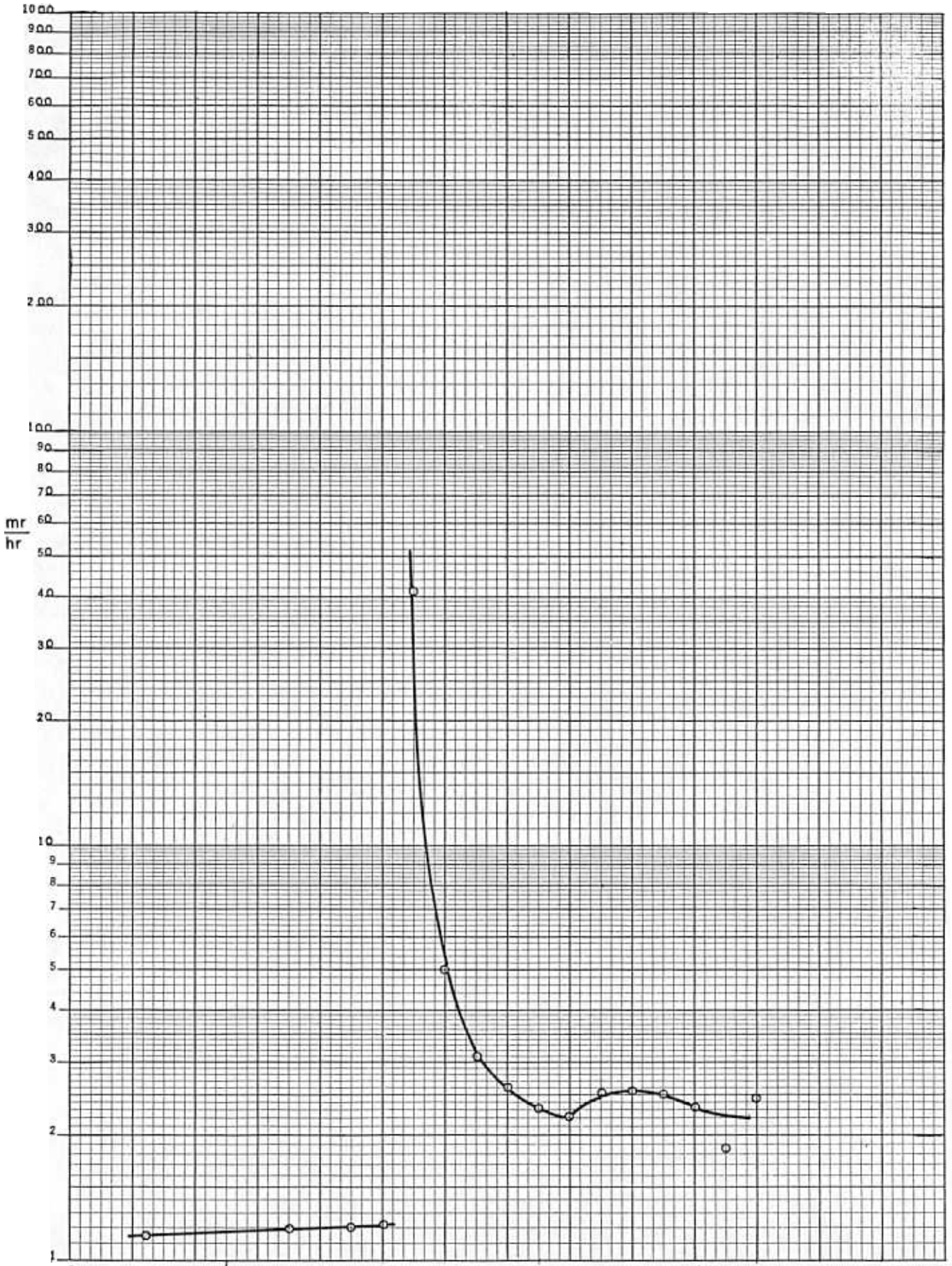
- ● NUCLEAR ACCIDENT DOSIMETERS
- ▲ HURST DOSIMETERS
- ■ AIR SAMPLERS

0 10 20 30 40 70 100
SCALE IN FEET

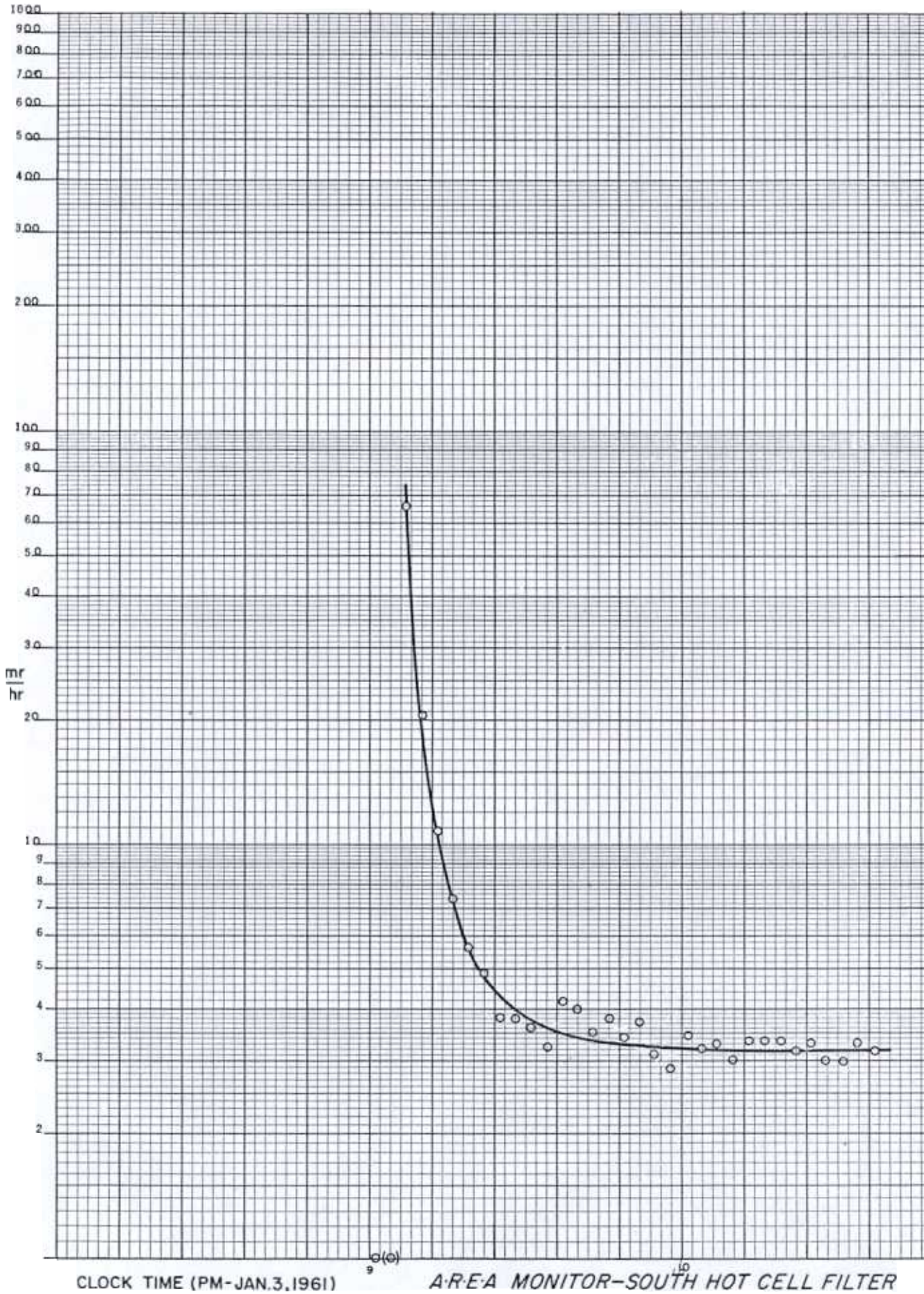
SL-1 SITE

NUCLEAR DOSIMETERS & AIR SAMPLERS

Fig. 78



A·R·E·A MONITOR-WEST WALL-OPERATING CORRIDOR
Fig. 79



A·R·E·A MONITOR–SOUTH HOT CELL FILTER

Fig. 80

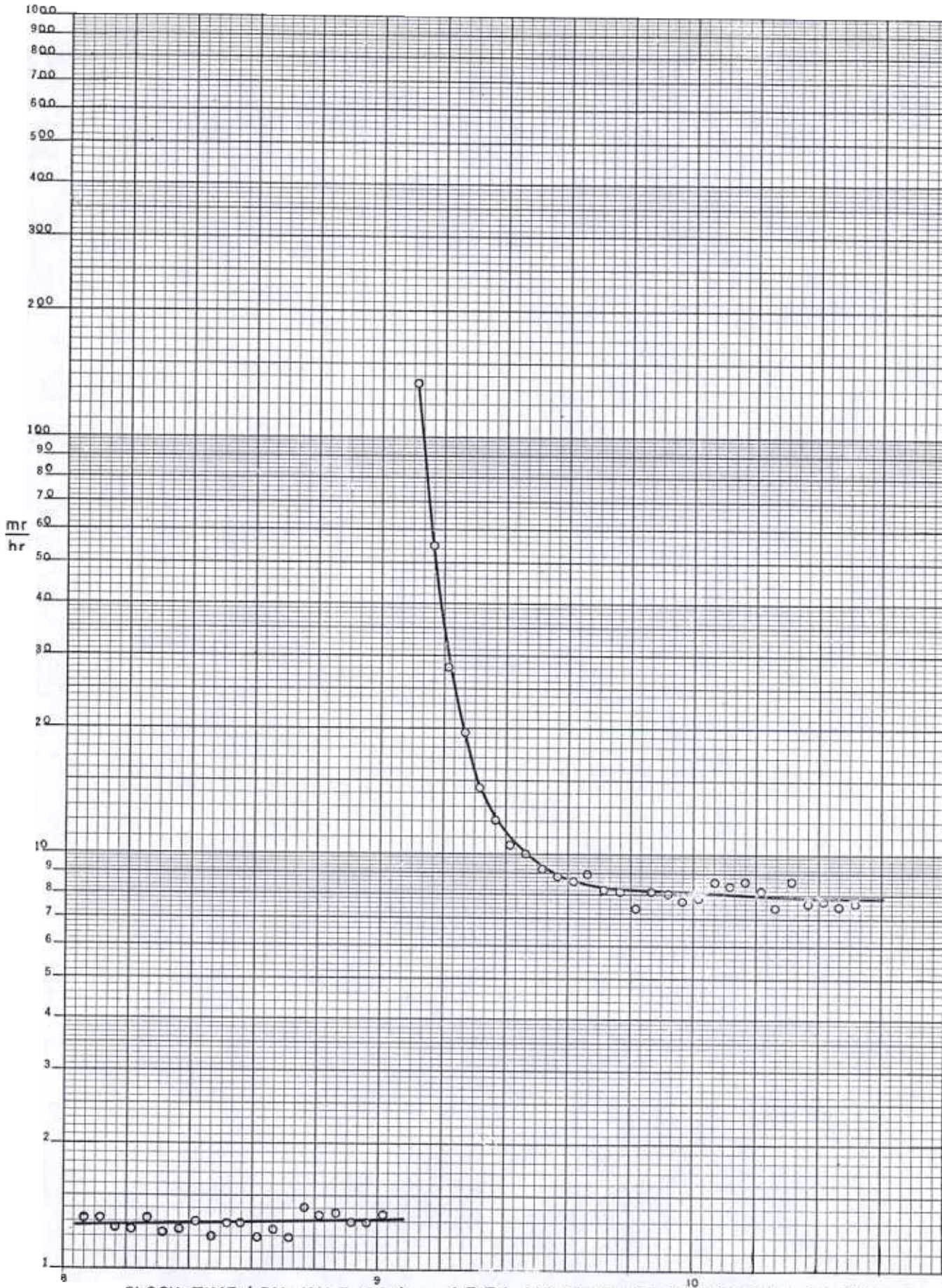
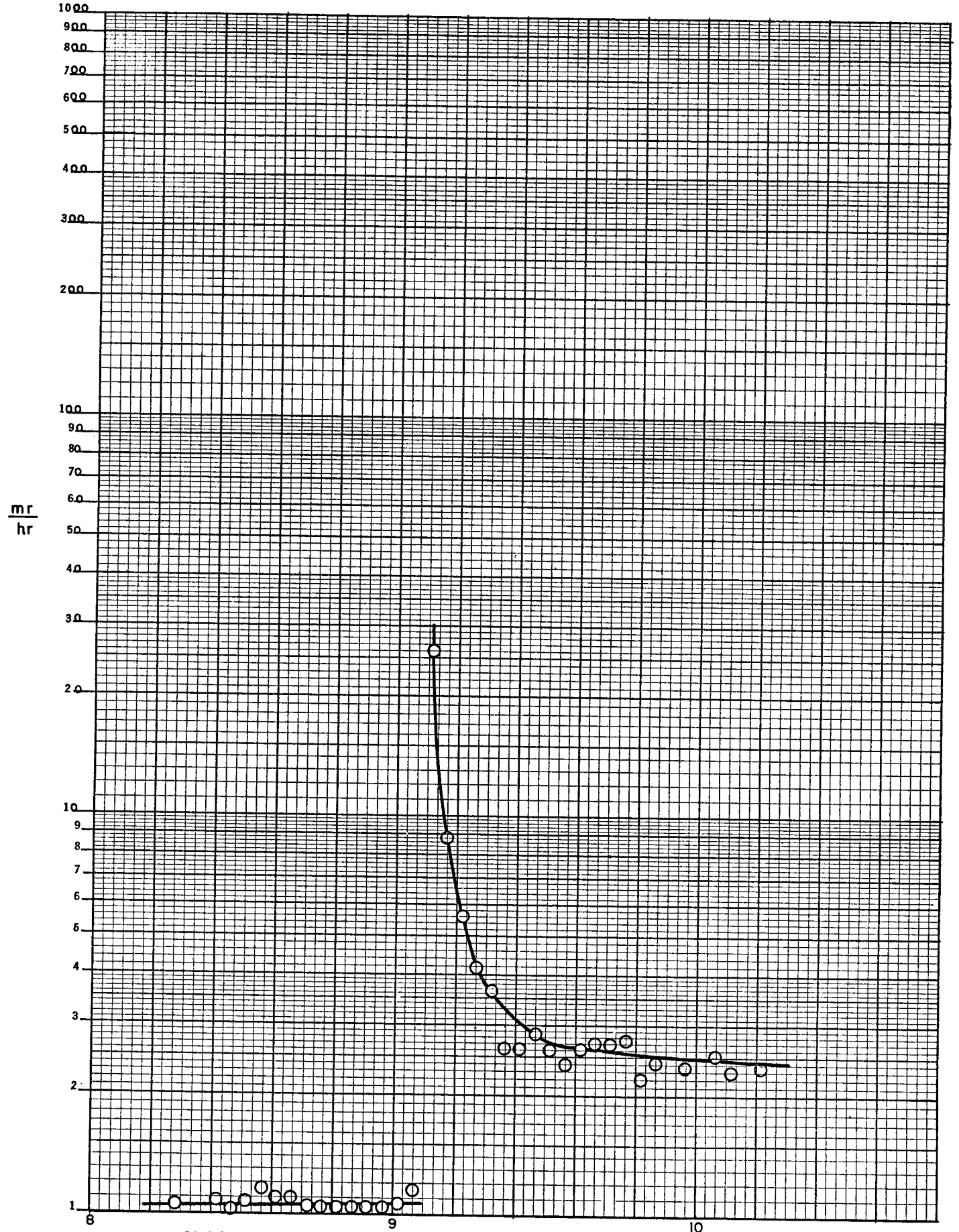
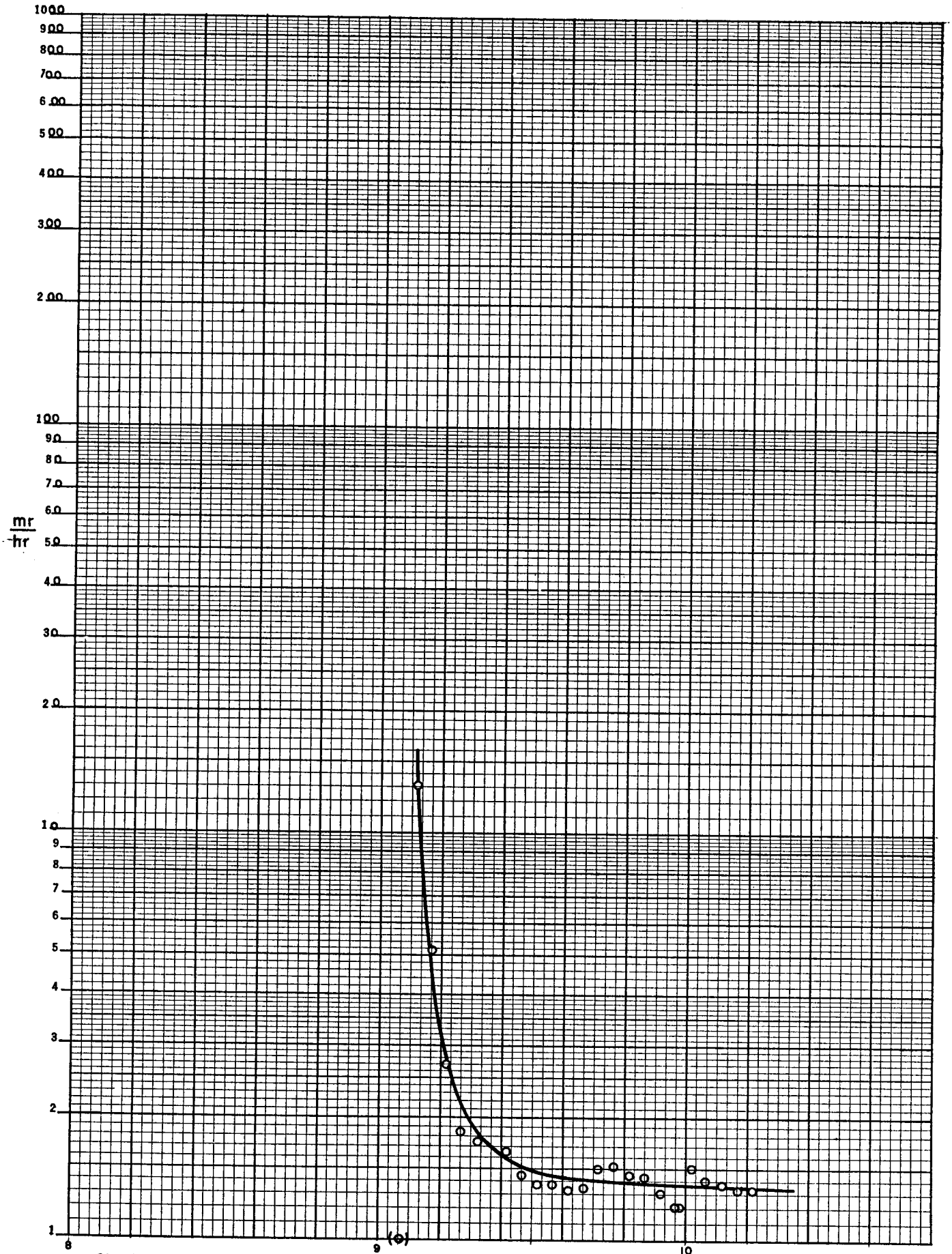

1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
mr
hr
8
9
10
CLOCK TIME (PM- JAN. 3, 1961)
A·R·E·A MONITOR-NORTH HOT CELL FILTER

Fig. 81



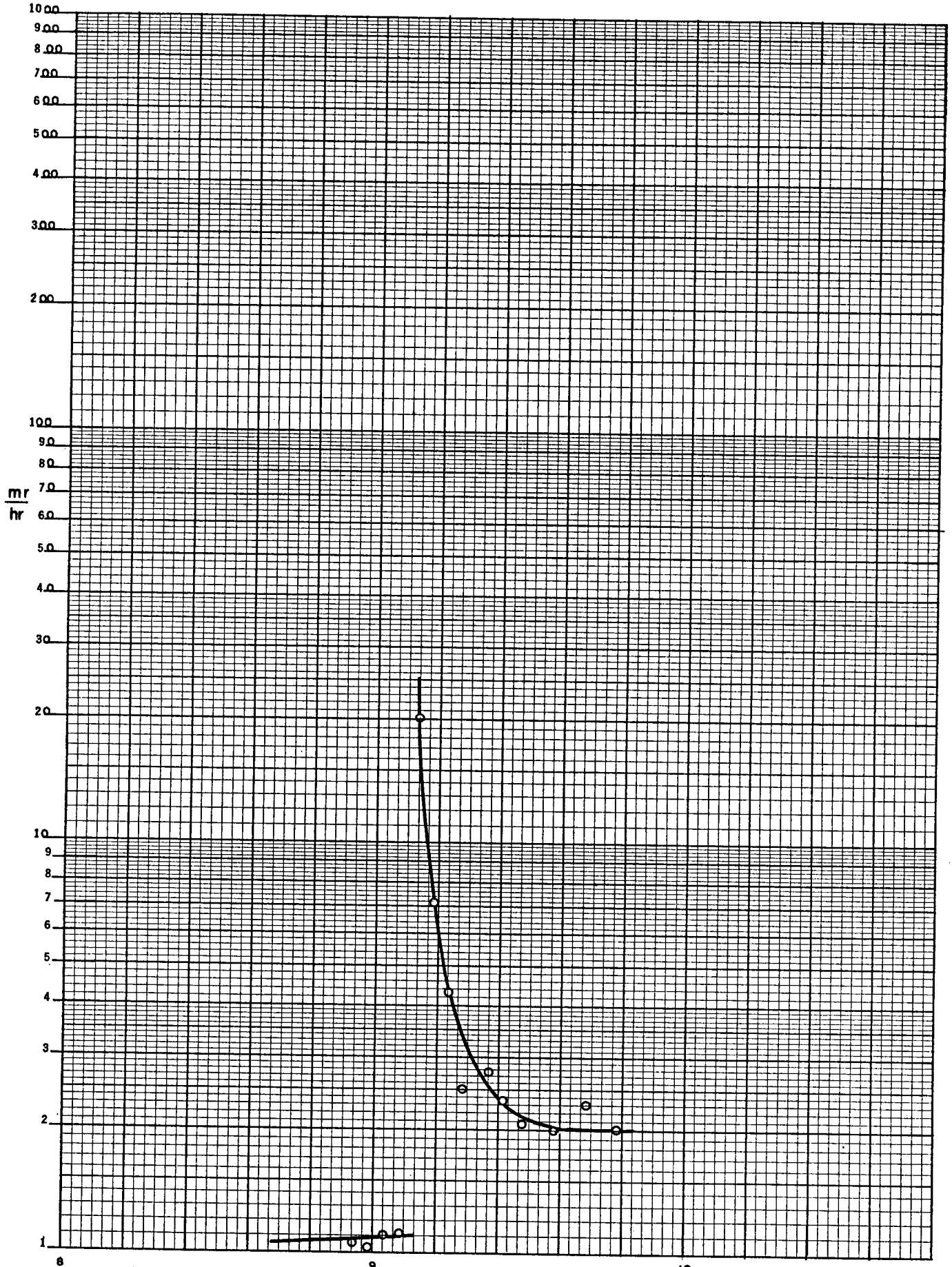
AREA MONITOR—
DECONTAMINATION ROOM

Fig. 82

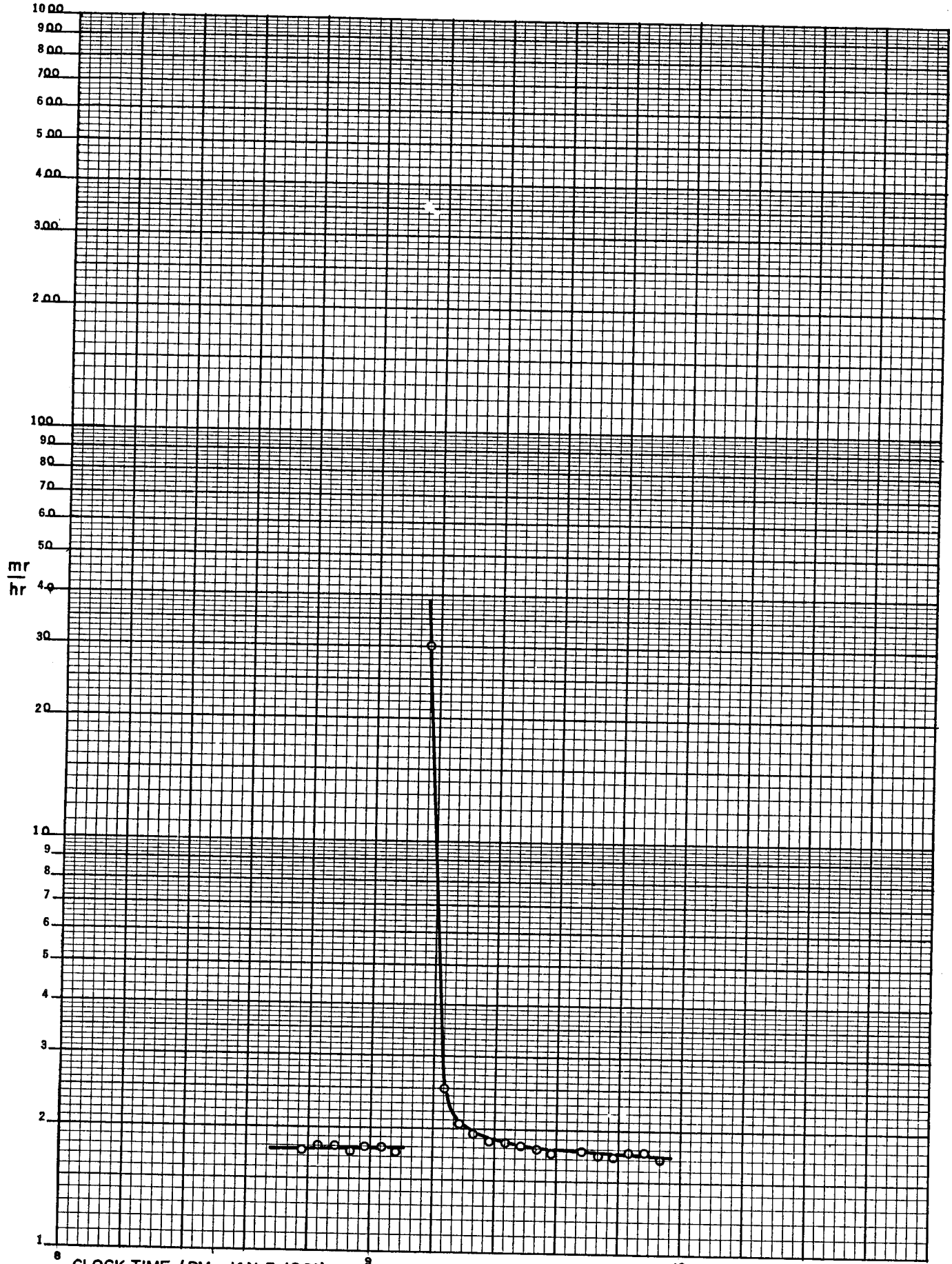


AREA MONITOR- CHEMISTRY LABORATORY

Fig. 83



A·R·E·A MONITOR-SERVICE AREA Fig.84



A·R·E·A STACK MONITOR

Fig. 85

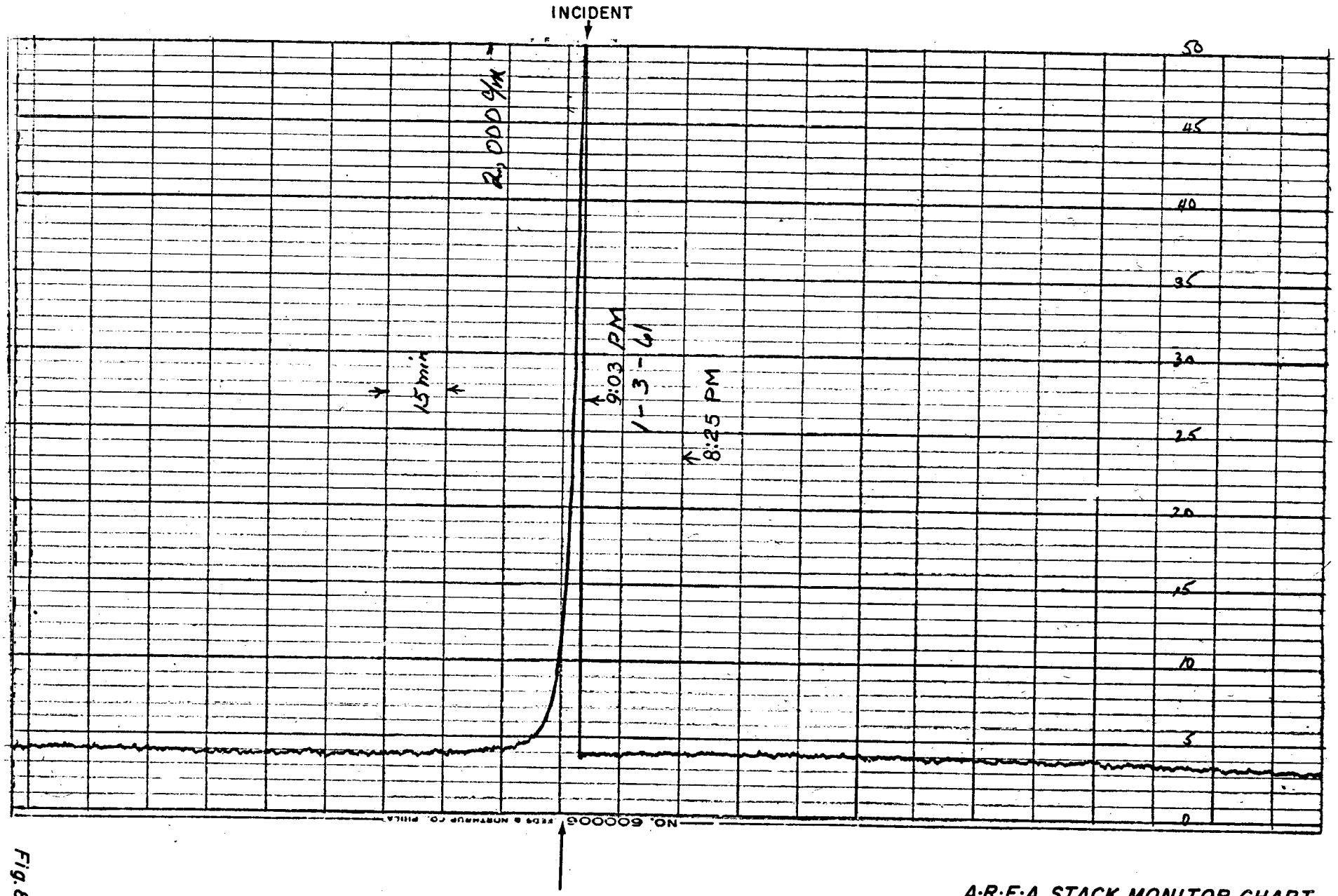


Fig. 86

A·R·E·A STACK MONITOR CHART
Fig. 86

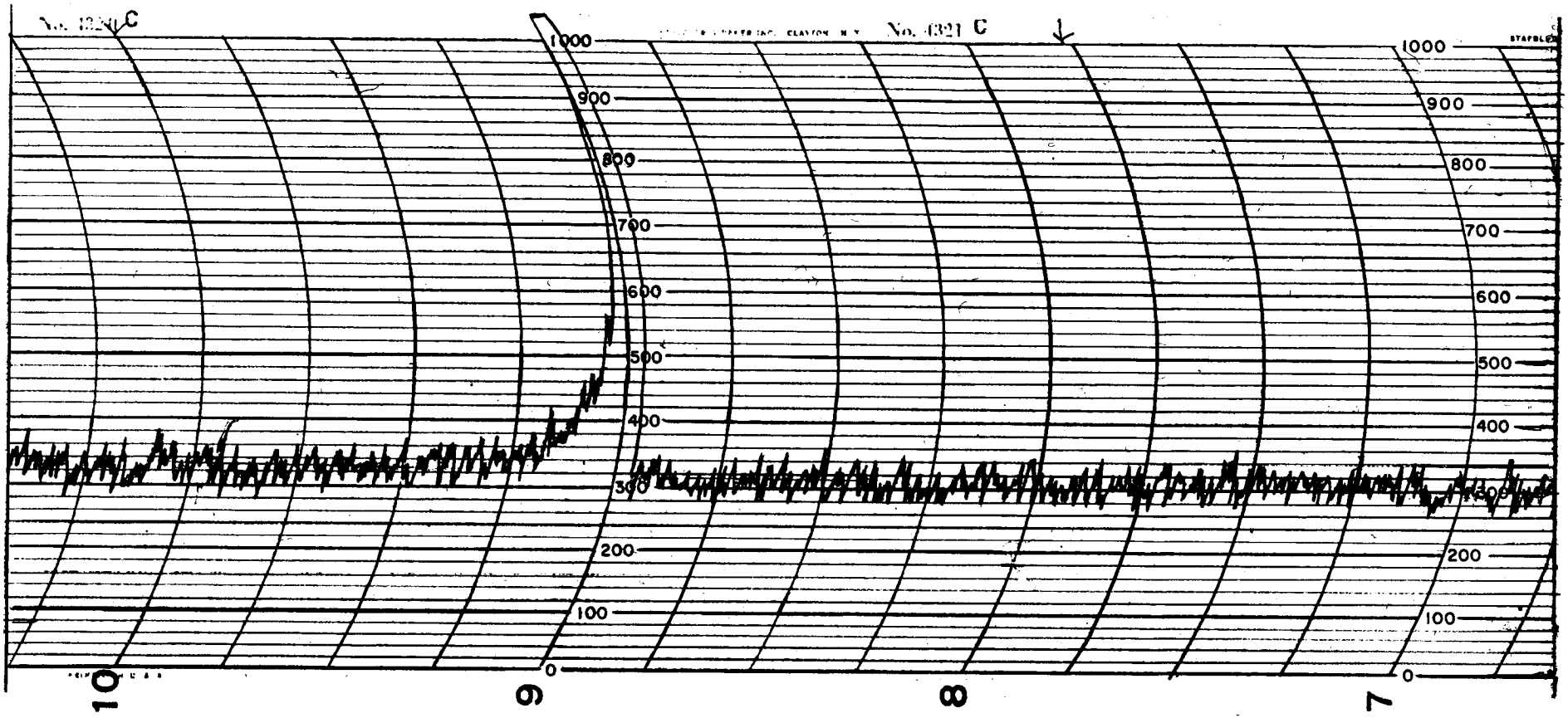


Fig. 87

A·R·E·A CONSTANT AIR MONITOR CHART
Fig. 87

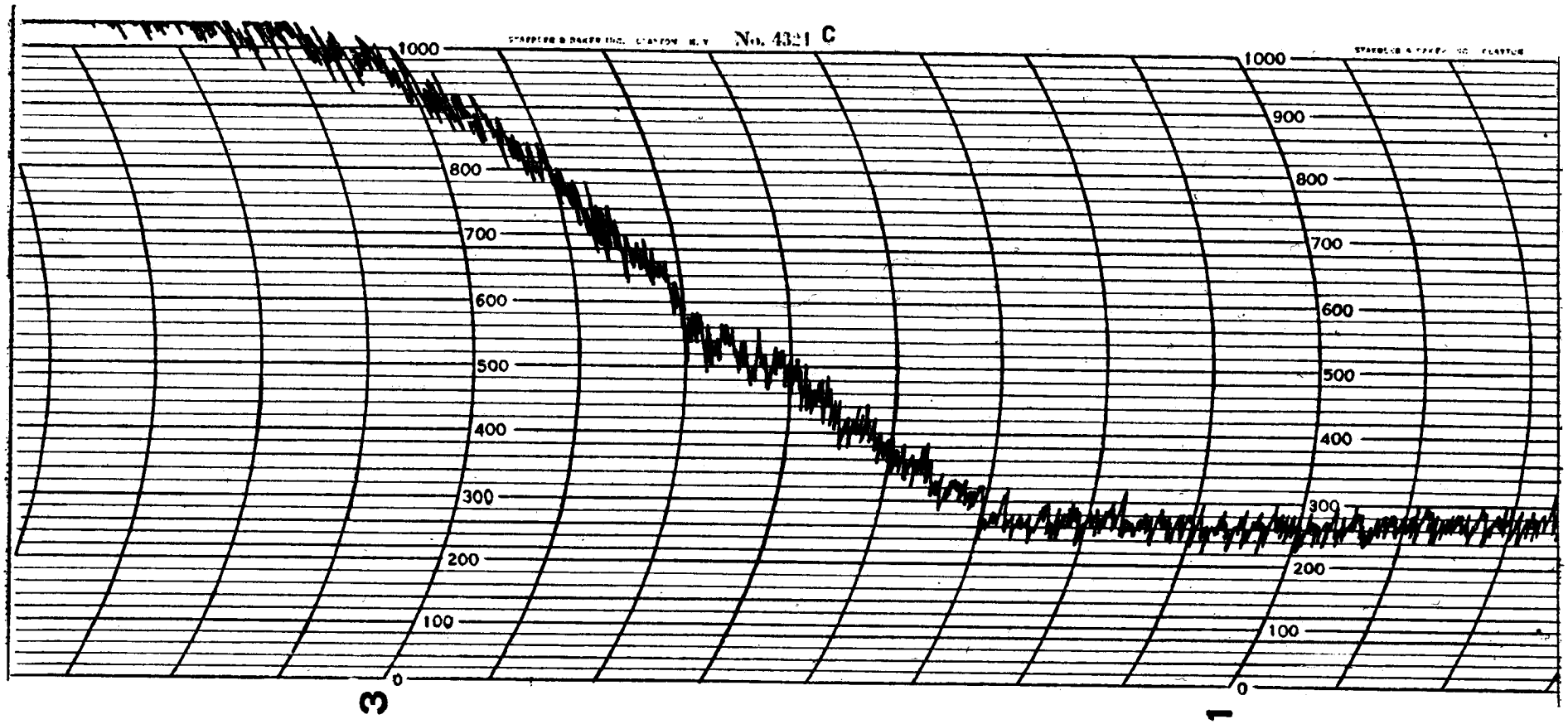
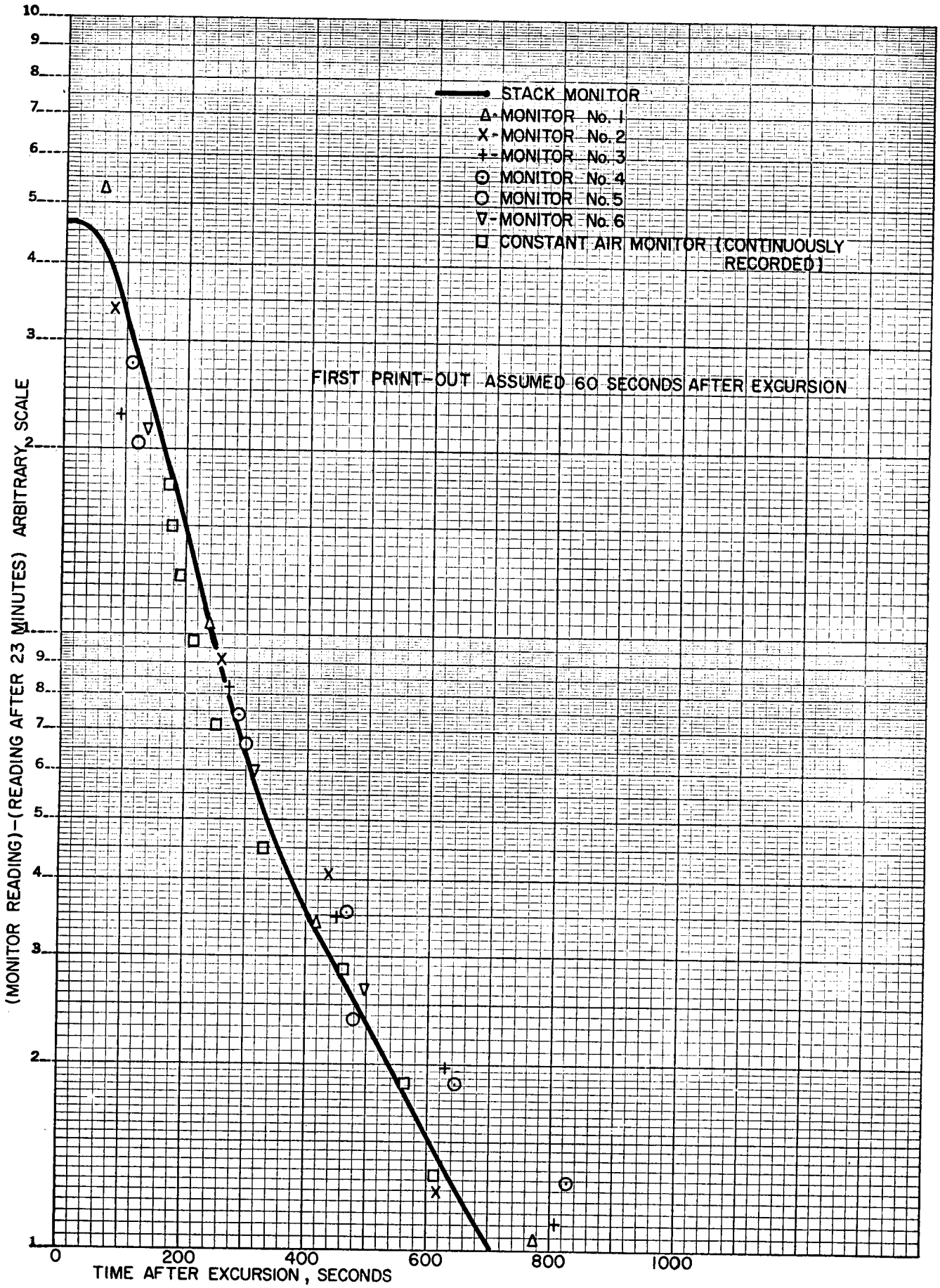


Fig. 88

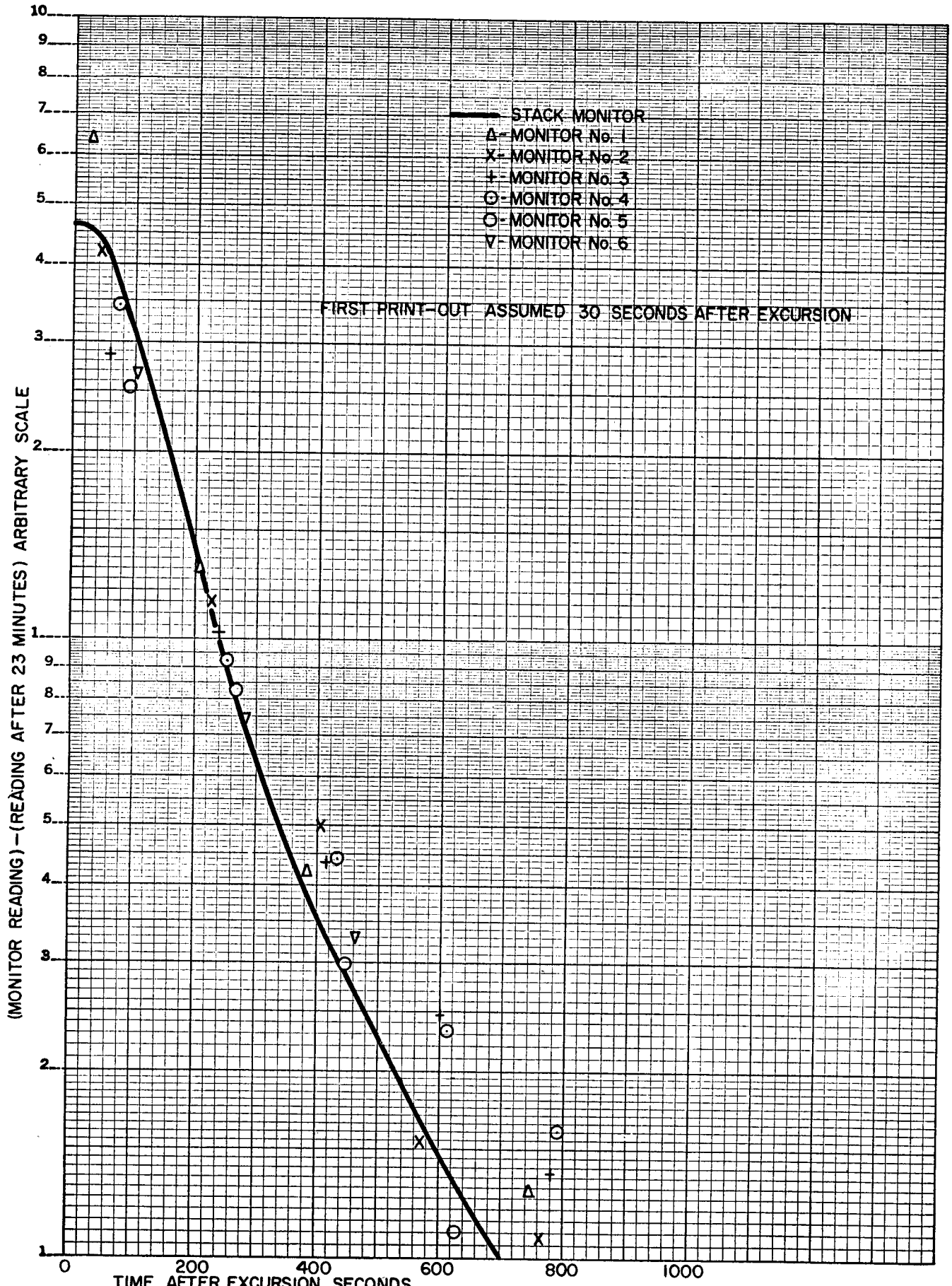
ACCUMULATION OF FISSION PRODUCTS
ON A·R·E·A CAM FILTER

Fig. 88



COMPARISON OF DECAY CURVES OF A·R·E·A MONITORS STARTING 60 SECONDS AFTER EXCURSION

Fig. 89



COMPARISON OF DECAY CURVES OF A·R·E·A MONITORS STARTING 30 SECONDS AFTER EXCURSION

Fig. 90

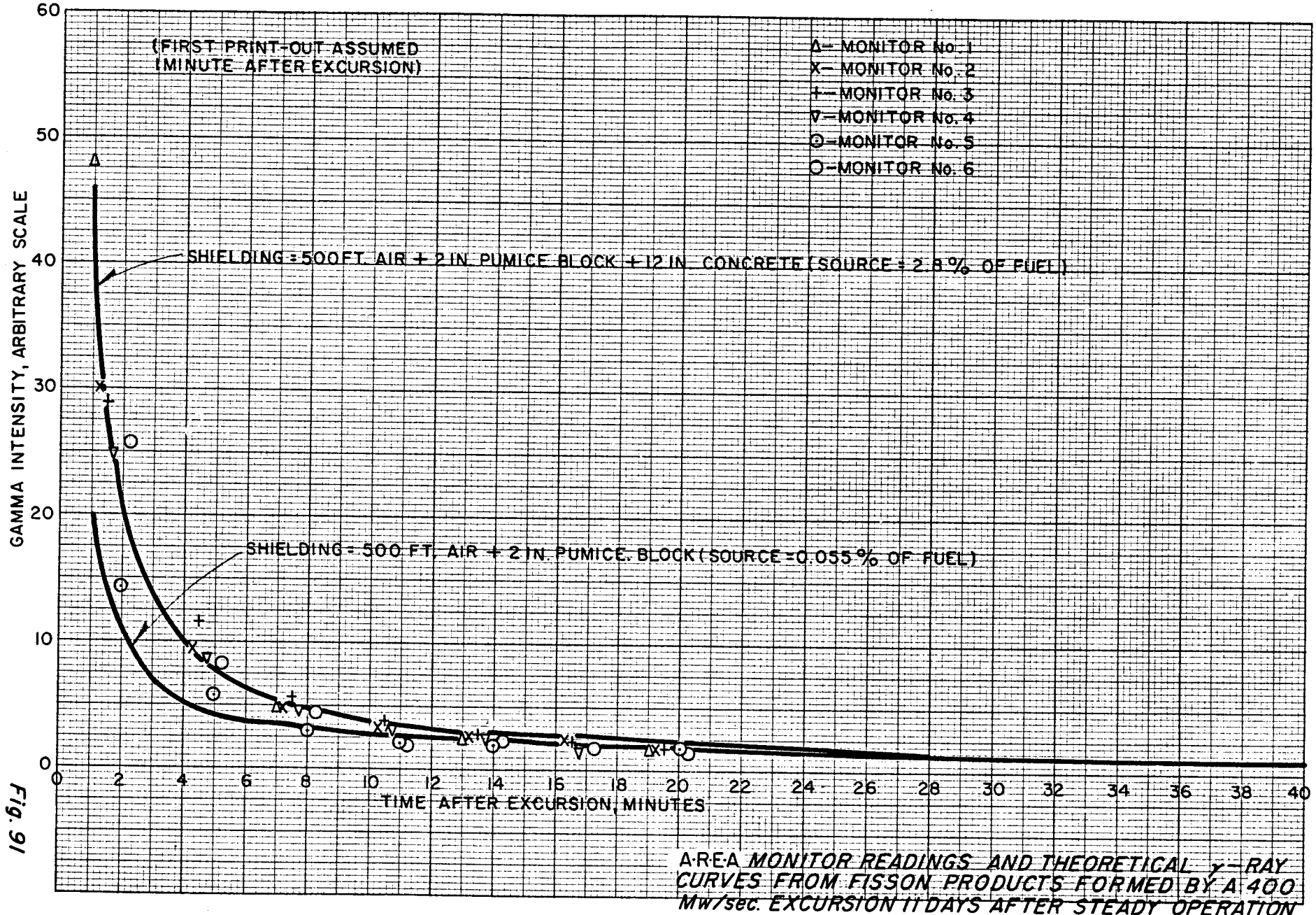


Fig. 91

AREA MONITOR READINGS AND THEORETICAL γ-RAY CURVES FROM FISSON PRODUCTS FORMED BY A 400 Mw/sec. EXCURSION 11 DAYS AFTER STEADY OPERATION AT 2.25 Mw

Fig. 91

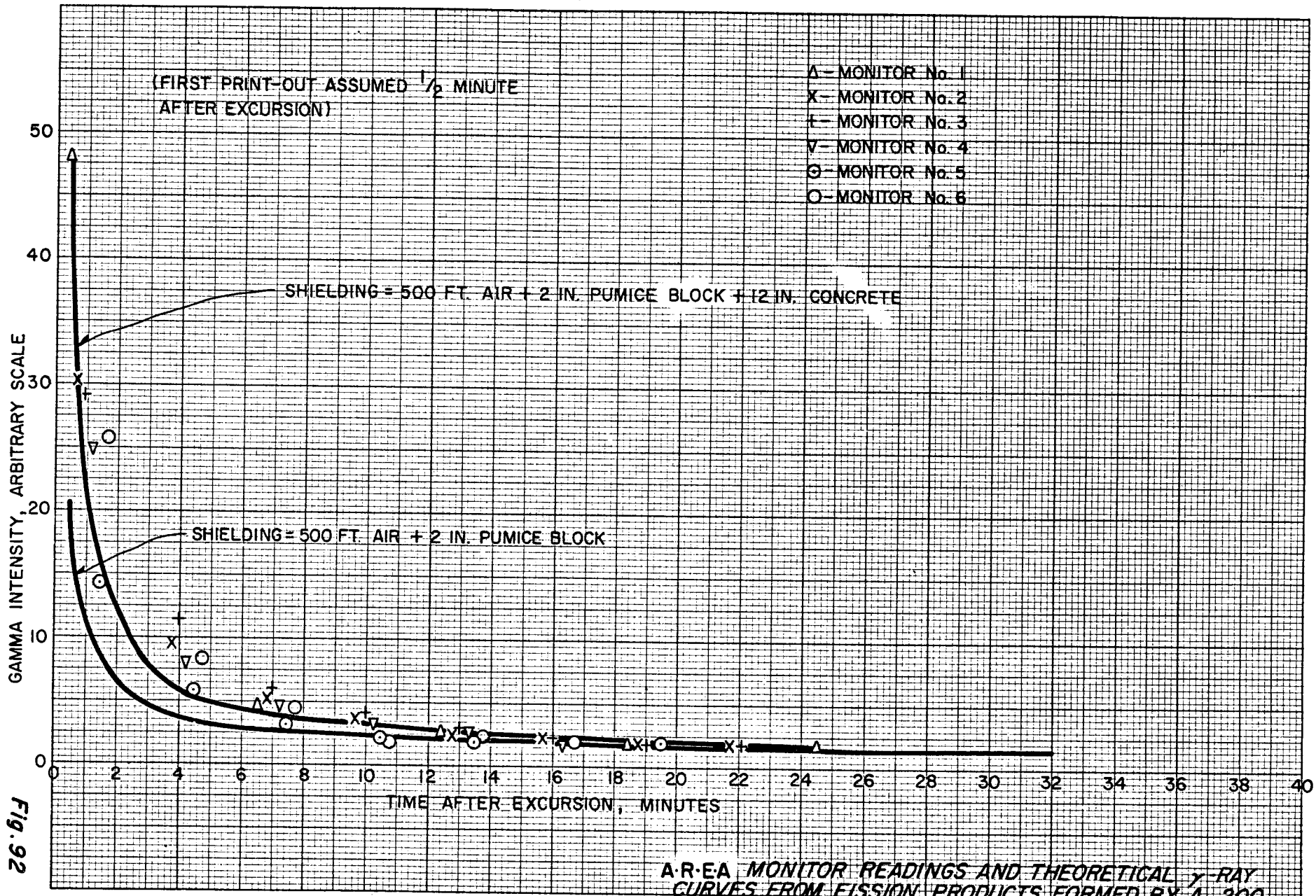
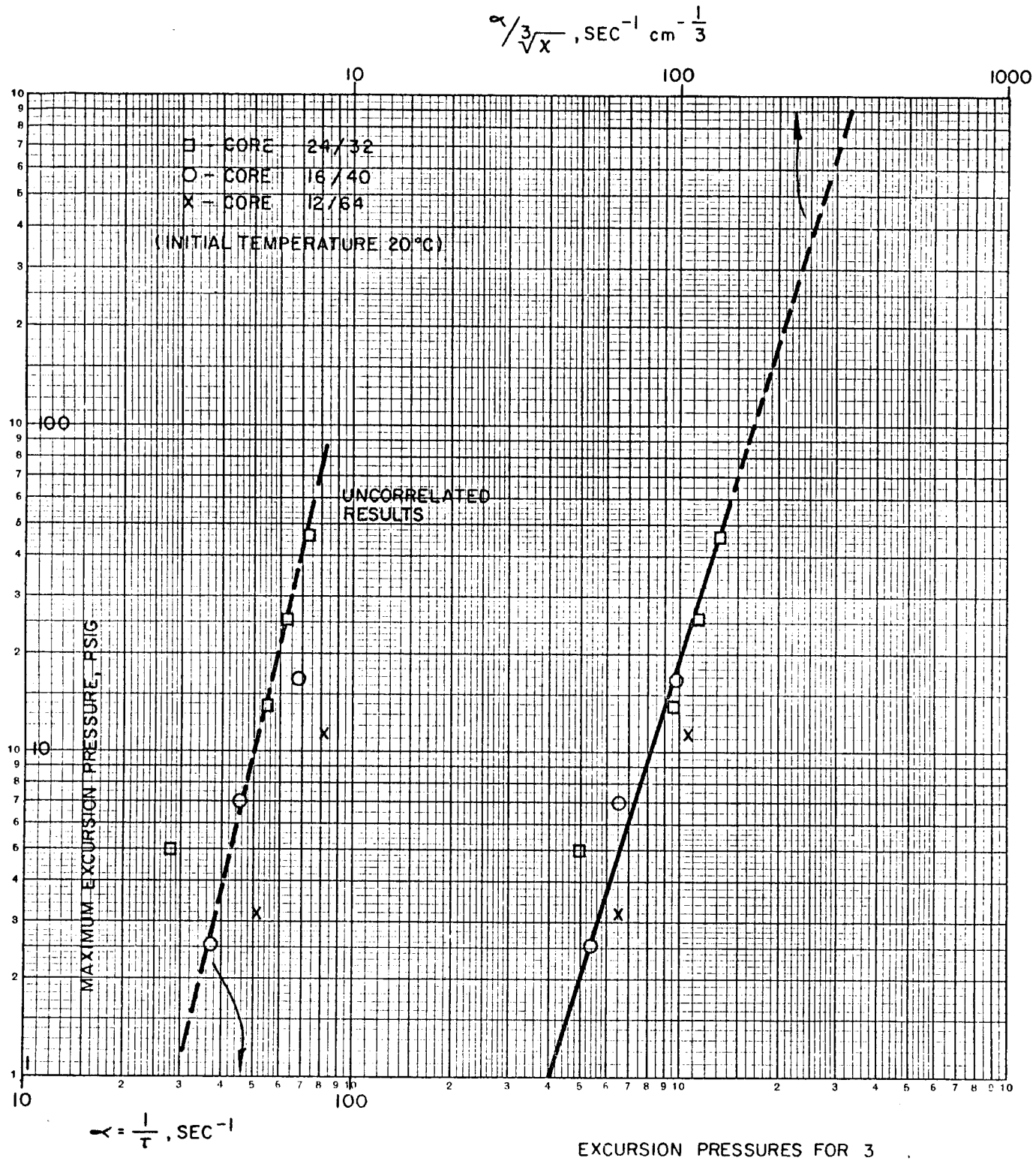


Fig. 92

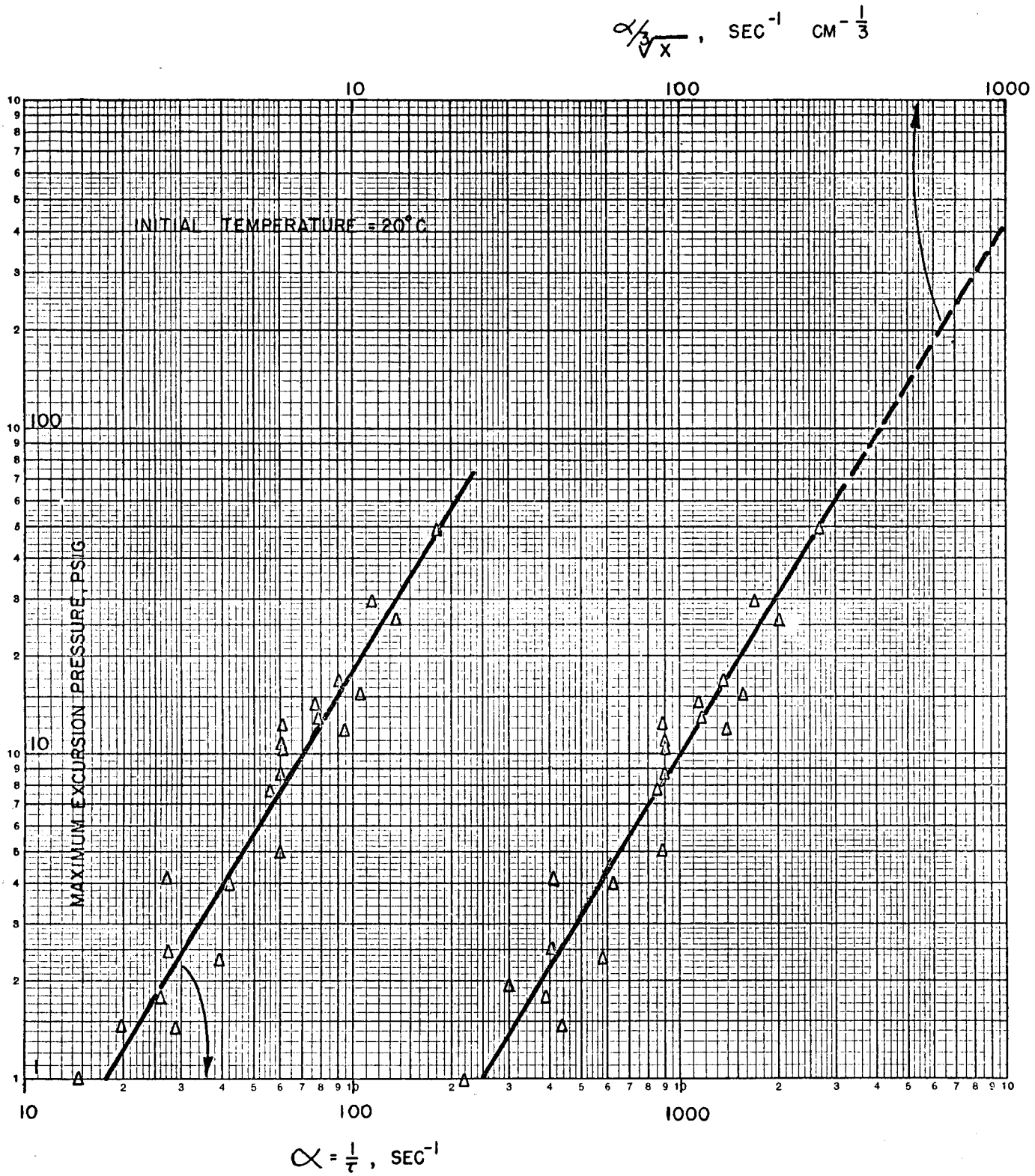
A·R·E·A MONITOR READINGS AND THEORETICAL γ-RAY CURVES FROM FISSION PRODUCTS FORMED BY A 200 Mw/sec. EXCURSION 11 DAYS AFTER STEADY OPERATION AT 2.25 Mw

Fig. 92



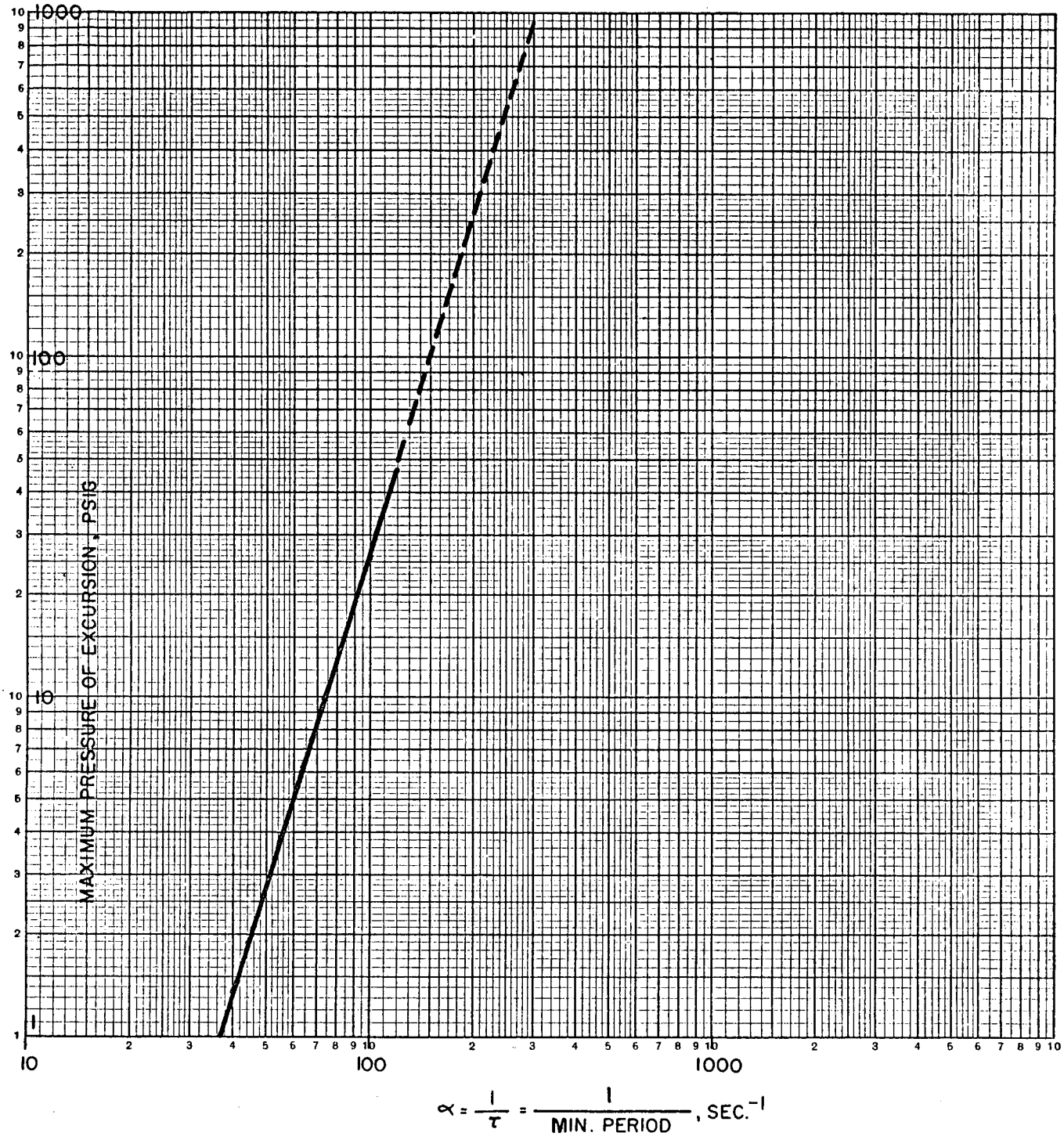
EXCURSION PRESSURES FOR 3 SPERT CORES

Fig. 93



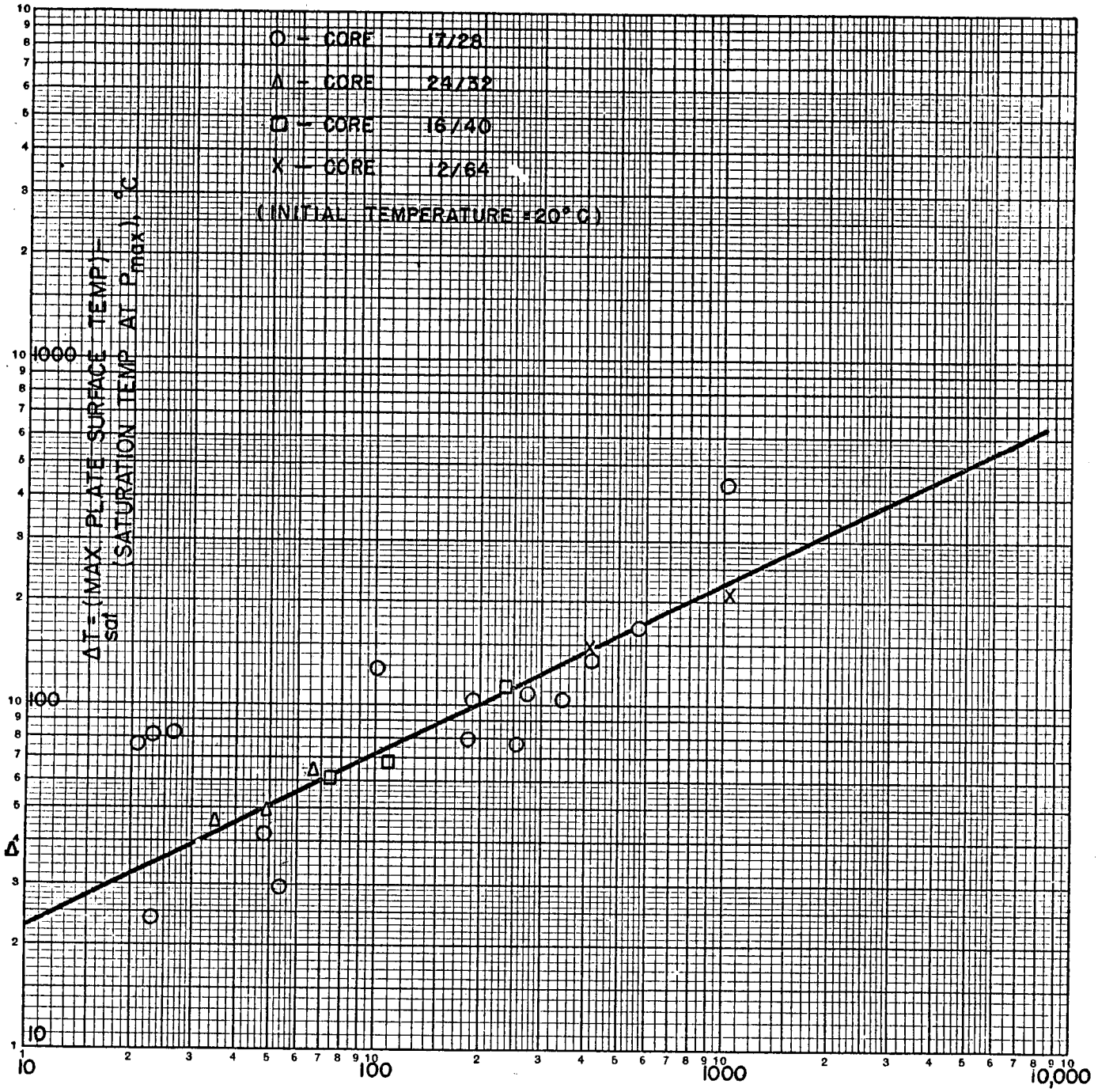
EXCURSION PRESSURES FOR
SPERT CORE 17/28

Fig. 94



MAXIMUM EXCURSION PRESSURE IN SL-1 AS INFERRED FROM SPERT CORRELATION, NOT VALID WHEN PLATES MELT

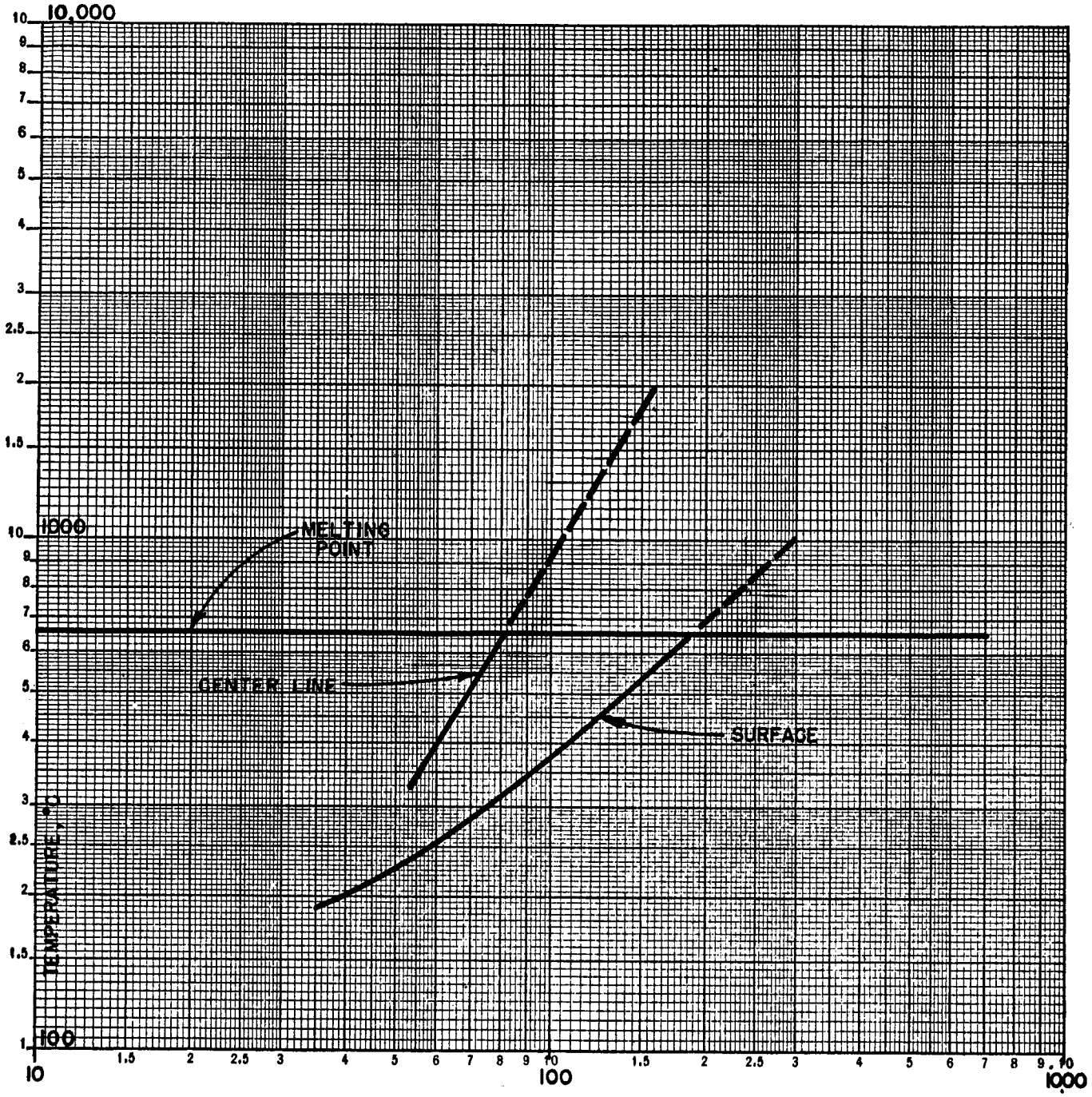
Fig. 95



$$\frac{\alpha^2 \ell}{C_v NB}, \text{ (cm}^3\text{/sec) PER FUEL PLATE}$$

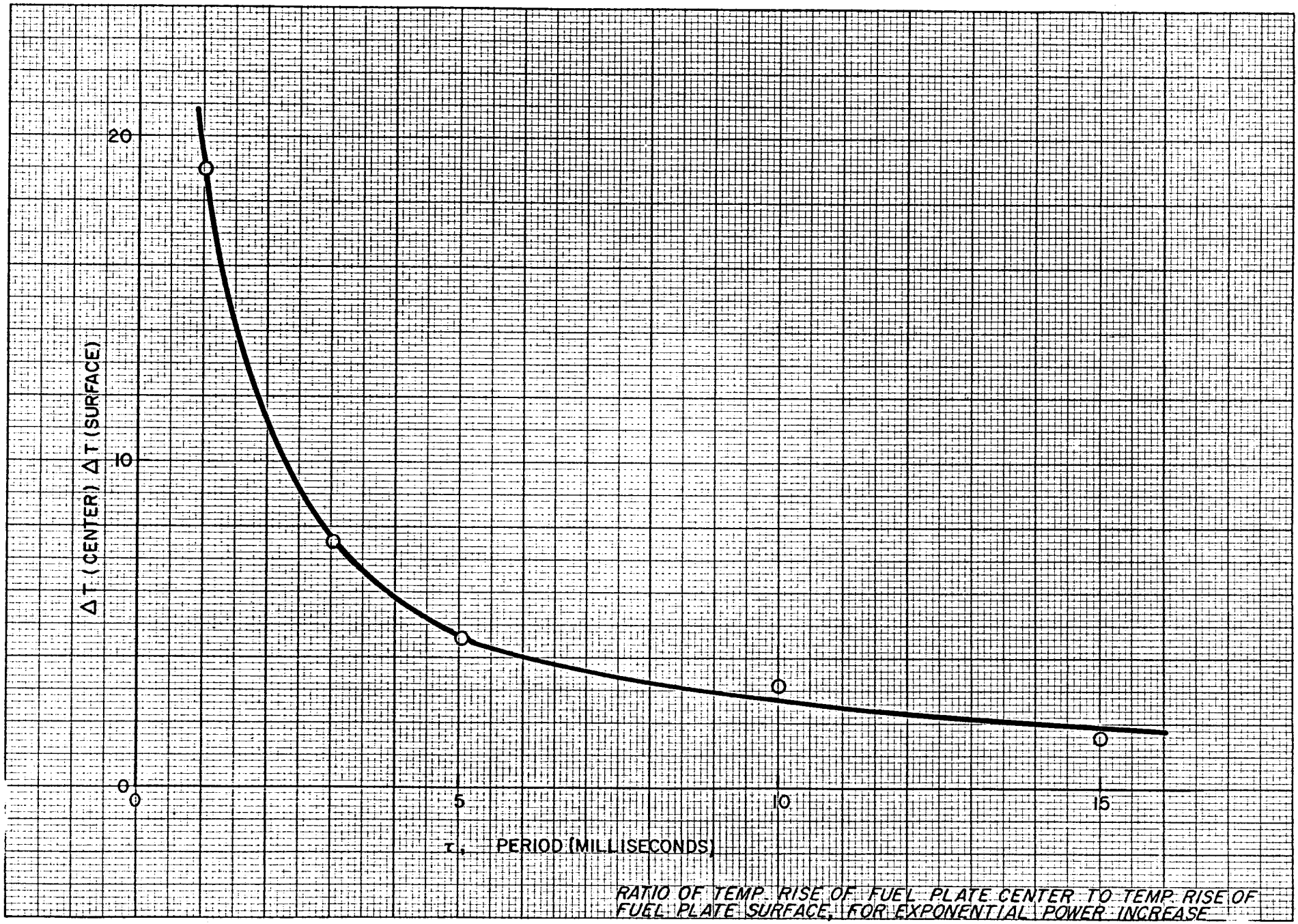
FUEL PLATE SURFACE TEMPERATURE RELATION FOR 4 DIFFERENT SPERT CORES

Fig. 96



ESTIMATED MAXIMUM FUEL PLATE TEMPERATURES FOR SL-1

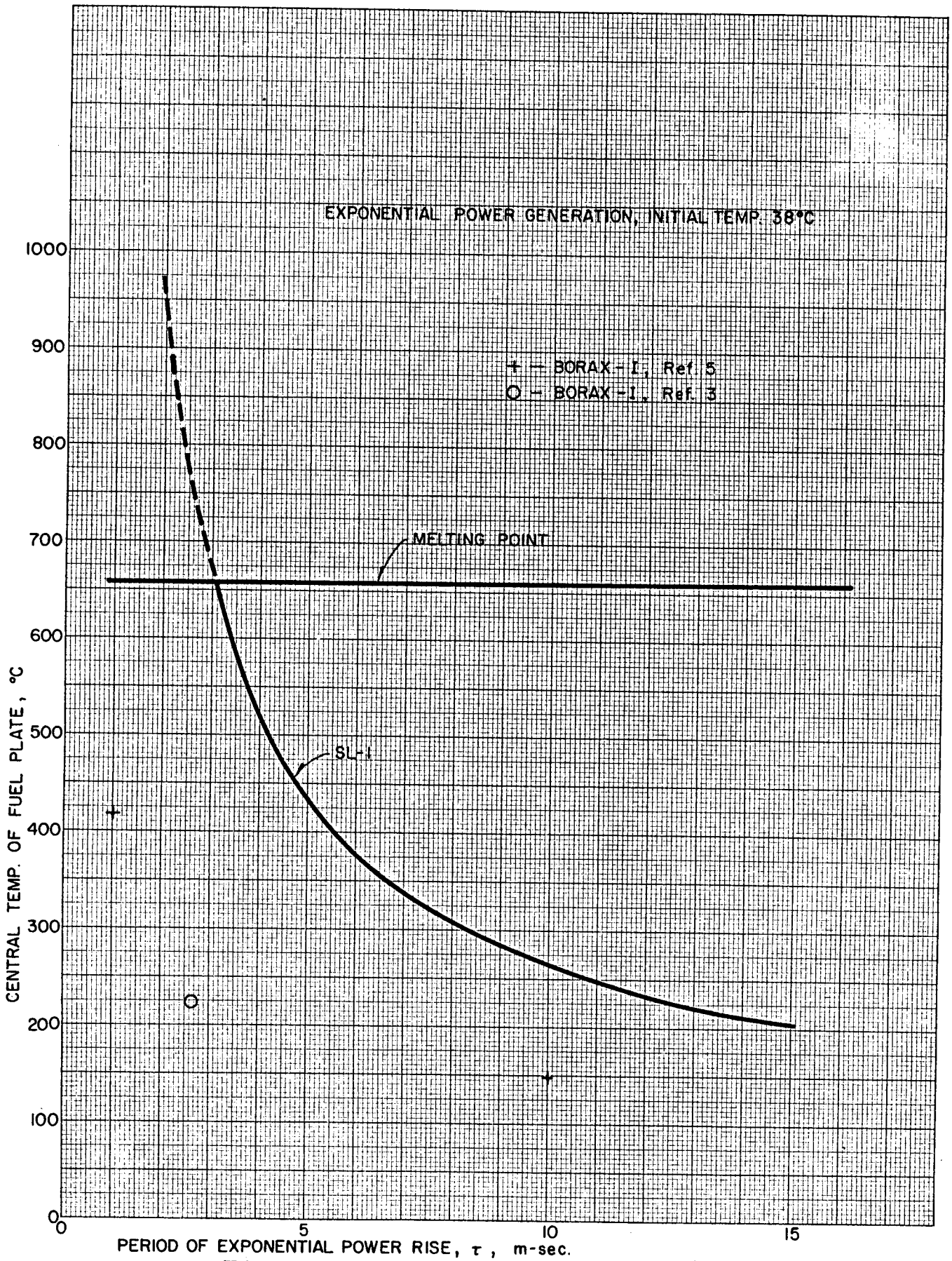
Fig. 97



RATIO OF TEMP. RISE OF FUEL PLATE CENTER TO TEMP. RISE OF FUEL PLATE SURFACE, FOR EXPONENTIAL POWER INCREASE

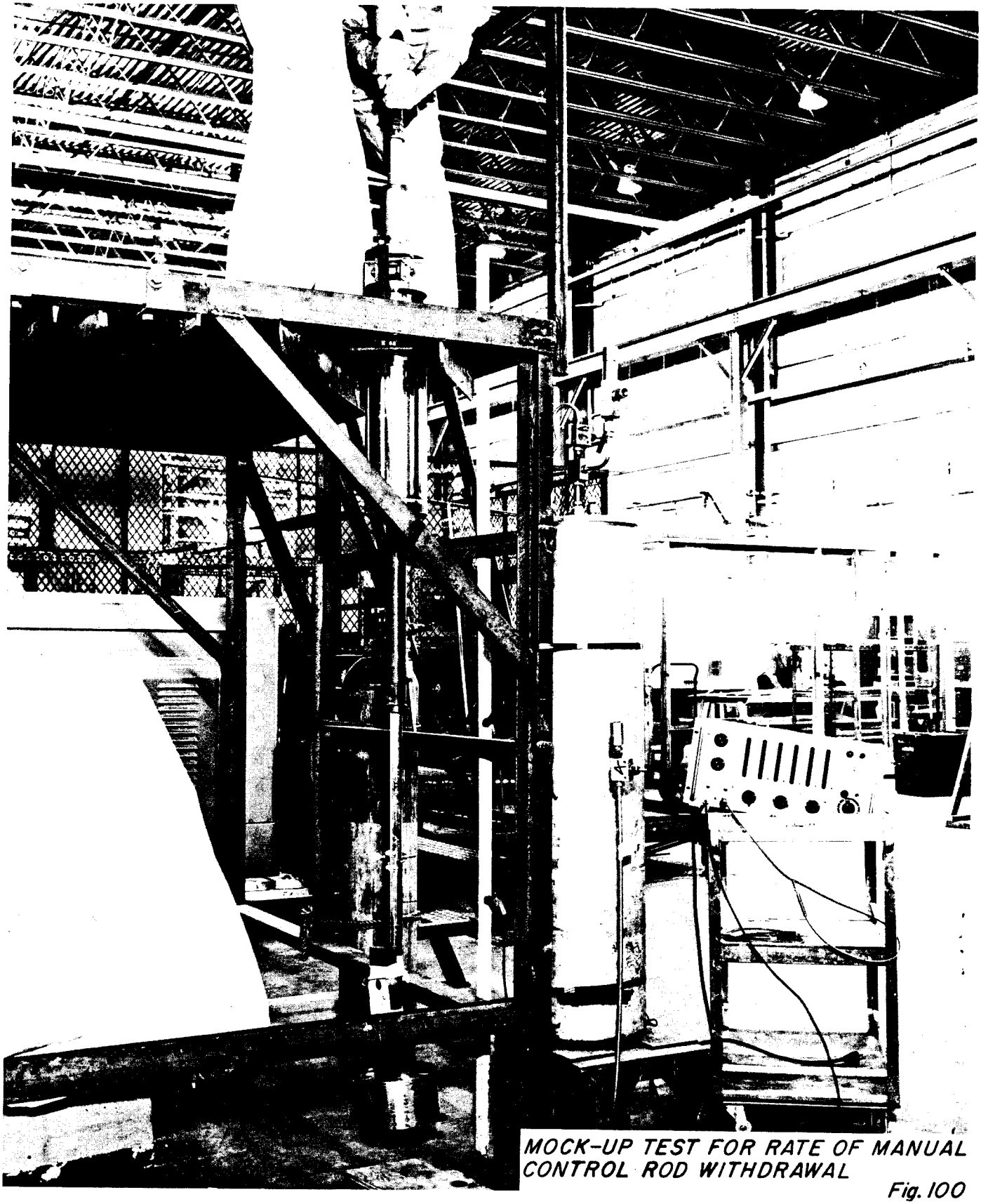
Fig. 98

Fig. 98



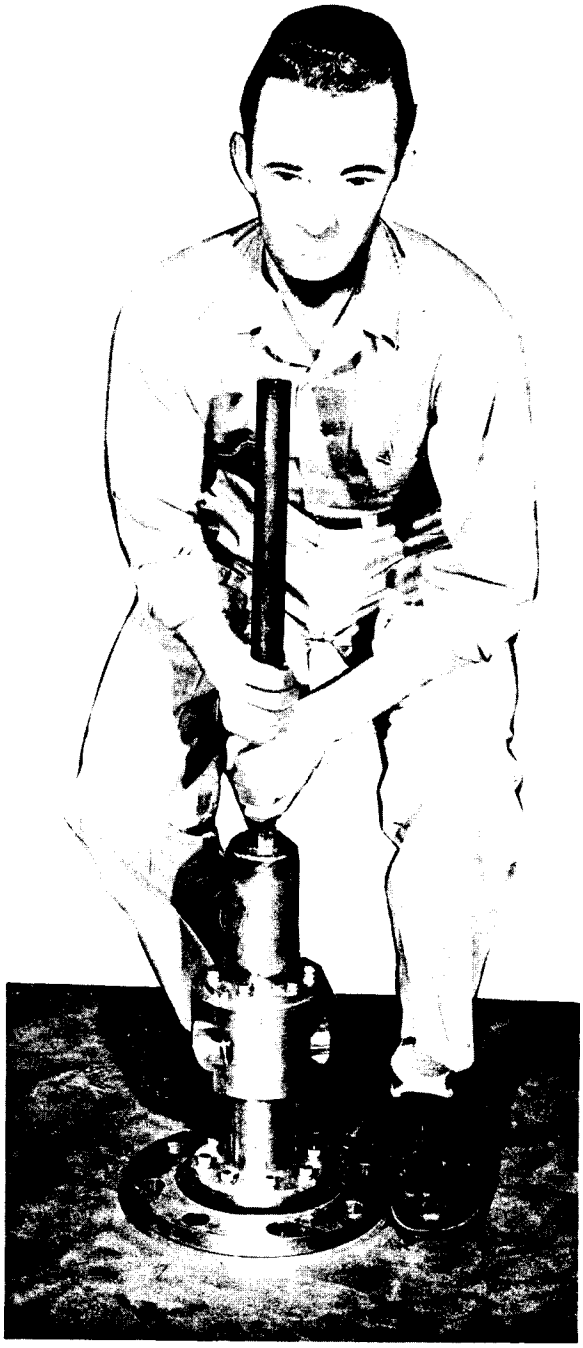
TEMP. AT CENTER OF FUEL PLATE WHEN SURFACE TEMP. REACHES 121°C

Fig. 99

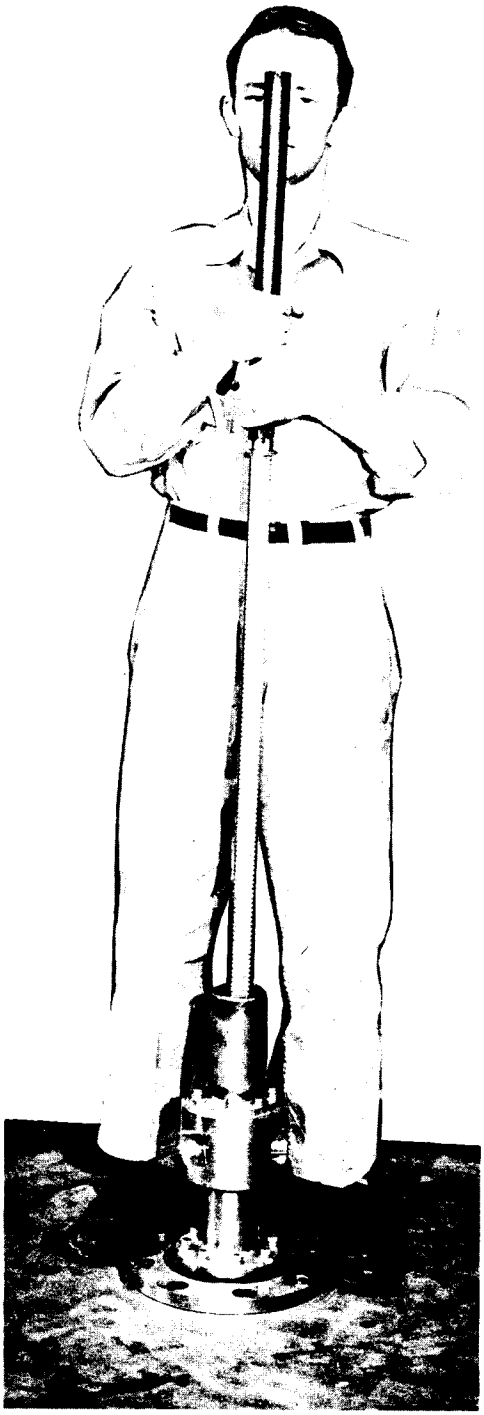


MOCK-UP TEST FOR RATE OF MANUAL CONTROL ROD WITHDRAWAL

Fig. 100



POSITION OF MECHANIC PREPARING TO LIFT SL-I CONTROL ROD



POSITION OF MECHANIC AFTER LIFTING CONTROL ROD 30 INCHES

CONTROL ROD LIFTING TESTS ON MOCKUP

Fig. 101

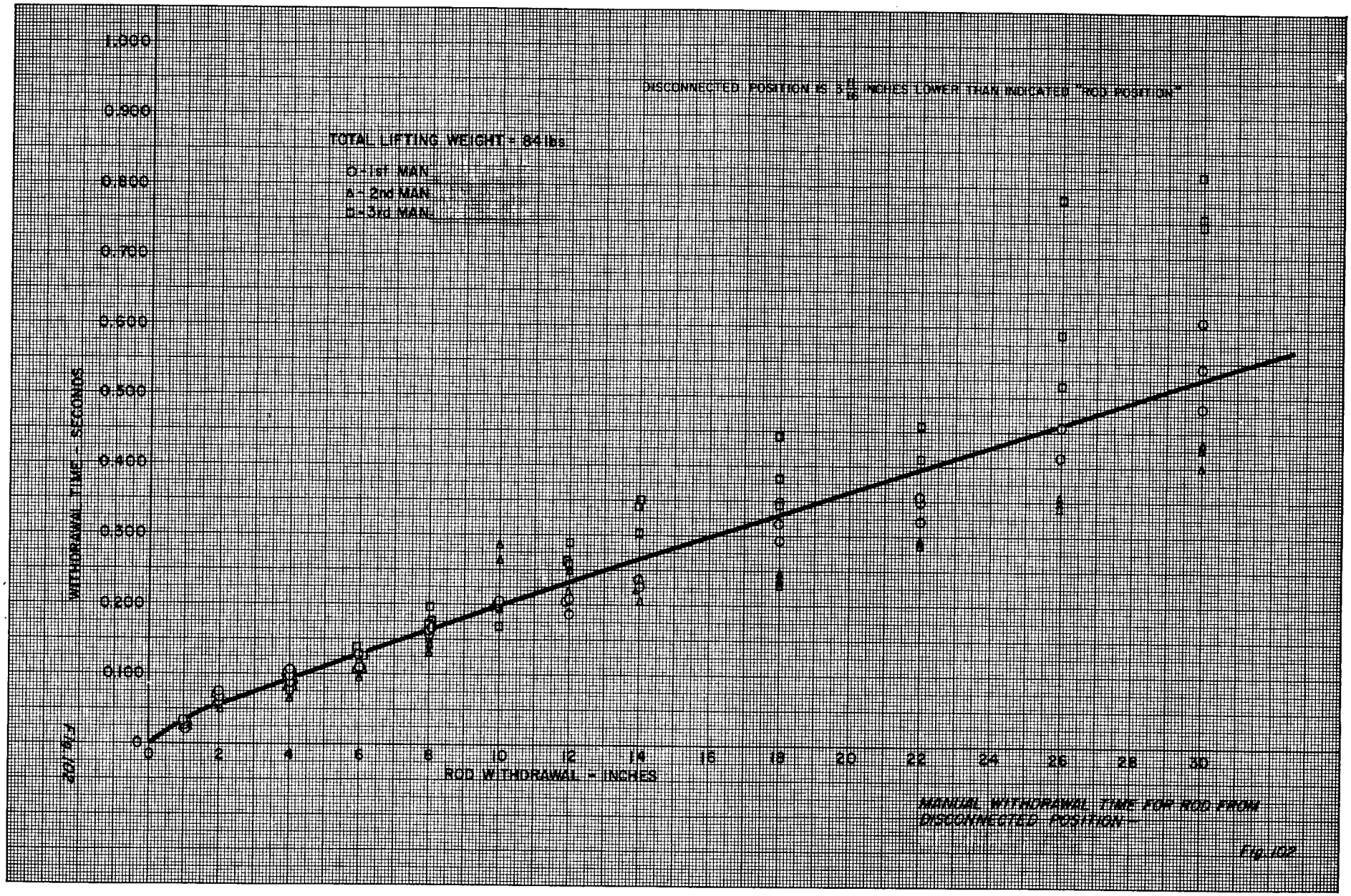
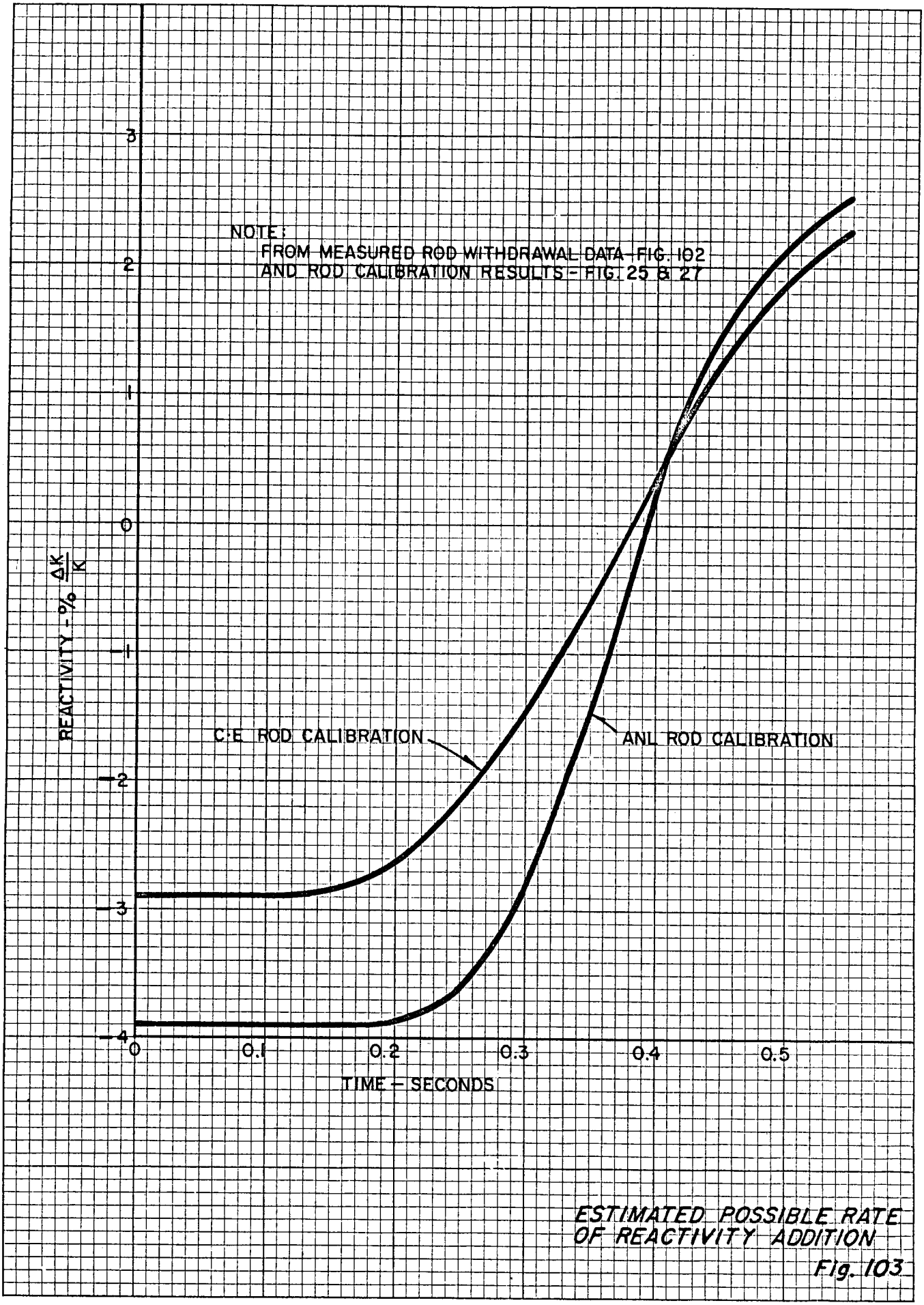

DISCONNECTED POSITION IS 3 11/16 INCHES LOWER THAN INDICATED "ROD POSITION"
TOTAL LIFTING WEIGHT = 84 lbs.
O - 1st MAN
A - 2nd MAN
□ - 3rd MAN
WITHDRAWAL TIME - SECONDS
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
ROD WITHDRAWAL - INCHES
MANUAL WITHDRAWAL TIME FOR ROD FROM DISCONNECTED POSITION

Fig. 102



ESTIMATED POSSIBLE RATE OF REACTIVITY ADDITION

Fig. 103

LEGEND

SYMBOLS

 - Areas Obscured by #9 Control Rod

 - Area Obscured by Upper Spray Ring

 - Fuel Element Boxes and Spare Boxes

 - Possible Additional Boxes

ANNOTATIONS

A	- Upper Spray Ring
B	- Lower Spray Ring
B'	- Lower Spray Ring Bracket
C	- Filler Pipe - Lower Spray Ring
D	- Spare 1" Pipe
E	- Purification Water Inlet
F	- #5 Rod Extension
G	- #7 Rod Extension
H	- Probable Cross-Stanchion from #9 Shroud Area
J	- Possible Cross-Stanchion from #9 Shroud Area
K	- Shrouds
L	- Possible Shroud
M	- Probable Tops of Fuel Boxes
N	- Unidentified

REFERENCES

REFERENCES

1 ANL-5566 "ALPR Preliminary Design Study Phase I" Mr. Treshow, April 1956

2 ANL-6084 "Initial Testing and Operation of The Argonne Low Power Reactor" (ALPR) December 1959

3 Quote from "Talk on Pre-Power Zero-Power Reactor Physics Experiments on the ALPR", page 2, D. H. Shaftman (ANL) presented October 11, 1960

4 Exhibit I to Modification No. 4 to Contract AT(10-1)-967. Program letter for the period ending September 30, 1960 (page 3) as confirmed by Program letter through September 30, 1961, Modification No. 9

5 ABWR Program Proposal, September 26, 1960 (page 5, 3.6 "Manpower Summary")

6 ABWR Program for Contract Year, October 1, 1960 through September 30, 1961 (page 3, 3.6 "Manpower Summary")

7 AEC, Idaho Operations Office letter of March 13, 1959 from V. V. Hendrix, Director, Division of Military Reactors to W. B. Allred, SL-1 Project Manager, Combustion Engineering

8 AEC, Idaho Operations Office letter of March 15, 1959 from V. V. Hendrix, Director, Division of Military Reactors to W. B. Allred, SL-1 Project Manager, Combustion Engineering

9 Combustion Engineering letter of May 28, 1959, from W. B. Allred, SL-1 Project Manager to V. V. Hendrix, Director, Division of Military Reactors, Idaho Operations Office, AEC

10 ANL-FGF-137, "Bonding of Aluminum with Elemental Silicon", R. A. Noland and D. E. Walker, October 1958

11 "Performance of Materials During Six Years Service in The Materials Testing Reactor", A/Conf. 15/p/1878, M. H. Bartz, 1958

12 "Effects of Radiation on Materials", Chapter 7, Reinhold, 1958

13 ANL-6180, "Irradiation of an Aluminum Alloy-Clad, Aluminum-Uranium Alloy Fueled Plate", July 1960

14 H. Kittel (ANL) Telecon of February 1, 1961

15 "Principles of Physical Metallurgy", p. 332, M. C. Smith, Harper, 1956

16 AERE-M/R-1750, "The Behavior of Fissile Material Under Irradiation at Elevated Temperature", L. M. Wyatt, 1955

31 "Analysis of Self-Shutdown Behavior in the SPERT I Reactor" (AEC Research and Development Report) IDO-16528 - Reactors-General TID 4500 (14th Ed.)

32 AEC, Idaho Operations Office letter MR:RLM:RD:8 of August 17, 1959 from V. V. Hendrix, Director, Division of Military Reactors to W. B. Allred, SL-1 Project Manager (CEND)

33 Reactor Handbook Engineering, Ch. 1.8, "Transient Generation and Removal of Heat", pp 150 and 151 by J. P. Silvers and J. R. Dietrich U. S. Atomic Energy Commission, McGraw - Hill Book Company, Inc. 1955

34 Nuclear Science and Engineering, Vol. 6, No. 1, p. 11,"Approximate Analysis of Reactor Startup Incidents", by M. Hurwits, Jr., July 1959

35 CEND letter OP-RO-3119 of April 13, 1961 from W. B. Allred, SL-1 Project Manager to Dr. C. Wayne Bills, Technical Director, SL-1 Recovery Operations, AEC

36 CEND letter ABWR-ADM-5016 of May 9, 1961 from W. B. Allred, SL-1 Project Manager to Dr. C. Wayne Bills, Technical Director, SL-1 Recovery Operations, AEC

APPENDIX

APPENDIX A

SL-1 CONTROL ROD OPERATIONAL HISTORY

Rod No. 1

Date	Reactor Condition	Rod Operation	Drop Time (sec)	Drop Height (in)	Hang up Location (in)	Type of Sticking	Action Taken
7/26/59	162°F Cold	Rod Withdrawal				I	Retested O.K., 30" drop in .9 secs.
9/4/59	Hot-300 psi	RDT*	2.05	30		I	Retested O.K., 30" drop 1.05 sec. Sept. 9
10/9/59	Hot-300 psi	RDT		20	20	II	Retested O.K. 10" drop in .45 sec.
10/31/59	Hot-300 psi	RDT	6.6	30	17	I	Removed negator spring, retested O.K. 30" drop 1.45 sec.
7/5/60	Hot-300 psi	Scram		18.6	17.8	II	Retested; stuck at 29 from 29.9 drop; removed negator spring Retested; stuck at 1" Retested; stuck at 30". Replaced negator spring and retested O.K. 2 times.
7/11/60	Hot-300 psi	Scram			17	II	Retested O.K. from 10" drop - July 25
8/21/60	112°F Cold	Rod Withdrawal			14.3	III	Retested; stuck at 15" Control rod disassembled. Sticking in shroud. Retested again and drops freely from 20"
8/23/60	Cold	RDT Withdrawal			22.4	II	Retested O.K. 20" drop in .85 sec.
9/3/60	Hot-300 psi	1" Rod Exercise		18.2		II	Exercise O.K. at 17.8" 4 Sept; limited to 20" withdrawal Sept. 7
9/11/60	Hot-300 psi	*RDT		10	10	III	Retested O.K. 10" drop in .4 sec. Sept. 13

APPENDIX A (Continued)

Rod No. 3 (Cont)

Date	Reactor Condition	Rod Operation	Drop Time (Sec)	Drop Height (in)	Hang up Location (in)	Type of Sticking	Action Taken
9/4/59	Hot-300 psi	RDT	2.75	30		I	Retested O.K. from 30" in .96 sec. 9 Sept.
9/12/59	Hot-300 psi	RDT	6.55	27		I	Retested O.K. from 30" in .59 sec. Sept.14
9/14/59	Hot-300 psi	RDT	5.6	30		I	Removed 1 negator spring; retested O.K. from both 25 & 30" Sept.15
10/3/59	Hot-300 psi	Scram	3.0	24		I	Retested O.K. 10" drop in .35 sec. Oct.9
10/30/59	Hot-300 psi	RDT	6.7	30		I	Removed negator spring;retested O.K. from 30" drop in .71 sec.
7/5/60	Hot-300 psi	Scram		18.6	17.8	II	Retested O.K. Dropped from 30" in .71 sec.
7/11/60	Hot-300 psi	Scram		17.6	17	II	Removed negator spring;retested O.K. from 10" drop July 15
8/14/60	Hot-300 psi	Scram	2.8	17.4		I	Retested O.K. 20" drop in .59 sec. 21 Aug.
12/19/60	Hot-300 psi	Individual Rod Scram		25	25	II	Retested,hung up at 3". Retested O.K. dropped from 16" in 1.22 sec.
12/23/60	Hot-300 psi	Individual Rod Scram		19.4	19	II	Plant shut down
			Rod No. 5				
4/24/59	Hot-300 psi	RDT		17.3	1.8	II	Retest from 10", drop time .8 sec.

APPENDIX A (Continued)

Rod No. 5 (cont)

Date	Reactor Condition	Rod Operation	Drop Time (Sec)	Drop Height (in)	Hang up Location (in)	Type of Sticking	Action Taken
12/17/60	Hot-300 psi	Rod Exercise (Withdrawal)		20	19	III	Clutch assisted by hand. Retested O.K. 30" drop in 1.71 sec. Dec. 20
12/19/60	Hot-300 psi	Rod Withdrawal		20	20-28	III	Clutch assisted using a pipe wrench.
12/19/60	Hot-300 psi	Individual Rod Scram		25	25	II	Retested O.K. dropped from 16" in .52 sec.
12/22/60	Hot-300 psi	Rod Exercise (Full)		30	26.7	II	Dropped clean from approx. 19.5" in .82 sec. on 12/23/60
			Rod No. 7				
4/24/59	Hot-300 psi	RDT		17.3	2.5	II	Retest from 10", drop time .8 sec.
4/25/59	Hot-300 psi	Scram		19.4	5	II	Retested O.K. April 27
5/1/59	Hot-300 psi	Scram		21.4	21.4	II	Retested.Failed to drop past 25" from 30" drop.Retested O.K. 10" drop in .8 sec. May 4
5/8/59	Hot-300 psi	Scram		21.3	20	II	Retested O.K. 30" drop in 1.5 sec. May 9
5/14/59	Hot-300 psi	Scram		19	14.8	II	Retested O.K. May 15
5/20/59	Hot-300 psi	RDT		30		II	Hung up on all 5 tests Retested 5 times O.K. from 10" .6 sec. drop time - May 21
6/1/59	Hot-300 psi	RDT (Withdrawal)			25.2	III	Could not reach 30" O.K. on full travel June 10.

APPENDIX A (Continued)

Rod No. 7 (Cont)

Date	Reactor Condition	Rod Operation	Drop Time (sec)	Drop Height (in)	Hang up Location (in)	Type of Sticking	Action Taken
12/7/60	Hot-300 psi	Scram	3.9	19.1		I	Retested O.K. dropped clean from 19.4
12/7/60	Hot-300 psi	Scram		19.4	1	II	Retested O.K. dropped clean from17"
12/12/60	Hot-300 psi	Scram		19.2	3	II	Retested O.K. dropped clean from 18.8 on Dec.13.
12/19/60	Hot-300 psi	Individual Rod Scram		25	25	II	Retested O.K. dropped from 16" in .51 sec. Dropped from 30" in 1.71 sec.
12/22/60	Hot-300 psi	Rod Exercise (Full)		19.6	<3	II	Failed to drop from 19.4", 12/23/60
12/23/60	Hot-300 psi	Individual Rod Scram		19.4	19.4	II	Plant Shut down

APPENDIX B

PROCEDURE FOR ZEROING RODS

1. With reactor shutdown and in a cold condition, check to insure that the rods are at their zeroed position as indicated by the control rod position indicators on the control console.
2. Remove the pipe plug from the top of the rod drive housing.
3. Screw in the guide tube in the pipe plug opening until it is completely bottomed. The guide tube contains a slotted hole and a zeroing mark.
4. Insert the measuring rod down through the guide tube until it bottoms on top of the threaded portion of the control rod rack. Check to insure that it is properly bottomed by slipping the lower end of the measuring tube off the top of the rack and bottoming it on upper surface of the scram stop washer (a distance of 1-1/8 inches).
5. In the event the scribe marks of the guide tube and measuring rod do not line up, it is necessary to perform the following using 3 men:
   a. Disconnect the splined section of the universal coupling from the shaft assembly which supports the negator spring drum. The buffer springs will either raise the rod or the rod will depress the springs depending upon whether the rod was low or high as determined by the difference between scribe marks of the measuring tube and guide tube.
   b. When the scribe marks are lined up, connect the universal coupling to the shaft assembly. If the spline sections are not rotationally aligned, for engagement, rotate the coupling equivalent to a maximum of $\frac{1}{2}$ of a spline tooth, and in the direction which reduces the small difference that may be present between the scribe marks, and then engage the coupling to the shaft assembly.
   c. Recheck the zero position with the measuring rod and on the control rod indicators before putting the pipe plug back on the rod drive housing.
6. Install pipe plugs.

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