BOOK11R 5055 on bottom edge

Notes:
CA-25 APPR BOOK II on front of book.

Blank pages:1-9, 160-300, inside back cover.

-Each page has 1 graph glued to it: 43, 45, 49, 57, 65, 77, 87, 93, 102, 104, 110, 113, 119, 121, 130.

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
July 29, 1999

SECRET

SOME INSTRUCTIONS FOR USE OF THIS NOTEBOOK

This notebook is assigned to personnel performing research and development work and must be used for all original calculations, notes and abstracts from reports.

Assignee is responsible for the safeguarding of this notebook in accordance with security regulations.

This notebook must be returned to issuing office whem completed or upon termination of assignee.

Every page or entry should bear a date and the signature of the person who made the entry.

Entries should be made in ink whenever it is reasonable to do so.

Alteration or amplification of entries made on previous dates should be made as separate entries under their own dates and cross referenced to the previous entries.

Charts, drawings and graphs drawn on special paper should be glued or otherwise securely fastened in place and should individually bear a date and signature. Do not obscure any information.

The notebook should be periodically reviewed by one or more independent persons in the department and should be signed and dated by them. Likewise, they should make a statement that they have "read and understood the foregoing material." Witnessing stamps for this purpose are available in your department's office.

It is advisable to preface each new item, such as a heat treatment, process or reaction, etc., with a very brief description of the purpose, objective or approach.

Description of the invention or discovery should be complete enough to be understood by anyone skilled in the art.

Reference to name or catalogue number should be made when standard items are being discussed, i.e., Westinghouse pump.

In cases where work is conducted in cooperation with others, it is often necessary to meet with them from time to time and discuss new developments. The occurences of such conferences should always be entered in your notebook regardless of recording elsewhere, giving the date, who was present (if possible), and an outline of the subjects discussed. This often will establish error in occasional claims of other parties that you have appropriated information from them revealed during an interview, and thus provide you with patent protection.

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5-25-60

(58)

NOTEBOOK NO. 5055

58 AUI

Assigned to: A. D. Callihan

Department: Applied Nuclear Physics

Location: Bldg. 9213, y-12

Date: Oct 19, 1955

This notebook is assigned to personnel performing research and development work and must be used for all original calculations, notes and abstracts from reports.

58 AUI

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Subject

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DATE 6-3-60
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY
AUTHORITY DELEGATED BY AEC 9-18-57

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This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

7-10
10-9
12-12
2-14
9-16
11-17
10-18

Expr. 9-39 Time 6:00 AM (PM) Date 11-22 1955
Purpose Zero check on run 9-38.

Personnel:

INSTRUMENT CHECK

Date 11-22 1955 Time 5:00 AM (M) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3 ✓	50	10x20	3"	
Log N ✓	125m	125m		
R-1 ✓	5	.8v/100 x100	contact	
R-2				
P. M. ✓			contact	

Loading - exactly the same as 9-38 (I, p 218):

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	5	3	4	5	6	2	11	9	7	12	12	8		15	9		10
material	f	f	S	f	S	f	f	f	S	f	f	S	f	f	[redacted]	f		f

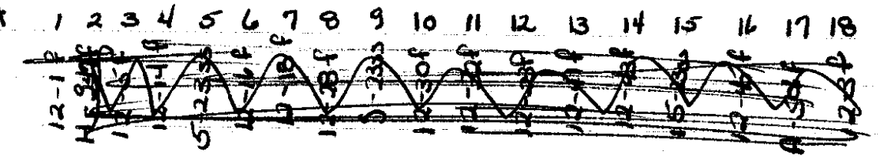
Box		slot 14	slot 17		slot 14	slot 17
	1	1-9	H-959	24	6-9	12-23
	2	-21	539	25	rod	
	3	-23	H-958	26	-21	1-11
	4	-25	435	27	-23	6-40
	5	-37	H-	28	-25	H-928
	6	2-9	10-25	29	-37	516
	7	-21	[redacted] 4-20	30	7-9	10-23
	8	-23	10-37	31	-21	510
	9	rod		32	-23	H-913
	10	-25	11-9	33	-25	511
	11	-37	#507	34	-37	1-16
	12	3-9	11-21	35	8-9	3-1
	13	-21	578	36	-21	1-16
	14	-23	H-961	37	rod	
	15	-25	4-27	38	-23	1-17
	16	-37	10-21	39	-25	#505
	17	4-9	4-28(238)	40	-37	1-19
	18	-21	H-951	41	9-9	H-960
	19	-23	6-32	42	-21	512
	20	-25	1-9	43	-23	H-930
	21	rod		44	-25	512
	22	-37	12-21		-37	H-952
	23	rod		46		

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by DW
Instrument and Safeties Checked and React by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by DM Time 5:30 AM (PM) Date 11-22 195 5

All APPR [redacted] eccentric rods in full without fuel attached on the bottom.
APPR central rod [redacted] fuel section attached on bottom.

Slot 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Series & meter:



Log N has been re-calibrated.

Critical Conditions:

Temp.	73°F	DC-3	68(10x20)
Height	109.3	Log N	0.18
Blade	16.02		
Rod	29.02		
Eccentric Rod	0.01		
Central Rod.	24.15		

Expr. 9-40 Time 6:15 PM Date 11-22 1955
Purpose measurement of δk between central + eccentric rod all the way out
Personnel:

START-UP CHECK LIST
Equipment Checked by HB Personnel Check by HB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by HB
Start-Up OK'd by DM Time 6:15 AM (PM) Date 11-22 1955

Loading - exactly the same as 9-39 except slot 17, box 7 now contains ss 1-7 instead of 4-20.

Didn't go critical.
Water up.
Rod + Blade out.

Expr. 9-41 Time 6:45 AM (PM) Date 11-22 1955
Purpose δk measurement. - new zero point.
Personnel:

START-UP CHECK LIST
Equipment Checked by HB Personnel Check by HB
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by HB
Start-Up OK'd by JL Time 6:50 AM (PM) Date 11-22 1955

Loading. - same as 9-39 except for the following exchanges:

Box	now in slot 17
1	3-24
5	3-5
3	3-3
43	3-43
45	3-45
41	3-41 (poor 4-20 replaced)

Rod .2905 DC-3 69 (10 × 20)
Blade 13.75 BORON .178
Temp. 73°F

(1.28 - .68) = 0.60 .60 × 2.52 → 4.5¢ value of 6 half plates perimeter in slot 17 or $\frac{4.5¢}{95g}$ = 0.047 ¢/g

Expr. 9-42 Time 8[15] PM Date 11-22 1955
Purpose: New zero point prior to evaluating δK of fuel plates (by comparison to blade position)
Personnel: J L, DWM, M.B.

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by DWM
Instrument and Safeties Checked and Reset by J L
"Source In" Checked by M B Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light ~~On~~ Checked by DWM
Start-Up OK'd by M B Time 8[15] ~~AM~~ PM Date 11-22 1955

Loading: ~~Same~~

4 Half plates exchanged for 4 full plates in slot 17 in boxes 14, 18, 28 & 32. (Added 2 equiv. plates) to the loading of 9-41.

Removed	H961	from box 14	slot 17;	inserted	3-14.
	H951	" box 18	"	"	3-18
	H928	" " 28	"	"	3-28
	H913	" " 32	"	"	3-32

Control Rod	29.02	Log N	0.19
Control Blade	10.73	DC-3	79x10x20
Eccentric Rod In	00.01	Water Ht.	109.6
Control Rod Out (~~[illegible]~~ 24.15)		Water Temp	73 °F

R-1; 4.6x100x1000

Expr. 9-43 Time 9[00] ~~AM~~ PM Date 11-22 1955
Purpose: Compare 3 fuel plates with control Blade.
Personnel: MB DWM JL RJ HB.

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by DWM
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by M. B. Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light ~~On~~ Checked by DWM
Start-Up OK'd by M.B. Time 9[03] ~~AM~~ PM Date 11-22 1955

Loading: 9-42 Loading less 3 fuel plates from slot 17 boxes 11, 26 and 39 -- (507, 1-11, 505. removed) SS 1-11, 26, and 39 inserted.

APPR Control Rod	24.14	Log N	0.18
" Eccentric Rod	0.01	DC-3	68.5 x10 x20
Control Blade	20.01	R-1	4.1 x100 x1000
" Rod	29.02	Water Ht.	109.5
		Water Temp.	73

3 fuel plates worth (20.01 − 10.73) on control blade

or ~~(2.365 − .165) x7.57 = 2.2 x 7.57 = 16.6 ¢~~

35.2 − 18.8 = 16.4

START-UP CHECK LIST

Equipment Checked by IL Personnel Check by HGB
Instrument and Safeties Checked and Reset by IL
"Source In" Checked by WRJ Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by OK DWM
Start Up OK'd by WRJ Time 10⁰² AM PM Date 11-22 1955

Expr. 9-44 Time 10⁰⁰ AM PM Date 11-22 1955
Purpose Evaluate 2 plates
Personnel: WRJ DWM JL MA HGB.

Loading: Same as 9-42 less 10-21 & 10-23 from slot 17 of boxes 16 and 30. resp. (Replaced 507 1-11 and 505 in boxes 11, 26, & 39 slot 17 from ~~9-42~~ 9-43)

Critical cond.

APPR Control Rod	Log N
" Eccentric Rod	DC-3
Control Blade 28.00	R-1
" Rod	Water Ht
	" Temp

Sub Critical

Expr. 9-45 Time 10³⁰ AM PM Date 11-22 1955
Purpose Evaluate fuel plate 10-23 from 30-17
Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by DWM
Instrument and Safeties Checked and Reset by WRJ
"Source In" Checked by WRJ Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by OK DWM
Start Up OK'd by WRJ Time 10³⁰ PM Date 11-22 1955

Loading: Same as 9-42 less plate 10-23 from Box 30 slot 17.

Critical Conditions	Log N
APPR Control Rod	DC
" Eccentric Rod	R-1
Control Blade	Water Ht
" Rod	Water Temp.

Sub Critical.

Expr. 9-46 Time 1055 AM PM Date 11-22 1955
Purpose
Evaluate half fuel plate in Box 30 Slot 17
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by WRJ Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by CR DWM
Start-Up OK'd by WRJ Time 1055 AM PM Date 11-22 1955

Loading: ~~Critical~~ Insert half plate in Box 30 Slot 17 5-21
from previous loading. (Removed 1-30 steel)
(Loading is 1/2 plate less than 9-42)

Barely Subcritical Asy Period ~ 1000 sec.

APPR Critical	24.14	Log N 0.10 R
" Ec	00.01	R. 1x2.1 x 100 x 1000
Control Blade	28.28	Water Ht. 109.7
" Rod	29.02	Temp 73

2.37 x 7.57 = 17.9 ¢
36.8 - 18.8 = 18.0

Expr. 9-47 Time 1820 AM PM Date 11-22 1955
Purpose Evaluate 8k δ + 1/2 in slot 2 and
-1/2 plate in slot 17 of box 16.
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by WRJ
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by WRJ Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by CR DWM
Start-Up OK'd by DWM Time 1820 AM PM Date 11-22 1955

Loading: Box 16 Interchange plate 5-16 slot 2
with plate 10-21 slot 17, assume this adds 17.9 ¢ δk
~~Box 30~~ when 1/2 plate added in slot 2.
Box 30 Interchange plate 5-21 with plate 10-23
in slot 17.

Critical Cond:

		log N	0.12
APPR Critical	24.14	DC-3	46 x 20 x 10
Eccentric	0.01	R-1	2.68 x 100 x 1000
Control Blade	26.00	Water Ht.	110.1
" Rod	29.02	" Temp.	73

36.6 - 18.8 = 17.8
~~17.9 ¢ + 17.9~~ 17.8 + 18.0 = 35.8 ¢ value 1/2 plate
in slot 17

Total Reactivity difference between 3 ecc + 1 centre
and 4 ~~central~~ eccentric rods is ~~1.49~~ for the 8 fuel plates
in boxes 7, 11, 16, 20, 26, 30, 35, & 39.
267.2 g U or 249 g U-235 or 0.56 ¢/gm

2 x 16.4 = 32.8
2 x 18.0 = 36.0
2 x 35.8 = 71.6
140.4
Total worth 8 fuel plates

The previous rod 23 fuel plates are in error

Slot			
1	MAC 259	10	12-37
2	A 506	11	11-23
3	SS	12	11-25
4	341	13	
5	SS	14	11-37
6	A 264	15	
7	12-9	16	
8	12-25	17	
9	SS	18	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	2	3	4	5	6	7	5	9	7	11	12	11	14	15	8	1	10
f		f		f	f		f			f		f			f		f

Expr. 7-13. Time 7:15 AM PM Date 11-23 1955
Purpose Check on critical mass - effect of long time burning
Personnel:

INSTRUMENT CHECK

Date 11-23 1955 Time 7:15 AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	50	20x10	
Log N	✓	15a	16cm	
R-1	✓	6	18x100 x160	
R-2				
P. M.	✓			5"

START-UP CHECK LIST

Equipment Checked by DW Personnel Check by DM DW
Instrument and Safeties Checked and Reset by DW
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DM
Start-Up OK'd by DW Time 7:26 AM PM Date 11-23 1955

Loading cold-clean critical loading:

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	4	5	6	7	5	9	7	11	12	8	14	15	9	1	10
material	f	S	f	S	S	f	S	f	S	f	S	S	f	S	S	f	S	f

plus:

box 11 slot 8 contains #378 instead of half fuel
7 3-41
35 4-20
39 6-40

All series of plates have been weighted.

End boxes on.

Summary of weighing—

Series	Weight in H_2O 10-20-55 (7-8)	Weight in H_2O 11-23-55	Weight change between 10-20 & 11-23	Total Void Volume 11-23-55
1	8096	7675	421	785
2		7787.5		[illegible]
3		8001		459
4	8048	7781	267	679
5	7417	6932	485	776
6	8137	8009	125	451
7	8120	7874.5	245	585
8	8243	8131	112	329
9	8312	8071	241	389
10	8247	8047	415	413
11		7832		628
12		6626		1835
41 extra plates in 9-39	64670	62741		558

Total Volume

673

Critical conditions.

water	109.0 cm.	Lag N	0.19
rod	29.015 in	DC 3	82 (10×20)
blade	17.72 in	Temp.	72.5°F

Total void volume = 4187 cm^3

Mass: $7.5 \times 45 + 2 = 337.5 + 2 = 339.5$ plates

$339.5 \times 31.1 = 10.56$ kg-U-235

blade correction = $-.01$

10.55

11-25-55

The following plates were opened to let gas escape

1-1	3-5	5-2	6-6	7-10	8-1
2	14	4	15	11	6
5	25	5	23A	14	9
6	32	6	35	15	10
8	34	14	37	16	13
9A	42	17	38	19	14
10	45	18	39	31	28
19A		23	40A	33	34
21		25	41	42	41
26		26	42		
27		27	45		
30		28		9-1	10-39
31		30		3	40
34		31		45	41
35		34			42
36		36			43
37		38			
38		43			
39					
40					
41					
42					
43					
44					
45					

Fuel plates weighing in H_2O

Zero	767		Dry weight	Total Volume	
1	8863	8096	9660	7895	
3	8862	8095	9637	7773	
5	8235	7468	8868.5	6832	
6	8982	8215	9647	6663	
7	8946	8179	9630	6832	
8	9025	8258	9741	6714	
9	8991	8224	9667	6668	- Uranium Void deleted
10	8990	8223	9682	6690	
	64758			55177	2017

Expr. 7-14 Time 3 30 AM PM Date 11-25-55

Purpose Evaluation of voids

Personnel: J.L., DWM, E.E.D

INSTRUMENT CHECK

Date 11-25 1955 Time 3 30 AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	56	10×20	
Log N	✓	15	15	
R-1	✓	5	8×1000	~6"
R-2			×100	
P. M.	✓		31"	

START-UP CHECK LIST

Equipment Checked by J.L. Personnel Check by DWM

Instrument and Safeties Checked and Reset by E.E.D.

"Source In" Checked by DWM Source No.

Emergency Equipment in Control Room Checked by DWM

Red Light On by DWM (CH)

Start-Up OK'd by DVPW Time 4 45 AM PM Date 11-25 1955

Loading: Same as 7-13

Critical Cond:

Control	Blade	0.05	Log N 0.20
	Rod	29.	DC-3
Water	Ht	90.5	R-1
Water	Temp	72°F	

Expr. 7-15 Time 4 15 AM PM Date 11-25 1955

Purpose Evaluation of Voids

Personnel: DVPW DWM JL MB EED

START-UP CHECK LIST

Equipment Checked by J.L. Personnel Check by MB

Instrument and Safeties Checked and Reset by E.E.D

"Source In" Checked by DVPW Source No.

Emergency Equipment in Control Room Checked by DWM

Red Light On by DWM AM

Start-Up OK'd by DVPW Time 4 15 PM Date 195

Loading: Remove # 378 (NAC) from Box 11 Slot 8

3-41	7 "
4-20	35
6-40	39

(9 1/2 - 4 Leaf plate)

	Dry Weight	11-25 Wt in H_2O	Δ (Volume)	Void Volume	11-23	Δ
1	9659.5	8096	1563.5	364	7675	1984.5
3	9636.5	8095	1541.5	365	8001	1635.5
5	8868.5	7468	1400.5	317	6932	1936.5
6	9646.7	8215	1431.7	245	8009	1637.7
7	9629.5	8179	1450.5	281	7884.5	1755.0
8	9640.5	8258	1382.5	202	8131	1509.5
9	9660.5	8224	1436.5	236	8071	1589.5
10	9681.5	8223	1458.5	237	8047	1634.5
	7641 2302	64758	11[illegible].2	2247		1680.2

Not quite critical: blade out, water up
Water temp 72°F

Void volume = $2247 - \frac{2247}{337.5} \times 4 = 2220$

Mass: $7.5 \times 45 - 2 = 337.5 - 2 = 335.5$
$= 10.43$ kg.

11-28-55:
"Flattened" (opened, applied pressure & closed) the following plates:

		Series 11-8 -24 #531	Series 12
2-1	4-3		#678-12-38
2	5		#-271-12-1
12A	7		684-
14	9		667
18	10		675
24	11		674
28	12		660
29	13		679
33	18		677
38	21		669
39	20A		672
40	23		680
41	25		673
43	27A		→ 12-41
44	29		
45	31		
42	32		
	37		
	41		
	42		
	44		

contained a lot of water.

Expr. 9-48 Time 6:25 PM 11-29 1955
Purpose 5-APPR rods ~~[illegible]~~ half in.

Personnel:

INSTRUMENT CHECK

	50	10 / 20	3½"
	12sec	12sec	
R-1	5	.8×1000 / ×100	1"
R-2			
P. M.			2½"

Loading: all boxes: (11 plates per box)

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	4	5	6	7	8	9	~~10~~ 7	11	12	13	2	15	9	11	10
+ material	f	s/s	f	f	s/s	f	s/s	f	s/s	f	s/s	f	s/s	f	s/s	f	f	f

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by DM
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DM
Start-Up OK'd by JL Time 6:30 PM Date 11-29 1955

All five APPR rods mounted: the eccentric rods are at 12 inches above the core ("half-way in")

With source in, water at 68 cm., ~~positive~~ central rod all the way in, reactor going on positive period. Much too super critical. loading.

Expr. 9-49 Time 9:00 PM Date 11-29 1955
Purpose 5-APPR rods half in.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by DM
Red Light On by HP
Start-Up OK'd by DW Time 9:00 PM Date 11-29 1955

Loading: all boxes: (10 plates per box)

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	4	5	6	7	8	9	7	11	12	13	2	15	9	1	10
+ material	f	s/s	f	f	s/s	f	s/s	f	s/s	f	s/s	f	s/s	f	s/s	f	s/s	f

With APPR central rod all the way out, very super critical.
With APPR central rod all the way in, water all the way up reactor sub-critical.
Source Pulled Out, Eccentric Rod. 12.02 in.

Central Rod	Water	
11.025 in.	62.7	– critical (approx)
10.84 in.	63.0	– critical (approx)
10.2 in.	63.3	– critical (approx)
9.80 in	64.0	– " "
9.13 in.	64.9	– " "
8.70 in.	65.7	– " "
8.13 in.	67.0	– " "
7.72 in.	68.1	– " "
7.12 in	70.1	– " "
~~[illegible]~~ 6.41	73.0	– " "
5.8	76.0	– " "

Central Rod	5.27	Water Right	80
	4.83		83.6
	4.43		90.0
	4.28		∞ (109)

Expr. 9-60 Time 11:00 AM PM Date 11-27 1965
Purpose 5 - APPR rods full in.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Operable DW
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DW Time 11:00 AM PM Date 11-27 1965

Loading: for all boxes except APPR rod boxes:

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	4	5	6	7	8	9	7	4	12	13	*	15	9	1	D
material	f	S/S	f	S/S	S/S	f	S/S	f	S/S	f	S/S	f	S/S	2/4	S/S	f	S/S	f

The APPR boxes are ~~similar~~ like above except slot 4 contains fuel

Source Out; Eccentric Rod at 12.02 (blade all the way in)
Central Rod 18.52 in. Water Right ~~69~~ 70.8 cm critical

12.86	71.2
11.82	73.8
11.02	77.7
10.46	84.8
10.16	109.1 critical

Pulling plate out : 28.28 in.
Central Rod 9.65 in; Water Right 109.1cm critical

START UP CHECK LIST

Equipment Checked by MB Instrument Check by DM
Instrument and S... DM
"Source In" Ch... DM ... No.
Emergency Equi... Room ...cked by MB
Red Light On by JL
Start-Up OK'd by DM Time 12:30 (AM) Date 11-30 1965

Expr. 9-30-51 Time 12:30 (AM) PM Date 11-30 1965
Purpose 5-APPR rods in. half way.

Personnel:

Loading - all boxes:

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Serial	1	2	3	4	5	6	7	8	9	7	11	12	13	2	15	9	1	10
material	f	ss	f	ss	ss	p	ss	f	ss	f	ss	f	ss	f	ss	f	ss	p

APPR ~~rods~~ eccentric rods ~~in to~~ out 11 7/8".
(Driven rod at 11.86)

Central Rod	15.02 in.	Water height	78.5 cm
	14.26		74.5
	13.62		75.9
	13.30		76.2
~~Eccen~~	Eccentric rod inadvertantly inserted to ~~11.78~~ 11.75		
	12.70		79.6
	12.01		86.1
	~~11.78~~		88.0
	11.77		92.8

Blade pulled all the out

Central 11.055 Water 109.3 super critical.
Ecc. 11.78

~~Central~~ 11.03 Water 109.3 sub-critical
Ecc. 11.78

Temp. 73°F
Center Rod 11.03 in ~~critical~~ 109.3 ~~super~~ super critical.
Ecc Rod 11.87 in
Blade 28.29 in

Center Rod inserted 11.00 in — sub critical.

9 x 45 = 405 gal. H2O

401 x 3.8 = 1523.8 kg H2O

B-26

Expr. 9 Time 5:55 AM (PM) Date 11-30 1965
Purpose Power Distribution — 5 rods full in — zero rods.
Personnel:

INSTRUMENT CHECK

Date 11-30 1965 Time 6:00 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
P. [illegible]				
I. [illegible]				
D. [illegible]	✓	50	10X20	
Log N	✓	10	10Sec	
R-1	✓	6	1000X 100	
R-2				
P. M.	✓			3

START-UP CHECK LIST

Equipment Checked by HB Personnel Check by DW
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by HB
Start-Up OK'd by DW Time 6:00 AM (PM) Date 11-30 1965

loading — complete loading of 9; exactly the same as 9-51 (page 32)
the purpose of this run is for zero check with 9-51; to get experience running this configuration in order to expose foils; to see exactly where this loading will go critical.
No foils are in.
Log N has been recalibrated.

Mass = 12.60
blade condition = .05
12.55

Critical Conditions:

				9/60:
Temp.	73°F	Axial Blade	2.25" in	2.72
Height	109.5 cm.	Axial Rod	all	0.41
DC-3	49 (10×50)	APPR Central	11.88	11.88
Log N	0.2	APPR Eccentric	11.87	11.82
R-1	3.1 (200×1000)			

Expr. 8-27 Time 9:00 AM (PM) Date 11-30 1965
Purpose Power Dist — 5 Appr Rods Half In.
Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DW
Instrument and Safeties Checked and Reset by DW + DM
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DW Time 9:00 AM (PM) Date 11-30 1965

Loading — complete loading of 9: same as 9-6 (page 32) except F-1 (MAC# 507) in slot 10, box 23 and F-2 (MAC# 571) in slot 10, box 16.

Foil Location — F-1: top to bottom. F-2: top to bottom

B-182	B-83
B-17	B-122
B-173	B-22
B-116	B-70
B-51	B-115
B-64	B-180
B-135	B-110
B-34	B-88
B-74	B-82
B-161	B-140
B-7	

½ power at 9:24:32 pm. (Log N reading at 1.1)
Scramed by photo-multiplier.
Something appears to be drastically changed from last foil exposure: at the scram, log N was reading 1.3 — a much lower value than our usual foil exposure level (2.0) but R-1 was reading 6.9 on 1000×1000 scale — approx. a factor of 2 over our usual foil exposure level. (3.9)
The photo-multiplier voltage was at the usual 900 volts.
The most plausible reason is that the five rods have made an entirely new reactor with very different leakage.

Expr. 8-28 Time 10:40 AM PM Date 11-30 1955
Purpose POWER DIST — 5 APPR RODS HALF IN.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by DW DM
Instrument and Safeties Checked and Reset by
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by DM
Red Light On by MB
Start-Up OK'd by DW Time 10:40 AM PM Date 11-30 1955

LOADING - Exactly the same as 8-27.

FOIL LOCATION - Special plate F-2; top to bottom: slot 10, box 16.

B-24
B-33
B-131
B-52
B-53
B-20
B-50
B-117
B-37
B-146
B-18

H-V on photo-multiplier turned down to 800 volts
1/e power at 11:03:00 (LogN = 0.37)

Run conditions.

LogN	1.0	Central APPR	11.875
DC-2	70 (10x5)	Eccentric APPR	11.02
R-1	5.3 (1000x1000)	Rod	0.15
Temp.	73°F	Blade	6.99
Height	109.3		

Twenty minute exposure.
Register on proportional counter not operating properly.

Expr. 8-29 Time 5:25 AM PM Date 12-1 1955
Purpose POWER DIST — 5 APPR RODS HALF IN; VERTICAL DIST IN BOX 16 AND IN FUEL SECTION CONNECTED TO CENTRAL ROD.
Personnel:

INSTRUMENT CHECK
Date 12-1 1955 Time 5:25 AM PM Source No.

Instrument	Trip	Value	Scale	Source Distance	Paper Pin Hole
DC-1					
DC-2					
DC-3	✓	50	20x10	3"	
Log N	✓	12sec	12sec		
R-1	✓	5.2	.8x1000	1½"	
R-2					
P. M.	✓	900V.		3"	

Note: The special catcher foil plates are developing holes in the uranium foil due to water in the plates. No regular fuel plate has been torn apart to see if this condition is also occurring in it

START-UP CHECK LIST
Equipment Checked by HB Personnel Check by DM MB
Instrument and Safeties Checked and Reset by
"Source In" Checked by JL
Emergency Equipment in Control Room Checked by
Red Light On by DM
Start-Up OK'd by DW Time 6:20 AM PM Date 12-1 1955

8:15 pm - start-up. Delayed by register on proportional counter. Replaced the register with a "rebuilt" one.

Photomultiplier voltage turned down to 800 V.

Foil location. top to bottom

Slot 10, Box 23 — plate F-2;

1" B-147
" -100
-65
-158
-31
-85
-176
-106
-130
-27
-29

Slot 10, Box 23 — plate F-1

1 B-44 - very small amount of interference
3 -132
5 -45
7 -38
9 -136
11 -84
12 -137
-169
-66
-48
-40

½ power at 8:32:05 (½ final power = 0.37 on log N)

Run conditions.

Temp.	73.6°F	APPR	Central	11.88
DC-2	65 (10x5)		Eccentric	11.875
R-1	5 (1000x1000)	Control	Blade	0
Log N	1.0		Rod	0.105
		Height		109.7cm.

12-6-55

An analysis of a H_2S sample taken on 12-5-55 showed that there was less than 0.01 ppm U in the water. Wipe tests on bottom of tank and on pipe support showed 500 — 1000 c/min (5" x 5" area)

Dwm

Full boron, or "B" plates — 1.889 gm Nat B/plate.
½ boron, or "C" plate — 0.944 gm Nat B/plate

On 12-5, a fluoroscoptic analysis on the physical condition of the U-foils in 17 plates was made. Seven of these 17 showed small holes in the foils. Detailed results are on page 17 of D.W.M.'s notebook.

Expr. 13-1 Time 5:05 AM (PM) Date 12-6 1955
Purpose Rod Evaluation, with Boron. — 3 ecc. & 1 cent. rod in; normal positions.
Personnel:

INSTRUMENT CHECK

Date 12-6 1955 Time 5:00 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	45	10x20 Contact	
Log N	✓		12 cm.	
R-1	—	5	1000	
R-2			100x8	
P. M.	3		3"	

START-UP CHECK LIST

Equipment Checked by J.L. Personnel Check by D.W.
Instrument and Safeties Checked and Reset by M.B
"Source In" Checked by D.W. Source No.
Emergency Equipment in Control Room Checked by D.M.
Red Light On by D.W.
Start-Up OK'd by D.W. Time 5:15 AM (PM) Date 12-6 1955

Loading:

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	4	2	4	6	*	8	8	11	7	11*	12	5	2	15	9	*	10
Material	f	f	f	s	f		f	s	f	f	s	f	f	f	s	f	f	f

APPR rods: in positions 9, 21, 23, 37.; fuel sections not on in position 25, rods ~~[redacted]~~ fuel section in core; Poison section not attached

* boron plates (Series "C" — ~~[redacted]~~ half boron) in slot 11 & the following boxes: 1, 3, 5, 6, 8, 10, 12 - - - - - 38, 40, 41, 43, 45.

	slot [redacted] 17	slot [redacted] 6		slot [redacted] 17	slot [redacted] 6
Box 1	[redacted] 1-9	(?) S.S.	24	11-21	H-960
2	2-9	1-9*	25	12-21	1-11*
3	3-9	~~10-39~~ S.S.	26	1-23	H-952
4	4-9	10-37	27	2-23	H-27*
5	6-9	S.S.	28	3-23	S.S.
6	7-9	#878	29	4-23	H-23*
7	8-9	11-37	30	6-23	S.S.
8	9-9	5-9	31	7-23	6-32*
9	— rod —		32	8-23	S.S.
10	10-9	5-21	33	9-23	#A264
11	11-9	MAC-677 (12-37)	34	10-23	H-961
12	12-9	5-23	35	11-23	#759
13	1-21	1-19*	36	12-23	H-958
14	2-21	S.S.	37	— rod —	
15	3-21	1-17*	38	1-37	H-959
16	4-21	S.S.	39	2-37	2-21*
17	6-21	1-16*	40	3-37	8-41*
18	7-21	S.S.	41	4-37	S.S.
19	8-21	1-15*	42	6-37	4-20*
20	9-21	5-37	43	7-37	S.S.
21	— rod —		44	8-37	6-40*
22	10-21	H-951	45	9-37	S.S.
23	— rod —				

Critical Conditions:

Water 8.45 cm.

Appr { Central 0.05
Fuentric 0.00

Control { Blade 0.02
Rod 29.015

Long N 1.5

DC-3 60 (10×10)

Mass of U^{25} = 17.075 Kg

2 half B plates
2 × 0.944 B plates
= 22.66 g of B total

12.5 plates/rod × 41 × 31.1
= 15.939

2 plates × 31.1 (gram/plate) = .746

16.685

16.685 × 45/41 = 18.31 Kg-U-25

Expr. 13-2 Time 3:50 AM PM Date 12-6 1955
Purpose Rod Evaluation with boron:
3 ecc. & 1 control in.
Personnel:

START-UP CHECK LIST

Equipment Checked by J.L. Personnel Check by D.M.
Instrument and Safeties Checked and D.M.
"Source In" Checked by D.M. D.M.
Emergency Equipment in Control Room
Red Light On by D.W.
Start-Up OK'd by D.W. Time 5:05 AM PM Date 12-6 1955

Loading: Fuel exactly the same as 13-1.
Boron: slot 11 contains boron throughout the reactor.

Not critical.

Expr. 13-3 Time 6:20 AM (PM) Date 12-6 195 5
Purpose Rod evaluation with boron.
3 ccc + 1 control in.
Personnel:

START-UP CHECK LIST
Equipment Checked by J.L. Personnel Check by R.J.
Instrument and Safeties Checked and Reset by DW
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by MB
Start-Up OK'd by DW. Time 6:20 AM (PM) Date 12-6 195 5

Loading: Fuel exactly the same as 13-1.
Boron.: slot 11 contains boron except for boxes:
3, 15, 17, 20, 26, 29, 31, 43. Amounts are
B in Boxes 9, 21, 23 & 27 ∴ Actual amount of B in each =
Critical Conditions: 33 × 0.944 = 31.15g.

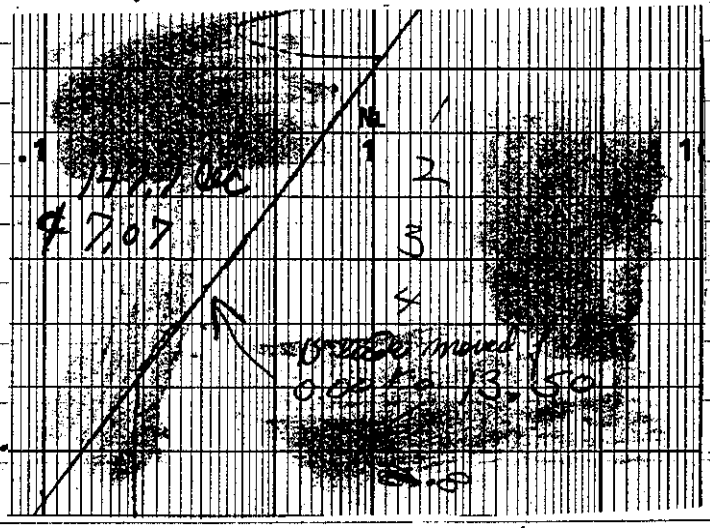
Height	109.5	Control	Blade	0.00
Log N.	0.2		Rod	15.11
		APPR	Eccentric	0.00
			Central	0.05

Blade pulled to 13.50 inches. ; positive period taken
Scrammed on photo-multiplier (set at 900V)

Log N at ~1.0

Blade worth 00.00 → 13.50"
= 7.1 cents

U^{235} = [illegible] kg



Expr. 13-4 Time 8³⁰ ~~PM~~ Date 12-6 1955
Purpose ROD EVALUATION with BORON

Personnel: DVPW, JL, WRJ, DWM

START-UP CHECK LIST
Equipment Checked by DWM [illegible] by DWM
Instrument and Safety [illegible] DWM
"Source In" Checked by DVPW
~~Emergency Equipment in Control Room~~ [illegible] DWM
Red Light On by DWM
Start-Up OK'd by DVPW Time ~~8~~ 40 ~~PM~~ Date 12-6 1955

Because of Rod shielding blade, blade worth has decreased
Returned to Boxes 9, 21, 23, ~~0~~25 as the 4 APPR rods
in by interchanging ~~box~~ 25 and eccentric APPR rod.
Hence box 25 is in box 37 position in a control rod
fuel and SS plates

Loading:

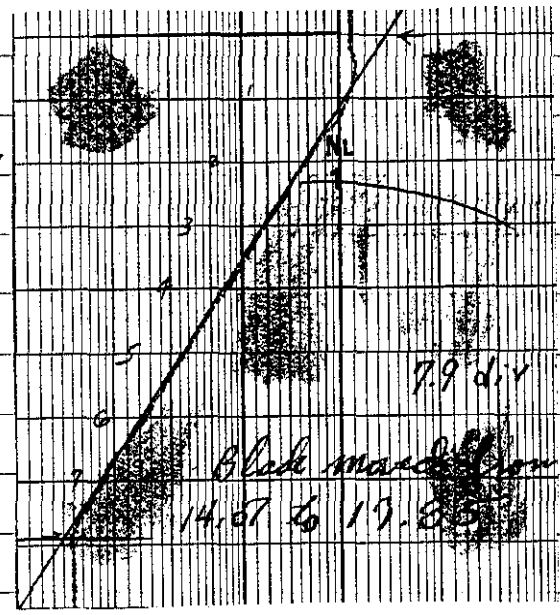
Same as 13-3 with above box change.

[Eccentric rod that is out has boron attached, other rods have no fuel]

P.M. voltage decreased to 800 V.

Critical Conditions:

Control APPR	~~00.0~~	Water height	109.5 cm
Ecc APPR	~~[illegible]~~ (23.99)	Temp	71°F
Control Blade	~~[illegible]~~	Log N	0.16
Control Rod	~~29.02~~ Count	DC-3	74. x 10 x 10



Positive period

Cont. Blade @ 17.85 ← 14.07 = 3.78"

176.5 sec period → 6.2 ¢

Leveled off with Cont Rod

29.02 → 12.46

6.56" → 6.2 ¢

Mass U^{235} = 17.025 ± See Page 41

≈ 15 g in Cont. Blade

≈ mass = 18.31 − .025 = 18.29

Expr. 13-5 Time 10:50 (AM) PM Date 12-6 1955
Purpose Rod Evaluation with Boron:
3 sec in close position & control in.
other eccentric completely out
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by DM
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by JL
Red Light On by MB
Start-Up OK'd by DW Time 10:50 (AM) PM Date 12-6 1955

Loading -
Same as 13-3 with the following changes.

Box #	15	is now in position	9
	17		21
	31		25
	29		37
Rod			31

APPR poison in # 15, 17, & 29. (+ also #23 plate C-16 is now in slot 11 of box 15

SS 11-15	16
C-24	31
SS 11-31	24
C-30	29
SS 11-29	30

Subcritical - full water height, blackout.

mass U^{25} = 17.075 kg

Expr. 13-6 Time 11:45 AM (PM) Date 12-6 1955

Purpose Rod Evaluation with Boron.
Boxes in close position at one central in; other eccentric completely out.

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM

Instrument and Safeties Checked and Reset by

"Source In" Checked by DW Source No.

Emergency Equipment in Control Room Checked by DM

Red Light On by MJS

Start-Up OK'd by DW Time 11:45 AM (PM) Date 12-6 1955

Loading: same ful loading as 13-4 together with the box positions of 13-5.
exapt: boxes 1, 3, 5, 14, 16, 18, 28, 30, 32, 41, 43, & 45 are the only ones containing [redacted] SS in slot 11; the rest contain boron series "C".

Subcritical

Expr. 13-7 Time 12:10 (AM) PM Date 11-7 195 5
Purpose Rod evaluation with boron — 3 ecc. rods in close position + central rod in. One eccentric out.
Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by DM
Instrument and Safeties Checked and Reset by DW.
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by RJ.
Red Light On by MB
Start-Up OK'd by DW Time 12:10 (AM) PM Date 11-7 195 5

Loading: same fuel loading as 13-1 together with the box changes mentioned in 13-5.

Boron loading - listing is position # not box #. Proper plate is in each box. Boron is in slot 11 in the following positions. (In the rest of positions, ss. is in slot 11):

1, 3, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 41, 43, + 45. (total of 25)

Total mass B^{10} = 4.44 gm. (in 25 plates)

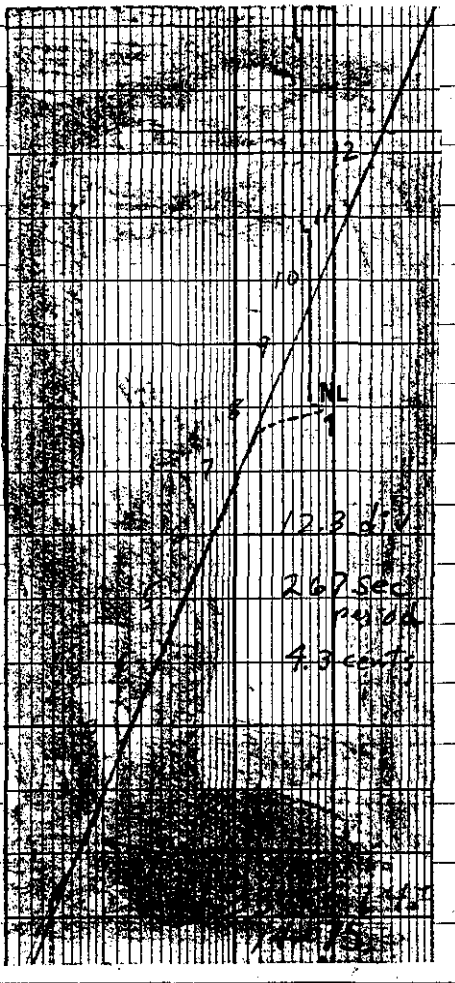
Total mass U^{25} = 17.075 Kg.

Critical Conditions:

Temp.	71.25°F		
De-3	69 (20x10)	Water	109.4 cm
Log N	0.15	APPR Control	0.05 in
R-1	3.58 (100x1000)		
		Control Rod	29.01
		Blade	11.33

Rod positions - 15, 17, 23, 29: rods in full; no fuel attached
position: 31; rod will fuel section attached full out.

blade pulled to 14.07 & period measured.



Expr. 13-8 Time 1:10 (A.M.) P.M. Date 12-7 1955

Purpose Rod evaluation with boron — 4 ecc. in full & in close position. Central rod out.

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ. Personnel Check by DW

Instrument and Safeties Checked and Reset by DM

"Source In" Checked by DW Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by DW Time 1:10 (A.M.) P.M. Date 12-7 1955

Loading - exactly the same as 13-7 except the control rods in positions 31 & 23 have been physically interchanged.

∴ Now, APPR rods in positions 15, 17, 29, & 31 in full. Have no fuel on bottom

APPR rod in position #23 completely out; fuel section attached.

Not critical - water up; blade out.

Log N 0.015

Expr. 14-1 Time 6:50 AM Date 12-7 1955
Purpose Critical mass with boron.
(No APPR rods)
Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	50	1 3"	
Log N		12sec.		
R-1	✓	5.5	.8 x1000 x100	
R-2				
P. M.	✓	900V	3"	

START-UP CHECK-LIST

Equipment Checked by RS Personnel Check by DM
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB 7:50 AM
Start-Up OK'd by JL Time [illegible] AM PM Date 12-7 1955

Loading:

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	2	3	4	5	6	7	8	9	7	"C"	12	13	2	15	9	1	10
Material	f	f	f	f	f	f	f	f	f	f	B	f	f	f	f	f	f	f

fuel loading – complete loading of 9. (12.6 kg U^{25})
Boron loading – loading of 1-1/2 plate in all boxes except 3, 15, 17, 20, 26, 29, 31, + 1/3. (6.56 gm B^{10})
Note: fuel boxes are all in normal position except: because of bad box, box 22 is replaced by box 9; in position 9, an APPR rod-bottom + "dummy" rod are inserted. All fuel numbers correspond to their position. (not box)
Much too reactive: critical at ~ 77½ cm. water height.

Expr. 14-2 Time 8:20 AM PM Date 12-7 1955
Purpose Critical Mass with Boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM
Instrument and Safeties Checked and [illegible] JL
"Source In" Checked by JL [illegible]
Emergency Equipment in Control Room [illegible] by DM
Red Light On by MB
Start-Up OK'd by JL Time 8:20 AM PM Date 12-7 1955

Loading exactly the same as 14-1 except slot 16 row 5 contains servo fine fuel instead of servo 9.

Still too reactive - water height ~ 88.7; critical

JF

Expr. 14-3 Time 8:50 AM PM Date 12-7 195 5
Purpose Critical mass with boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DW
Instrument and Safetics Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by DM
Red Light On by MB
Start-Up OK'd by JL Time 8:55 AM PM Dated 12-7 195 5

Loading: exactly the same as 14-1 except slot 16.
In all boxes slot 16 now contains seven five plates except in positions 7, 9, 11, 21, 23, 25, 35, 37, +39. in which slot 16 contains S.S.

U mass = 11.75 kg U^{25}

Boron = 6.56 gm B^{10}.

Temp. 72°F

$\log N \approx 0.1$

Reactor sub-critical. Blade out, rod out, water up.

We were slightly sub-critical. It is felt that the reactor would have been critical had we left in the last plates in 21 & 25 ~~It is felt that~~

54

Expr. 14 – 4 Time 9:30 AM PM Date 12-7 195 5
Purpose CRITICAL MASS WITH BORON ROD EVALUATION
Personnel:

START-UP CHECK LIST
Equipment Checked by J. L. Personnel Check by J. L
Instrument and Safeties Checked and Reset by D. M
"Source In" Checked by D. M. Source No
Emergency Equipment in Control Room Checked by D. W.
Red Light On by J. L
Start-Up OK'd by M. B. Time 9:30 AM PM Date 12-7 195 5

LOADING SAME AS 14-1 EXCEPT SLOT 16
SLOT 16 NOW CONTAINS SERIES 5 PLATE
EXCEPT BOXES 7, 9, 11, 23, 35, 37, 39
which contain S.S.
U MASS 11.78 Kg – U^{25} MD
B " 6.56 gm B^{10} 34.93 g Natural B

TEMP 72 11.78
LOG N 0.11 .02 MD
WATER 109.3 cm. 11.76 with blade out
DC-3 69 x10 y10
CONTROL BLADE 14.45
ROD 29.01
NO APPR RODS

Expr. 14.5 Time 10:20 (AM) PM Date 12-7 1955
Purpose Critical mass with Boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by R.J. Personnel Check by J.L.
Instrument and Safeties Checked and Reset by RJ.
"Source In" Checked by RJ. Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-up OK'd by RJ Time 10:20 (AM) PM Date 12-7 1955

Loading.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	4	5	6	7	8	9	7	11*	12	13	2	[redacted]	16*	1	10
material	f	S	[redacted]	S	S	f	S	f	S	f	S	f	S	f	S	S	S	f

* Boron series C

slot 11 contains [redacted] in boxes: 1, 3, 5, 6, 8, ... 40, 41, 43, 45.

slot 16 contains series 5 fuel in boxes: 8, 10, 21, 25, 36, 38.

Total U mass = 11.27 kg U^{235} ; 11.29 kg U^{235}

Total B mass = 4.26 gm B^{10} 22.44 g of B

Not critical, water up, blade & rod out.
with sources out, reactor going on "source" period.

Expr. 14-6 Time 10:55 AM PM Date 12-7 1955

Purpose Critical Mass with Boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB

Instrument and Safeties Checked and [illegible] RJ

"Source In" Checked by RJ [illegible]

Emergency Equipment in Control Room Checked by JL

Red Light On by MB

Start-Up OK'd by RJ Time 10:55 AM PM Date 12-7 1955

Loading - same as 14-5 except slot 16.

Slot 16 contains 3 s. in all boxes except 8, 10, 14, 18, 28, 32, 36, 38

Still sub-critical.

21, 25, 28, 32, 36, 37, 38

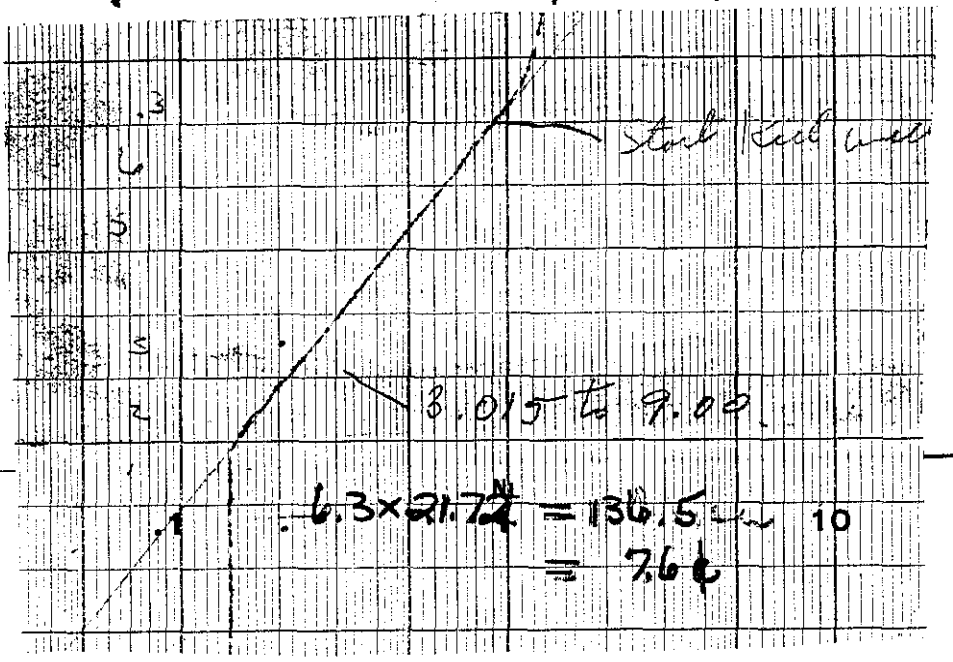
U mass = 11.37 kg U^{25}
Boron mass = 4.26 gm B^{10}

Critical Conditions:

Temp.	71.5°F	Height	109.2 cm.
Log N.	.15	Blade	3.015 in
DC-3	57 (10×20)	Rod	29.01 in

blade width 11.38 − .06 = 11.32

Rod pulled to 9.00 in.; positive period measured.



Expr. 14-7 Time 11:38 AM PM Date 12-7 1955
Purpose Critical Mass with Boron

Personnel:

START-UP CHECK LIST

~~Equipment Checked by~~ MB ~~Personnel Check by~~ JL
Instrument and Safeties Checked and Reset by JL
~~"Source In" Checked by~~ RD ~~Source No.~~
Emergency Equipment in Control Room Checked by MB
~~Red Light On by~~ MB
Start-Up OK'd by RD Time 11:30 AM PM Date 12-7 1955

Loading - same as 14-5 except slot 16
Slot 16 contains ss in all boxes except 8, 9, 10, 14, 18
21, 25, 28, 32, 36, 37, 38.

U mass = 11.37 kg U^{25} — 11.38 ✓MD
Boron Mass = 4.26 gm B^{10}

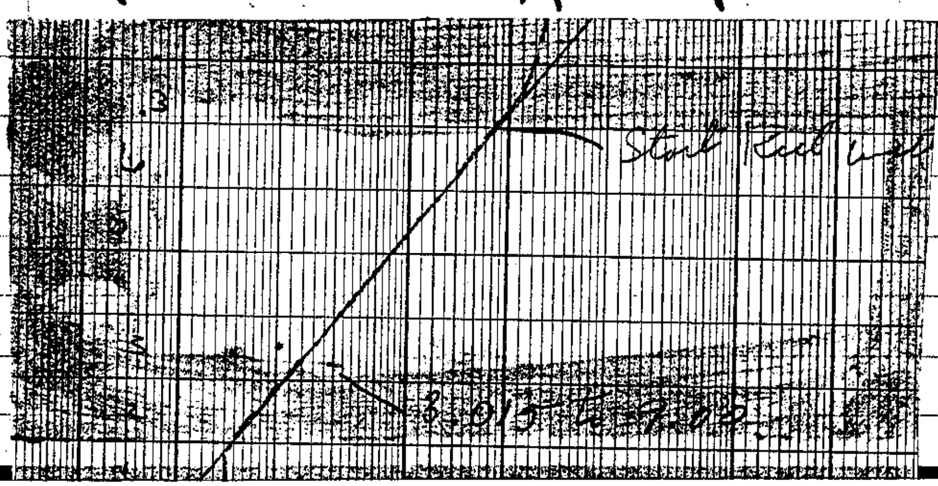
11.38
− .05 blade worth ... 2nd e...
11.33

Critical Conditions:

Blade worth: 11.38 − .06 = 11.32

Temp.	71.5°F	Height	109.2 cm.
Log N.	.15	Blade	3.015 in
DC-3	57 (10×20)	Rod	29.01 in

Rod pulled to 9.00 in.; positive period measured.



12-8-55

Preliminary solution analyses (uncorrected for iron)

1.1329 Spec. Grav

0.09698 gm U / gm solution

0.1099 gm U / cc

0.102 gm U-235 / cc

9213 Spec grav Meas. 1.1197

0.1086 gm U / cc

0.1012 gm U-235 / cc

Design Element

2240 ± 10 cc

on 0.104 gm U-235 / cc

12-13-55,

Y-12 analytic lab requisition # 354736 gave for solution analysis:

0.096550 gm U / gm solution.

0.08998 gm U^{235} / gm solution.

Exp. 15-1 Time 6:30 P Date 12-8 1955
Purpose Homogenity effect. – zero run.

Personnel:

INSTRUMENT CHECK

Date 12-8 1955 Time ______ AM PM House No. ______

Instrument	Time	Scale	Source Distance	Start-Up Scale
BF-1				
BF-2				
DC-3	✓	47	10x20	
Log N	✓		12 cm.	
R-1	✓	5	3x1000	
R-2		3	x100	
R. M.	✓			3"

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by DW, MB
Instruments and Safety ... MB
"Source In" ... MB ... MB
Emergency ... MB
Red ... MB
Start ... MB 630 8 Dec 5

Loading: "Cold Clean Critical", $7\frac{1}{2}^{+}$ plates/Box

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	2	3	4	5	6	7	5*	9	7	11	12	11	14	15	8	1	10
Type	F	S/S	F	S./S.	S./S.	F	S/S	F/2	S/S	F	S/S	S/S	F	S/S	S/S	F	S/S	F.

*Slot 8, Boxes 7, 11, 35, 39.

			Fuel Plate
Box.	7	Slot 8	# 3-41
"	11	"	MAC 378
"	35	"	4-20
"	39	"	6-40

Loading / Box w/ $7\frac{1}{2}$ plates = 233 gms U^{235}
Mass. 10.562

Critical.

Log N - .105	Control Blade 7.39
DC-3 76 x [redacted] x 10	Control Rod 29.01
Water Ht 109.5	Temp. 72° F.

[redacted]s

It was decided to pull the equivalent of 2-½ plates in order to put the critical position of the blade further out. This is in anticipation of an increase in reactivity of ~15¢ when the Homogeneous element is substituted for a Normal Fuel Box.

Note: Boxes are in the same location as listed on page 51.

Expr. 15-2 Time 7-15 PM Date 8-Dec 1955
Purpose Homogeneity Effect - Zero Run
- Adjusting Blade position by removing Mass
Personnel: MB, JL, RJ

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
~~Source In~~ Provided by MB Source No:
Emergency Equipment in Control Room Checked by RJ
~~Red Light~~ On by RJ
Start-Up OK'd by MB Time 715 PM Date 8-Dec 1955

Loading: Same as 15-1, except the following ½ plates were substituted for full plates in Boxes 7+39.

Slot	Box	Plate	Substituted For	Plate
8	7	5-7 (½ Plate)	"	3-41 (Full Plate)
8	39	5-39 "	"	6-40

Mass. 10.531

Critical:

Log N - .103
DC-3 74 1/10x10
Water Ht - 109.7

~~Cal~~ Control Blade 12.49
Control Rod 29.01
Temp 72°F

The remaining 2 full plates in Slot 8 will be replaced in order to give more Control Blade area to control the homogeneous Box.

Results.

2-½ plates in Box 7+39 are worth - (12.46 - 7.39) = 5.07 in.
This is worth 8.3¢ from chart (calibration curve) or 0.2674 $\Delta k/k$

Expr. 15-3 Time 7.40 Date 8 Dec 1955
Purpose Homogeneity Effect - Zero Run

Personnel: MB JL - RJ DW

START-UP CHECK LIST
Equipment Checked by MB Checked by JL
Instrument and Safeties Checked JL
Source In Checked by MB
Emergency Equipment Checked RJ
Red Light On by RS
Start-Up OK'd by MB Time 7-40 PM Date 8 Dec 1955

Loading: Same as 15-1, with no extra full plates, uniform 7½ Plates/Box.
Mass - 10.5 Kg U^{235}

Critical:

Log N .112	Control Blade 20.91
DC-3 76 x 10 x 10	Control Rod 29.01
Water Ht 109.5	Temp: 72° F

From the control blade evaluation curve, this change in position (between 15-3 & 15-2) is worth ~~4.2~~ $ 10.7¢
The fuel in this position is ∴ worth ~~0.33~~ ¢/gm U^{25}
when averaged with 15-2, the fuel worth comes out to be ~~0.291~~ ¢/gm U^{25} for this position.

Expr: 15-4 Time 9:45 AM (PM) Date 12-8 1955
Purpose Homogeneity effect - homogeneous box in position 37.
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by JL
Instrument and Safeties Checked and Reset by DW
"Source In" Checked by DW Source No
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DW Time 8:45 AM (PM) Date 12-8 1955.

Loading - "pure" 7½ loading - same as 15-1 without the extra full plates.

In position 37, the special fuel box has been inserted. This box is a water-tight container the same size as the fuel box. Eighteen S.S. plates in normal position are inside the box.

See note p. 4

The box contains 2,529.5 gm. of solution or ± 2 gm. of U^{235}. The rest of the boxes contain 7½ plate of fuel or 253 gms U^{235}.

Critical Conditions.

(1.) Water height 99.2 cm. Rod 29.01
Log N 0.062 Blade 0.01.

(2.) Rod inserted. Water taken up.
Water height 109.4 cm. Rod 15.25
Log N 0.205 Blade 0.015
DC-3 82.5 (10x20)
Temp. 72.5°F

Rod withdrawn to 29.02 Positive period measured

For a factor of 10, the period to 40 divisions.

40 × 21.72 = 869 sec

= 1.44 ¢

The blade from 20.91 to 0 is worth ~~23.9~~ 24.8 ¢
(from rod calibration curve)

∴ The total change in reactivity between runs 15-3 & 15.4 is ≈ 25.3 ¢

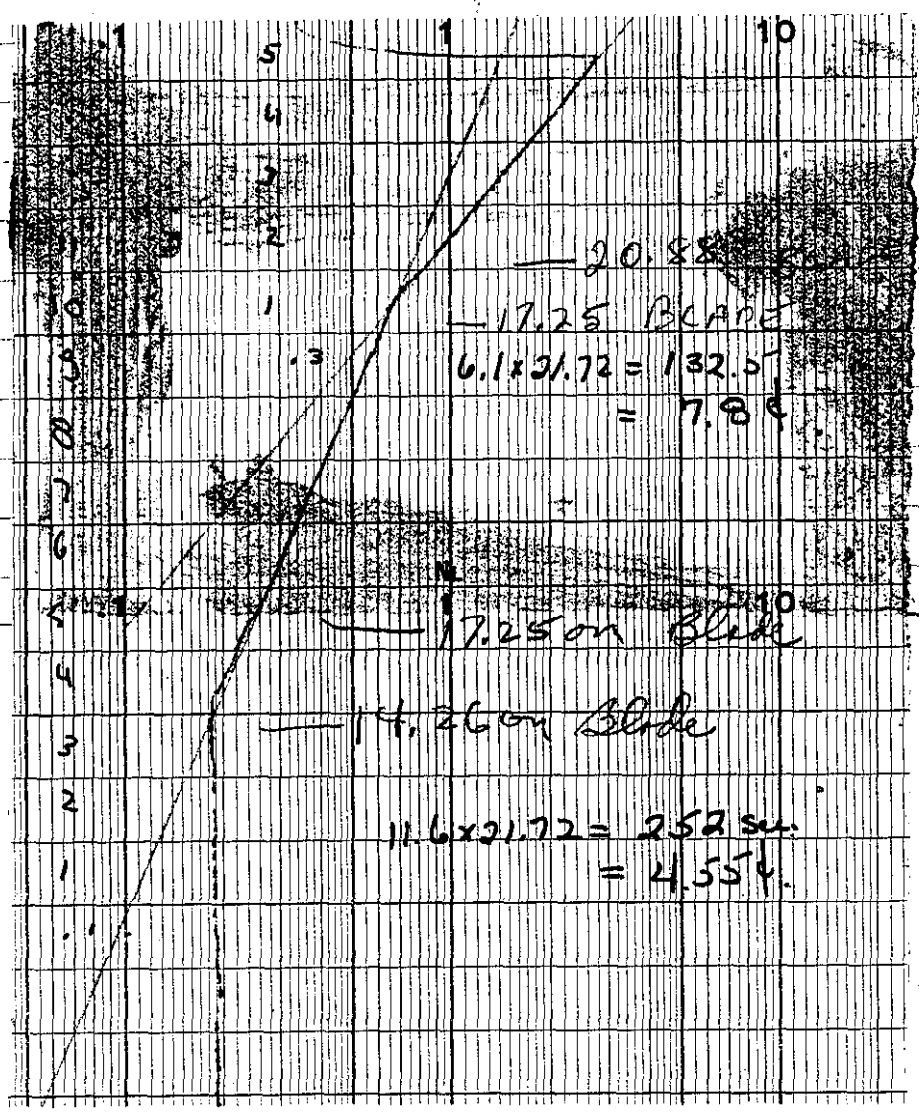
Note. Volume of solution in container was determined by three methods: weight loss of container: 2,529.5 ± 1 gm.
weight gain of element. 2525 ± 1 gm.
volume of material put in element. 2250 cc.
Using the average of the density measurements (pg 58) together with the volume measurement, the mass inserted [redacted] gm.

2257.5

Critical Conditions.

Height	109.3	Log N	0.195
Rod	29.02	DC-3	75.5 (10×20)
Blade	14.26	Temp	71.5°F

Blade pulled to 17.25" positive period measured
Blade pulled to 20.88 ; positive period again measured.



Expr. 15-5 Time 9:50 AM PM Date 12-8 1955
Purpose Homogeneity effect. - homogenious box in position #3.
Personnel:

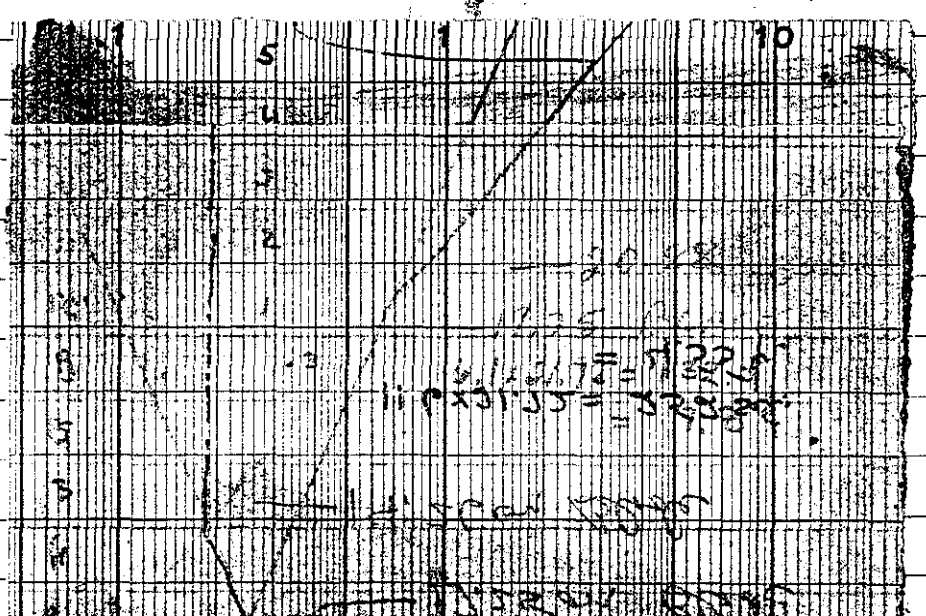
START-UP CHECK LIST
Equipment Checked by [redacted] Personnel Check by DW
Instrument and Safeties Checked and Reset by DW
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DW Time 9:50 AM Date 12-8 55

Loading exactly the same as 15-4 except the Homogenious box is now in position #3.

Critical Conditions.

Height	109.3	Log N	0.195
Rod	29.02	DC-3	75.5 (10×20)
Blade	14.26	Temp.	71.5°F

Blade pulled to 17.25 positive period measured
Blade pulled to 20.88 ; positive period again measured.



Expr. 15-6 Time 10:45 AM PM Date 12-8 1955
Purpose Homogeneity effect - New zero point evaluation.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DW Time 10:45 AM PM Date 12-8 1955

Loading - same as 15-4 (including homogenious box in position 37) except half plates pulled from boxes 21 & 25.

Critical conditions.

Height	109.4	Log N	.19
Rod	29.02	De-3	72 (10×20)
Blade	16.25	Temp.	71.5°F

This has evaluated the fuel in half plates boxes 21 & 25.
∴ Value of blade at 16.25 is 20.2 ¢. (from calibration curve.)
∴ The value of the fuel is therefore 20.2 + 1.44 = 21.6 ¢.
(0.695 ¢/gm U^{25})

MB

Expr. 15-7 Time 11:15 AM PM Date 12-8 1955
Purpose Homogenity effect - Homogenious element in position 23
Personnel:

START-UP CHECK LIST
Equipment Checked by RJW Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 11:15 AM PM Date 12-8 1955

Loading: same as 15-4 with the homogenious box in position 23. - Complete loading of 7½ plates with the half plates removed from boxes 7, 11, 21, 25, 35 & 39.

The value of the half plates removed is assumed to be 8.3 ¢ + 9.8 ¢ + 21.6 ¢ = 39.7 ¢ from experiments 15-2, 15-3, & 15-6 respectively.

J

Expr: 15-7 Time 11:15 AM/PM Date 12-8 1955
Purpose Homogeneity effect - new zero point evaluation
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 11:15 AM/PM Date 12-8 1955

Loading - complete loading of 7½ with half removed from 7, 11, 35, 39. Homogenious element in #37. (For series numbers, see page 59)

Condition

Log N	0.14	Water	109.1
DC-3	51 (10×20)	Rod	29.01
Temp.	71.5°F	Blade	15.995

∴ The value of the half plates in 7, 11, 35, 39 is the value of the blade from 16 to 0 plus 1.44¢ (see experiment. 15-4)
This is (from the blade calibration curve)
19.99 + 1.44 = 21.43¢.
MB

Expr: 15-8 Time 11:50 AM/PM Date 12-8 1955
Purpose Homogeneity effect - homogenious element in position 23.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 11:50 AM/PM Date 195

Loading - complete loading of 7½ with half plates removed from 7, 11, 21, 25, 35, & 39. Homogenious element in #23. (For series numbers, see page 59.)

The total value of fuel removed from the reactor from the original zero point (15-3) to this loading is 21.43¢ (exp. 15-7) plus 21.6¢ (exp. 15-6) or a total of 43.0¢.

Log N	0.11	Height	109.4
Dc-3	79. (10×10)	Rod	29.01
Temp.	72°F	Blade	13.06

The blade value between 20.9 (exp 15-3) + 13.06 (this exp.) is ~~9.6~~ 12.3¢.
∴ The total reactivity change between the "zero" run (exp. 15-3) + having the homogenious box in position 23 is ~~9.6~~ 12.3¢ + 43.0¢ = ~~52.6~~ 55.3¢.

Expr. 16-1 Time 6:00 AM (PM) Date 12-14 1955
Purpose Zero-run: Δk/k / Δm/m experiment
Personnel:

INSTRUMENT CHECK

Date 12-14 1955 Time 6:00 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	45	10×20	
Log N	✓	Log sec.		
R-1	✓	4.5	.8×1000 ×100	
R-2				
P. M.	✓		3"	

START-UP CHECK LIST

Equipment Checked by RJ Personnel Checked by MB
Instrument and Safeties Checked and Set by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by MB+JL AM
Start-Up OK'd by Time 6:00 (PM) Date 12-14 1955

Loading - a straight 7½ with these additional plates:

Box 7 contains 6-40 in slot 8 instead of it's half plate.
11 " 3-41 " " " " " "
35 MAC#378
39 4-20
43 1-17

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	2	3	4	5	6	7	5	9	7	11	12	11	14	15	8	1	10
Material	f	$\frac{S}{3}$	f	$\frac{S}{3}$	$\frac{S}{5}$	f	$\frac{S}{5}$	f	$\frac{S}{5}$	$\frac{S}{5}$	f	$\frac{S}{6}$	$\frac{S}{6}$	f	$\frac{S}{6}$	$\frac{S}{6}$	f.	

Note: Yesterday evening when we went to take the homogeneous box out of the core & found that it has been leaking solution. The contamination in the tank was very well localized to the box #24, the center plug, & the rubber cover over the dump valve. (See previous page)

Conditions — super critical.
blade in; rod in; water up

It is desirous to get the zero run condition with the blade near zero.

We are pulling, therefore, full plate 4-20 out of slot 8 of box 39 and re-inserting plate 5-39

12-13-55

To determine the amount of U solution lost from the liquid fuel element, its contents were removed and weighted.

3571 g. = wt of Red solution bottle (final)
1059 g. = tare wt. of bottle (some solution still in it)
2512 g = amount removed from liquid element

∴ 13 g short of original wt in element (p. 64)

Wt. of solution removed (in five steps: 470 cc, 452, 401, 446 and 393 = total of 2242 cc

∴ ~8 cc lost from water added of 2250 cc (p. 64)

(Cont. bottom p 72)

Expr. 16-2 Time 6:45 AM (PM) Date 12-14 1955
Purpose Zero Run

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by RJL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by JL Time 6:45 AM (PM) Date 12-14 1955

Loading - Same as 16-1 except 4-20 removed & replaced by 5-39.

Critical Condition:

Height	109.6 cm	DC-3	89.1 (10×10)
Rod	13.13	Log N	0.11
Blade	0.03	RI	4.75 (50×1000)

Man = 10.562 Kg
- .050 for Blank
10.512 Kg Crit. Mass

12/14/55 10P

Water sampled following mixing in Runs 16-2, 3 & 4-

Sample Req 354741
Gross wht 76.759 gm.
Tare 45.373
Net 31.386

12/15 Result (by phone) 0.03 ppm U
(~ 0.2 gm U in 1500 gal).

Expr. 16-3 Time 8:15 AM PM Date 12-14 1955
Purpose C.C.E. loading:
slot 10, box 25 removed.

Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by JL Time 8:45 AM PM Date 12-14 1955

Loading - same as 16-2 except fuel in slot 10, box 25 removed & replaced by s.s. : fuel 7-25 replaced by s.s. 10-25

Log N 0.09
Temp. 73°F

Barely subcritical with source out.
Blade out. Rod at 13.13.

74

Expr. 16-4 Time 9:25 Date 12-14 195 5
Purpose CCC loading Slot 8 box 25
½ plate removed
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Safety Check by MB
Instrument and Safeties Checked by JL
"Source In" Checked by MB
Emergency Equipment in Control Room Checked by JL
Red Light On by JL
Start-Up OK'd by MB Time 9:25 AM Date 12-14 195 5

Loading same as 16-2 except 55 now in slot 8 & 5-25 removed from slot 8 box 25

Critical conditions

Height	109.4	DC-3	82 (10x10)
Rod	13.13	Log N	0.103
Blade	12.09	RCT	2.25 K (100x1000)
Temp	72.5°F		

12.09" = 13.3 ¢ which is

width of ½ fuel plate in slot 8 of box 25

Expr. 16 — 5 Time 11:05 AM (PM) Date 12-14 1955
Purpose Zero with one full boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by JL
Instrument and Safeties Checked and [illegible] DUPW
"Source In" Checked by DUPW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by DUPW Time 11:05 AM (PM) Date 12-14 1955

Loading - complete loading of 9½ with one full boron plate per box.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	2	3	4	5	6	7	5	9	7	9	12	11	"B"	15	8	1	10
material	f	s	f	s	f	f	s	f	s	f	f	s	f	B	s	f	s	f

Mass U = 13.3 kg U^{25} 13.295 Kg 4-23-1

Mass B = 850 gm Nat. Boron

Sub-critical

LogN 0.15

Source out; bleeder rod out; water up.

Considered ~~crit~~ within 1% criticality.

Expr. 16-6 Time 11:30 (AM) PM Date 12-14 1955
Purpose Critical mass with one full boron

Personnel: - - -

START-UP CHECK LIST

Equipment Checked by DC Personnel Check by DC
Instrument and Safeties Checked and Reset by DC
"Source In" Checked by DVPW
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by DVPW Time 11:30 (AM) PM Date 12-14 1955

Loading - same as 16-5 except half plates in boxes 7+35 replaced by full plates.

5-7 replaced by 6-40x
5-35 " " 1-17x ✓MB

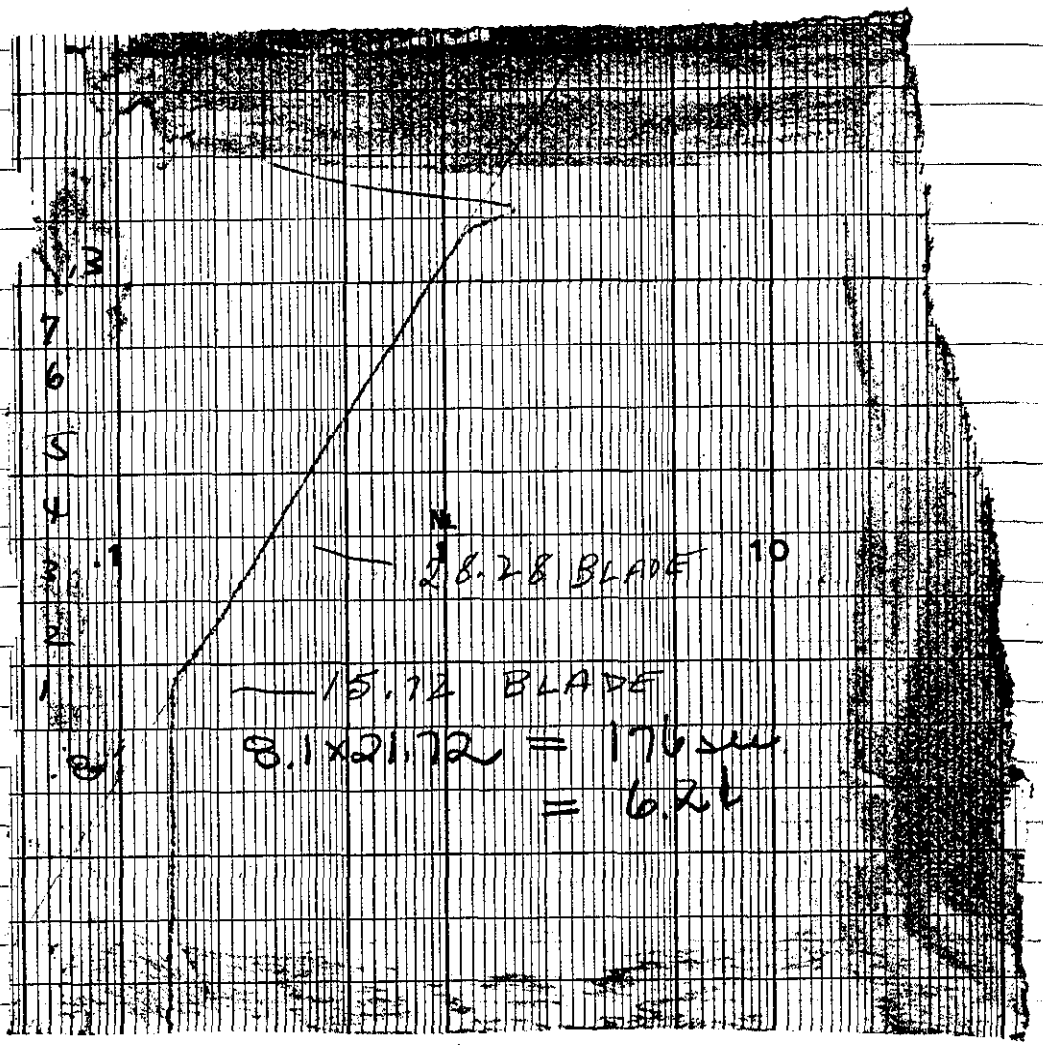
U mass = 13.34 Kg U^{25} 13.33 Kg - u-235
Boron mass = 85.0 gm. Nat boron. 85.0 gm B
13.31 Kg. - u-235 contained

Critical Conditions.

Height	109.6 cm.	DC-3	60(10x20)
Blade	15.72 in.	R-1	3.4(100x1000)
Rod	29.01 in.	Log N	0.15
		Temp.	75°F

Blade pulled to 28.20: positive period measured.

Blade correction = 0.03
mass with blade correction = 13.30



9.5 x 45 = 427.5

.5 x 2 = 1

427.5 x 33.4 = 14,229 kg

x 31.1 = 13,295 kg U-235

Expr. 16-7 Time 12:05 (AM) PM Date 12-15 1955
Purpose Critical Mass with one full boron.

START-UP CHECK LIST
Equipment Checked by DC Personnel Check by DC
Instrument and Safeties Checked and Reset by DVPW
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB (AM)
Start-Up OK'd by JL Time 12:05 PM Date 12-15 1955

Loading - same as 16-5 except half plates in boxes 7, 21 & 35 replaced by full plates.

5-7 replaced by 6-40*		13.295
5-21 " " #378		+ .047
5-35 " " 1-17*		+ 13.342
		- 26 plates
		13.316

Critical ~~Height~~ Conditions

Blade	11.635	Log N	0.1 ↓
Rod	29.01	DC-3	55 (10×20)
Water	109.3	R-1	3.1 (100×1000)
		Temp.	73°F

Expr. 16-8 Time 12:25 (AM) PM Date 12-15 1965
Purpose $\Delta k/dm$ evaluation — one full boron plate per box.
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On MB
Start-Up OK'd by RJ Time 12:25 (PM) Date 12-15 1965

Loading — same as 16-7 except half plate in box 25 replaced by S.S.
5-25 replaced by S.S. 8-25

Critical Conditions.

Water	109.2	LogN	.15
~~Rod~~ Blade	15.32	DC-3	56 (10x20)
~~Rod~~ Rod	29.01	R-1	3.2 (100x1000)
		Temp.	73 °f

Using the c.c.c. blade calibration curve (which from exp. 16-6 looks to be valid), the value of the fuel in slot 8 turns out to be 6.21 cents.

/ 80

Expr. 17-1 Time 6:20 AM (PM) Date 12-15 1955
Purpose Effect of bumping [redacted] boron.
Zero Run
Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source No.
Emergency ~~Equipment in Cont. Room~~ Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 6:20 AM (PM) Date 12-15 1955

Loading: complete loading of 9½ plus four exchanges of ~~half~~ plates by full plates.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Swing	1	2	3	4	4	6	7	5	9	7	9	12	11	"B"	15	8	1	10
Material	f	5/5	f	5/5	f	f	5/5	f	5/5	f	f	5/5	f	B	5/5	f	5/5	f

except. slot 8 box 7 contains 6-40* instead of 5-7
21 " #378 " " 5-21
35 " 1-17* " " 5-35

INSTRUMENT CHECK

Date 12-15 195[illegible] Time 6:20 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓			
Log N	✓	12 cm.		
R-1	✓	5	1000X	
R-2			100	
P. M.	✓		3"	

Water up, blade out, rod out, source out.
LogN 0.8
Reactor sub-critical

Expr. 17-2 Time 7:00 AM (PM) Date 12-15 1955
Purpose Effect of lumping boron
Zero Run
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 7:00 AM (PM) Date 12-15 1955

Loading: Same as 17-1 plus:

full plate in slot 8 box #11 (1-16½ in → 5-11 out)
25 (1-19½ in → 5-25 out)
39 (3-4½ in → 5-39 out)

We thus now have a complete loading of 9½ plus 6 half plates.
Note: run 17-1 should have agreed with run 16-7. The "zero" seems to have taken a drastic shift.

Critical conditions:

Blade	13.33	Log N	0.91
Rod	29.01	BF_3	67 (10×10)
Water	109.2	R-1	4.1 (50×1000)
		Temp.	73°F

Expr. 17-3 Time 8.20 ○ Date 16 Dec 1955
Purpose The Effect of Lumping Boron
~~Correction~~ (Full Boron replaced By 2 ½ plates)
Personnel: MB DW RS

START OF SHIFT
Equipment Checked by MB Safety Check by RS
Instrument and Safety Check by MB
"Source In" Checked by MB
Emergency Equipment Checked by DW
Red Light On by DW
Start-Up OK'd by MB Time 8.20 ○ Date 14 Dec 1955

Loading: Same As 17-2: ~~Except~~ Except The Boron Full plate in slot 14, Box 23 was Replaced By Boron ½ plates in Slots 14 + 2., and steel removed from slot.

Subcritical: Source Out, Rod Blade out,
Log N .1

By Changing the Boron from a single full plate to two ½ plat the effect of Boron Poisoning is increased.
The apparent magnitude of this effect is > 29." - 13.3" on the Control Blad
≥ 27 - 16 = 11¢

Expr. 17-4 Time 9.00 AM (PM) Date 15 Dec 1955
Purpose The effect of Lumping Boron (Evaluation of Fuel)
Personnel: MB, JL RJ

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by RS
Instrument and Safeties Checked and Re[illegible] JL
Source In" Checked by MB [illegible] No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 900 AM (PM) Date 14 Dec 1955

Loading: Same as 17-2, except that a full Fuel plate 1-15 was put in place of ½ plate 5-37, in slot 8 of Box 37.

Critical.

Water. 109.5	Control Blade 12.46
Log N .1	Control Rod 29.01
DC-3 77 X10X10	Temp 72.5°F

The apparent effect of loading the extra ½ fuel plate was only of the order of ¢. At This point it was decided to recheck the Zero loading of 17-2.

Expr. 17-6 T 930 O 16 Dec 1955
Purpose The effect of Lumping of Boron
[Recheck Zero Run (17-2)]
Personnel: MB JL WRS

Equipment Checked by MB Checked by RJ
Instrument an[illegible] MB
"Source In[illegible] MB
Emergency [illegible] JL
Red Light On by JL
Start-Up OK'd by MB 930 O Date 14 Dec 1955

Loading: Same as 17-2

Critical:

Water 109.5	Control Blade 16.49
Log N. .11	Control Rod 29.01
Dc-3 76 x10x10	Temp 72.6

The "Zero" position found for this loading in run 17-2 was at 13.33" on the Control Blade.

Higher power level position was:

Critical

Water 109.5	Control Blade 15.01
Log N - .19	Control Rod 29.01
DC-3 79.5 x10x20	TEMP. 72.5

Expr. 16-9 Time 10:40 AM Date 12-15 1955
Purpose Critical Mass with boron
1½
Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB
Instrument and Safetys Checked and Reset by JL
"Source In" Checked by RJ
Emergency Equipment in Control Room Checked by MB
Red Light On by RJ
Start-Up OK'd by RJ Time 10:50 AM Date 12-15 1955

Loading:

shot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	"C"	4	6	7	5	9	7	9	12	U	"B"	15	8	2	10
material	f	s	f	B	f	s	s	f	s	f	f	s	p	B	s	f	s f	f

Reactor very sub-critical blade out, rod out, water up.
Log N 0.01.

Expr. 16-10 Time 11:25 AM (PM) Date 12-15 195
Purpose Critical Mass with Boron — 1 + 1/2 plates
Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL
~~Instrument and Safeties Checked and Reset by~~ RS
"Source In" Checked by RJ Source No.
~~Emergency Equipment in Control Room Checked by~~ MB
Red Light On by MB
~~Start Up OK'd by~~ RS ~~Time~~ 11:25 AM (PM) ~~Date~~ 12-15 195 5

Loading - complete loading of 11.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	2	3	"C"	4	6	7	12	9	7	9	12	11	"B"	15	8	2	10
material	f	S_5	f	B	f	f	S_2	f	S_3	f	f	S_5	f	B	S_3	f	f	f

Critical at water height of 90.5 cm.

Log N = 0.12

DC-3 84 (5×10)

Rod out ; blade in. source out.

Too reactive: going to pull 12 - half plates.

Critical Conditions:

Log N	0.16	Height	109.2
DC-3	58.5 (20×10)	Blade	13.40
R-1	3.6 (100×1000)	Rod	29.01
Temp.	75°F		

blade correction = −.03

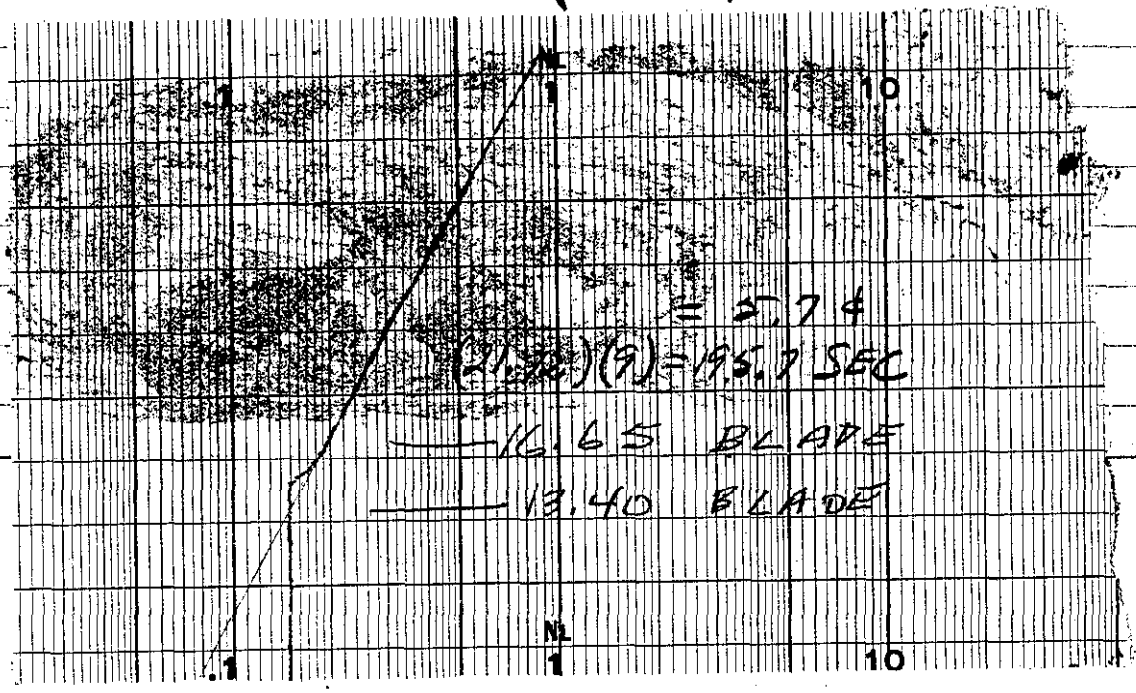
critical mass with blade = 15.18

U mass = 15.21 kg U^{235} — 15.208 kg ✓MB

B mass = 127.5 gm Nat B — .2° dia 4

15.178 kg 24

Blade pulled to 16.65 + positive period measured.



Expt. 16-11 Time 11:50 AM PM Date 12-15- 1965
Purpose Critical mass with boron — ½ plates

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 11:50 AM PM Date 12-15 1965

Loading — same as 16-10 except slot B contains half plates in the following boxes: 1, 3, 5, 14, 16, 18, 28, 30, 32, 41, 43, 45

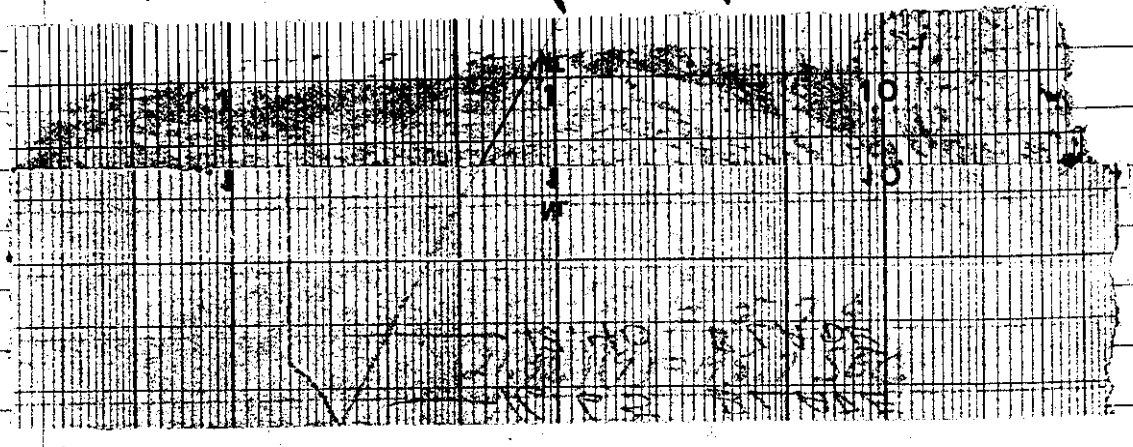
Critical Conditions:

Log N	0.16	Height	109.2
DC-3	58.5 (20×10)	Blade	13.40
R-1	3.6 (100×1000)	Rod	29.01
Temp.	75°F		

blade correction = −.03
critical mass with blade = 15.18

U mass = 15.21 kg U^{235} — 15.208 kg ✓MB
B mass = 127.5 gm Nat B — 20 blade
15.188 kg - 20

Blade pulled to 16.65 + positive period measured.



INSTRUMENT CHECK

Date 16 Dec 1955 Time 4.42 AM PM Trip (3) Source No.

Instrument	Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	85	X10X20	2in
Log N	✓	~125cc		Contact
R-1	✓	56	X100000	2 in
R-2				
P. M.	✓	✓		3 in

Expr. 16-12 Time 1700 AM PM Date 16 Dec 1955

Purpose Critical Mass w. Boron Zero Run

Personnel:

START UP CHECK LIST

Equipment Checked by JL Double check by JL RJ

Instrument and Safety Tags

Source In

Emergency Equipment Double checked by RJ

Red Light ON by RJ

Start-Up OK'd by RJ Time 1700 AM PM Date 16 Dec 1955

LOADING SAME AS 16-11 ZERO CHECK

CRITICAL CONDITIONS

WATER: HEIGHT 109.1 TEMP 73°

LOG N .155

DC 3 54 (10 X 20)

R1 3.4 (100/5 X 1000)

BLADE: ~~17.99~~ 16.50 IN.

ROD: 29.01

Expr. 16-13 Time 1805 AM PM Date 16 Dec 1955
Purpose Critical Mass with Boron
Fuel Evaluation for BK fam
Personnel: RJ JL

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by JL
Start-Up OK'd by JL Time 1807 AM PM Date 16 Dec 1955

Loading: Same as 16-12. except SS Plate 8-25 in Slot 8 Box 25 in place of fuel 12-25

The following full plates were put in in place of ½ plates, in Slot 8.

Full Plate	MAC 378	Box 1	in Place of ½ Plate		5-1
" "	1-17X	" 3	" " "	"	5-3
" "	4-20'	" 5	" "	"	5-5
" "	6-40X	" 41	" "	"	5-41
" "	1-16X	" 43	" "	"	5-43
" "	1-19'	" 45	" "	"	5-45

This extra fuel was added to Balance the removal of the fuel plate (12-25) and also to bring the critical Blade position ~~down~~ up ~~low~~ high enough so that the excess reactivity addition when a ½ plate is put in Slot 8 Box 25 can be measured on the Control Blade.

The Arrangement was Subcritical

Expr. 16-14 Time 18:59 AM PM Date 16 Dec 1965

Purpose Critical Mass with Boron
Fuel evaluation for ΔK/Δm measurement

Personnel: RJ, JL.

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL
Instrument and Safeties [illegible] RJ
Source In Checked by JL
Emergency Equipment [illegible] RJ
Red Light On by RJ
Start-Up OK'd by JL Time 1900 AM Date 16 Dec 1965

Loading: Same as 16-13 except ½ plate 6-13 is inserted in Box 13 Slot 9 ~~instead of~~ in place of SS 9-13

This arrangement was Subcritical

Expr. 16-15 Time 1925 AM PM Date 16 Dec 1955
Purpose Critical Mass with Boron
Fuel Evaluation for ΔK/ΔM measurement
Personnel: RJ, JL

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Reset by JL
Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by JL Time 1926 AM PM Date 16 Dec 1955

Loading: Same as 16-14 except ½ plate 5-27, is inserted in Box 28 Slot 9 in place of SS 9-28.

Critical:

log N .16	Control Blade 18.02
DC-3 56 x 20 x 20	Control Rod 29.01
Water Ht 109.8	Water Temp. 73°F

This critical position will be used to find the value of a ½ fuel plate added to Slot 8, Box 25, in place of a stainless steel plate.

15.301 k_eff of 25
- .006 g.
15.295

Expr. 16-16 Time 17:40 AM PM Date 16 Dec 1955
Purpose Critical Mass With Boron (Fuel evaluation) AK/km
Personnel: RJ, JL

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Tested JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by JL Time 1240 AM PM Date 16 Dec 1955

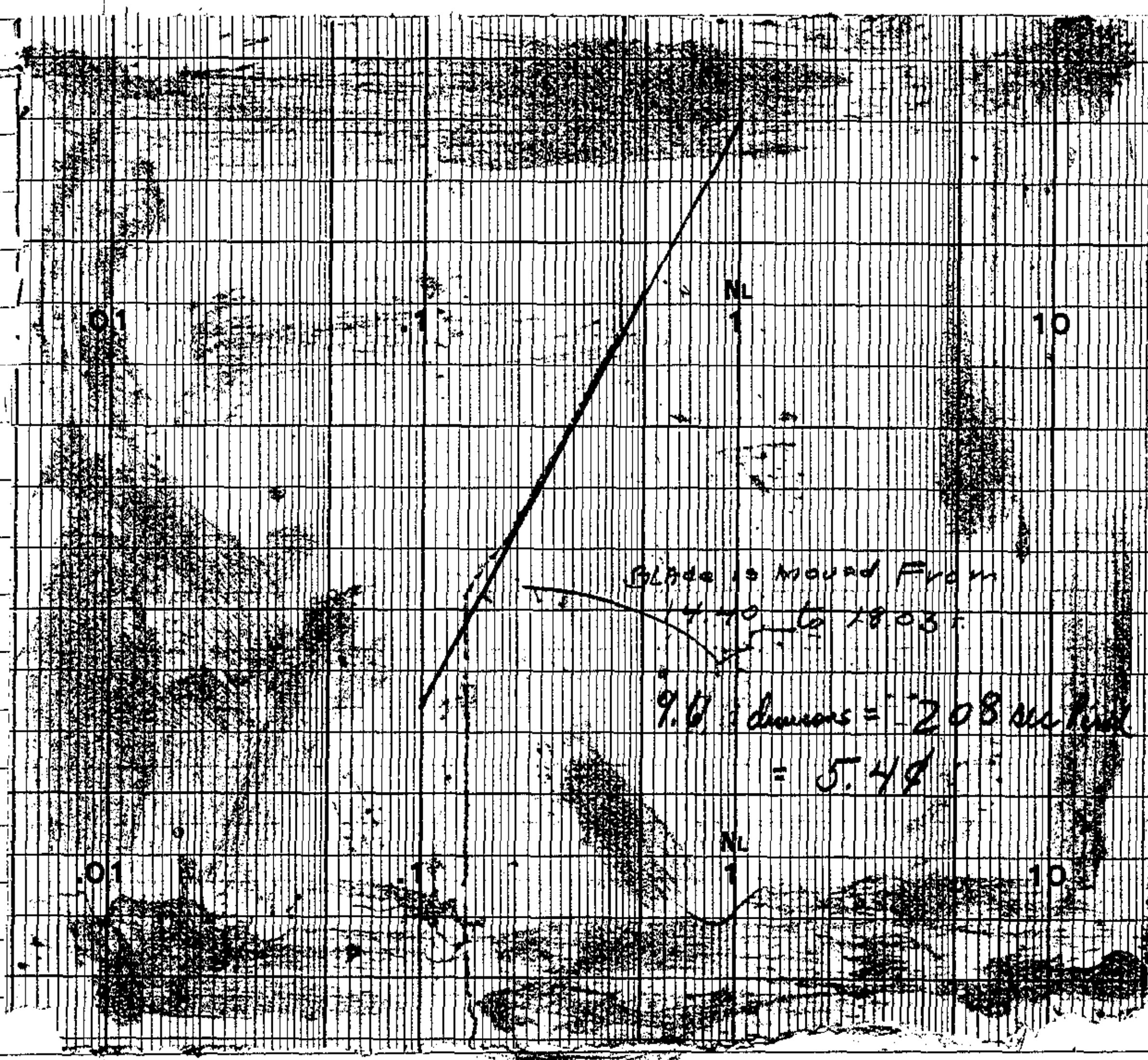
Loading: Same as 16-15 except that SS 8-15 in slot 8 of Bor 25 was replaced by ½ Plate 5-25.

This (Run 16) experiment compared with 16-15 will give the value of a ½ plate in slot 8 Bor 25.

Critical:

Log N.	.16	Control Blade	14.40
Oc3	54 x 10 x 20	Control Rod	29.01
Water Ht.	109.6	Water Temp	73 °F

Control Blade Pulled to 18.03 from 14.4 giving a ~~The blade was pulled to positive~~ positive period of 208 Sec.
This period calculates to be 5.4¢.


NL
.01
.1
1
10
Blade is moved from
4.40 to 1803
9.6 divisions = 208 sec
= 5.4
NL
.01
.1
1
10

Expr. 16-17 Time 2121 AM/PM Date 16 Dec 1955
Purpose Critical Mass With Boron 2 plates/Box

Personnel: DM, DW, RJ JL

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by RJ
Instrument and Safeties [illegible] JL
"Source In" Checked by DM
Emergency Equipment in Control Room [illegible] by RJ
Red Light On by RJ AM
Start-Up OK'd by DM Time 2121 PM Date 16 Dec 1955

Loading

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	6	5	12	9	7	9	14	11	"B"	15	8	2	10
Type	f	f	f	B	f	f	f/2 SS*	f	SS	f	f	f/2 ⊗	f	B	f/2	f	f	f

Equivalent to a full 13 plate/Box loading.

× Slot 7

Contains SS in Boxes 1-3-5-6-8-10 - - - 36-38-40-41-43-45

Contains ½ fuel (5) in Boxes 2-4-7-9-11- - - - 37-39-41-42-44.

(Note: Box 25 has fuel (5) in Slot 8, fuel 12-25 in slot 7)

⊗ Slot 12

Contains fuel Series 14 in Boxes 1-3-5-6-8-10 - - - 36-38-40-41-43-45

Contains fuel/2 Series 5 in Boxes 2-4-7-9-11- - 37-39-42-44.

Boron Mass = 2 x 45 x 1.889 gms = 170 gms

U^{235} Mass = 13 x 1.4 Kg = 18.2 Kgs

Super Critical at 78.1" of Water

Expr. 16-18 Time 2215 AM PM Date 16 Dec 1955
Purpose Critical Mass With Boron 2 Plates

Personnel: DM, DW, RJ, JL

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by RJ
Instrument and Safeties Checked and Reset by JL
Source In Checked by DM Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by DM Time 2215 AM PM Date 16 Dec 1955

Loading: Same as 16-17 except all series "5" ½ plates were removed from Slots 7 & 12 of Boxes 2-4-7-9-11--- 37-39-42-44, and replaced with SS of the proper Series (7 & 12 Slot 8, Box 25 still contains a ½ plate (Series 5) and a full fuel plate in slot 7.

Supercritical: with water at 82.9

Expr. 16 -19 Time 2240 AM PM Date 16 Dec 1955
Purpose Critical Mass with Boron
Personnel: DM, DW, JL, RJ

START UP CHECK LIST
Equipment Checked by DM Personnel Check by RJ
Instrument and Safety Check by DM
"Source In" Checked by DM
Emergency Equipment Room Checked by RJ
Red Light On by RS
Start-Up OK'd by DM Time 2240 AM PM Date 16 Dec 1955

Loading

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	6	7	12	9	7	9	12	11	"B"	15	8	2	16
Type	f	f	f	B	f	f	S_S	f	S_S	f	f	S_S	f	B	S_S	f	f	f

Slot 8 Box 25 Contains Series 5 plate, Slot 7 Box 25 Contains Foil 12

Super critical 92.3

Expr. 16-20 Time 2305 AM PM Date 16 Dec 1955
Purpose Critical Mass with Boron – 2 plate per element.

Personnel: DM, DW, JL, RS

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by RJ
Instrument and Safeties Checked and Reset by DM
Source In" checked by DM Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RS
Start-Up OK'd by DM Time 2305 AM PM Date 16 Dec 1955

Loading:

Same as 16-19 except the following ¼ plates were put in the place of full Plates –

Box 7, ¼plate 5-7 put in in place of plate 13-7 in slot 2

Box 11 " " 5-11 " " " " " " " 13-11 " " 2

Box 35 " " 5-35 " " " " " " " 13-35 " " 2

Box 39 " " 5-39 " " " " " "

Also Box 25 SS plate 7-25 was put in in place of Full ¼plate 5-25. (Slot 7)

~~Kg~~ Kg 25 = $(12 \times 1.4) - (4 \times .0155) = 16.73$ Kg 16.732 ✓MB

Blade correction = −.08 −blade .056

Critical 16.65 ~~16.674~~ 16.676

Log N .17	Control Blade 4.99
OC-3 69 X10 X20	Control Rod 29.01
Water ht. 109.7	Water Temp. 72.5°

98

Expr. 11-21 Time 4:45 (PM) Date 12-19 1955

Purpose Δk/k on with boron — zero rods

Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10 x 20	3"
Log N	✓		125	
R-1	✓	6.5	10-6	
R-2			10-6	
P. M.	✓		800 V	

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by dL

Instrument and Safeties Checked and Reset by JL

"Source In" Checked by RJ Source No. ____

Emergency Equipment in Control Room Checked by MB

Red Light On by JL

Start-Up OK'd by RJ Time 4:55 AM (PM) Date 12-19 1955

Loading:

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	6	7	12	8	7	9	12	11	"B"	15	B	2	10
Material	f	f	f	B	f	f	S	f	S	f	f	S	f	B	S	f	f	f

Except for the following exchanges in slot 2:

Box 7 contains 5-7 instead of 13-7

11 5-11 13-11

35 5-35 13-35

39 5-39 13-39

and fuel 12-25 and ss 7-25 have been interchanged.

Reactor subcritical — rod in, blade in, water up, source out.

Expr. 16-22 Time 5:30 (AM) (PM) Date 12-19 1955

Purpose Δk/ℓm with beam - 2 Cr rods

Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL

Instrument and Safeties Checked and Reset by JL

"Source In" Checked by RJ Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by RJ Time 5:30 (AM) (PM) Date 12-19 1955

Loading - Same as 16-21 except 13-9 fuel has been replaced by 2-9 SS.

Still to reactive - Source out, rod out, blanket in.

Expr. 16-23 Time 5:46 AM (PM) Date 12-19 1955
Purpose Date/am with boron - servo run

Personnel:

START-UP CHECK-LIST

Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 5:45 AM (PM) Date 12-19 1955

Loading - same as 16-21 except fuel N13-16 in slot 2, box 16 has been replaced by S.S. 2-16.

Critical conditions:

DC-3	56 (10×20)	Height	109.2 [redacted]
Log N	0.14	Blade	6.30
R-1	3.3 (100×1000)	Rod	29.01
Temp.	72.5°F.		

Man 16.700
- .07 = Hed .07
Corrected Man 16.659 Kg U^{235}
16.63

Loop

Expt. 16-24 Time 1800 AM PM Date 12-19 1955

Purpose ΔK/δm with Boron
Adding 1 (t) plate 6 Box 25

Personnel: MB JL RJ

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 1800 AM PM Date 12-19 1955

Loading: Same as 16-23 except ½ fuel plate 5-25 was put into slot (8) Box 25, in place of SS 7-25

Critical Conditions:

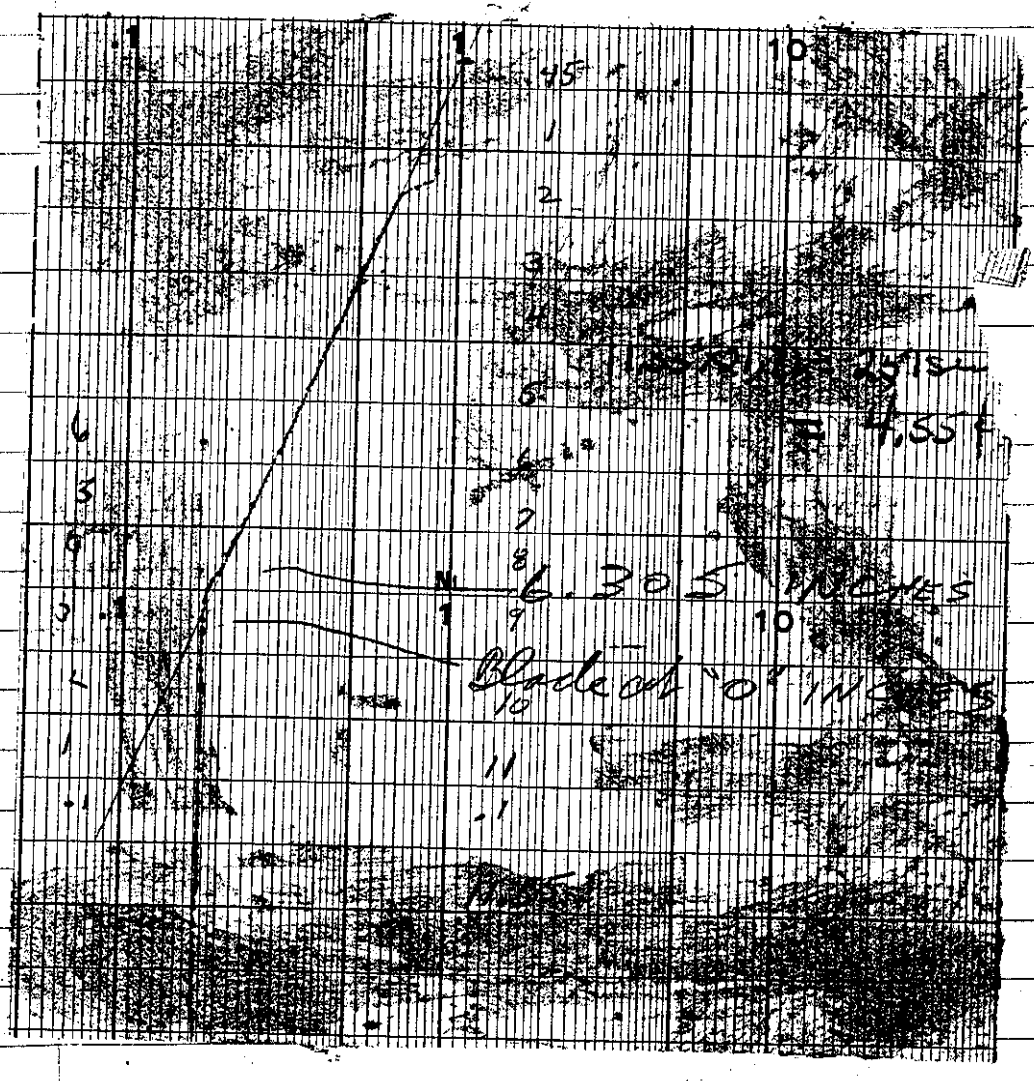
DC-3	74 x 10 x 20	Wt ht	109.2
Log N	.18	Control Blade	0.00
R-1	4.15 x 100 x 1000	Control Rod	29.01
Temp			

Control Blade pulled out to 6.30", the pr. Critical blade position of the 16-23 zero Run.

16.716

Δk/k = −0.09

16.63


4.55 ft
6.305 inches

Expr. 17-6 Time 1835 AM PM Date 19 Dec 1955
Purpose Effect of Lumping of Boron

Personnel: MB JL, RS

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by RS
Instrument and Safeties Checked and Reset by MB
~~Source In~~ Checked by MB ~~Source No.~~
Emergency Equipment in Control Room Checked by RS
~~Red Light On~~ by RJ
Start-Up OK'd by MB Time 1835 AM PM Date 19 Dec 1955

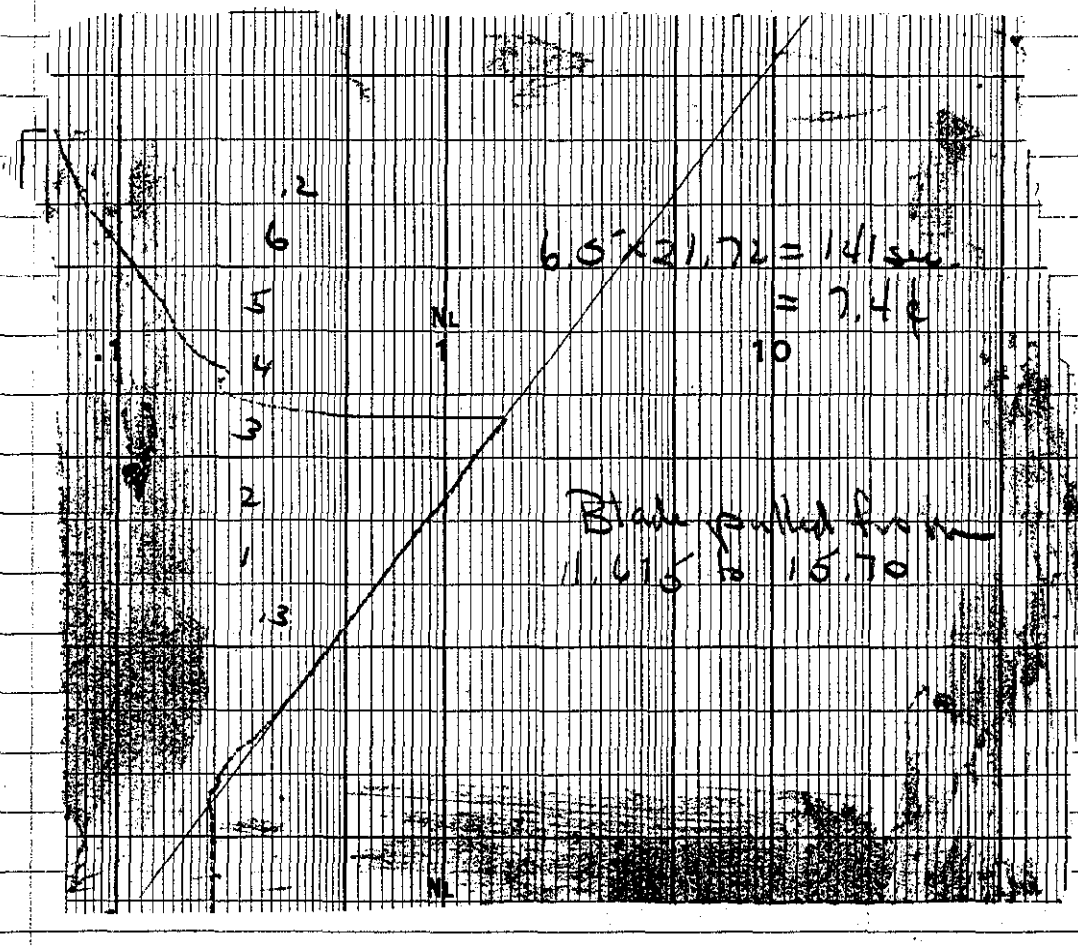
Loading Same as 16-24, except that Boron ½ plates were inserted in Slots 4, 7, 12, 14 of Box 23, and Boron full plates removed from Slots 4+14, 5S plates 7-23, and 12-23 were removed from slots 7+12 respectively.

Critical Condition.

DC-3 82 10X20 Wt Ht 109.6
Log N - -2 Control Blade 11.615
R-1 - 2.2 200x100 Conduel Rod - 29.01
Temp. 275

Control Blade pulled to 15.70 for a point on a new Blade Calibration Curve

Worth ~ 129


6.6 x 21.72 = 143.35
= 7.4 ft
NL
1
10
.1
.6
.4
.3
.2
1
.3
NL

Expr. 16-25 Time 8:30 AM PM Date 12-19 1955
Purpose Critical Mass with Boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by RJ
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by RJ Time 8:35 AM PM Date 12-19 1955

14 fuel + 2 poison

Loading—

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	[redacted]	5	12	[redacted]	7	9	12	4	"B"	5	8	2	10
material	f	f	f	B	f	f	f	f	[redacted]	f	f	[redacted]	f	B	f	f	f	f
									"C" B									

14 — corrected M.B.

Complete loading at 13½ fuel, 4 2½ Boron.

Plates which are not in proper series position:

Box	Slot 15	Slot 12
36	A-26A	
37	3-41X	
38	1-15A	
40	1-17X	
41	4-20X	
42	6-40X	
43	1-16X	
44	1-19A	
45	961-H	952-H.

Subcritical at water height ~ 89.6 cm.
Blade in, rod out, source out.

Expr. 16-26 Time 2048 AM PM Date 19 Dec 1955
Purpose Critical Mass with Boron
2½ plates
Personnel: MB JL RS

START-UP CHECK LIST
Equipment Checked by RS Panel Board by JL
Instrument and [illegible] MB
"Source In" [illegible] MB
Emergency [illegible] RS
Red Light On by RS 2049 AM
Start-Up OK'd by MB Time ~~18~~ PM Date 19 Dec 1955

Loading: Same as 16-25 except that 6 ½ plate were removed and Replaced by Steel in the following Boxes.

In Box 8 fuel(½) 5-8 in slot 7 was Replaced by SS 7-8
" " 10 " 5-10 " " 7 " " SS 7-10
" " 21 " 5-21 " " 7 " " SS 7-21
" " 25 " 5-25 " " 7 " " SS 7-25
" " 36 " 5-36 " " 7 " " SS 7-36
" " 38 " 6-38 " " 7 " " SS 7-38

~~Loading the 5 x 7 [illegible]~~

Critical at Water height 91.3

Expr. 16-26 Time 2107 AM/PM Date 19-Dec 1955
Purpose Critical Mass with Boron 2½ plates
Personnel: MB, JL RJ

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safety [illegible] MB
"Source In" Checked by MB [illegible] No.
Emergency [illegible] Tool Room Checked by RS
Red Light On by RJ 2109 AM
Start-Up OK'd by MB Time 2109 PM Date 19-Dec 1955

Loading: Same as 16-25 with the following changes

In Box 7 ½ fuel plate 5-7, in slot 7 was Replaced by SS 7-7
" " 9 " " " 5-9 " " " " " " SS 7-9
" 11 5-11 " " " " " " 7-11
" 21 5-21 " " " " " " 7-21
" 23 5-23 " " " " " " 7-23
" 25 5-25 " " " " " " 7-25
" 35 5-35 " " " " " " 7-35
" 37 5-37 " " " " " " 7-37
39 5-39 " " " " " " 7-39

Expr. 16-27 Time 9:30 AM PM Date Dec 19 1955
Purpose Critical Mass with Boron

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 9:30 AM PM Date Dec 19 1955

Loading - same as 16-25 except for slot 7 :
slot 7 contains series five fuel in boxes 1, 3, 5, 6, 8,
10, 12 . . . . 38, 40, 41, 43, 45; s.s. series 7 steel
in rest of boxes.

Critical Conditions

Log N	0.13	Height	109.2
DC-3	50(10x20)	Rod	28.02
Rt	3.0(100x1000)	Blade	11.36
Temp	78°		

Mass: $13 \cdot \left(\frac{24}{15}\right)\left(\frac{1}{2}\right) \cdot 1.4 = 13.267\ (1.394) = 18.57$ ~~18.50~~ kg

MB = 18.566 Kg of U-235
.026 Rod worth
18.540 Kg of U-235

Under correction = −.05
18.52

boron = 47.2

Expr. 16-28 Time 9:50 AM (PM) Date Dec 19 1955
Purpose Ak/δm with Boron — 2½ boron plates.

Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start Up O.K'd by RJ Time 9:50 AM (PM) Date Dec 19 1955

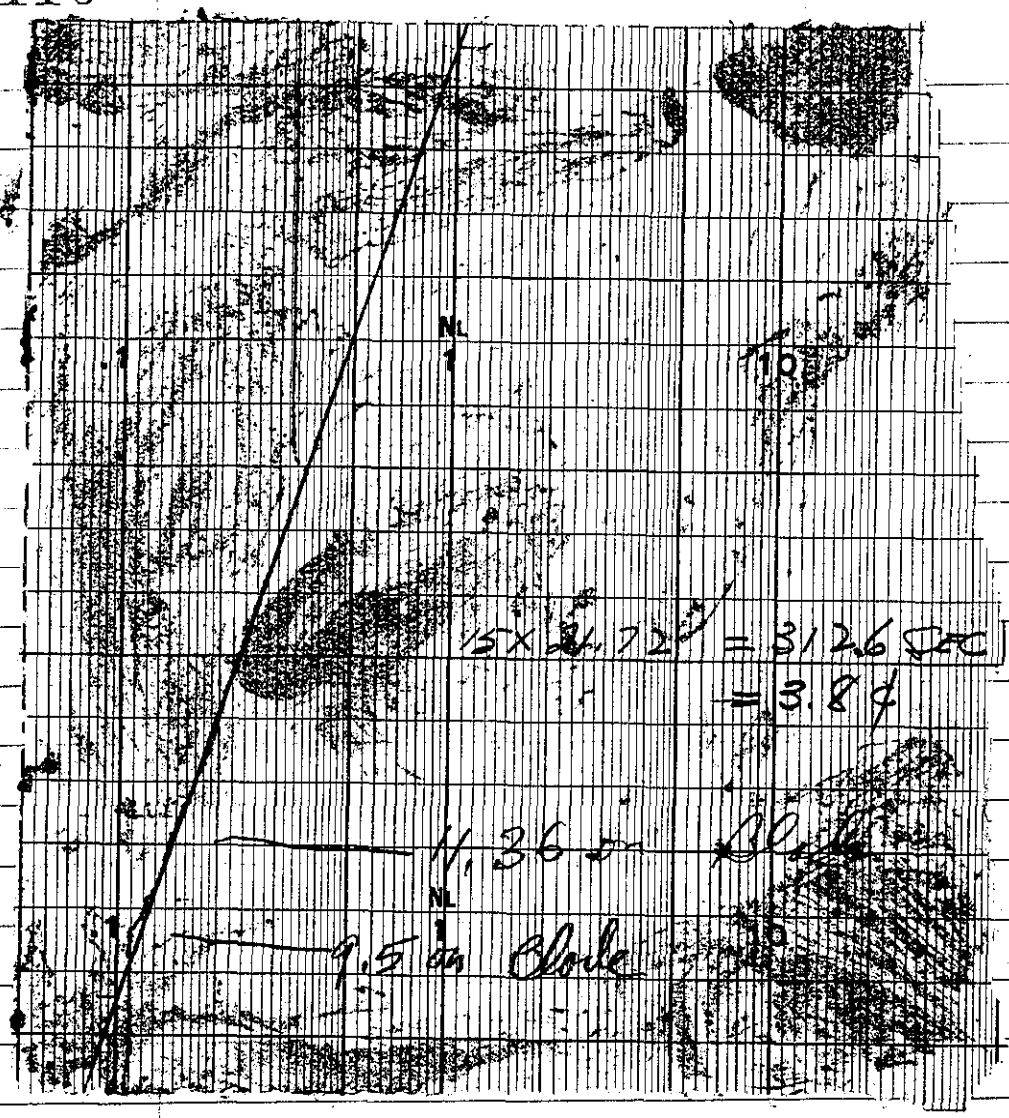
Loading - Same as 16-27 except ~~half plate~~ 33 removed from slot 7 & replaced by half plate in box 25 only.

Critical conditions

Log N	0.11	Height	109.4
DC-3	44 (10×20)	Rod	29.02
R-1	2.6 (100×100)	Blade	~~9.54~~ 9.50
Temp.	73°f		

Blade pulled to 11.36, the zero point of Run 16-27, inducing a period of 312.6 sec. or 3.8 ℓ.

Mass: ~~18.585 = 18.575~~ g. 18.581 mass
− .034 blade weight
18.547


NL
1
1
10
15 x 24.72 = 3126 SEC
= 3.87
1,36 m
NL
1
1
9,5 m Blade

Expr. 16-29 Time 2220 AM PM Date 19 Dec 1965
Purpose OK/DM, With Boron, 2½ plates
Personnel: MB JL, RJ DW

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ AM
Start-Up OK'd by MB Time 2221 PM Date 19 Dec 1965

Loading: Same as 16-28 except that in Box 25 Full 5-25 in Slot 7 and Full 12-25 in slot 8 were interchanged, so that ½ plate 5-25 is in Slot 8, and Full Plate 12-25 is in Slot 7,

Critical Conditions

Log N. 19 Control Blade 10.37
DC-3 83-X10X20 Control Rod 29.02
R-1 2.27 X 200X100 Water Ht 109.6
Water Temp 73°F

Mass 18.585 Kg U^{235}

Expr. 16-30 Time 2240 AM PM Date 19 Dec 1965
Purpose ΔK/ΔM, With Boron, 2½ Boron plates
Personnel: MB, JL, RS, DW

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Source Loading and Operability MB
Source In" Checked by: MB Source No.
Emergency [illegible] in control room checked by RS
Red Light On by RS AM
Start-Up OK'd by MB Time 2240 PM Date 19 Dec 1965

Loading: Same as 16-29, except SS 7-25 is put in in place of 5-25 in Box 25 slot 8.

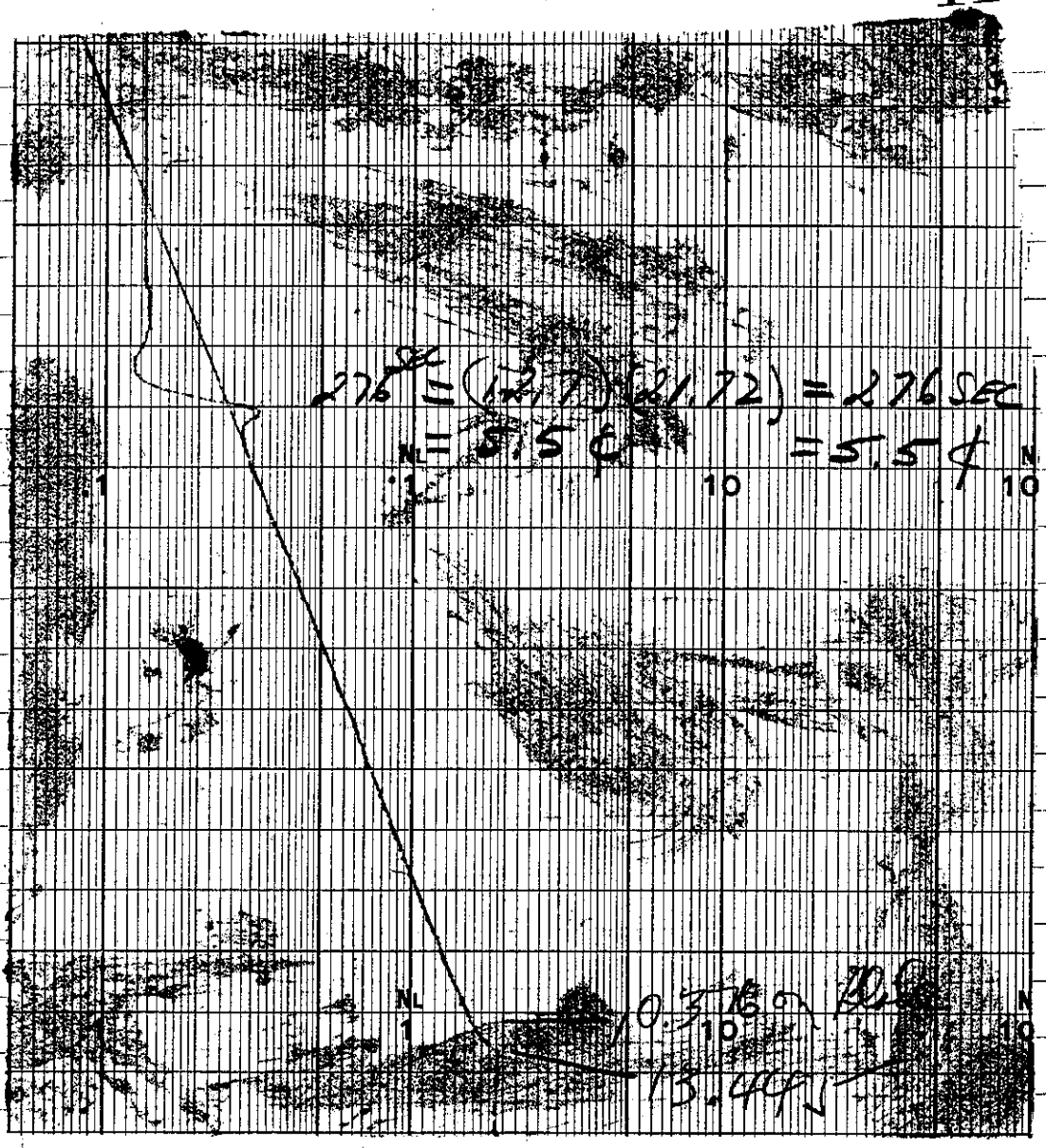
Mass - 18.69 Kg. U^{235}

Critical:

Log N - 1.9
DC-2 80 X10X10
R-1 Jammed
Water Temp 73°F

Control Blade 13.445
Control Rod 29.02
Water Ht. 109.5

Control Blade moved into 10.37, the critical position of 16-29, to find the worth of the ½ plate in slot 8.


NL
1
10
N
NL
1
10
N

Expr. 16-31 Time 6:30 AM PM Date 12-20 1955

Purpose Critical mass w.th boron - 3 full boron plates.

Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10 x 20	
Log N	✓		12 cm.	
R-1	✓	5	.8 x 1000 x 100	1"
R-2				
P. M.	✓		600V	3"

Loading -

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	13	3	B	4	6	5	12	B	7	9	15*	11	B	14	8	2	10
material	f	f	f	B	f	f	f	f	B	f	f	f	f	B	f	f	f	f

* Slot 12 is loaded as follows.

Box #	Fuel	Box	Fuel	Box	Fuel	Box	Fuel
1	MAC 625 (12-35)	12	15-12	23	1-17	34	15-7
2	12-38 (12)	13		24	MAC 378	35	15-8
3	H-951 (3)	14		25	1-15	36	F-1
4	12-26 (12)	15		26	B-41	37	A-505
5	MAC 674 (12-34)	16		27	MAC A-264	38	510
6	MAC 669 (12-29)	17		28	15-1	39	F-2
7	MAC 667 (12-27)	18	15-18	29	16-2	40	A-506
8	12-37 (12)	19	1-19	30	15-3	41	516
9	15-9	20	1-16	31	15-4	42	H-962
10	15-10	21	6-40	32	15-5	43	515
11	15-11	22	4-20	33	15-6	44	H961
						45	512

START-UP CHECK LIST

Equipment Checked by RS Personnel Check by JL

Instrument and Safeties Checked and Tested by MB

"Source In" Checked by MB Source No.

Emergency Equipment in Control Room Checked by RS

Red Light On by JL

Start-Up OK'd by MB Time 1843 AM/PM Date 20 Dec 1955

MASS: ~~EE~~ $14\frac{1}{2} \times 1.399 = 20.3$ Kg^{235}

Critical Conditions (Slightly Super)

Log N. -7 Water Ht 93.

DC-3 Blade 0.00

R-1 Rod 19.02

Water temp. 73°F.

Expr. 16.32 Time 8:50 AM (PM) Date 12-20 1955

Purpose Critical mass with boron — 3 full plates.

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB

Instrument and Safeties Checked and [illegible] JL

"Source In" Checked by RJ [illegible]

Emergency Equipment in Control Room Locked by MB

Red Light On by JL

Start-Up OK'd by RJ Time 8:50 AM (PM) Date 12-20 1955

Loading —

Same as 16-31 except:

box 8, slot 12 now contains s.s.

- 10 " " " " "
- 21 " " " " "
- 25 " " " " "
- 36 " " " " "
- 38 " " " fuel
- 3 " " " 6.40
- 42 " " " 1-15
- 44 " " " 15-10

MB

Total U mass = 20.1 kg. U^{235} 20.105 Kg

Total B mass = 2355 gm Nat. B. — 80.4 Mach mix

20.101 corrected mass

Critical Conditions —

LogN	0.14	Rods	19.03
DC-3	47.5 (10x20)	Rod	29.02
R-1	3.03 (100x1000)	Water	109.2
Temp.	72.5°F		

Expr. 16.33 Time 9:00 AM (PM) Date 12-20 1955
Purpose Ak/am with boron — Zero run.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
~~Instrument and Safeties Checked and Reset by~~ JL
"Source In" Checked by RJ Source No.
~~Emergency Equipment in Control Room Checked by~~ MB
Red Light On by MB
Start-Up OK'd by RJ Time 9:00 AM (PM) Date 12-20 1955

Loading —
Same as 16-32 except:
in box 25, slot 7 now contains S.S. (instead of half plate)
slot 12 now contains fuel #507 [F-1]

Critical conditions —

DC-3	45.5 (10×20)	Blade	15.01
R-1	2.8 (100×1000)	Rod	29.02
Log N	0.125	Water	109.2 cm.
temp.	72.5°F		

Expr. 16-34 Time 926 AM PM Date 20 Dec 1965
Purpose $\Delta K/\Delta M$, With Boron — slot 7
Personnel: MB, RJ, JL

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source Pos.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RS
Start-Up OK'd by MB Time 9 30 AM PM Date 20 Dec 1965

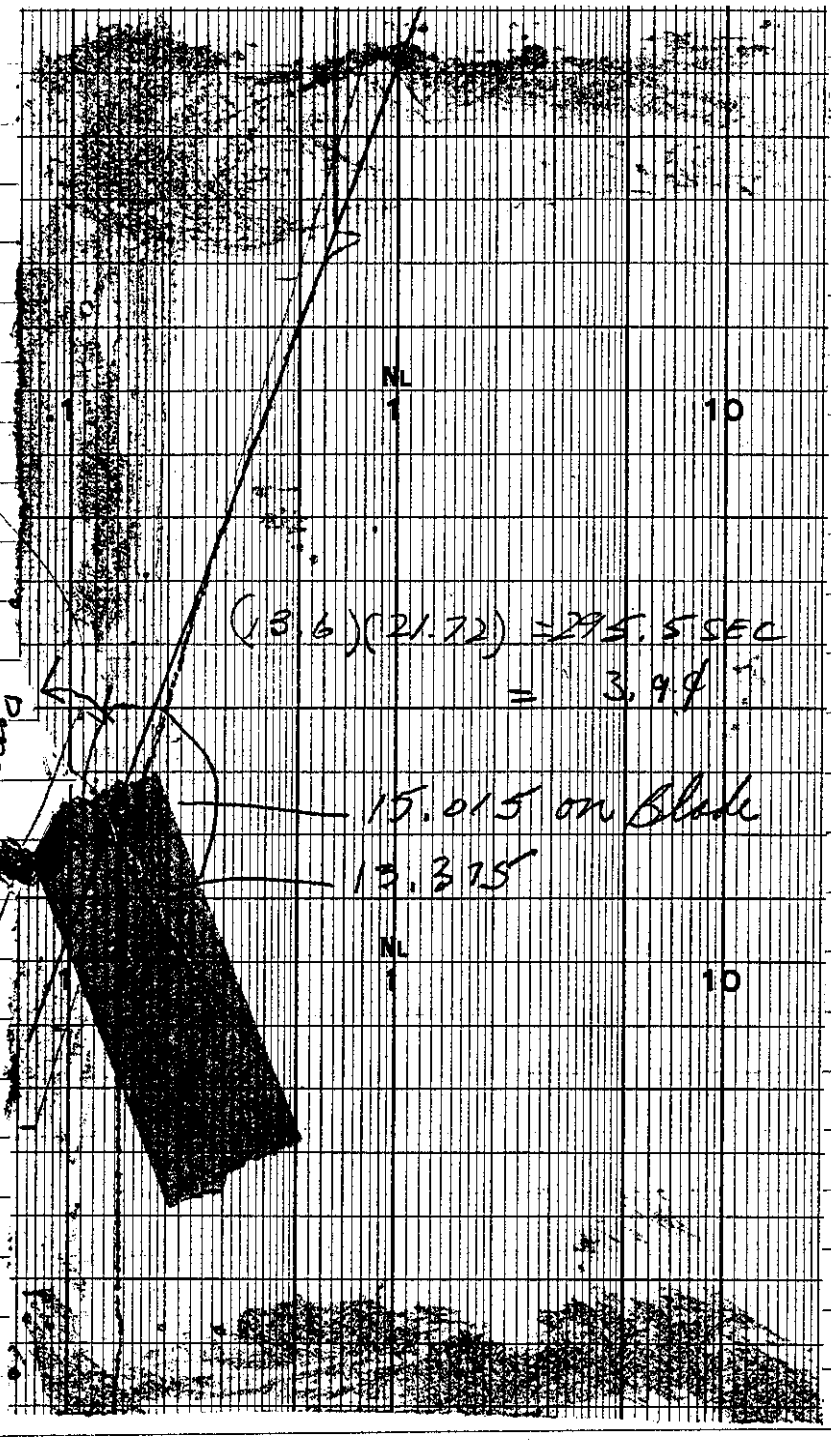
Loading: Same as 16-33, except that ½ fuel plate S-25 is put into Slot 7, Box 26, in place of SS, (12-25)

Critical Conditions

Log N	.16	Control Blade	13.38
Oc-3	56 x 10 x 20	Control Rod	29.02
Water Temp	72.5	Water Ht.	109.5

Control Blade pulled out to 15.01" to critical position of 16-53, to measure the reactivity worth of adding a ½ fuel plate to Slot 7, Box 25.

Mon 20.132
− .020 blade worth
20,112



(3.6)(21.72) = 295.5 SEC

= 3.9 ft

15.015 on Blade

13.375

This seems unreasonable

Expr. 16-35 Time 10:25 AM (PM) Date 12-20 1955
Purpose Δk/δm with 3 full boron - slot 8

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RS Time 10:25 AM (PM) Date 12-20 1955

Loading - same as 16-33 except slot 7 Box 25 now contains fuel 12-25 and slot 8, box 25 contains s.s. 12-25.

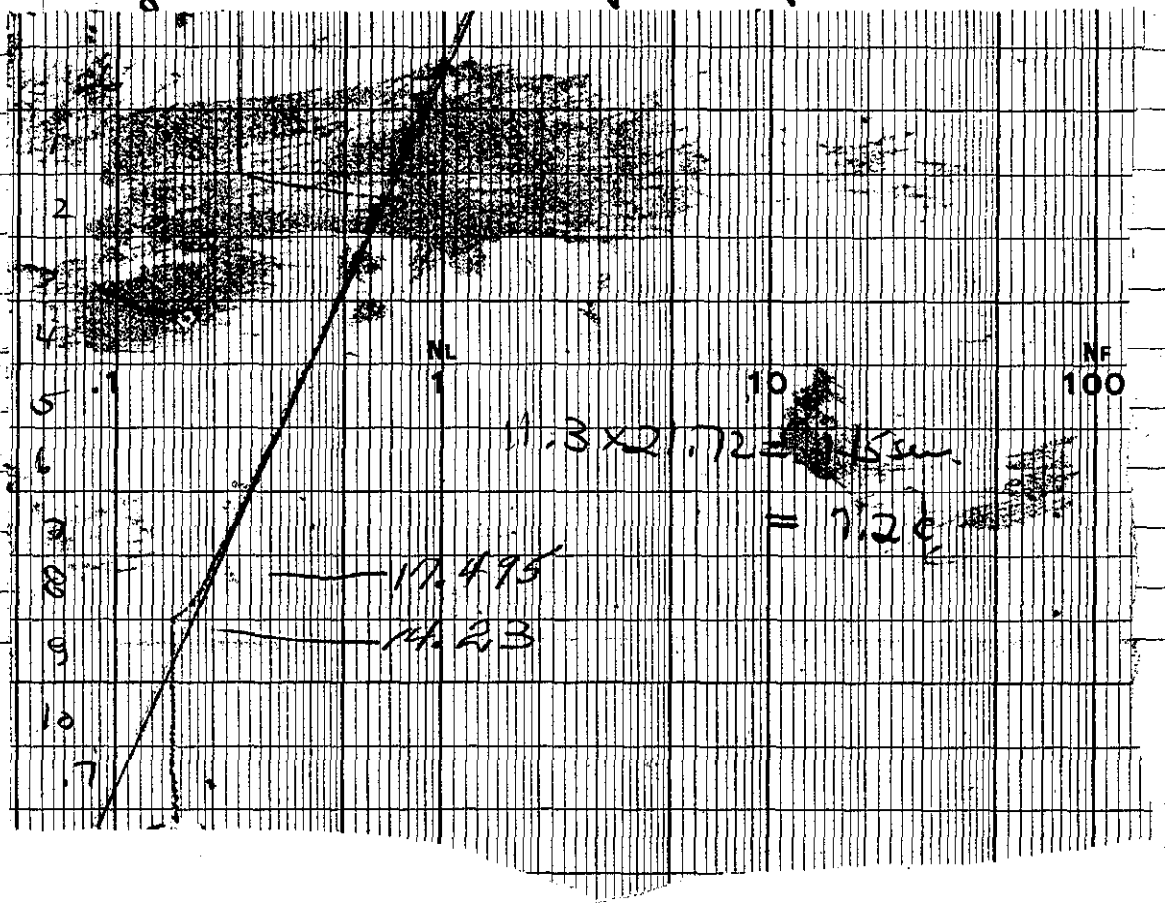
Critical Conditions

Log N	0.12	Blades	17.5 in.
DC-3	43.5 (10x20)	Rod	29.02 in
R-1	2.78 (	Water	109.2 in
Temp.	72.5°F		

Critical Conditions—

LogN	0.150	Water	109.2
DC-3	6.1 (10×20)	Blade	14.23
R-1	3.8 (100×1000)	Rod	29.01
Temp	72.5°f		

Pulling blade to 17.495 for positive period measurement.



Expr. 16-36 Time 10:46 AM Date 12-20 1955
Purpose Alpha with 3 full boron — slot 8

Personnel:

START-UP CHECK LIST

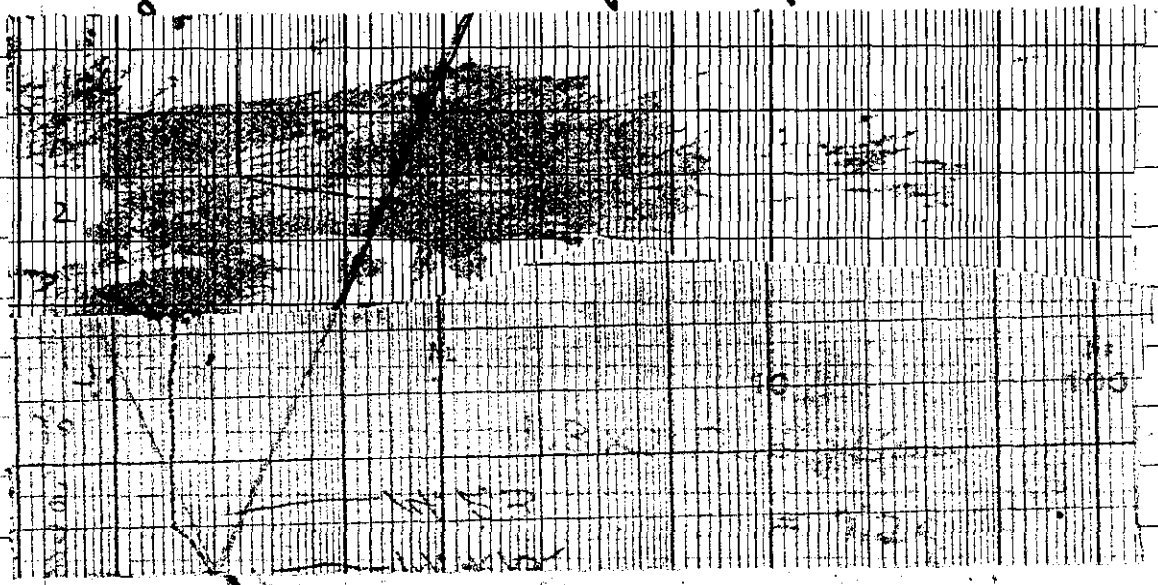
Equipment Checked by JL Personnel Check by JL
~~Instrument and Safeties Checked and Reset by~~ JL
"Source In" Checked by RJ Source No.
~~Emergency Control Rods Checked by~~ MB
~~Red Light~~ MB
~~Start~~ RJ 10:46 12-20 1955

Loading — same as 16-35 except slot 8 box 25 which now contains 5-25 instead of 5s 5-23.

Critical Conditions —

Log N	0.150	Water	109.2
DC-3	6.1 (10×20).	Blade	14.23
R-1	3.8 (100×1000)	Rod	29.01
Temp	72.5°f		

Pulling blade to 17.495 for positive period measurement.



Expr. 18-1 Time 5:55 AM (PM) Date 12-21 1955
Purpose Critical mass with 80% boxes in rod positions
Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by RJ Time 5:55 AM (PM) Date 12-21 1955

INSTRUMENT CHECK

Date 12-21 1955 Time 5:55 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10X20	
Log N		12sec		
R-1	✓	5.5	.9X1000X100	
R-2				
P. M.	✓		1"	

Loading- for all boxes except rod boxes.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	13	3	B	4	6	[illegible]	12	B	7	9	*	11	[illegible]	[illegible]	B	2	10
material	f	f	f	B	f	f	f	f	B	f	f	f	f	B	14	f	f	f

#	slot 7	slot 12		slot 7	slot 12		slot 7	slot 12
1	10-9	1-9	18	9-31	15-18	35	13-37	15
2	10-15	4-2	19	-25	15-19	36	-31	516
3	-21	6-32	20	-23	1-16	37	— rod —	
4	-23	6-40	21	— rod —		38	-25	R-2
5	-25	1-11	22	-21	4-20	39	-23	A 505
6	-31	2-12	23	— rod —		40	-21	617
7	-37	4 259	24	-15	4 378	41	-15	619
8	B-15	B-1	25	— rod —		42	-9	1-15
9	— rod —		26	-9	3-41	43	614	618
10	-9	510	27	4-37	[illegible]-264	44	621	15-10
11	-37	15-11	28	-31	15-1	45	615	616
12	-31	15-12	29	-25	15-2			
13	-25	15-13	30	-23	15-3			
14	-23	15-14	31	— rod —				
15	— rod	15-15	32	-21	15-5			
16	-21	15-16	33	-15	15-6			
17	9-37	15-17	34	-9	15-7			

Loading for rod position boxes — 9, 15, 21, 23, 25, 31, & 37.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	5	3	3	5	6	5	12	B	7	5		11	B	14	5	2	5
material	f	f	f	B	f	f	f	f	B	f	f	f	f	B	f	f	f	f

Box	slot 2	5	11	16	18	12
9	5-1	5-2	5-3	5-4	5-5	15-9
15	-6	-7	-8	-10	-11	15-15
21	-12	-13	-14	-16	-17	512
23	-18	-19	-20	-22	-24	1-17
25	-26	-27	-28	-29	-30	515
31	-32	-33	-34	-35	-36	15-4
37	-38	-39	-40	-41	-43	A506

Very sub-critical.
Water up
Source out
Log N 0.007
Blade out
Rod out.

Expr. 18-2 Time 6:50 AM (PM) Date 12-21 195 5
Purpose Critical mass with 80% boxes in rod positions
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 6:50 AM (PM) Date 12-21 195 5

Loading – fuel loading in all boxes is the same as 18-1
– boron loading is the same as 18-1 except:
in "core" boxes – the series "B" boron in slot 9 has been changed to series "C".
in "rod" boxes – 9, 21, 25 & 37 contain boron series "C" in slots 9 & 14
– 15, 23, & 31 contain S.S. plates in slot 9.

Critical – water Right 78.7
Log N 0.09

Expr. 18-3 Time 20:20 AM (PM) Date 12-21 195 5
Purpose CRITICAL MASS with 80% boxes in 7 Rod positions
Personnel:

START-UP CHECK LIST
Equipment Checked by M.B. Personnel Check by M.B
Instrument and Safeties Checked and Reset by M.B
"Source In" Checked by J.L Source No.
Emergency Equipment in Control Room Checked by M.B
Red Light On by J.L
Start-Up OK'd by M.B. Time 20:20 AM (PM) Date 12-21 195 5

LOADING – SA FUEL IN ALL BOXES AS IN 18-1
– BORON LOADING FOR ROD BOXES SAME AS IN 18-2
– CORE BOXES SAME AS 18-2 EXCEPT BOXES ~~2, 4~~ 1, 3, 5, 6, 8, 10 ..... 41, 43, 45 (LARGE ~~SMALL~~ CHECKER BOARD) NOW CONTAIN SERIES "B" BORON

CRITICAL – water ~~height~~ 84.7
LOG N 0.16

Expr. 18-4 Time 2100 AM (PM) Date 12-21 1956
Purpose Critical mass with 80% boxes in seven rod positions
Personnel:

START-UP CHECT LIST
Equipment Checked by MB [illegible] hecked by MB
Instrument and Safeties Checked and [illegible] MB
"Source In" Checked by MB [illegible]
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by MB Time 2100 AM (PM) Date 12-21 1956

LOADING - SAME AS 18-1 EXCEPT THAT
ROD POSITION BOXES, 9, 15, 21, 23, 25
31, 37 NOW CONTAIN SERIES E"
(±) BORON PLATES IN SLOT 9

CRITICAL CONDITIONS
WATER HEIGHT 109.6 cm WATER TEMP 71.°F
LOG-N ~~0.22~~ 0.22 R-1 3.7 (200X1000)
DC - 3 52 (10X50)

ROD POSITION 29.02
BLADE " 16.21

Mass: 15 × 38 × 31.1 = 17.73 kg.
+ 12 × 7 × 31.1 = 2.61
20.34
Burn correction −.02
20.32

Boron:
3 × 38 × 1.889 = 215
2.5 × 7 × 1.889 = 33
248 gm.

Expr. 18-5 Time 22:30 AM (PM) Date 12-21 1956
Purpose Critical Mass with 80% boxes in seven rod positions — with four extra steel plates in each rod position
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 2230 AM (PM) Date 12-21 1956

Loading - Same as 18-4 except ¼" steel plates added to each rod-position box. Two of these plates were added in slots 4 + 14 adjacent to the boron. The other two were taped to the east + south sides of the boxes

Not Critical -
Water up.
Blade out
Rod out.
Source out
Log N 0.015

Expr. 18-6 Time 2255 AM/PM Date 12-21 1955
Purpose Critical mass with 80% rod boxes
Extra steel plates in rod boxes
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB AM
Start-Up OK'd by RJ Time 2255 PM Date 12-21 1955

Loading — Same as 18-5 except full boron plates removed from the following boxes & replaced with Ref-boron plates: 8, 10, 14, 18, 28, 32, 36, 38.

H_2O Height 109.0 H_2O Temp 72°F
Log N (0.13)
~~DC-3~~ ~~43~~
R1 43 (100 x 100)
DC-3 67 (10 x 20)

BLADE 19.15 IN.
ROD 29.02 IN.

Mass = Mass of 18-4 = 20.34 kg
blade correction = −.01
20.33 kg

Boron = 3×38×1.889 − 4×1.889 = 208 gm.
+2.5×7×1.889 = 33
241

Expr. 18-6 Time 2325 AM/PM Date 21 Dec 1955
Purpose Critical Mass with 80% rod Boxes
& 22% Steel in these Boxes
Personnel: MB JL RJ

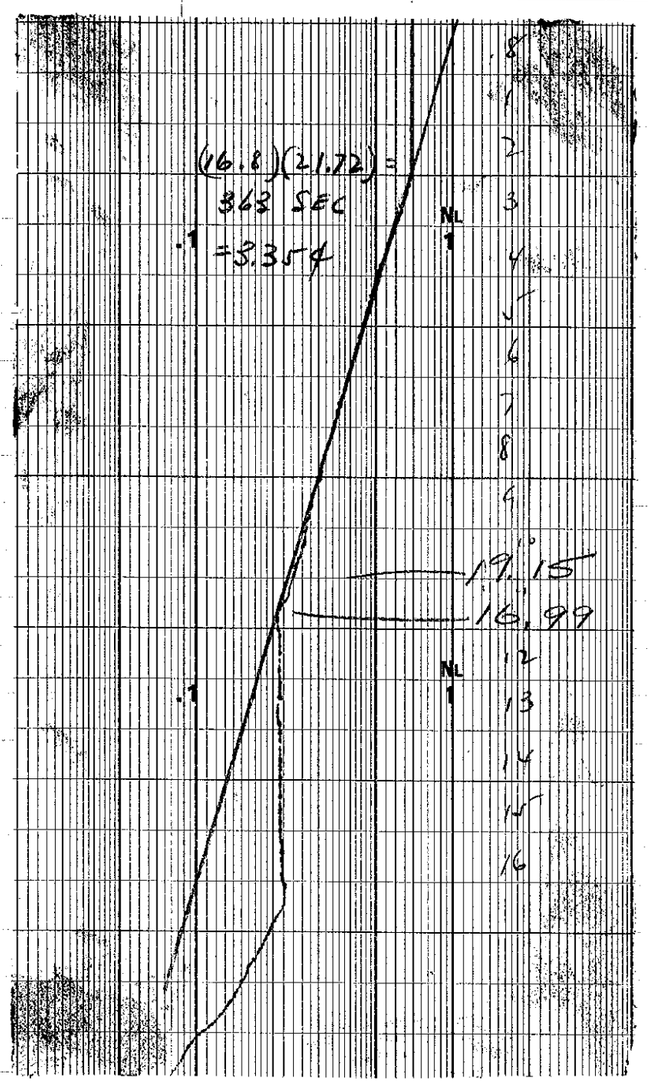
START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ AM
Start-Up OK'd by MB Time 2325 PM Date 21 Dec 1955

Loading: Same, except end boxes added to top of all Boxes.:

Critical Conditions:

Log N	.22	Control Blade	16.99
DC-3	50×50×10	Control Rod	29.02
Watertemp	72.5	Water Ht.	109.6

The effect of adding end boxes to the top of the assembly is that the core is slightly more reactive. Control Blade is lowered from 19.15 (exp 18-6) to 16.99 (18-7) or 3.35 ¢. This difference is negligiable when considered in term of Uranium Mass.



Expr. ~~19~~ 19-1 Time 4:44 AM (PM) Date 22 Dec 1955
Purpose Flux + Power Traverse, with Full Boron Loading (3 pl/box) Zero Pwr
Personnel: JL, RS DW

INSTRUMENT CHECK

Date 22 Dec 1955 Time ~~4:33~~ 16:33 AM PM Source No. _____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	X10X20 3"	
Log N	✓	12		
R-1	✓	5 X100 X10	2"	
R-2				
P. M.	✓		2"	

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL
Instruments and Safeties Checked and Reset by RS
"Source In" Checked by DW Source No. _____
Emergency Lights, etc. in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by DW Time 5.00 AM PM Date 22 Dec 1955

Loading: Same as 16-32, with some changes in the odd loading of Slot 12

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	6	5	12	"B"	7	9	15*	11	"B"	14	8	2	10
Type	F	F	F	B	F	F	F/2	F	B	F	F	F	F	B	F	F	F	F

(over)

Slot 12.

Box		Box		Box		Box	
1	1-9	12	15-12	23	1-17	34	15-7
2	4-2	13	15-13	24	#378	35	15-8
3	6-32	14	15-14	25	# ~~SS~~ SS	36	# ~~SS~~ SS
4	6-40	15	15-15	26	3-41	37	# A 606
5	1-11	16	15-16	27	# A-264	38	SS 516
6	2-12	17	15-17	28	15-1 ~~15~~	39	# A 506
7	#259	18	15-18	29	15-2	40	617
8	SS 517	19	1-19	30	15-3	41	619
9	15-9	20	1-16	31	15-4	42	~~SS~~ 1-15
10	SS	21	# ~~SS~~ SS	32	15-5	43	618
11	1511	22	4-10	33	15-6	44	15-10
						45	616

Mass U = 20.1 kg U^{235}

Critical ; water ht 91.3 cm

Expr. 19-2 Time 5 20 AM PM Date 22 Dec 1955
Purpose Max Power Trouble w/Boron Zero Run
Personnel: DW, JL, RS

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by RS
~~Source In~~ Checked by RS Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by RS Time 5 22 AM PM Date 22 Dec 1955

Loading: Same as 19-1, except fuel plates #259, 15-11, #~~A 506~~, 15-8 & #A 505 removed from Slot 12 of Boxes 7, 11, 35 + 39 respectively, and replaced with SS.

Super Critical with water at 109.0, rod and Blade full in.

It was discovered after this run that in boxes 8, 10, 14, 18, 28, 32, 36 + 38 slot 9 contained Boron ± plates instead of Tall Boron plates as specified in loading 19-1. These had the effect of making the reactor super critical.

Expr. 19-3 Time 5 52 AM (PM) Date 22 Dec 1965
Purpose Zero Run
Personnel: JL, RS

START-UP CHECK LIST
Equipment Checked by RS Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by JL Time 5 52 AM PM Date 22 Dec 1965

Loading: Same as 19-1, except Boxes 8, 38 contain fuel #512 + #516 respectively, in slot 12

~~Critical~~ Mass = 20.16 Kg U^{235}

Critical

Log N	.135	Control Blade	15.54
DC-3	50 X 10 X 20	Control Rod	~~29.5~~ 29.02
R-1	32. X 100 X 100	Water Ht	109.5
Water Temp	73.5		

Expr. 19-4 Time 6 20 AM (PM) Date 22 Dec 1965
Purpose Power Distribution with Boron
Personnel: ~~RS~~ RJ, JL

START-UP CHECK LIST
Equipment Checked by RS Personnel Check by RS
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by RS Time 6 20 AM (PM) Date 22 Dec 1965

Critical Conditions

Log N	1.0	Control Blade	15.73
DC-3	—	Control Rod	29.02
R1	6.35 X 500 X 1000	Water Ht.	109.2
Water Temp	73.5	(Loading Same as 19-3)	

End Boxes on Bottom, Not on top

Foil Run:
to be leveled at 1. on Log N meter.
Clocks started at 6.36'15", Log N read - .37
Reactor Scramed at 6.56', 15"

Catcher Foil Positions

Top	B-2	59
	12	62
	13	65
	15	67 Bottom
	21	
	36	
	42	

Expr. 80-1 Time 9:00 AM PM Date 27 DEC 195 5

Purpose ZERO RUN FINE STRUCTURE IN BOXES 16 & 23

Personnel:

INSTRUMENT CHECK

Date 27 (DEC) 195 5 Time 850 AM Source No.

Instrument	Value	Trip Pt's	Source Distance	Check On Scale
PC-1				
PC-2				
D.C.	80	(10 X 20)	3	
Log N	12			
R-1	5		✓	
R-2				
P. M.	✓		3	

START-UP CHECK LIST

Equipment Checked by J.L Personnel Check by

Instrument and Safeties Checked and Reset by J.L

"Source In" Checked by Source No.

Emergency Equipment in Control Room Checked by J.L

Red Light On by J.L AM

Start-Up OK'd by Time PM Date 195

LOADING: Same as loading in slot ~~19~~ 19-3 except slot 11 and box 16 & 23

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SERIES	1	13	3	"B"	4	6	5	12	"B"	7	9	15	#	"B"	14	8
TYPE	f	f	f	B	f	f	½	f	B	f	f	f	≡	B	f	f
SLOT														17		18
SERIES														2		10
TYPE														f		f

FOR SLOT 13 LOADING SEE NEXT PAGE

Slot # 13

Box								
1	1-16A	12	14-16	23	11-23	34	11-34	
2	2-16	13	15-16	24	11-24	35	11-35	
3	3-16	14	1-23	25	8-23	36	11-36	
4	4-16	15	2-23	26	11-26	37	11-37	
5	6-16	16	11-16	27	9-23	38	11-31	
6	7-16	17	3-23	28	10-23	39	11-39	
7	8-16	18	4-23	29	12-23	40	11-40	
8	9-16	19	5-23	30	13-23	41	11-41	5/2
9	10-16	20	11-20	31	14-23	42	11-42	
10	12-16	21	7-23	32	11-32	43	11-43	6/7
						44	11-44	
11	13-16	22	11-22	33	1-17*	45	11-45	6/8

Box 23

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SERIES 11 EXCEPT AS NOTED	13	14	15	B	17	18	5 23	19	B	21	25	27	28	5 B	11	11	11	11
															28	29	30	31

Box 16

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SERIES # 11 EXCEPT AS NOTED	33	1	2	B	3	4	5 16	5	B	6	7	8	16	B	9	10	11	12

~~NOT CRIT~~

SUPER CRITICAL WATER HEIGHT 96

" TEMP 73°F

SLOT 12 LOADING FOR EXP 20-1

BOX							
1	1-9*	12	15-12	23	11-27	34	15-7
2	4-2	13	15-13	24	*328	35	15-8
3	6-32	14	15-14	25	SS	36	SS
4	6-40	15	15-15	26	3-41	37	A506
5	1-41	16	11-27B	27	*A-264	38	516
6	2-42	17	15-17	28	15-1	39	*A505
7	*259	18	15-18	29	15-2	40	617
8	512	19	1-19	30	15-3	41	619
9	15-9	20	1-16	31	15-4	42	1-15
10	SS	21	SS	32	15-5	43	618
11	15-11	22	4-20	33	15-6	44	15-10
						45	616

Expr. 20-2 Time 10:26 AM PM Date 27 DEC 195J
Purpose ZERO RUN CONT'D FIVE STRUCTURE IN BOX 18-23
Personnel:

START-UP CHECK LIST
Equipment Checked by J.L. Personnel Check by J.L
Instrument and Safeties Checked and Reset by J.L
"Source In" Checked by DFC Source No.
Emergency Equipment in Control Room Checked by J.L
Red Light On by J.L AM
Start-Up OK'd by Time PM Date 195

LOADING: SAME AS EXP 20-1 EXCEPT FUEL PLATES 516 & 512 REPLACED BY SS IN SLOT 12 BOXES 38 & 8 RESPECTIVELY

CRITICAL CONDITIONS

WATER HT. 109 WATER TEMP 72.5
LOG N .11 CONTROL ROD 29.02
DC-3 66 (10X20) CONTROL BLADE 8.8 ±.3
R-1 4.2 (100X,000)

Expr. 20 -3 Time 12:10 AM PM Date 27 DEC 195 5
Purpose FINE STRUCTURE FOIL RUN

Personnel:

START-UP CHECK LIST
Equipment Checked by J. L Personnel Check by J. L
Instrument and Safeties Checked and Reset by J. L
"Source In" Checked by DFC Source No.
Emergency Equipment in Control Room Checked by DFC
Red Light On by DFC
Start Up OK'd by DFC Time 12:10 AM PM Date 27 DEC 195 5

LOADING: SAME AS EXP 20-2 WITH GOLD FOILS AS NOTED BELOW

Foil J57 on plate B in slot 14 between slots 13 & 14 in Box 16
" J-42 " " 11-9 " " 15 " " " 14 & 15 " " "
J45 11-10 16 15 & 16 1L
J40 11-11 17 16 & 17 1L
J65 11-12 18 17 & 18 1L
J63 on outside of box 23 between box 23 & 16
Cd COVERED foils J-32 on plate 11-18 in slot L between slots 6 & 7 box 23
J-41 " " 5-23 " " 7 " " 6 & 7 " 23
J-50 " " 11-19 " 8 7 & 8 " 23
J-~~52~~ 54 B 9 8 & 9 " 23
Norm foil N-41 on plate 11-30 in box 23 slot 17 between slots 17 & 18
Time started at 12:34:25
" Scrammed at 12:~~54~~ 54:25

CRITICAL CONDITIONS
WATER HT 109 WATER TEMP 22.5
DC-3 OFF SCALE R-1 OFF SCALE
LOG-N ~~OFF SCALE~~ EXT ROD 29.02
DC-2 62 (20 X 10) EXT BLADE ~~11.93~~ 11.76

Expr. 20 - 4 Time 9:05 AM PM Date 28 DEC 195 5
Purpose ZERO RUN FINE STRUCTURE
IN BOXES 16 & 23
Personnel: LESLIE & JOHNSON

INSTRUMENT CHECK

Date 28 DEC 195 5 Time 0900 AM PM Source No. _____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	83 - ~~88~~	(10 X 20)	21N	
Log N	✓	12 SEC		
R-1	4.5	(100 X 1000)	1 IN	
R-2				
P. M.	✓		21N	

START-UP CHECK LIST

Equipment Checked by R. J. Personnel Check by R. J.
Instrument and Safeties Checked and Reset by J.L.
"Source In" Checked by J. L. Source No.
Emergency Equipment in Control Room Checked by J.L
Red Light On by R.J.
Start-Up OK'd by J.L Time 9:08 AM PM Date 28 DEC 195 5

LOADING SAME AS 20-3

CRITICAL COND

WATER HT. 109.2 WATER TEMP 71
LOG N 0.07 EXT BLADE 18.05
R-1 5.4 (50 X 1000) EXT ROD 29.02
DC-3 82 (10 X 10)

decided to put one fuel plate in Box 38 slot 12 for next run

Expr. 20 - 5 Time 11:20 AM PM Date 28 DEC 195 5
Purpose FOIL RUN Au & Cd COVERED Au FOILS
FOR FINE STRUCTURE IN BOXES 16 & 23
Personnel: LESLIE & JOHNSON

START-UP CHECK LIST

Equipment Checked by J. L Personnel Check by J. L
Instrument and Safeties Checked and Reset by J. L
"Source In" Checked by R J Source No.
Emergency Equipment in Control Room Checked by J.L.
Red Light On by R. J.
Start-Up O.K'd by R. J. Time 11:20 AM PM Date 28 DEC 195 5

LOADING: SAME AS 20-4 EXCEPT FUEL PLATES 4-27+; 512; 51L IN BOXES 38, 8, 36 RESPECTIVELY IN PLACE OF 55 IN SLOT 12

An attempt was made to go critical with foil in and only 1 fuel plate 4-27+ in box 38 and the reactor never got critical. Log N reading was 0.02, a factor of 100 below foil Run level. The two extra fuel plates were added to boxes ~~55~~ 38 and 8 in place of 55. ~~The~~ New foils were not reloaded after the false start ~~but~~ and the same foil was left in.

CRITICAL CONDITIONS

TIME CLOCK STARTED 11:29
TIME RUN ENDED 11:49
LOG N 2 WATER HT 109
DC-2 69 (10 X 20) WATER TEMP 72
CONTROL ROD 29.02 CONTROL BLADE 7.6

(OVER)

Foil # J-47 on plate # 5-23 Box 23 slot 7 between slots 6 & 7
" J-41 " " 11-19 " 23 " 8 " " 7 & 8
" J-53 " " B 23 " 9 " " 8 & 9
Norm " N-39 " " 11-30 " 23 " 17 " " 17 & 18
Cd COVERED " J-49 " " B " 16 " 14 " " 13 & 14
J-66 " " 11-9 " 16 " 15 " " 14 & 15
J-60 " " 11-10 " 16 " 16 " " 15 & 16
J-44 " " 11-11 " 16 " 17 " " 17 & 18
J-35 " " 11-12 " 16 " 18 " " 17 & 18

Expr. 20 - 6 Time 16:18 AM (PM) Date 28 DEC 195 5
Purpose Fine structure in Boxes 16 & 23
foil foils run.
Personnel: JOHNSON CALHAN LESLIE

START-UP CHECK LIST
Equipment Checked by J.L. Personnel Check by J.L.
Instrument and Safeties Checked and Reset by R.J.
Source in Checked by R.J. Source No.
Emergency Equipment in Control Room Checked by J.L.
Red Light On by J.L.
Start-Up OK'd by R.J. Time 16:20 AM (PM) Date 28 DEC 195 5

LOADING. SAME AS FOR 20-5 WITH FOILS LOADED AS NOTED BELOW

Bare foil J-39 on plate B Box 16 slot 14 between slots 14 & 15
" " J-37 " " 11-9 " 16 " 15 " " 15 & 16
" " J-34 " " 11-11 " 16 " 17 " " 17 & 18
" " J-56 " " 11-12 " 16 " 18 " " 18 & BOX WALL
Norm " N-44 " " 11-30 BOX 26 " 17 " " 17 & 18
" " N-48 " " 13-30 BOX 30 " 2 " " 2 & 3
Cd covered " J-55 " " 5-23 " 23 " 7 " " 7 & 8
" " " J-62 " " 11-19 " 23 " 8 " " 8 & 9

START CLOCK AT 16:41:00 @ .74 ON LOG N
REACTOR SCRAMMED AT 17:01:00
WATER HT. 109 WATER TEMP ~~##~~ 70.8 °F
LOG N 2.0 EXT. ROD 29.02
DC-2 68 (10 X 20) EXT. BLADE 10.77

Expr. 20-7 Time 5:00 AM/PM Date 1-3 1956
Purpose Zero Check
Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM/PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10x20 2"	
Log N	✓	12sec		
R-1	✓	5	.8x1000 x100	
R-2				
P. M.	✓	800V	1"	

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by RJ+JL
Instrument and Safeties Checked and Reset by mB
"Source In" Checked by RJ Source No. ____
Emergency Equipment in Control Room Checked by mB
Red Light On by JL
Start-Up OK'd by RJ Time 5:00 AM/PM Date 1-3 1956

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	1	13	3	"B"	4	6	5	12	"B"	7	9	15		"B"	14	8	2	10
type	f	f	f	B	f	f	f/2	f	B	f	f	f		B	f	f	f	f

for slot 13, see page 137 ; slot 12, page 138
for boxes 23+16, see page 137.
(This loading is exactly the same as 20-1 page 136.)
except: 4-27*, 512, 516 in boxes 38, 8, 36 slot 12 instead of S.S.
Reactor supercritical — water up, blade + rod in.

Expr. 20-8 Time 7:00 AM/PM Date 1-3 1956
Purpose Fine structure flux Bare Au foils in 23 & 16
Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No. ____
Emergency Equipment in Control Room Checked by mB
Red Light On by mB
Start-Up OK'd by RJ Time 7:00 AM/PM Date 1-3 1956

LOADING SAME AS IN 20-8 ? EXCEPT SS 12-36
IN PLACE OF FUEL 516 IN SLOT 12 BOX 36
GOLD FOILS LOADED AS NOTED BELOW

BARE Au FOIL J-31 ON PLATE 11-14 BOX 23 SLOT 2 BETWEEN SLOTS 2 & 3
" " " J-45 " " B BOX 23 " 4 " " 4 & 5
" " " J-38 " " 11-18 " 23 " 6 " " 6 & 7
" " " J-54 BETWEEN PLATES 5-23 & 11-19 BETWEEN SLOTS 7 & 8
" " " J-56 " " 11-19 & "B" " " 8 & 9
NORM " " " N-34 ON PLATE 11-30 BOX 23 SLOT 17 BETWEEN SLOTS 17 & 18
NORM " " " N-35 " " 13-30 BOX 30 SLOT 2 " " 2 & 3
Cd COVERED " " J-51 " " 11-12 " 16 " 18 " " 18 & Box
" " " J-33 " " 11-11 " 16 " 17 " " 17 & 18
" " " J-46 " " 11-9 " 16 " 15 " " 15 & 16
" " " J-61 " " "B" " 16 " 14 " " 14 & 15

CLOCK STARTED 7:12:19 PM
Scram 7:32:19 PM
WATER HT 109 WATER TEMP 69.°F
LOG N 2 DC-2 87.5 (5X10)
BLADE 3.38 ROD 14.03

Expr. 20-9 Time 10.25 AM PM Date 3 Jan 1956
Purpose Fine Structure w/ Bare Dysprosium Foils in boxes 16 & 23
Personnel: MB RS, JL

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RS
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 10:25 AM Date 3 Jan 1956

Loading: Same as 20-8, except for a different foil arrangement:

Dysprosium Foil #1 on Fuel Plate 11-21 in Slot 10 Box 23
" " #2 Boron plate " " 9 " "
" " #3 " Fuel Plate 11-19 " " 8 " "
" " #4 ½ " " 5-23 " " 7 " "
" " #6 " " " 11-18 " " 6 " "
" " #7 " " " 11-17 " " 5 " "
" " #8 Boron Plate " " 4 " "
" " #9 " Fuel Plate 11-15 " " 3 " "
" " #10 " " " 11-13 " " 1 " "
" " #11 " " " 11-12 " " 18 " 16
" " #12 " " " 11-11 " " 17 " 16
" " #13 " " " 11-9 " " 15 " "
" " #14 Boron plate " " 14 " "
" " #15 Fuel plate 11-16 " " 13 " "

Dysprosium Foil #16 on Fuel Plate 11-7 in Slot 11 Box 16
" " " #17 on Boron plate in Slot 9 Box 16
" " #18 on Side of Box 16 adjacent to Box 23
Au Normalizing Foil N=37 on Fuel Plate in Slot [redacted] Box
" " " " #43 " " " " " "

Clock started at 10 37' 13" PM

Critical Conditions:

Water Ht	109.5	Control Blade	6.60
Dc-2	89 x5 x10	Control Rod	29.02
Log N	2.0	Water Temp	69°
Rtl	4.6 x1000 x1000		

Expr. 20-10 Time 4:30 AM (PM) Date 1-4 1956
Purpose Zero Check
Personnel:

INSTRUMENT CHECK

Date 1-4 1956 Time 4:30 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	BS	10x20	
Log N	✓		125m.	
R-1	✓	4	.8x1000 x100	
R-2				
P. M.	✓		800V	

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by JL
Start-Up OK'd by RJ Time 4:30 AM (PM) Date 1-4 1956

Loading - same as 20-1, page 136 ~~except: (from 2883 S.S. 12-36 Box replaced fuel #16, slot 12, box 36)~~ S.S.

except: fuel 512 in placed S.S. in slot 12, box 8.

Critical conditions:

Bladder	16.28	Log N	0.17
Rod	29.02	DC-3	60x(20x10)
Water	109.4	R-1	4(100x1000)
		Temp.	69°F

Expr. 20-11 Time 5:40 AM (PM) Date 4 Jan 1956
Purpose Fine Structure Au Normal Foils
Dy Cd covered foils
Personnel: WRJ, JL, MB

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by JL
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start Up OK'd by MB Time 5:40 AM (PM) Date 4 Jan 1955

Loading ~~Same as 20-10, page 136~~

Same as 20-10, except fuel plate 4-27*cs put in, in place of SS in Slot 12, Box 38

Dy. Foil #12, on plate 11-11 Box 16 Slot 17, Cd Covered
" " " 7 " " 11-17 " 23 " 5, cd "
Au " " N32 " " 13-30 " 30 " 2, No cd
Au " " N42 " " 11-30 " 23 " 17, " ".

Clock Started at 5:51':28"

In order to approximate as closely as possible the run 20-9, the assembly was leveled at Log N = 1.6, since the clock was started at .74, $(2.0/e)$, the run will be accomplished 20 seconds earlier than the clock would indicate for a 20 minute run, thus keeping the time interval between the start of the run $Ln N = \frac{1.6}{e}$, and the period, 20 minutes. ~~30~~ 31 seconds being the period between $\frac{1.6}{e}$ and $\frac{2.0}{e}$

Critical Conditions.

Log N	1.6	Control Blade	12.44
DC-2 ~~#~~	89 X10X5	Control Rod	29.02
R-1 ~~#~~	5.3 X1000X1000	Water Temp	69
Water Ht	109.5		

Expr. 19-5 Time 650 AM Date 4 Jan 1956
Purpose Vertical power Distribution w Boron

Personnel: RJ JL, DM

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by DM Source No. RS
Emergency Equipment in Control Room Checked by
Red Light On by RS
Start-Up OK'd by Time AM/PM Date 195

Loading: Same as 20-11:
Catcher foil plate is in Box 23, Slot 11, in place of full fuel 11-25.

Catcher Foils:	Position (0 = vertical center of Core)	
B-1	+10	
3	+8	
16	+6	
26	+4	
41	+2	Normalizing foil A-40, at center outside skirt -.
43	0	
81	-2	
119	-4	
142	-6	
163	-8	
164	-10	

Clock Started at 7:17-18"

Critical Conditions.

Log N	2.0	Control Blade	12.35
DC-2	58 x 10 x 10	Control Rod	29.02
R-1	6.4 x 1000 x 1000	Water Ht.	109.4

Water Temp. 69°F

Expr. 1-9-6 Time 11:15 AM PM Date 1-4 1956

Purpose Diagonal-horizontal power distribution with boron. End boxes on.

Personnel: RJ, JL, MB

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL

Instrument and Safeties Checked and Reset by JL

"Source In" Checked by RJ Source No.

Emergency Equipment in Control Room Checked by MB

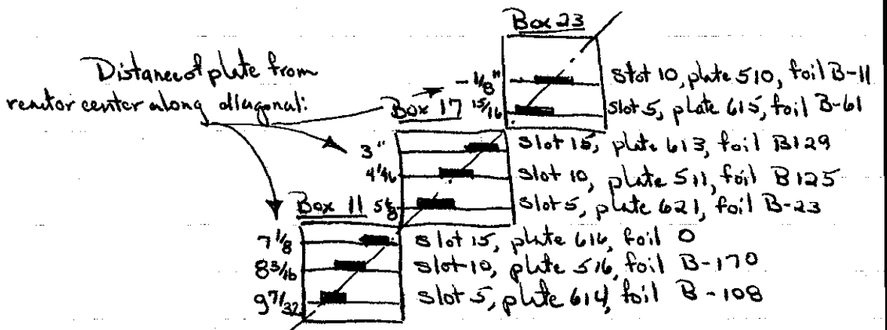
Red Light On by MB

Start-Up OK'd by RJ Time 11:15 AM PM Date 1-4 1956

Loading - same as 20-10 except 515 has replaced 616 in slot 12, box 45

& 11-17 & 11-~~12~~ 21 now in boxes 36 & 10 slot 12 instead of S.S.

also the following foil plates have replaced the fuel originally in these slots:



Standardizing foil #20 in holder #1.

Note: reactor was very sub-critical on first trial. We then added fuel plates 11-17 & 11-12 & are making a second trial. The reason for the low reactivity of the core is not certain — the core was checked for possible plate vacancy but none was found. Log N got up to 0.1 on first trial but for a very short period of time.

ve power at: 12:01:27 a.m.

Run conditions —

Blade	9.14	Log N	2.0
Rod	29.02	DC-2	61 (10×10)
Water	109.3 cm.	R-1	6.6 (1000×1000)
		Temp	69°F

Expr. 19-7 Time 5:50 AM Date 1-5 1956
Purpose Zero check

Personnel:

INSTRUMENT CHECK

Date 1-5 1956 Time 5:50 AM Source No.

Instrument	Value	Scale	[illegible]	Start Up Scale
DC-1				
DC-2				
DC-3	✓ 80	10×20		
Log N	✓	12 sec.		
R-1	✓	.8×1000	1"	
R-2	4	×100		
P. M.	✓	800V	constant.	

Log N can now be check-calibrated every day by the following procedure — lay the γ-source on top of the core so that the source is touching the thimble housing the Log N chamber. In this position, log N should read 0.09.

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Reset by MB+RJ
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 6:30 AM Date 1-5 1956

Loading — same as 20-10, page 150 except 515 has replaced 616 in slot 12, box 45. plus. fuel plate 4-2* in slot 12, box 38.

Reactor just critical — water up, blade + rod up.

Log N = 0.1

Expr. 19-8 Time 8:20 AM PM Date 1-5 1956
Purpose Radial power distribution with beyond end boxes.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by JL
Instrument and Safeties Checked and Set JL
"Source In" Checked by RJ
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 8:20 AM PM Date 1-5 1956

Loading- mass-wise; ~~run~~ run 19-7 plus two full plates

Box	Slot	Distance from center	Plate	Foil	
23	10		618	B-212	
	5		619	206	
16	15		614	216	Std. foil - A-117
	10		613	214	
9	15		615	209	
	10		621	218	
	~~5~~		616	201	
3	10		512	208	
	5		617	217	

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
~~series~~	1	13	3	"B"	4	6	5	12	"B"	7	9	~~*~~	*	"B"	14	8	2	10
material	f	f	f	B	f	f	f	f	B	f	f		f	B	f	f	f	f

for slot 13, see page 137
box 23, see page 137
box 16, see page 137

slot 12.

1	1-9*	16	11-8	31	15-4
2	4-2	17	15-17	32	-5
3	6-32	18	15-18	33	-6
4	6-40	19	1-19	34	-7
5	1-11	20	1-16	35	-8
6	2-12	21	H-961	36	S.S.
7	#259	22	4-20	37	A-506
8	5 11	23	11-27	38	4-27*
9	15-9	24	#328	39	A-505
10	512	25	H-959	40	515
11	15-11	26	3-41	41	4-3
12	15-12	27	#A-264	42	1-15
13	-13	28	15-1	43	7-3
14	-14	29	15-2	44	15-10
15	-15	30	15-3	45	4-9

1/e power at 8:22:40
20 min. exposure.
Run conditions:

Rod	8.87	DC-2	64 (10×10)
Blade	29.02	R-1	—
Water	109.4	H_2O_2	2.0
		Temp.	69°F

SECRET

SECRET

Classification Change to Decl. By
Authority of E. J. Murphy Date 6/3/60

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45 x 31.1 = 1395