Fuel-Element Failures in Hanford Single-Pass Reactors 1944-1971

Hanford Environmental Dose Reconstruction Project

S. P. Gydesen

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Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

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Preface

The Hanford Environmental Dose Reconstruction (HEDR) Project was prompted by mounting concern about possible health effects to the public from more than 40 years of nuclear operations at the Hanford Site. The primary objective of the HEDR Project is to estimate the radiation dose (with descriptions of the uncertainties inherent in such estimates) that individuals could have received as a result of emissions since 1944 from the U.S. Department of Energy's (DOE) Hanford Site near Richland, Washington. An independent Technical Steering Panel (TSP) directs the work on the project which is conducted by Battelle, Pacific Northwest Laboratories (BNW) under contract with the Centers for Disease Control and Prevention.

The HEDR Project work is conducted under several technical and administrative tasks, among which are the Source Terms Task and the Information Resources Task. Under the Source Terms Task, estimates of radioactive emissions from Hanford facilities since 1944 are developed. These estimates (source terms) are based on historical measurements and production information. The Information Resources Task staff identify, search for, retrieve, declassify (if necessary), and make available to HEDR Project staff and the public those documents essential to meet project information needs such as the historical measurements and production information necessary to develop the source terms.

To estimate the radioactive emissions from Hanford facilities, the sources of emission must be identified. One source of emissions was fuel containers that failed. Whenever a leak developed in the fuel container, radioactive emissions to the Columbia River were likely to increase. These leaks were known as fuel-element failures.

The Information Resources Task staff searched for and retrieved those documents that recorded the fuel-element failures in single-pass reactors. The purpose of this letter report is to make available to the public copies of the original documents which recorded the fuel-element failures. The data in these documents will be used by the staff of the Source Terms Task to determine the contribution of fuel-element failures in single-pass reactors to the radioactivity of the reactor effluent.

Summary

The primary objective of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate the radiation dose that individuals could have received as a result of emissions since 1944 from the U.S. Department of Energy's (DOE) Hanford Site near Richland, Washington. To estimate the doses, the staff of the Source Terms Task use operating information from historical documents to approximate the radioactive emissions. These historical documents are identified, searched for, retrieved, declassified (if necessary), and made available by the Information Resources Task staff.

Scope of Work

One source of radioactive emissions to the Columbia River came from leaks in the aluminum cladding of the uranium metal fuel elements in single-pass reactors. The purpose of this letter report is to provide photocopies of the documents that recorded these failures. The data from these documents will be used by the Source Terms Task to determine the contribution of single-pass reactor fuel-element failures to the radioactivity of the reactor effluent from 1944 through 1971. Each referenced fuel-element failure occurring in the Hanford single-pass reactors is addressed. The first recorded failure was in 1948, the last in 1970. No records of fuel-element failures were found in documents prior to 1948. Data on the approximately 2000 failures which occurred during the 28 years (1944-1971) of Hanford single-pass reactor operations are provided in this report.

Technical Approach

The search tree method (Shipler 1993, p. 12.8) was used to find the fuel-element failure information. Once the documents were identified, the fuel-element failure data were extracted and provided to the staff of the Source Terms Task. The Source Terms Task staff then electronically recorded the data in the Source Term fuel-element failure file for use in estimating the Columbia River source term.

Results

All recorded, applicable fuel-element failures have been identified. The information presented in this report is available to the public and for use by the Source Terms Task staff to estimate the radiation emitted to the Columbia River.

Glossary

Only those definitions for the data needed by the Source Terms Task are defined here. For example, fuel-element lot identification and component codes will not be used by the Source Terms Task, so those terms are not defined in this report. Such definitions may be found in Newell (1969a). Any other terms not defined in Newell or this report may be found in the cited report from which the data were extracted.

General Terms

Days in Pile	Days in reactor
GPM	Gallons per minute
KW	Kilowatts
MWD/T	Megawatt days per ton
Slug Rupture	Term used interchangeably with fuel-element failure

Type of Metal

I&E E	Symbol for internally and externally cooled reactor fuel elements, enriched in uranium-235
I&E EB	Symbol for internally and externally cooled reactor fuel elements which are enriched with uranium-235, have projections (bumpers), and are irradiated in ribbed process tubes
I&E ES	Symbol for internally and externally cooled reactor fuel elements which are enriched with uranium-235, have projections (bumpers), and are irradiated in ribless process tubes
I&E N	Symbol for internally and externally cooled natural uranium reactor fuel elements
I&E NB	Symbol for internally and externally cooled natural uranium reactor fuel elements which have projections (bumpers) and are irradiated in ribbed process tubes

I&E NS	Symbol for internally and externally cooled natural uranium reactor fuel elements which have projections (bumpers) and are irradiated in ribless process tubes
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Thoria	Solid element containing thorium oxide target material.
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Type of Failure

1. Terms Used to Identify the Location of the Failure

C Core	Cleavage or growth failure
E End	Failure at the end of the fuel element
H Hole	Failure on the internal surface of the I&E fuel element
S Side	Failure on the side of the fuel element
U Unknown	Location of failure unknown

2. Terms Used to Identify the Reason for the Failure

M Defect	Failure caused by a defect in fuel fabrication
E Examined Not Found	Suspected failure pieces examined but no failures found. Other detector systems, such as Panellit, gamma monitor, etc., however, provided conclusive proof of failure.
G Groove Corrosion	Failure caused by groove-pitting corrosion attack
H Hot Spot	Failure caused by accelerated high-temperature corrosion attack
L Ledge Corrosion	Failure caused by ledge or other near-uniform corrosion attack
D Mechanical Damage	Failure caused by mechanical damage to the fuel element
N Not Examined	Failure not examined
P Parallel Split	Failure caused by cleavage of the core in a direction parallel to the axis of the fuel element
T Transverse Split	Failure caused by cleavage of the core in a direction transverse to the axis of the fuel element
U Unclassified	No other character logically applies to the failure

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Introduction

The first step in determining radiation doses from Hanford Site operations is to calculate the source terms—the radionuclides that were released to the environment. The quantities of radionuclides available for release at any time are a function of the irradiation history of the fuel, the time elapsed since the fuel was removed from the reactor, and the amount of irradiated fuel being dissolved. Fuel-element failures fall under the category of fuel irradiation. Historically, once the fuel was sealed inside a container, it was irradiated. Whenever a leak developed in the fuel container, the radioactivity of emissions to the Columbia River was likely to increase. These leaks are known as fuel-element failures. The data recorded when fuel-element failures occurred in single-pass reactors are necessary to estimate the source term for the Columbia River pathway.

The purpose of this report is to provide the fuel-element failure data for the period of concern to the Hanford Environmental Dose Reconstruction (HEDR) Project: 1944-1971. In Gydesen (1992a and 1992b), the start-up and shut-down dates for the Hanford Site single-pass reactors are recorded. These are the dates that determine the period of study for the HEDR Project. The first fuel-element failure was not recorded until 1948. That was when the U. S. Government decided to increase the production of plutonium. To do this, the power levels were raised. The increased heat that resulted caused fuel-element failures. The last failure was recorded in 1970. Shortly after, in 1971, the last single-pass reactor was shut down.

Quality Assurance and Data Quality Objectives

The data quality objective established for the Information Resources Task is completeness (Shipler 1993). Completeness is necessary as a data quality objective to ensure that all available 1) operating information needed for dose reconstruction and 2) monitoring information indicating concentrations of radioactive materials in the environment will be found. Completeness ensures that discovery of any additional information would not alter the HEDR Project reconstructed results. The approach to achieve completeness is to use the search tree process to review currently available subject, author, periodical, and serial indices for documents of interest to the HEDR Project, which in this report are the fuel-element failure documents.

The search for the fuel-element failure documents was performed using the search tree method (Shipler 1993, p. 12.8). Internal peer reviews of this process were performed by the author's line manager and the Source Term Task leader. The line manager's review ensures that the development of the search trees was sufficient for this particular activity. The Source Term Task leader's review ensures that the information necessary to reconstruct radioactive releases has been provided. Additionally, a surveillance was performed by the quality engineer to verify 1) that the internal reviews performed were sufficient and 2) that for those fuel-element failure documents that are not available, it is indeed because they have been destroyed. These activities ensure that all applicable (single-pass reactor) fuel-element failures have been identified and the corresponding data provided to the Source Terms Task staff.

Fuel-Element Failure Data

Photocopies of the data on the approximately 2000 fuel-element failures which occurred during the 28 years (1944-1971) of Hanford single-pass reactor operations are provided in this report. The data reproduced here include:

1. Date of failure
2. Tube number and reactor in which failure occurred
3. Days in pile or date fuel was loaded
4. Fuel (slug) power in kilowatts (kw)
5. Type of failure

Only fuel-element failures from single-pass reactors are addressed because it is only the releases from single-pass reactors that could have an effect on the source term. The name, single-pass reactor, refers to the fact that the cooling water passed through the reactor core only once before being released to the retention basin and thence to the Columbia River. When a fuel-element failure occurred, the releases that resulted went directly to the river with the holdup time provided by the retention basins being less than 4 hours. Therefore, it is important to calculate the source terms for the single-pass reactor releases that resulted from fuel-element failures.

This contrasts with the N reactor which recirculated the primary cooling water through the reactor continually during operation. Because the N reactor recirculated its cooling water, no discharge went directly from it into the Columbia River. When a fuel-element failure occurred in the N reactor, the recirculating water was flushed out and stored in tanks or plastic-lined ponds. The only way radioactivity from fuel-element failures in the N reactor could have reached the Columbia River would have been by leakage from these tanks and ponds through the soil into shallow springs that eventually fed into the river. Such releases were indirect and much lower than those from the Hanford single-pass reactors. Therefore, fuel-element failures that occurred as a result of N reactor operations are not addressed in this report nor will they be used in the calculation of source terms.

The vast majority of the fuel-element failures involved either natural or enriched uranium fuels. The other failures involved thorium (metal), thoria (thorium oxide), lithium targets (variously referred to as P-10 or mint), and enriched uranium-aluminum driver fuel (C slugs or J slugs). In the early 1950s a small number of failures occurred in the lithium target fuels. In 1965 a thoria program was initiated for the production of uranium-233 from the irradiation of thorium or thorium-oxide target elements. During this program, which was completed in 1968, a total of 27 failures occurred. A brief history of the program and the first 25 failures are reported by Bowles and Schmidt (1966). These other types of fuel-element failures did not significantly contribute to the radioactivity of the reactor effluent.

Appendixes A-Q present photocopies of the fuel-element failure data. Only that information needed for source term calculations (as determined by the Source Terms Task Leader) were extracted for each fuel-element failure and included in this report. The Source Terms Task will use 1) date, 2) burnup, and 3) weight loss for the few failures for which weight-loss data are available. The weight-loss data are not provided in this report but will be referenced in the forthcoming report on key reactor releases to the Columbia River.

Because fuel-fabrication information (e.g., vendor and fabrication history, core geometry, aluminum-component history and canning-serial history) will not be used by the Source Terms Task, any acronyms found in the appendixes concerning fuel fabrication are not defined in this report. Should the reader need these definitions, they may be found in the referenced report from which the tables were extracted.

Every effort was made by the Information Resources staff to locate the most consistent data among the historical documents and make that information available to the Source Terms staff. It should be noted, however, that there were numerous organizations working at the Hanford Site from 1944-1971. Their fuel-element failure documents did not always report the same types of data or even the same number of failures for the same month. This was due to the fact that, depending on the date a report was written, a suspected failure may or may not have been verified by that time as indeed being a failure. Whenever there was a reading on a monitor that implied a failure, that information was recorded as a failure until it was proven otherwise. Those that proved to be failures were assigned a number. It is the data from these numbered fuel-element failures that the Source Terms staff will use to calculate emissions. The entries without numbers are those that turned out not to be failures after all. That information is, of course, of no interest to the HEDR Project.

Because the fuel-element failure information in this report was photocopied directly from the historical documents, legibility varies depending on the quality of the original copy. Nonetheless, to avoid introduction of errors when working with large collections of numbers, the tables have not been retyped. A glossary of selected initialisms has been developed to aid the reader. A bibliography of selected topical reports on fuel-element failures is also included for additional reading.

Results

All recorded, applicable fuel-element failures in single-pass reactors have been identified. The information presented in this report is available for use by the Source Terms Task staff to estimate the radiation emitted to the Columbia River which resulted from fuel-element failures. The results of that study will be reported in a future document on Columbia River radionuclides.

All documents relating to this report have been placed in the U. S. Department of Energy Richland Operations Office Public Reading Room and sent to the Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee. OSTI abstracts, indexes and adds the documents to energy databases which can be electronically searched on several commercial systems.

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APPENDIX A

FUEL-ELEMENT FAILURE DATA FOR 1948-1951

RUPTURED SLUG DATA - MAY 1948-FEBRUARY 1951

Tube No.	1165-F	0569-B	1572-D	11,76-DN	3286-H	3168-LR	3270-H	2562-H
Failure No.	1	2	3	4	5	6	7	8
Date Failed	5-30-48	11-25-48	6-23-50	11-29-50	12-6-50	1-11-51	1-31-51	2-2-51
Date Charged	5-19-48	10-11-48	4-26-50	11-4-50	6-7-50	9-29-50	6-7-50	10-2-50
Days in Pile	11	45	58	25	154	104	238	123
Days of Operation	*	*	*	23	192	100	204	107
Tube Exp. H ₂ O/T	6	40	92	40	314	182	429	219
Tube Power KW at Failure	156	226	196	360	301	361	353	278
Tube Power KW Average	*	*	*	205	261	241	270	260
Slug Power KW at Failure	3.46	3.13	4.26	7.90	6.7	8.3	4.3	6.00
Slug Power KW average	*	*	*	4.1	4.4	5.1	4.4	4.4
Slug Exp. H ₂ O/T	.2	.7	1.9	.8	4.4	3.9	4.4	4.4
Local H ₂ O Temp. at Failure C°	28	49	38	37	38	44	53	18
Local H ₂ O Temp. Average C°	*	*	*	24	44	40	44	44
Slug Position from Front	33	52	38	30	34	37	53	21
Canning Date	4-30-48	2-1-48	3-2-50	*	4-6-50	3-10-50	4-6-50	7-3-50
Type and Line	ARG-2	ARG-2	ZRII-9	*	MRII-6	MRC-5	MRII	FT-313-110-47
Time up since last start-up	*	*	*	4 Days	3 Days	6 Days	5 Days	2 Days
Total No. of shutdowns	*	*	*	4	21	16	30	18
No. of Rapid shutdowns	*	*	*	1	8	9	13	11
Tube zone	.240	.175	.240	.240	.245	.240	.285	.285
Type of Failure	Cap	Cap	Cap	*	Side & Cap	Cap	Cap	Side
Downtime due to rupture hours	240.0	0	168	79.6	77	86.6	18	92
Number of purges	*		16	0	9	1	11	5

* Data unavailable
 ** Average values omitted for 1165 because of non-cosine flux distribution

RUPTURED SLUG DATA - APRIL-MAY 1951

Tube No.	2780-F	1477-II	1377-DR	0986-F	3373-II	2475-F	3489-F	1973-D
Failure No.	9	10	11	12	13	14	15	16
Date Failed	4-9-51	4-10-51	4-15-51	4-19-51	4-23-51	4-30-51	5-3-51	5-13-51
Date Charged	9-13-51	6-28-50	11-4-50	8-2-50	2-12-51	6-13-50	10-11-50	1-16-51
Days in File	208	286	162	260	70	321	204	117
Days of Operation	165	233	145	206	57	257	167	106
Tube Exp. H ₂ O/T	318	537	433	307	176	510	240	234
Tube Power KW at Failure	271	345	375	266	355	289	224	290
Tube Power KW Average	243	288	380	189	381	253	196	282
Slug Power KW at Failure	5.8	6.70	8.36	5.9	6.75	6.2	5.00	6.10
Slug Power KW average	5.2	**	8.2	4.1	**	5.4	4.3	5.9
Slug Exp. H ₂ O/T	6.7	†*	9.4	6.7	†*	10.8	5.2	4.9
Local H ₂ O Temp. at Failure C°	36	17	37	36	25	44	33	33
Local H ₂ O Temp. Average C°	37	†*	36	27	†*	40	27	29
Slug Position from Front	38	13	30	32	23	37	33	26 est. ***
Canning Date	7-14-50	4-26-50	5-5-49	6-2-50	1-15-51	5-16-50	9-5-50	12-7-50
Type and Line	MRII	Mill-2	Mill-3	Mill-5	MRII-1	MRII-3	MRII-1	MRII-11
Time up since last start-up	27 Days	2 Days	3 Days	7 Days	1 Day	4 Days	1 Day	22 Days
Total No. of shutdowns	20	43	23	29	11	37	22	7
No. of Rapid shutdowns	5	22	11	9	9	11	9	2
Tube Zone	.240	.285	.240	.240	.285	.240	.240	.240
Type of Failure	Slide & Cap	Cap	Side	Side	Side	Side	Cap	Cap
Downline due to rupture hours	30.2	18.0	36.0	31.4	32.7	30.5	1.8	25.0
Number of purges	6	11	6	7	6	9	6	5

*** Estimated position

RUPTURED SLUG DATA - MAY-JULY 1951

Tube No.	1368-DR	1171-D	3179-H	2278-H	1475-DR	1476-D	4380-F	3486-H
Failure No.	17	18	19	20	21	22	23	24
Date Failed	5-13-51	5-21-51	6-2-51	6-13-51	6-28-51	6-28-51	6-30-51	7-1-51
Date Charged	9-24-50	9-2-50	6-20-50	7-10-50	11-30-50	9-4-50	5-23-50	1-24-51
Days in Pile	231	261	347	338	210	297	403	158
Days of Operation	208	225	280	271	190	259	331	119
Tube Exp. MH/T	551	440	635	635	568	522	394	345
Tube Power KW at Failure	356	258	337	325	335	311	176	368
Tube Power KW average	355	251	291	299	380	279	147	372
Slug Power KW at Failure	5.0	4.0	3.91	6.60	4.30	6.90	4.0	7.06
Slug Power KW average	5.3	4.1	**	**	4.8	6.0	3.2	**
Slug Exp. MH/T	8.2	7.2	**	**	7.2	11.3	8.5	**
Local H ₂ O Temp. at Failure C°	68	55	65	57	39	48	40	54
Local H ₂ O Temp. Average C°	66	56	**	**	24	35	35	**
Slug Position from Front	51	49	50	40	11	35	34	40
Canning Date	1-5-50	7-10-50	1-12-51	5-17-50	7-27-49	8-1-50	2-27-50	12-29-50
Type and Line	* - 5	ZINC-2	MIG-4	MHH-8	MRH-5	MHG-2	MHG-*	MHG-3
Time up since last start-up	1 Hr.	4 Days	4 Days	6 Days	2 Days	29 Days	23 Days	2 Days
Total No. of shutdowns	33	20	54	51	21	22	43	30
No. of Rapid shutdowns	19	5	27	26	17	6	13	18
Tube Zone	.240	.240	.285	.285	.285	.240	.175	.285
Type of Failure	*	Slide	Slide	Slide	Cap	Cap	Cap	Slide & Cap
Downtime due to rupture hours	69.1	15.0	22.3	13.3	18.5	26.6	269.0	19.7
Number of Purges	8	10	19	18	11	12	13	10

RUPTURED SLUG DATA - JULY-AUGUST 1951

Tubo No.	1768-D	2169-B	1487-DR	1961-D	4086-B	1963-D	1874-F	1572-D
Failure No.	25	26	27	28	29	30	31	32
Date Failed	7-14-51	7-10-51	7-19-51	7-21-51	7-27-51	7-28-51	7-28-51	8-3-51
Date Charged	2-14-51	2-7-51	5-9-51	10-25-50	2-7-51	2-14-51	10-24-50	3-28-51
Days in File	150	161	71	279	170	164	277	128
Days of Operation	132	145	56	245	154	144	212	111
Tube Exp. H ₂ O/T	304	368	144	488	246	315	461	248
Tube Power KW at Failure	270	341	355	272	234	280	269	318
Tube Power KW average	300	325	329	265	206	285	278	285
Slug Power KW at Failure	5.70	6.30	7.80	3.20	4.30	6.00	4.80	6.30
Slug Power KW average	6.3	5.5	7.1	3.2	4.5	6.0	4.3	5.3
Slug Exp. H ₂ O/T	6.4	6.2	3.1	5.9	5.3	6.6	7.2	4.6
Local H ₂ O Temp. at Failure C°	48	68	58	64	50	51	66	64
Local H ₂ O Temp. Average C°	47	63	48	56	42	47	48	60
Slug Position from Front	36***	48	36	55	35	38	50	45***
Canning Date	12-15-50	12-27-50	*	8-13-50	12-15-50	4-19-51	10-#-50	3-19-51
Type and Line	MNG-8	MNG-3	*	MNG-2	MNG-7 &	MNH-11	MNH-#	Fall-9
Time up since last start-up	13 Days	3 Days	1 Day	2 Days	8 Days	3 Hrs.	5 Hrs.	3 Days
Total No. of shutdowns	10	10	14	20	12	14	29	12
No. of Rapid shutdowns	5	3	9	9	4	9	13	9
Tube Zone	.240	.240	.265	.240	.200	.240	.240	.240
Type of Failure	Cap	Cap	Cap	Slide	Slide	2!cs.	Cap	Cap
Downtime due to rupture hours	26.8	25.8	31.4	27.0	25.0	26.5	27.3	27.8
Number of Purges	7	8	4	12	8	9	9	6

RUPTURED SLUG DATA - AUGUST 1951

Tube No.	1963-B	1485-B	406-B-II	3658-D	2073-D	2584-B	1861-B	2068-II
Failure No.	33	34	35	36	37	36	39	40
Date Failed	8-7-51	8-12-51	8-13-51	8-17-51	8-23-51	8-26-51	8-29-51	8-30-51
Date Charged	4-3-51	1-24-51	5-2-51	7-11-50	2-14-51	1-23-51	2-7-51	8-8-51
Days in Pile	126	200	103	402	190	217	203	22
Days of Operation	259	176	77	333	160	188	177	16
Tube Exp. H ₂ O/T	269	391	194	522	379	456	395	43
Tube Power KW at Failure	318	224	302	254	318	331	300	356
Tube Power KW average	302	283	317	200	304	308	284	323
Slug Power KW at Failure	6.60	4.60	4.3	5.5	6.6	6.9	6.6	6.8
Slug Power KW average	6.2	5.7	**	4.3	6.2	6.3	6.1	**
Slug Exp. H ₂ O/T	5.5	7.9	**	11.1	7.8	9.4	8.5	**
Local H ₂ O Temp. at Failure C	47.0	45	55	53	59	70	55	53
Local H ₂ O Temp. Average C	32	51	**	40	66	43	64	**
Slug Position from Front	25	41	40	37	40***	40***	36***	40***
Canning Date	2-14-51	1-4-51	11-3-50	6-7-50	1-18-51	1-5-51	12-26-50	7-7-51
Type and Line	MRG-2	MRG-2	MRG-*	MRG-R	MRG-2	MRG-7	MRG-10 &	MRG-3
Time up since last start-up	15 hrs.	3 Days	19 Hrs.	10 Days	2 Days	10 Days	1 Day	2 Days
Total No. of shutdowns	8	16	16	33	34	17	16	3
No. of Rapid shutdowns	5	0	8	13	14	10	9	3
Tube Zone	.240	.240	.240	.200	.240	.240	.240	.285
Type of Failure	Several Fcs.	Several Fcs.	Side	Cap	Cap	Cap	Slide	Cap
Downtime due to rupture hours	26.7	64.0	14.6	52.1	27.0	27.5	5.0	22.6
Number of Purges	4	10	8	17	11	10	9	2

RUPTURED SLUG DATA - SEPTEMBER 1951

Tube No.	1756-D	2293-F	1562-D	2061-F	1765-D	1860-D	0970-B	1479-D	3273-DR
Failure No.	41	42	43	44	45	46	47	48	49
Date Failed	9-1-51	9-2-51	9-3-51	9-5-51	9-6-51	9-10-51	9-17-51	9-19-51	9-20-51
Date Charged	2-14-51	6-13-50	3-28-51	1-5-50	2-14-51	2-14-51	2-20-51	1-16-51	3-7-51
Days in File	199	446	159	274	204	208	209	246	197
Days of Operation	167	355	134	208	167	169	181	205	172
Tube Exp. MD/T	304	516	288	460	389	382	400	467	523
Tube Power KW at Failure	280	239	211	232	298	256	218	329	375
Tube Power KW average	233	155	279	284	297	285	283	294	390
Slug Power KW at Failure	5.1	5.3	3.4	2.9	6.6	5.1	4.8	7.2	6.3
Slug Power KW average	4.9	3.4	4.6	3.6	6.5	5.5	6.2	6.4	6.6
Slug Exp. MD/T	6.4	11.2	4.7	5.9	8.5	7.4	8.7	10.2	8.8
Local H ₂ O Temp. at Failure C°	53	46	53	58	47	33	39	50	68
Local H ₂ O Temp. Average C°	43	29	60	59	43	27	41	42	69
Slug Position from Front	38***	33***	49	54	33***	22***	32***	33***	48***
Canning Date	12-15-50	5-17-50	*	10-2-50	12-15-50	12-15-50	1-23-51	12-8-50	2-13-51
Type and Line	MRG-6 & 7 Days	MHI-1 & 1 Day	*	MHI-7 1 Day	MRH-3 1 Day	MRG-10 & 3 Days	MRH-2 & 5 Days	MRG-1 & MHI-2 & 7 Days	28 Days
Time up since last start-up	20	9	17	29	23	24	18	26	23
Total No. of shutdowns	13	3	13	14	15	16	8	17	13
No. of rapid shutdowns	.240	.175	.240	.240	.240	.240	.240	.240	.285
Tube zone	Cap	Cap	Cap	Cap	Cap	Cap	Cap	Slide	Cap
Type of failure									
Downtime due to rupture hours	27.6	26.3	33.5	23.5	23.5	26.5	.5	20.0	0.6
Number of purges	12	16	8	10	12	12	8	14	12

RUPTURED SLUG DATA - SEPTEMBER-OCTOBER 1951

Tube No.	1264-DR	1288-B	1766-D	3604-II	1261-F	3964-B	4374-B	2867-F
Failure No.	50	51	52	53	54	55	56	57
Date failed	9-20-51	9-20-51	9-29-51	9-30-51	10-1-51	10-5-51	10-8-51	10-9-51
Date charged	4-10-51	12-13-50	2-14-51	1-24-51	12-21-50	12-13-50	2-7-51	3-7-51
Days in Pile	163	287	227	249	284	296	243	216
Days of Operation	140	248	184	189	214	256	210	170
Tube Exp. MWD/T	376	465	439	560	456	477	350	409
Tube Power KW at Failure	370	282	342	333	349	288	168	319
Tube Power KW average	347	239	306	379	275	241	215	311
Slug Power KW at Failure	7.0	6.2	6.2	6.9	7.0	6.1	3.7	7.1
Slug Power KW average	6.4	4.0	5.5	**	6.0	5.0	4.7	6.8
Slug Exp. MWD/T	7.0	7.8	7.9	**	9.9	9.9	7.6	8.9
Local H ₂ O Temp. at Failure C°	34	60	66	40	49	58	43	45
Local H ₂ O Temp. Average C°	23	62	59	**	39	47	42	42
Slug Position from Front	20	48***	46***	29	34	39***	31	33***
Canning Date	3-2-51	11-7-50	12-15-50	1-2-51	11-2-50	11-7-50	12-15-50	2-1-51
Type and Line	H ₂ G-10 & 28 Days	H ₂ G-12 & 8 Days	MRG-3 8 Days	MRH-1 & 17 Hrs.	MRH-8 & 1 Day	MRG-10 & 6 Days	MRG-7 4 Days	MRH-11 6 Days
Time up since last start-up	23	25	25	42	33	27	21	26
Total No. of shutdowns	13	12	20	27	16	14	13	15
No. of rapid shutdowns	.285	.200	.240	.285	.240	.200	.175	.240
Tube zone	Slide	Cap	Cap	Cap	Side	Cap	Cap	Cap
Type of failure								
Downtime due to rupture hours	9.5	0.3	28.0	26.0	29.6	0.3	25.0	25.8
Number of purges	9	13	14	18	10	14	10	9

RUPTURED SLUG DATA - OCTOBER 1951

Tube No.	2465-D	3276-DR	1489-F	0859-D	3491-II	2164-B	3465-B	2959-F
Failure No.	58	59	60	61	62	63	64	65
Date Failed	10-13-51	10-15-51	10-15-51	10-17-51	10-19-51	10-20-51	10-22-51	10-24-51
Date Charged	3-7-51	3-7-51	1-6-51	1-16-51	5-2-51	1-23-51	1-23-51	1-24-51
Days in Pile	220	222	282	274	170	270	272	273
Days of Operation	179	175	208	224	131	232	234	216
Tube Exp. HMD/T	439	590	416	375	292	564	547	484
Tube Power KV at Failure	321	345	336	273	206	313	293	276
Tube Power KV average	312	385	278	211	285	326	303	287
Slug Power KV at Failure	6.0	6.8	7.0	5.5	4.6	6.2	3.7	6.1
Slug Power KV average	5.8	7.5	5.6	4.1	**	6.2	3.9	6.2
Slug Exp. HMD/T	8.1	11.4	8.4	7.3	**	10.7	7.0	10.5
Local H ₂ O Temp. at Failure Co	64	32	36	61	33	56	64	40
Local H ₂ O Temp; Average Co	61	31	28	40	**	61	66	40
Slug Position from Front	45	22	24	43	32***	44***	54***	32
Canning Date	2-9-51	2-13-51	12-21-50	1-8-50	1-31-50	1-5-51	12-27-50	1-8-51
Type and Line	MRG-6	MRH-3 & MRH-3 &	MRH-11	MRH-3 &	MRG-11 &	MRG-6 &	MRH-11 &	MRG-8 &
Time up since last start-up	1 Day	3 Days	4 Days	3 Days	2 Hrs.	7 Days	1 Day	6 Days
Total No. of shutdowns	25	28	35	30	26	28	28	35
No. of rapid shutdowns	19	16	19	21	15	17	16	19
Tube Zone	.240	.285	.240	.200	.240	.240	.240	.240
Type of Failure	Slide & Cap	Slide & Cap	Slide	Cap	Cap	Cap	Slide	Cap
Downtime due to rupture hours	27.0	9.9	27.0	29.0	0.5	0.3	80.0	50***
Number of purges	14	13	10	17	12	13	13	10

**** Total of 336 Hours due to water leak

RUPTURED SLUG DATA - OCTOBER 1951 (Cont'd)

Tube No.	1166-DR	3467-B
Failure No.	66	67
Date Failed	10-26-51	10-31-51
Date Charged	6-26-51	1-23-51
Days in Pile	122	281
Days of Operation	107	241
Tube Exp. MD/T	321	570
Tube Power KW at failure	363	307
Tube Power KW average	306	303
Slug Power KW at failure	7.6	3.1
Slug power KW average	7.8	3.1
Slug Exp. MD/T	6.5	5.9
Local H ₂ O Temp. at failure	56	65
Local H ₂ O Temp. Average Co	60	65
Slug Position from Front	41	57
Canning Date	6-6-51	1-5-51
Type and Line	HRH-1	MDG-7 &
Time up since last start-up	3 hrs.	2 days
Total No. of shutdowns	15	31
No. of rapid shutdowns	9	19
Tube Zone	.285	.240
Type of Failure	Side & Cap	Cap
Downtime due to rupture	37.1	33.3
hours	6	13
Number of purges		

Extracted from DeMERS 1951, page 11.

RUPTURED SLUG DATA - NOVEMBER 1951

TUBE NO.	1262-DR	0971-D	3270-DR	3366-D	1964-D	2768-DR	1639-DR	2700-D
Failure Number	68	69	70	71	72	73	74	75
Date Failed	11-1-51	11-1-51	11-2-51	11-5-51	11-7-51	11-7-51	11-9-51	11-12-51
Date Charped	5-9-51	9-7-51	6-6-51	3-28-51	2-14-51	6-26-51	7-19-51	1-23-51
Days in file	176	55	149	222	266	134	113	293
Days of Operation	150	41	129	174	209	116	101	233
Tube Exposure M'D/T	395	99	374	425	505	325	260	504
Tube Power at Failure	337	312	359	208	346	347	344	276
Tube Power Average	339	317	371	312	310	358	329	277
Slug Power at Failure	6.2	6.5	7.1	5.3	7.5	7.5	6.7	5.1
Slug Power Average M	6.3	6.6	7.4	5.8	6.7	7.7	6.4	5.1
Slug Exposure M'D/T	7.3	2.1	7.4	7.9	11.0	7.0	5.0	9.3
Local H ₂ O Temperature at Failure	54	53	27	26	45	45	53	47
Local H ₂ O Temperature Average	58	53	33	26	40	43	55	47
Slug Position	45	39	23	20	31	36**	43	40**
Canning Date	4-10-51	7-1-51	4-16-51			5-22-51	6-25-51	1-4-51
Type and Line	MRI#9	MRI-12	MRI#1			ZRG#6	MRI#10	MRI-11
Time Up Since Last Start-up	3 Days	1 Day	7 Hours	1 Day	2 Hours	2 Days	1 Day	5 Days
Total Number of Shutdowns	27	8	21	31	35	19	17	33
Number of Rapid Shutdowns	16	7	16	20	25	14	11	21
Tube Zone	.285	.240	.285	.240	.240	.285	.285	.240
Type of Failure	Cap	Side	Side			Side	Side	Cap & Side
Downtime due to Rupture	0.6	32.0	19.0	37.0	22.0	.5	19.9	.5
Number of Purges	10	6	8	17	20	7	6	14

The blank spaces are at the present unavailable. They will be included in next month's report.

* Data not available
 ** Estimated Position

RUPTURED SLUG DATA - NOVEMBER 1951 (Cont'd)

TUBE NO.	1792-D	2835-ER	2065-DR	1965-DR	2489-DR	1708-F	0762-B
Failure Number	76	77	78	79	80	81	82
Date Failed	11-14-51	11-19-51	11-20-51	11-20-51	11-22-51	11-24-51	11-28-51
Date Charged	1-16-51	6-26-51	4-10-51	6-26-51	5-9-51	5-8-51	2-7-51
Days in Life	302	145	224	147	197	200	294
Days of Operation	241	126	192	127	167	153	252
Tube Exposure M/D/T	514	372	527	349	418	352	421
Tube Power at Failure K/I	268	383	385	354	175	314	249
Tube Power Average K/I	273	378	352	352	320	295	214
Slug Power at Failure	5.8	8.0	7.8	*	3.8	6.0	5.4
Slug Power Average K/I	5.9	7.6	7.1	*	6.9	5.6	4.6
Slug Exposure M/D/T	11.1	7.5	10.6	*	9.0	6.7	9.1
Local H ₂ O Temperature at Failure	23	28	28	*	26	52	47
Local H ₂ O Temperature Average	30	31	29	*	40	51	46
Slug Position	30**	24**	24	*	36	44**	36
Canning Date	12-8-50	5-26-51	3-5-51	3-5-51	4-12-51	4-16-51	1-1-51
Type and Line	MHI#4	MRC#6	MHI#5	MHI#5	MRC#5	MHI#4	ZRC#10
Time up since last Start-up	5 Days	6 Days	2 Hours	2 Hours	15 Hours	22 Days	3 Days
Total Number of Shutdowns	40	23	39	23	35	26	33
Number of Rapid Shutdowns	26	16	24	17	24	13	22
Tube Zone	.200	.285	.285	.285	.285	.210	.175
Type of Failure	Cap	Cap	Side & Cap	Side & Cap	Cap & Side	Cap	Side
Downtime due to Rupture	.5	.75	15.5	0	15.0	.73	27.0
Number of Purges	21	7	12	7	12	7	14

Extracted from WOOD 1951, page 4.

RUPTURED SLUG DATA - NOVEMBER 1951 (Cont'd)

TUBE NO.	1562-B	3878-B
Failure Number	83	84
Date Failed	11-28-51	11-29-51
Date Charged	2-20-51	3-21-51
Days in File	281	252
Days of Operation	241	217
Tube Exposure MWD/T	551	479
Tube Power at Failure KW	302	302
Tube Power Average KW	293	283
Slug Power at Failure	6.6	6.1
Slug Power Average KW	6.4	5.7
Slug Exposure MWD/T	12.0	9.7
Local H ₂ O Temperature at Failure	37	26
Local H ₂ O Temperature Average	39	28
Slug Position	33**	24**
Canning Date	2-2-51	3-2-51
Type and Line	MRI#9	MRI#8
Time up Since Last Start-up	3 Days	3 Days
Total Number of Shutdowns	32	30
Number of Rapid Shutdowns	22	21
Tube Zone	.240	.240
Type of Failure	Cap	Cap
Downtime due to Rupture	0	0
Number of Purges	13	10

Extracted from WOOD 1951, page 5.

RUPTURED SLUG DATA - DECEMBER 1951

Tube No.	2873-D	1565-DR	3286-DR	2963-B	1081-H	2977-B	2765-B	1777-J
Failure No.	85	86	87	88	89	90	91	92
Date Failed	12-3-51	12-5-51	12-6-51	12-7-51	12-10-51	12-11-51	12-13-51	12-1-51
Date Charged	5-23-51	4-10-51	4-10-51	4-3-51	4-4-51	5-16-51	4-3-51	2-14-51
Days in File	194	239	241	248	250	209	254	153
Days in Operation	146	209	207	213	201	176	218	240
Tube Exp. MWD/T	380	582	551	503	579	448	530	606
Tube Power KW at Failure	339	390	362	231	393	122	326	346
Tube Power KW Average	333	357	341	306	369	326	311	320
Slug Power KW	*	7.7	5.5	3.6	8.4	2.0	5.4	*
Local H ₂ O Temp.	*	*	*	28	*	*	*	*
Slug Position from Front	*	*	*	30	*	*	*	*
Canning Date	4-26-51	3-6-51	3-6-51	3-16-51	3-22-51	4-30-51	2-23-51	1-12-51
Type and Line	HHH-3 &	HHG-3 *	FEH-1 &	HHH-7 &	HHH-1 &	HHG-1 &	HHH-3 &	HHG-9 &
Time up Since Last Start-Up	1	3	1	3	8	2	2	10
Total No. of Shutdowns	35	44	45	31	30	31	33	44
No. of Rapid Shutdowns	24	28	29	23	19	24	25	29
Tube one	.240	.285	.285	.240	.285	.240	.240	.240
Type of Failure	Cap	Bott	Side	Side	Side	Side	Cap-1	Cap-1
Downtime due to Rupture	.8	.6	.75	18.5	.5	.5	.4	.5
Hours	16	18	18	10	19	8	16	21
Number of Purges								

* Data Unavailable

Extracted from WOOD 1952, page 3.

RUPTURED SLUG DATA - DECEMBER 1951 (Cont'd)

Tube No.	2869-D	2963-DR	1180-DR	0956-B	0964-D	3762-II	2771-II	2878-F
Failure No.	93	94	95	96	97	98	99	100
Date Failed	12-21-51	12-23-51	12-23-51	12-24-51	12-26-51	12-26-51	12-26-51	12-27-51
Date Charged	3-7-51	4-10-51	4-10-51	10-4-50	1-16-51	4-4-51	5-22-51	9-18-51
Days in Pile	289	257	257	446	344	266	218	103
Days of Operation	232	223	223	373	280	217	178	80
Tube Exp. M.W./T	597	560	594	493	604	566	565	163
Tube Power KW at Failure	319	370	388	200	370	371	386	354
Tube Power KW Average	329	321	341	169	277	334	406	261
Slug Power KW	*	8.0	8.1	4.2	*	7.9	7.0	7.2
Local H ₂ O Temp.	*	39	25	*	*	*	24	50
Slug Position from Front	*	36	26	*	*	*	25	41
Canning Date	2-9-51	3-5-51	3-6-51	8-24-50	12-19-50	3-20-51	11-2-50	(1)
Type and Line	MHC-12 &	MHC-12 &	MHC-8g	MHC-8g	MHC-8g	MHC-8 &	MHC-1 &	(1)
Time up Since Last Start-up	6	8	8	10	4	15	15	4
Total No. of Shutdowns	42	48	48	48	46	30	27	22
No. of Rapid Shutdowns	29	31	31	29	31	20	17	10
Tube Line	.240	.285	.285	.175	.240	.285	.235	.240
Type of Failure	Cap-1	(1)	(1)	Cpd. Cap	Cap	Cap	Slide	(1)
Downtime due to Rupture								
Hours	.5	19.4	20.6	27.0	.5	.7	15.5	30.0
Number of Purges	21	15	15	21	23	19	15	2

* Data Unavailable
(1) Stuck in Tubes

Extracted from WOOD 1952, page 4.

RUPTURED SLUG DATA - DECEMBER 1951 Cont'd)

Tube No.	3965-DR	2260-DR	4178-II	2777-DR	1658-D
Failure No.	101	102	103	104	105
Date Failed	12-27-51	12-28-51	12-30-51	12-30-51	12-30-51
Date Charged	5-18-51	5-8-51	4-4-51	6-6-51	5-23-51
Days in File	223	234	276	207	221
Days in Operation	194	199	218	180	173
Tube Exp. MD/T	481	449	527	496	397
Tube Power KW at Failure	346	349	336	391	259
Tube Power KW Average	317	289	310	353	294
Slug Power KW	(2)	(2)	6.8	8.2	4.9
Local H ₂ O Temp.	1.1	#	#	47	#
Slug Position from Front	1.1	#	#	40	#
Canning Date	(2)	(2)	3-7-51	5-3-51	4-25-51
Type and Line	(2)	(2)	ZRU-9 &	MUG-3 &	MUG-1 &
Time Up since Last Startup	1	.03	2	1	3
Total No. of Shutdowns	41	46	32	42	39
No. of Rapid Shutdowns	29	32	20	32	28
Tube Zone	.240	.205	.285	.285	.200
Type of Failure	(2)	(2)	Cap	(1)	Cap
Downtime due to Rupture					
Hours	.6	.4	.5	22.1	.8
Number of Purges	15	15	20	13	17

*Data Unavailable
 (1) Stuck in Tubes
 (2) Metal from Tube not Separated

Extracted from WOOD 1952, page 5.

APPENDIX B

FUEL-ELEMENT FAILURE DATA FOR 1952

RUPTURED SLUG DATA - JANUARY 1952

<u>Tube No.</u>	<u>Date of Failure</u>	<u>Days in Pile</u>	<u>Canning Date</u>	<u>Tube * Power at Failure</u>	<u>Position In Tube (From Front)</u>	<u>Type of Failure</u>
1471-DR	1-3-52	239	4-12-51	374 KW	*	—
2582-B	1-6-52	278	2-23-51	343 KW	*	Cap
3763-DR	1-7-52	243	4-23-51	362 KW	4.8	Compound Cap
3636-B	1-10-52	324	2-5-51	269 KW	*	Cap
2585-F	1-11-52	275	3-8-51	304 KW	42	Compound Cap
0978-DR	1-11-52	179	6-23-51	349 KW	44	Split
1166-F	1-12-52	249	4-17-51	401 KW	48	Compound Cap
0864-D	1-13-52	270	1-9-51	318 KW	*	Cap
2462-D	1-15-52	272	4-3-51	342 KW	*	Compound Cap
1560-DR	1-16-52	252	4-11-51	353 KW	30	Split
2961-B	1-16-52	245	4-5-51	247 KW	15	Compound Cap
2562-F	1-17-52	291	2-27-51	359 KW	22	Split
2669-B	1-25-52	254	4-28-51	342 KW	*	Cap
0860-B	1-25-52	352	12-26-50	249 KW	35	Compound Cap
2082-F	1-27-52	263	4-14-51	386 KW	48	Cap
2787-D	1-27-52	326	**	291 KW	28	**
2076-DR	1-28-52	236	4-30-51	356 KW	*	Cap
2777-D	1-30-52	252	***	335 KW	*	***
0770-F	1-30-52	134	8-23-51	354 KW	43	Split
0666-F	1-30-52	343	1-23-51		*	Cap

* Position not known

** Stuck in tube

*** Pushed into chute gate with other metal

Extracted from HAP0 1952a, page 84.

RUPTURED SLUG DATA - FEBRUARY 1952

<u>Tube No.</u>	<u>Date of Failure</u>	<u>Days in Pile</u>	<u>Power at Failure</u>	<u>KW per Slug</u>	<u>Local Water Temp., °C.</u>	<u>Canning Date</u>	<u>Type of Failure</u>
1774-DR	2-2-52	241	346 KW	0.8	47	4-30-51	Split
2180-H	2-2-52	178	362 KW	0.5	48	7-6-51	Split
1090-B	2-3-52	258	258 KW	0.4	*	2-26-51	Cap
1275-DR	2-7-52	246	334 KW	6.8	31	5-3-51	Split
4186-B	2-12-52	272	264 KW	**	*	4-5-51	Cap
1871-DR	2-14-52	253	417 KW	7.6	*	5-9-51	Cap
1058-DR	2-15-52	123	290 KW	5.5	16	4-5-51	Split
3465-H	2-15-52	191	390 KW	**	*	6-6-51	Cap
1675-F	2-15-52	169	362 KW	**	*	7-17-51	Split
4283-B	2-16-52	276	190 KW	0.5	*	4-28-51	Compound Cap
0772-F	2-16-52	284	404 KW	**	*	4-16-51	Compound Cap
3690-F	2-17-52	152	281 KW	6.2	28	3-30-51	Split
1057-D	2-18-52	348	304 KW	5.7	18	1-29-51	Split
2064-DR	2-21-52	240	393 KW	7.4	18	5-29-51	Split
1860-DR	2-25-52	292	341 KW	7.3	24	4-2-51	Split
1886-F	2-27-52	295	404 KW	**	*	4-14-51	Cap
3873-F	2-28-52	163	351 KW	6.2	53	6-17-51	Split

* Slug position unknown

** Data unavailable

*** Pushed into chute with other metal

Extracted from HAPO 1952b, page 86.

RUPTURED SLUG DATA - MARCH 1952

Tube No.	0975-II	3665-II	3694-B	2765-D	0984-D	1256-D	1080-F	0465-D
Failure	143	144	145	146	147	148	149	150
Date Failed	3-3-52	3-3-52	3-3-52	3-6-52	3-7-52	3-11-52	3-17-52	3-27-52
Date Charged	9-25-51	9-25-51	1-23-51	7-25-51	4-18-51	4-18-51	9-18-51	5-23-51
Days in File	160	160	405	225	324	328	181	309
Days of Operation	142	142	345	167	262	266	117	251
Canning Date	(3)	8-3-51	1-5-51	7-7-51	4-3-51	4-3-51	8-21-51	4-6-51
Type and Line	(3)	125T-G-3&	MIG-6 &	MIG-10 &	MIG-2 &	MIG-5 &	176-II -3 &	MIG-5 &
Time up Since Last Start-Up	11	11	1	15	1	3	1	6
Tube Exp. MWD/T	412	429	327	477	587	468	298	397
Tube Power KW at Failure	448	428	177	362	333	259	364	280
Tube Power KW Average	271	387	121	366	287	225	326	202
Slug Power KW	9.3	8.2	3.7	6.8	5.9	5.6	(1)	5.7
Slug Position from Front	27	*	39	*	*	*	*	25
Local H ₂ O Temp.	24	*	49	*	*	*	*	26
Downtime due to Rupture								
Hours	22.5	.5	17.0	0.5	0.4	0.4	0.7	29.0
Total No. of Shutdowns	18	18	56	35	54	55	39	57
No. of Rapid Shutdowns	13	13	40	32	39	40	25	40
Tube Zone	.285	.285	.140	.240	.240	.200	.240	.200
Number of Purges	12	12	21	15	20	20	3	20
Type of Failure	C. Cap	Split	C. Cap	Cap	C. Cap	Cap	Split	C. Cap

- * Data Unavailable
- (1) Metal Mixed with Rest of Discharge.
 - (2) No Rupture Found
 - (3) Canning Data Obliterated During Removal from Tube

Extracted from LANG 1952a, page 3.

RUPTURED SLUG DATA - MARCH 1952 (Cont'd)

Tube No.	3565-II	3686-B
Failure No.	151	
Date Failed	3-27-52	3-1-52
Date Charged	9-25-51	8-30-51
Days in File	184	211
Days of Operation	166	183
Canning Date	8-30-51	No Slug Found
Type and Line	125-T - B-88	No Slug Found
Time up Since Last Start-Up	12	13
Tube Exp. H ₂ O/T	497	345
Tube Power KW at Failure	413	306
Tube Power KW Average	383	242
Slug Power KW	8.1	(2)
Slug Position from Front	*	*
Local H ₂ O Temp.	*	*
Downtime due to Rupture		
Hours	30.0	26.0
Total No. of Shutdowns	20	37
No. of Rapid Shutdowns	15	29
Tube Zone	.285	.240
Number of Purges	14	10
Type of Failure	Side	(2)

* Data Unavailable

(1) Metal Mixed with Rest of Discharge

(2) No Rupture Found

(3) Canning Data Obliterated During Removal From Tube

Extracted from LANG 1952b, page 4.

RUPTURED SLUG DATA - APRIL 1952

Tube Number	3088-D	4287-F	2489-B	3653-B	2493-F	0855-D	0562-F
Failure	152	153	154	155	156	157	158
Date Failed	4-2-52	4-4-52	4-4-52	4-6-52	4-6-52	4-7-52	4-7-52
Date Charged	8-22-51	5-8-51	8-14-51	1-23-51	5-8-51	1-16-51	9-28-50
Days in Pile	224	332	234	439	334	447	558
Days of Operation	279	240	108	361	242	371	419
Canning Date	8-2-51	4-16-51	7-17-51	1-5-51	4-14-51	12-8-50	8-8-50
Type and Line	MRH-2 &	MRG-4 &	MRH-9 &	MRG-5 &	MRH-9 &	MRG-2	MRG-1 &
Time up since Last Start-up	5	16	1	1	1	4	<1
Tube Exp. MD/T	439	329	469	365	465	471	559
Tube Power KW at Failure	291	231	357	149	263	256	248
Tube Power KW Average	201	175	319	129	246	163	171
Slug Power KW	5.4	4.3	6.5	2.6	5.3	5.5	5.8
Slug Position from Front	*	*	*	47	41	35	*
Local H ₂ O Temperature	*	*	*	53.8	45	37	*
Downtime due to Rupture Hours	.5	.5	.4	25.5	.6	29.0	None
Total No. of Shuttdowns	46	52	41	59	53	67	77
No. of Rapid Shuttdowns	32	32	32	42	33	45	44
Tube Zone	.240	.175	.240	.140	.200	.200	.200
Number of Purges	14	10	14	25	10	26	17
Type of Failure	Cap	Cap	C. Cap	Cap	Cap	Non-Classified	Cap

* Data 'n'available

Extracted from LANG 1952b, page 4.

RUPTURED SLUG DATA - APRIL 1952 (Cont'd)

Tube Number	3088-II	3681-H	4086-B	4056-B	1371-B	2192-DR	2659-F
Failure	159	160	161	162	163	164	165
Date Failed	4-12-52	4-14-52	4-15-52	4-15-52	4-23-52	4-23-52	4-28-52
Date Charged	9-25-51	9-25-51	7-28-51	5-16-51	7-11-51	10-15-51	12-5-51
Days in File	200	202	262	335	287	191	145
Days of Operation	176	176	209	273	226	163	97
Canning Date	8-25-51	8-31-51	6-14-51	4-28-51	6-11-51	Group 7	10-22-51
Type and Line	167-T-1 & G	1G2H92-9-&	MRH-11-&	MRG-5 &	ZRG-11 &	(1)	B6-173U &
Time up since Last Start-up	14	<1	7	7	6	11	<1
Tube Exp. MWD/T	496	529	374	358	608	307	262
Tube Power KW at Failure	378	396	297	186	373	273	341
Tube Power KW Average	361	385	229	168	128	241	346
Slug Power KW	6.4	5.2	5.3	3.6	6.3	5.2	5.9
Slug Position from Front	48	*	*	43	48	21	*
Local H ₂ O Temperature	55	*	*	44	60	20	*
Downtime due to Rupture							
Hours	23	2.4	.5	25.2	27.1	21.7	.7
Total No. of Shutdowns	20	21	46	52	50	49	28
No. of Rapid Shutdowns	15	16	37	41	41	33	15
Tube Zone	.285	.285	.200	.175	.240	.240	.240
Number of Purges	14	15	16	18	16	11	3
Type of Failure	Side	Non-Classified	Cap	C. Cap	Side	Non-Classified	Split

* Data unavailable
 (1) Slug broken in small pieces, cap lost.

RUPTURED SLUG DATA - APRIL 1952 (Cont'd)

Tube Number	0386-B	4060-D
Failure	166	167
Date Failed	4-29-52	4-29-52
Date Charged	1-23-51	3-7-51
Days in Pile	462	419
Days of Operation	383	348
Canning Date	1-5-51	2-12-51
Type and Line	MFG-2 &	MFG-6 &
Time up since Last Start-up	4	19
Tube Exp. MWD/T	385	617
Tube Power KW at Failure	157	268
Tube Power KW Average	129	227
Slug Power KW	3.1	2.9
Slug Position from Front	*	*
Local H ₂ O Temperature	*	*
Downtime due to Rupture Hours	.5	.3
Total No. of Shutdowns	62	65
No. of Rapid Shutdowns	45	45
Tube Zone	.140	.200
Number of Purges	26	25
Type of Failure	C. Cap	C. Cap

* Data unavailable

Extracted from LANG 1952b, page 6.

RUPTURED SLUG DATA - MAY 1952

Tube Number	4265-D	3088-B	2062-B	2470-B	3278-B	3261-H
Failure	168	169	170	171	172	173
Date Failed	5-1-52	5-3-52	5-4-52	5-4-52	5-13-52	5-16-52
Date Charged	4-18-51	7-11-51	1-6-52	8-12-51	10-10-51	9-25-51
Days in File	379	297	109	266	216	234
Days of Operation	310	243	89	222	181	206
Canning Date	4-3-51	6-8-51	11-16-51	8-1-51	9-15-51	9-1-51
Type and Line	HMG-6 &	2R-1 &	B-5- &	B-7- &	B-1- &	-3 &
Time up since last Start-up	1	3	<1	<1	8	<1
Tube Exp. MWD/T	550	570	274	586	480	542
Tube Power KW at Failure	265	308	359	368	361	312
Tube Power KW Average	227	300	394	334	339	337
Slug Power KW	4.5	5.9	5.9	7.1	6.3	(1)
Slug Position from Front	#	#	16	43	#	—
Local H ₂ O Temperature	#	#	17.9	56.3	#	—
Downtime due to Rupture Hours	.4	.5	18.2	8.0	24.5	120.4
Total No. of Shutdowns	63	52	20	47	40	25
No. of Rapid Shutdowns	45	43	17	38	34	18
Tube Zone	.175	.240	.240	.240	.240	.285
Number of Purges	22	16	8	15	14	17
Type of Failure	C. Cap	Cap	Split	Non-	Cap	Side
				Classified		

* Data Unavailable
(1) Part of Metal Mixed with normally discharged metal.

Extracted from BARTLETT 1952a, page 3.

RUPTURED SLUG DATA - MAY 1952 (Cont'd)

Tube Number	2461-B	2789-H	0564-F	2881-D	4185-D	3088 B-2
Failure	174	175	176	177	178	Suspect
Date Failed	5-19-52	5-20-52	5-24-52	5-29-52	5-30-52	5-3-52
Date Charged	11-2-51	9-25-51	5-8-51	11-29-51	4-18-51	7-11-51
Days in Pile	199	238	382	182	408	297
Days of Operation	169	208	284	162	337	243
Canning Date	9-22-51	8-25-51	4-14-51	10-11-51	4-3-51	6-8-51
Type and Line	B-8 &	G-1 &	MKG-10 &	G-8 &	MRH-9 &	ZR-1 &
Time up since last Start-up	3	1	3	11	1	3
Tube Exp. MWD/T	441	565	481	445	604	570
Tube Power KW at Failure	309	356	278	360	280	308
Tube Power KW Average	334	348	217	352	229	300
Slug Power KW	6.5	(1)	5.5	4.5	5.6	5.6
Slug Position from Front	*	*	*	*	*	*
Local H2O Temperature	*	*	*	*	*	*
Downtime due to Rupture Hours.7	*	*	5	5	4	0
Total No. of Shutdowns	34	25	65	33	69	52
No. of Rapid Shutdowns	30	18	40	21	47	43
Tube Zone	.240	.285	.200	.240	.200	.240
Number of Purges	14	17	10	7	23	16
Type of Failure	Cap	Cap	Cap	Cap	Cap	Slide

Extracted from BARILETT 1952a, page 4.

RUPTURED SLUG DATA - JUNE 1952

Tube Number	3292-D	1778-H	2758-H	2683-H	3063-H	1170-H	2584-F
Failure Number	179	180	181	182	183	184	185
Date Failed	6-4-52	6-6-52	6-6-52	6-6-52	6-7-52	6-10-52	6-17-52
Date Charged	4-18-51	11-20-51	9-25-51	2-15-52	9-25-51	3-3-52	7-12-51
Days in Pile	413	199	255	112	256	99	341
Days of Operation	341	174	221	96	213	83	256
Tube Exposure	616	504	503	266	576	230	683
Tube Power at Failure	255	401	311	376	337	379	322
Tube Power Average	231	371	291	355	346	355	341
Slug Power	5.0	7.6	6.7	13.3	5.6	13.4	4.0
Local H ₂ O Temperature	*	*	38	57	*	56	*
Slug Position	*	*	34	23	*	23	*
Canning Date	4-3-51	12-29-50	8-25-51	1-25-52	8-25-51	(1)	6-(1)-51
Type Metal	MR (Reg.)	MR (Reg.)	Reg.	A660	Reg.	(1)	MR (Reg.)
Manufacturing Truck No. and Line No.	G-1α	G-1α	(1)-10α	H-11α	G-9α	(1)	H-8α
Lot No.	---	---	22U	209X	22U	(1)	---
Metal Group No.	7	7	8	9	8	9	8
Days up Since Last Start-up	4	13	1	1	1	1	8
Total Number of Shutdowns	70	23	30	16	31	13	65
Number of Rapid Shutdowns	48	17	21	11	22	9	41
Tube Zone	.200	.285	.285	.285	.285	.285	.240
Type of Failure	Cap	Split	Split	Side	Split	Side	Cap
Downtime due to Rupture	.4	.8	8.5	13.0	3.5	27.2	0.5
Number of Purges	24	25	28	7	28	7	8

* Data Unavailable
(1) Data Obliterated

Extracted from BARTLETT 1952b, page 3.

RUPTURED SLUG DATA - JUNE 1952 (Cont'd)

Tube Number	0967-F	1392-B	4378-B
Failure Number	186	187	188
Date Failed	6-17-52	6-24-52	6-26-52
Date Charged	9-16-51	12-7-51	4-3-51
Days in Pile	275	200	450
Days of Operation	202	173	387
Tube Exposure	516	291	641
Tube Power at Failure	322	273	259
Tube Power Average	327	215	212
Slug Power	5.5	5.6	5.1
Local H ₂ O Temperature	*	63	32
Slug Position	*	40	23
Canning Date	8-22-51	2-6-51	3-14-51
Type Metal	Reg.	MR (Reg.)	MR (Reg.)
Manufacturing Truck No. and Line No.	B-9& 124T	G-10& —	G-4& —
Lot No.	8	7	7
Metal Group No.	8	26	26
Days up Since Last Start-up	41	29	62
Total Number of Shutdowns	55	25	49
Number of Rapid Shutdowns	35	.175	.175
Tube Zone	.240	Side	Non-Classified
Type of Failure	Split	25.5	30.2
Downtime due to Rupture	0.4	13	23
Number of Purges	4		

* Data Unavailable

(1) Data Obliterated

Extracted from BARTLETT 1952b, page 4.

RUPTURED SLUG DATA

- The following table contains the data for those slugs which ruptured in July 1952.

Data Sources

1. Tube number - Reactor Section ruptured slug reports.
2. Failure number - Chronological order of failures from Reactor Section daily report sheets.
3. Date charged - Reactor Section file of charge cards.
4. Days in pile - Calculated from charge dates and failure dates.
5. Days of operation - Days in the pile minus days down.
6. Tube exposure-Reactor section production scheduling.
7. Tube power at failure - $(.264) (\Delta T) (\text{flow})$
8. Tube power average - $\frac{(\text{Exposure}) (\text{Charge Weight})}{\text{Days of Operation}}$
9. Slug power - $\frac{(.94) (\text{Tube Power}) (\text{Radiation level of rupture})}{\text{Sum of Radiation Levels}}$
10. Local H_2O temperature - Assumed cosine flux distribution reported for exact position only because of error in estimated slug position.
11. Slug position - Only exact slug position reported. Slug position estimated from weasel data were found to be in error as much as 30 per cent due to pile flattening and non-cosine flux distribution.
12. Canning date - Visual inspection of piece.
13. Type metal - Regularly machined pieces, or re-processed rejects from slug markings and metal preparation section.
14. Manufacturing truck no. and line no. - Obtained from slug markings and Metal Preparation Section.
15. Lot No. - Metal from which slug manufactured. Obtained from slug markings and Metal Preparation Section.
16. Metal group no. - From manufacturing date, HW-24099.
17. Days p since last startup-Reactor Section daily report sheets.
18. Total number of shutdowns - Reactor Section daily report sheets.
19. Number of rapid shutdowns - Reactor Section daily report sheets.
20. Tube zone - Technical Section temperature maps.
21. Type of failure - Visual inspection of piece.
22. Downtime due to rupture - Reactor Section rupture slug reports.
23. Number of purges - Reactor Section pressure drop report sheets.

Possible Errors in Data

1. Tube power $\pm 5\%$ because flow not certain.
2. Slug power $\pm 10\%$ because of tube power error.
3. Local H_2O temperature $\pm 10\%$ because of non-cosine flux distribution.

Extracted from BARTLETT 1952c, pages 6-7

RUPTURED SLUG DATA - JULY 1952

Tube Number	1793-B	0560-F	3971-D	3189-H	1292-B	2677-H	0482-D	4460-H
Failure Number	189	190	191	192	193	194	195	196
Date Failed	7-2-52	7-3-52	7-5-52	7-5-52	7-6-52	7-7-52	7-16-52	7-18-52
Date Charged	9-12-51	5-8-51	1-25-52	11-20-51	3-2-52	1-24-52	5-23-51	4-4-51
Days in Pile	294	422	162	228	126	165	420	471
Days of Operation	248	317	146	198	109	140	359	389
Tube Exposure	408	454	373	586	179	436	576	489
Tube Power at Failure	259	214	336	330	255	427	258	242
Tube Power Average	211	183	327	379	210	399	211	161
Slug Power	44.8	5.2	(1)	6.1	(1)	8.9	5.4	(1)
Local H ₂ O Temperature	*	*	*	54	*	*	60	*
Slug Position	*	*	*	45	*	*	39	*
Canning Date	1-31-51	4-16-51	12-5-51	(2)	2-8-52	1-12-52	4-5-51	3-7-51
Type Metal	Reg.	Reg.	Reg.	(2)	Reg.	Reprocess	Reg.	Reprocess
Manufacturing Truck No. and	H-8	G-4	H-6	(2)	B-1	G-3	H-1	H-5
Line No.								
Lot No.	-	-	253X	-	11	ZRL51	-	-
Metal Group No.	7	7	8	8	8	PT-503-A	7	7
Days up Since Last Start-up	3	5	22	24	3	<1	9	2
Total Number of Shutdowns	50	72	27	26	16	23	73	59
Number of Rapid Shutdowns	42	44	16	20	13	18	48	40
Tube Zone	.175	.175	.240	.285	.175	.285	.175	.175
Type of Failure	C.Cap	C.Cap	Cap	Side	Cap	Split	Non-Glass	Split
Downtime due to Rupture	.5	.4	31.5	23.2	.6	1.8	31.0	.5
Number of Purges	18	10	5	18	8	12	24	36

* Data unavailable
 (1) Metal Mixed
 (2) Data Obliterated

RUPTURED SLUG DATA - JULY 1952 (Cont'd)

Tube Number	1791-B	0858-B	3769-D	3773-F	3684-F
Failure Number	197	198	199	200	201
Date Failed	7-20-52	7-21-52	7-28-52	7-29-52	7-31-52
Date Charged	12-7-51	5-16-51	5-6-52	12-5-51	1-18-52
Days in File	226	432	83	237	195
Days of Operation	196	368	76	175	149
Tube Exposure	410	621	213	479	383
Tube Power at Failure	276	243	367	398	372
Tube Power Average	268	216	359	350	329
Slug Power	4.8	6.0	6.3	2.8	6.0
Local H ₂ O Temperature	*	*	*	*	*
Slug Position	*	*	*	*	*
Canning Date	4-6-51	4-2-51	3-15-52	10-1-51	12-5-51
Type Metal	Reg.	Reg.	Reg.	Reg.	Reg.
Manufacturing Truck No. and	G-11	G-5	G-4	G-2	H-2
Line No.					
Lot No.	-	-	59	158H	247U
Metal Group No.	7	7	8	8	8
Days up Since Last Start-up	13	<1	9	6	1
Total Number of Shutdowns	33	66	12	49	40
Number of Rapid Shutdowns	28	53	5	25	22
Tube Zone	.200	.175	.210	.240	.240
Type of Failure	Cap	G.Cap	Cap	Cap	Cap
Downtime due to rupture	.6	.6	.5	.5	.3
Number of Purges	13	21	3	3	2

*Data Unavailable
 (1) Metal Mixed
 (2) Data Obliterated

RUPTURED SLUG DATA - AUGUST 1952

Tube Number	0274-B	3764-B	4068-F	3581-F	4460-D	0872-F
Failure Number	202	203	204	205	206	207
Date Failed	6-2-52	8-4-52	8-6-52	8-12-52	8-13-52	8-13-52
Date Charged	2-20-51	6-26-52	1-18-52	1-18-52	3-7-51	10-26-51
Days in File	529	39	201	207	525	292
Days of Operation	454	36	155	158	441	219
Tube Exposure	562	81	368	438	574	563
Tube Power at Failure	133	417	345	392	198	389
Tube Power Average	158	288	304	355	167	329
Slug Power	(1)	7.5	3.0	4.9	3.7	8.4
Local H ₂ O Temperature	*	49	77	*	59	46
Slug Position	*	31	59	*	45	29
Canning Date	1-31-51	12-31-51	12-13-51	12-6-51	2-8-51	9-10-51
Type Metal	MR (Reg.)	Reg.	Reprocess	Reprocess	MR (Reg.)	Reg.
Manufacturing Truck No. and Line No.	H-9	H-9	B-10	H-4	G-9	B-8
Lot Number	-	2	ZR139	ZR138	-	159 U
Metal Group Number	7	8	8	8	7	8
Days up Since Last Start-up	6	1	5	<1	1	<1
Total Number of Shutdowns	77	11	41	44	83	63
Number of Rapid Shutdowns	56	7	23	23	53	34
Tube Zone	.140	.240	.240	.240	.175	.240
Type of Failure	C. Cap	Split	Non-Class.	Cap	C. Cap	Split
Downtime due to Rupture	27.2	39.9	62.7	.1	29.6	45.9

* Data unavailable

(1) Metal Mixed with Normally Discharged Metal.

Extracted from BARTLETT 1952d, page 9.

RUPTURED SLUG DATA - AUGUST 1952

Tube Number	3467-F	3781-F	1055-II	1967-F	3079-F	3582-F	1568-D **
Failure Number	208	209	210	211	212	213	Special Irradiation
Date Failed	8-18-52	8-24-52	8-29-52	8-29-52	8-30-52	8-31-52	P. 18-52
Date Charged	12-5-51	12-5-51	4-4-51	1-18-52	1-18-52	1-18-52	
Days in Pile	257	263	513	224	225	226	
Days of Operation	189	194	430	169	170	171	
Tube Exposure	508	508	547	456	433	463	
Tube Power at Failure	390	374	226	367	351	363	
Tube Power Average	344	335	163	345	326	347	
Slug Power	2.0	2.4	(1)	4.3	5.7	4.0	
Local H ₂ O Temperature	86	*	Stuck	*	*	*	
Slug Position	63	*	Stuck	*	*	*	
Canning Date	10-10-51	10-11-51	3-23-51	12-13-51	12-5-51	12-6-51	
Typo Metal	Reg.	Reg.	Reprocess	Reg.	Reprocess	Reprocess	
Manufacturing Truck No. and Line No.	11-11	G-3	G-9	G-7	B-8	H-4	
Lot Number	189	158-II	-	221-II	ZR138	ZR138	
Metal Group Number	8	8	7	8	8	8	
Days up Since Last Start-up	1	5	44	3	<1	<1	
Total Number of Shutdowns	57	58	64	49	50	51	
Number of Rapid Shutdowns	29	30	44	27	28	29	
Tube Zone	.240	.240	.175	.240	.240	.240	
Type of Failure	Non-Class.	Cap	G. Cap	Cap	Cap	Cap	
Downtime due to Rupture	24.1	26.3	24.4	.4	.4	.3	

** Replaceable slug containing graphite sample.

* Data Unavailable

(1) Metal Mixed with Normally Discharged Metal

Extracted from BARTLETT 1952d, page 10.

RUPTURED SLUG DATA - SEPTEMBER 1952

Tube Number	2365-F	2574-DR	0365-D	0480-B	0567-F	3460-H	0574-B
Failure Number	214	215	216	217	218	219	220
Date Failed	9-4-52	9-6-52	9-8-52	9-9-52	9-12-52	9-13-52	9-15-52
Date Charged	12-5-51	12-24-51	3-28-51	9-12-51	1-19-52	1-24-52	11-2-52
Days in Pile	274	257	530	363	237	233	318
Days of Operation	203	230	442	306	179	203	272
Tube Exposure	557	596	583	503	340	483	580
Tube Power at Failure	365	394	204	252	294	355	294
Tube Power Average	351	329	169	210	243	305	273
Slug Power	7.9	8.0	3.7	4.8	4.0	8.0	6.4
Local H ₂ O Temperature	61	60	62	#	#	#	51
Slug Position	40	41	46	#	#	#	34
Canning Date	10-10-51	11-5-51	3-8-51	1-31-51	12-7-51	12-6-51	3-26-52
Type Metal	Reg.	Reg.	Reg.	HR(Reg.)	Reg.	Reprocess	HR(Reg.)
Manufacturing Truck No. and	B-5	B-5	11-3	11-3	H-10	G-8	G-11
Line No.	158-H	196-U	---	---	260	ZR-135	---
Lot Number	8	8	7	7	8	8	7
Metal Group Number	3	12	13	11	7	<1	3
Days up Since Last Start-up	61	38	85	66	52	33	57
Total Number of Shutdowns	34	21	55	49	31	26	42
Number of Rapid Shutdowns	.240	.285	.175	.175	.240	.285	.200
Tube Zone	Side	Side	Non-Class.	C Cap	Cap	Side	C Cap
Type of Failure	28.3	10.5	19.4	28.0	.5	.7	27.1
Downtime due to Rupture	Normal	Normal	Normal	Normal	Normal	Heavy	Normal
Slug Surface						Blistering	

* Data unavailable

Extracted from BARTLETT 1952e, page 10.

RUPTURED SLUG DATA - SEPTEMBER 1952 (Cont'd)

Tube Number	0868-F	2984-II	3966-F	2181-F	2265-F	3577-H
Failure Number	221	222	223	224 (1)	Suspect	225
Date Failed	9-16-52	9-17-52	9-19-52	9-20-52	9-20-52	9-27-52
Date Charged	1-27-52	3-6-52	12-5-51	1-18-52	—	5-13-52
Days in File	233	195	289	246	—	137
Days of Operation	177	171	214	186	—	117
Tube Exposure	431	505	505	506	—	376
Tube Power at Failure	384	402	370	375	—	409
Tube Power Average	312	378	302	348 (1)	—	411
Slug Power	1.5	16.8	6.6	Mixed	(1)	9.6
Local H ₂ O Temperature	82	48	*	*	*	*
Slug Position	64	16	*	*	*	*
Canning Date	12-7-51	2-7-52	10-11-51	12-13-51	—	4-15-52
Type Metal	Reg.	Reg.	Reg.	Reg.	—	Reg.
Manufacturing Truck No. and Line No.	G-11	B-2	B-3	H-4	—	G-2
Lot Number	260	7	158-H	221-H	—	110
Metal Group Number	8	9	8	8	—	9
Days up Since Last Start-up	1	—	1	<1	—	7
Total Number of Shutdowns	53	27	65	57	—	23
Number of Rapid Shutdowns	32	21	38	36	—	18
Tube Zone	.240	.285	.210	.240	.240	.285
Type of Failure	None	Side	Cap	Cpd.Cap	—	Side
Downtime due to Rupture	22.8	23.5	.5	.5	—	.3
Slug Surface	Heavily pitted	Normal	Blistered	Heavily pitted	—	Normal

(1) Tube 2181-F and 2265-F pushed at same time. One ruptured slug discovered and credited to tube 2181-F

* Data unavailable

RUPTURED SLUG DATA - OCTOBER 1952

Tube Number	0680-B	0866-F	1779-F	3054-B	3892-B	3971-F	4474-B
Failure Number	226	227	228	229	230	231	232
Date Failed	10-2-52	10-4-52	10-6-52	10-6-52	10-13-52	10-15-52	10-15-52
Date Charged	12-7-51	12-5-51	12-5-51	9-12-51	9-12-51	1-18-52	3-3-52
Days in Pile	300	304	306	390	397	271	223
Days of Operation	256	229	231	331	338	209	196
Tube Exposure	543	542	626	539	493	513	359
Tube Power at Failure	323	380	384	196	158	378	231
Tube Power Average	271	303	347	208	187	314	234
Slug Power	6.3	5.0	7.3	3.7	2.8	4.1	3.6
Local H ₂ O Temperature	#	#	#	#	24.7	78.5	#
Slug Position	#	#	#	#	18	60	#
Canning Date	4-6-51	10-6-51	10-16-51	2-1-51	2-1-51	12-5-51	2-21-52
Type Metal	Reg.	Reg.	Reg.	Reg.	Reg.	Reg.	Reg.
Manufacturing Truck	Q-4	Q-7	H-1	Q-2	H-2	Q-5	Q-1
No. and Line No.	-	63H	112	-	-	247-U	25
Lot Number	7	8	8	7	7	8	8
Metal Group Number	15	13	1	3	6	4	17
Days up Since Last Startup	51	68	69	71	72	62	29
Total Number of Shutdowns	37	40	41	54	55	40	23
Number of Rapid Shutdowns	.200	.240	.240	.175	.175	.240	.200
Tube Zone	C.Cap	C.Cap	Spill	C.Cap	Unclass.	Side	C.Cap
Type of Failure	0.4	0.4	50.4	0.4	25.0	26.8	0.9
Downtime due to Rapture	Heavily Blistered	Heavily Blistered	Normal	Heavily Blistered	Badly Mainte-	Heavily Pitted	Normal
Slug Surface					grated.		

* Data unavailable

Extracted from LANG 1952c, page 11.

RUPTURED SLUG DATA - OCTOBER 1952 (Cont'd)

Tube Number	2084-D	1479-F	0862-B	3965-F
Failure Number	233	234	235	236
Date Failed	10-16-52	10-19-52	10-29-52	10-30-52
Date Charged	5-6-52	1-18-52	12-7-51	12-5-51
Days in File	163	275	327	330
Days of Operation	145	212	281	252
Tube Exposure	424	567	606	586
Tube Power at Failure	392	389	311	346
Tube Power Average	374	342	276	298
Slug Power	6.0	5.2	2.7	6.4
Local H ₂ O Temperature	#	#	71	#
Slug Position	#	#	59	#
Canning Date	3-28-52	12-8-51	4-6-51	10-11-51
Type Metal	Reprocess	Reprocess	Reg.	Reg.
Manufacturing Truck	H-9	H-5	4	C-3
No. and Line No.				
Lot Number	179	137	-	158-H
Mesh Group Number	8	8	7	8
Days up Since Last Startup	11	3	12	6
Total Number of Shutdowns	23	63	55	76
Number of Rapid Shutdowns	12	41	41	48
Tube Zone	.240	.240	.200	.240
Type of Failure	Cap	Cap	C.Cap	Cap
Downtime due to Rapture	0.4	0.4	32.8	0.6
Slug Surface	Mildly Pitted	Mildly Pitted	Heavily Blistered	Blistered

* Data not available

Extracted from LANG 1952c, page 12.

RUPTURES SLUG DATA - NOVEMBER 1952

Tube Number	0347-B	1172-F	0373-B	0768-DR	0571-H	4488-B
Failure Number	237	238	239	240	241	242
Date Failed	11-3-52	11-6-52	11-10-52	11-14-52	11-15-52	11-20-52
Date Charged	3-21-51	12-5-51	9-12-51	4-25-52	5-12-52	3-2-52
Days in File	593	337	425	203	187	263
Days of Operation	507	256	362	193	167	225
Tube Exposure	514	699	588	487	397	229
Tube Power at Failure	174	402	149	322	327	183
Tube Power Average	129	350	208	323	304	130
Slug Power	3.6	7.6	1.1	6.5	12.5	2.0
Local H2O Temperature	57.3	*	53	55	*	15
Slug Position	38.4	*	60	41	*	9
Canning Date	2-27-51	10-22-51	2-1-51	2-27-52	4-5-52	2-18-52
Type Metal	Reg.	Reg.	Reg.	Reprocess	Reg.	Reg.
Manufacturing Truck	44	B-7	H-2	0-10	H-2	G-5
No. and Line No.	173-U	173-U	*	170	78	30
Lot Number	8	8	7	8	9	8
Metal Group Number	1	1	6	41	5	7
Days up Since Last Start-up	94	78	79	16	26	47
Total Number of Shutdowns	64	47	57	7	20	29
Number of Rapid Shutdowns	.140	.240	.175	.240	.240	.140
Tube Zone	Non	Cap	C. Cap	Non	Side	C. Cap
Type of Failure	26	0.6	26	20.1	24	25
Downtime due to Rupture	Normal	Blistered (Mildly)	Heavily Blistered	Heavily Blistered	Mildly Blistered	Normal
Slug Surface						

* Data not available.

Extracted from LANG 1952d, page 12.

RUPTURED SLUG DATA - DECEMBER 1952

Tube Number	0272-B	3156-D	4190-B
Failure Number	243	244	245
Date Failed	12-8-52	12-12-52	12-22-52
Date Charged	3-2-52	3-18-52	10-29-52
Days in Pile	281	269	54
Days of Operation	242	241	50
Tube Exposure	318	502	80
Tube Power at Failure	209	269	203
Tube Power Average	168	267	205
Slug Power	4.6	(1)	3.6
Local H ₂ O Temperature	*	*	18
Slug Position	*	*	18
Canning Date	2-7-52	2-16-52	12-17-51
Type Metal	Reprocess	Reprocess	Regular
Manufacturing Truck	11-3	G-2	G-1
No. and Line No.			
lot Number	161	167	225-II
Metal Group Number	8	8	8
Days up Since Last Startup	15	5	2
Total Number of Shutdowns	50	40	13
Number of Rapid Shutdowns	30	20	7
Tube Zone	.140	.175	.175
Type of Failure	C. Cap	Cap	C. Cap
Downtime Due to Rupture	0.5	0.5	25.0
Slug Surface	Normal	Heavily Blistered	Normal

* Date not available

(1) Metal Mixed.

Extracted from LANG 1953a, page 11

APPENDIX C

FUEL-ELEMENT FAILURE DATA FOR 1953

RUPTURED SLUG DATA - JANUARY 1953

<u>Tube Number</u>	<u>3787-F</u>	<u>2487-F</u>
Failure Number	246	247
Date Failed	1-21-53	1-29-53
Date Charged	1-17-52	4-7-52
Days in Pile	370	297
Days of Operation	252	206
Tube Exposure	573	550
Tube Power at Failure	358	390
Tube Power Average	227	267
Slug Power	*	4.3
Local H ₂ O Temperature	*	*
Slug Position	*	*
Canning Date	12-13-51	3-11-52
Type Metal	Reprocess	Reprocess
Manufacturing Truck	8-B	2-G
Number and Line Number		
Lot Number	ZR-139	ZR-175
Metal Group Number	8	8
Days Up since Last Start-Up	1	6
Total Number of Shutdowns	78	64
Number of Rapid Shutdowns	47	38
Tube Zone	.240	.240
Type of Failure	Side	Cap
Downtime Due to Rupture	27	0.5
Slug Surface	Heavily Blistered	Normal

* Data not available.

Extracted from LANG 1953b, page 12.

RUPTURED SLUG DATA - FEBRUARY 1953

<u>Tube Number</u>	1569-F	0462-H	2179-C	3892-DR
Failure Number	248	249	250	251
Date Failed	2-7-53	2-17-53	2-19-53	2-25-53
Date Charged	4-25-52	3-6-52	11-18-52	3-20-52
Days in Pile	288	348	93	342
Days of Operation	196	310	89	317
Tube Exposure	550	574	322	557
Tube Power at Failure	426	357	504	260
Tube Power Average	359	237	463	225
Slug Power	7.7	7.7	15.5	5.5
Local H ₂ O Temperature	*	*	13	26
Slug Position	*	*	8	27
Canning Date	3-13-52	2-19-52	8-22-52	1-22-52
Type Metal	Reprocess	Regular	Regular	Reprocess
Manufacturing Truck	G-3	G-10	B-4	G-9
No. and Line No.				
Lot Number	ZR-176	17	214	ZR-152
Metal Group Number	8	8	9	8
Days Up Since Last Startup	<1	18	16	16
Total Number of Shutdowns	55	45	20	35
Number of Rapid Shutdowns	39	33	17	12
Tube Zone	.240	.240	.318	.200
Type of Failure	Side	Cap	Split	Unclassified ⁽¹⁾
Downtime Due to Rupture	27.6	8.6	18.7	28.3
Slug Surface	Heavily Blistered	Normal	Normal	Normal

* Data Unavailable

(1) Slug broken into several pieces.

Extracted from LANG 1953c, page 11.

RUPTURED SLUG DATA - MARCH 1953

Tube Number	4165-F	3892-F	4263-F	4159-F
Failure Number	252	253	254	255
Date Failed	3-13-53	3-13-53	3-16-53	3-19-53
Date Charged	4-25-52	10-24-51	12-4-51	4-25-52
Days in Pile	322	506	468	328
Days of Operation	227	356	324	229
Tube Exposure	498	515	564	320
Tube Power at Failure	369	21.7	301	260
Tube Power Average	281	185	223	217
Slug Power	7.0	5.3	7.6	4.4
Local H ₂ O Temperature	#	44.8	*	63.4
Slug position	#	36	*	48
Canning Date	4-15-52	1-15-51	10-11-51	4-15-52
Type Metal	Regular	Reprocess	Regular	Regular
Manufacturing Truck	3-H	11-G	1-G	6-H
No. and Line No.				
Lot Number	108	---	158-H	108
Metal Group Number	8	7	8	8
Days Since Last Startup	17	17	< 1	1
Total Number of Shutdowns	67	103	98	72
Number of Rapid Shutdowns	42	63	59	46
Tube Zone	.240	.175	.200	.175
Type of Failure	Cap	Compound Cap	Slide	Cap
Downtime due to Rupture	(1)	(1)	18.7	16.0
Slug Surface	Heavily Blistered	Moderately Blistered	Heavily Blistered	Heavily Blistered

* Data not available.
 (1) The ruptures in tubes 4165-F and 3892-F were both removed during one shutdown. The downtime of 48.8 hours is charged to both ruptures.

Extracted from LANG 1953d, page 12.

RUPTURED SLUG DATA - APRIL 1953

Tube Number	3291-C	0565-H	0565-H	2690-C
Failure Number	256			
Date Failed	4-18-53		"C" Type Metal (1)	"C" Type Metal (1)
Date Charged	11-14-53			
Days in Pile	155			
Days of Operation	141			
Tube Exposure	422			
Tube Power at Failure	494			
Tube Power Average	383			
Slug Power	*			
Local H ₂ O Temperature	*			
Slug Position	*			
Canning Date	8-9-52			
Type Metal	Reprocess			
Manufacturing Truck No. and Line No.	6-B			
Lot Number	ZR-201			
Metal Group Number	8			
Days Up Since Last Startup	8			
Total Number of Shutdowns	35			
Number of Rapid Shutdowns	29			
Tube Zone	.318			
Type of Failure	Cleavage			
Downtime Due to Rupture	26.6			
Slug Surface	Normal			

* Date not available

(1) See page 2 for details.

Extracted from LANG 1953e, page 12.

RUPTURED SLUG DATA - MAY-JUNE 1953

Tube Number	4362-F	4265-F	1361-G	2859-G	3159-G	2671-G
Failure Number	257	258	259	260	261	262
Date Failed	5-3-53	5-3-53	5-5-53	5-7-53	5-18-53	6-27-53
Date Charged	11-29-51	6-22-52	11-18-52	11-18-52	11-18-52	3-5-53
Days in Pile	521	315	168	170	181	114
Days of Operation	367	216	157	158	166	102
Tube Exposure	549	442	583	525	563	455
Tube Power at Failure	218	291	577	530	577	638
Tube Power Average	191	262	475	425	434	571
Slug Power	4.7	6.1	*	9.3	9.9	22.3
Local H ₂ O Temperature	*	*	*	53.3	*	*
Slug Position	*	*	*	47	*	*
Canning Date	10-10-51	12-26-51	1-3-52	5-8-52	8-7-52	2-14-53
Type Metal	Regular	Regular	Reprocess	Reprocess	Reprocess	Reprocess
Manufacturing Truck No. and Line No.	6-B	10-B	5-H	3-G	2-B	6-G
Lot Number	158-H	256-H	251-I	ZR-188	ZR-198	ZM-5
Metal Group Number	8	8	8	8	8	9
Days Up Since Last Startup	11	11	<1	<1	<1	8
Total Number of Shutdowns	109	66	43	44	48	30
Number of Rapid Shutdowns	67	42	36	37	41	26
Tube Zone	.175	.200	.318	.318	.318	.318
Type of Failure	Side	Cap	Cleavage	Cleavage	Cleavage	Cleavage
Downtime Due to Rupture	12.0	12.0	25.9	26.9	23.0	25.2
Slug Surface	Mildly Blistered	Heavily Blistered	Normal	Normal	Normal	Moderately Blistered

* Data not available

Extracted from ANDERSON 1953a, page 13.

RUPTURED SLUG DATA - MAY-JUNE 1953 (Cont'd)

Tube Number	2379-H	0577-H	0577-H	3880-B	0870-DR
Failure Number	Suspect	Suspect	Suspect		J-1
Date Failed	5-27-53			6-29-53	5-14-53
Date Charged	10-20-52		11-25-52	1-21-53	5-1-53
Days in Pile	219	196	196		13
Days of Operation	167	149	149		9
Tube Exposure	532	(1)	(1)		~0
Tube Power at Failure	390	(1)	(1)		306
Tube Power Average	408	(1)	(1)		*
Slug Power	*	*	*		29.3 kw/ft
Local H ₂ O Temperature	*	*	*		31.3
Slug Position	*	*	*		6th J po.
Canning Date	8-4-52	11-14-52	11-14-52		4-8-53
Type Metal	Reprocess	Regular	Regular	Receptacle Slug	J Slug
Manufacturing Truck No.	-G	1-B	1-B		*
and Line No.					
Lot Number	ZR-196	360	360		J2-78
Metal Group Number	8	9	9		None
Days up Since Last Startup	9				< 1
Total Number of Shutdowns	44				6
Number of Rapid Shutdowns	36				2
Tube Zone	.313	.313	.313		.285
Type of Failure					Gap
Downtime Due to Rupture	0.5				2.2
Slug Surface	Moderately Blistered			25.5	

* Data not available

(1) This tube was charged with 30 "C" pieces and 10 pieces of Group 9 metal.

Extracted from ANDERSON 1953a, page 14.

RUPTURED C SLUG DATA - APRIL-MAY 1953

Tube Number	0565-H	2690-G	2692-H	2692-H	3492-H
Failure Number	G-1	G-3	G-4	G-5	G-6
Date Discharged	4-8-53	4-29-53	5-27-53	5-27-53	5-27-53
Date Charged	11-25-52	12-1-53	11-25-52	11-25-52	12-22-52
Days in Pile	134	149	183	183	156
Days of Operation	122	138	137	137	110
Tube Exposure (U235 Depletion)	9.7%	*	11.2%	11.2%	8.6%
Tube Power Near Discharge	381	345	399	399	343
Tube Power Average	367	*	378	378	334
Slug Power (Expressed in kw per foot of active metal)	19.3	*	24.7	18.3	17.2
Local H ₂ O Temperature	51.4	*	43.4	56.1	54.4
Slug Position With Respect to Upstream C Piece	25	*	18	27	27
Lot and Piece Number	2-463 (1)	1-39 Can Wall. Pinhole	2-80 Cap Pinhole	2-90 Can Wall Crack	2-955 Can Wall Crack
Type of Failure					

(1) See Page 2.

NOTE: Values which for regular uranium slug failures are based on date of failure are, in this tabulation, based on date of discharge since it is often impossible to determine the date on which a C piece fails.

Extracted from ANDERSON 1953a, page 15.

RUPTURED C SLUG DATA - MAY-JUNE 1953

Tube Number	3492-H	4186-H	4186-H	0577-H
Failure Number	0-7	0-8	0-9	0-10
Date Discharged	5-27-53	5-27-53	5-27-53	6-9-53
Date Charged	12-22-52	11-25-52	11-25-52	11-25-52
Days in Pile	156	183	183	196
Days of Operation	110	137	137	149
Tube Exposure (U ²³⁵ Depletion)	8.6%	11.1%	11.1%	13.0%
Tube Power Near Discharge	343	403	403	292
Tube Power Average	334	374	374	402
Slug Power (Expressed in kv per foot of active metal)	18.1	17.2	19.5	18.3
Local H ₂ O Temperature	53.3	57.3	54.9	35.2
Slug Position With Respect to Upstream C Piece	26	28	26	16
Lot and Piece Number	2-956	2-671	2-680	2-429
Type of Failure	Can Wall Crack	Can Wall Crack	Can Wall Crack	Can Wall Pinhole

Extracted from ANDERSON 1953a, page 16.

RUPTURED SLUG DATA - JULY-SEPTEMBER 1953

Tube Number	1267-H	3283-F	2070-D	2483-H	1463-C	1463-C
Failure Number	263	264	265	266		
Date Failed	7-17-53	8-9-53	8-25-53	8-30-53	9-5-53	9-5-53
Date Charged	10-20-52	1-29-53	3-26-53	6-25-53	4-28-53	4-28-53
Days in File	270	192	152	66	130	130
Days of Operation	216	159	131	61	114	114
Tube Exposure	708	486	421	215	(1)	(1)
Tube Power at Failure	460	409	414	444	609	609
Tube Power Average	411	391	411	451	499	499
Slug Power	31.7	24.6	25.2	23.4	56.0	59.8
Local H ₂ O Temperature	*	67.2	65.0	69.0	21.4	25.0
Slug Position	*	41	41	46	1st "E" pc.	3rd. "E" pc.
Canning Date	8-4-52	11-1-52	2-16-53	4-23-53		
Type Metal	Reprocess	Reg.	Reprocess	Reprocess	"E"	"E"
Manufacturing Truck No.	B-3	B-1	H	G		
and Line No.						
Lot Number	ZR-196	242	ZR-2	ZR-13		
Metal Group Number	8	8	8	PT-313-105-17-M	None	None
Days up Since last Startup	3	<1	2	8	<1	<1
Total Number of Shutdowns	65	24	26	15	29	29
Number of Rapid Shutdowns	53	15	15	14	26	26
Tube Zone	.313	.240	.283	.313	.318	.318
Type of Failure	Side	Split	Cap	Side	Split	Split
Downtime Due to Rupture	29.3	30.4	32.0	34.9	13.7	0
Slug Surface	Normal	Normal	Normal	Mild	Normal	Normal
				Blistering		

* Not available
(1) See Page 3.

RUPTURED SLUG DATA - SEPTEMBER 1953 (Cont'd)

Tube Number	3766-C	3262-B	1364-B	2358-C	3763-C	2790-C
Failure Number	—	267	268	269	270	271
Date Failed	9-5-53	9-10-53	9-13-53	9-17-53	9-22-53	9-22-53
Date Charged	4-28-53	6-15-53	2-12-53	12-1-52	5-19-53	12-1-52
Days in Pile	130	87	213	290	126	295
Days of Operation	114	79	186	263	114	267
Tube Exposure	(1)	221	547	(3)	457	(3)
Tube Power at Failure	595	332	409	564	587	543
Tube Power Average	498	358	376	498	513	467
Slug Power	60.1	16.0	18.1	*	33.5	26.9
Local H ₂ O Temperature	28.4	#	75.0	#	37.0	61.6
Slug Position	5th "E" Pc.	#	51	*	13	38
Canning Date	—	1-17-53	(2)	9-25-52	4-7-53	9-12-52
Type Metal	"E"	Reg.	(2)	Reprocess	Reg.	Reg.
Manufacturing Truck No.	—	H-1	(2)	G-5	H-4	G-5
and Line No.	—	—	—	—	—	—
Lot Number	—	F-11	(2)	ZR-208	F-56	278-H
Metal Group Number	None	12	8	8	11	8
Days up Since Last Startup	41	25	1	1	1	1
Total Number of Shutdowns	30	13	44	59	23	61
Number of Rapid Shutdowns	27	4	23	51	20	53
Tube Zone	.318	.240	.240 (2)	.318	.318	.318
Type of Failure	Split	Cap	Unclass.	Split	Split	Split
Downtime Due to Rupture	16.3	24.0	17.9	27.0	20.3	0.5
Slug Surface	Normal	Normal	(2)	Normal	Normal	Normal

* Data not available.

(1) See Page 3.

(2) Metal from this tube was mixed with normally discharged metal. The ruptured piece was not inspected.

(3) Enrichment tube - See page 3.

Extracted from ANDERSON 1953b, page 15.

RUPTURED SLUG DATA - SEPTEMBER 1953 (Cont'd)

Tube Number	2458-C	2158-C	3279-B	2881-H	2184-B
Failure Number	272	273	274	275	276
Date Failed	9-22-53	9-22-53	9-24-53	9-25-53	9-28-53
Date Charged	12-1-52	12-1-52	2-10-53	6-10-53	4-12-53
Days in Pile	295	295	226	107	169
Days of Operation	267	267	195	90	146
Tube Exposure	(3)	(3)	581	305	414
Tube Power at Failure	516	544	233	457	382
Tube Power Average	497	509	381	434	363
Slug Power	25.8	*	*	19.2	19.8
Local H ₂ O Temperature	25.6	*	*	75.7	74.9
Slug Position	17	*	*	52	47
Canning Date	9-25-52	9-24-52	1-9-53	4-23-53	1-30-53
Type Metal	Reprocess	Reprocess	Reprocess	Reprocess	Reprocess
Manufacturing Truck No. and Line No.	G-3	G-6	H-2	G-	G-3
Lot Number	ZR-208	ZR-208	ZR-216	ZR-13	ZR-4
Metal Group Number	8	8	8	PT-313-105-14-M	PT-313-105-7-M
Days up Since Last Startup	<1	<1	1	1	1
Total Number of Shutdowns	61	61	47	36	38
Number of Rapid Shutdowns	53	53	26	32	21
Tube Zone	.318	.318	.240	.313	.240
Type of Failure	Split	Split	Split	Side	Split
Downtime Due to Rupture	8.0	0.5	24.0	23.1	21.9
Slug Surface	Normal	Normal	Normal	Normal	Normal

* Not available.

(3) Enrichment tube. See page 3.

Extracted from ANDERSON 1953b, page 16.

RUPTURED C SLUG DATA - AUGUST-SEPTEMBER 1953

Tube Number	4270-H	4270-H	4270-H	1655-H	0574-H	4262-H
Failure Number	C-11	C-12	C-13	C-14	C-15	C-16
Date Discharged	8-2-53	8-2-53	8-2-53	9-3-53	9-9-53	9-9-53
Date Charged	12-22-52	12-22-52	12-22-52	12-22-52	4-12-53	11-25-52
Days in Pile	223	223	223	255	150	288
Days of Operation	171	171	171	199	106	227
Tube Exposure (U-235 Depletion)	14.7%	14.7%	14.7%	14.9%	8.7%	17.7%
Tube Exposure (MWD/AT)	501	501	501	507	298	643
Tube Power Near Discharge	417	417	417	325	335	324
Tube Power Average	372	372	372	320	351	360
Slug Power (KW/ft.)	24.9	28.2	27.8	18.7	14.7	14.9
Local H ₂ O Temperature	61.0	52.5	41.4	29.5	26.0	56.8
Slug Position with Respect to Upstream C Piece	23	18	12	7	2	27
Lot and Piece Number	2-847	2-854	2-859	2-1573	2-2255	2-710
Type of Failure(1)	Cap	Cap	Cap	Cap, with Can Split-ting	Cap, with Can Split-ting	Cap, with Can Split-ting

- (1) Each of the ruptured pieces had a swollen area extending from the cap end. In the cases in which can wall breaks occurred the break was in this swollen area. This indicates that in each case damage was initiated by water entry at the cap end of the slug.

Extracted from ANDERSON 1953b, page 17.

RUPTURED C SLUG DATA - SEPTEMBER 1953

Tube Number	4262-H	4262-H	4268-H	4268-H	0780-C
Failure Number	C-17	C-18	C-19	C-20	C-21
Date Discharged	9-9-53	9-9-53	9-9-53	9-9-53	9-17-53
Date Charged	11-25-52	11-25-52	11-25-52	11-25-52	11-18-52
Days in Pile	288	288	288	288	303
Days of Operation	227	227	227	227	275
Tube Exposure (U-235 Depletion)	17.7%	17.7%	18.4%	18.4%	19.4%
Tube Exposure (MWD/AT)	643	643	671	671	998
Tube Power near Discharge	324	324	325	325	524
Tube Power Average	360	360	374	374	455
Slug Power (KW/ft.)	19.4	19.8	20.2	17.2	30.2
Local H ₂ O Temperature	48.6	37.4	39.3	54.4	48.4
Slug Position with Respect to Upstream C Piece	20	12	13	24	13
Lot and Piece Number	2-580	2-588	2-619	2-608	1-563
Type of Failure(1)	Cap	Cap	Cap, with Can Splitting	Cap	Cap, with Can Splitting

(1) Each of the ruptured pieces had a swollen area extending from the cap end. In the cases in which can wall breaks occurred the break was in this swollen area. This indicates that in each case damage was initiated by water entry at the cap end of the slug.

Extracted from ANDERSON 1953b, page 18.

RUPTURED SLUG DATA - OCTOBER 1953

Tube Number	2058-C	2174-H	2187-C	3663-C	3661-C	2488-C	3660-C
Failure Number	277	278	279	280	281	282	283
Date Failed	10-3-53	10-4-53	10-7-53	10-8-53	10-10-53	10-10-53	10-19-53
Date Charged	12-1-52	6-25-53	5-19-53	5-19-53	5-19-53	5-19-53	6-12-53
Days in Pile	306	101	141	142	144	144	129
Days of Operation	276	85	125	125	126	126	114
Tube Exposure	(1)	297	560	520	510	550	458
Tube Power At Failure	543	449	680	646	612	592	533
Tube Power Average	(1)	447	573	532	518	559	514
Slug Power	*	20.8	40.6	37.9	38.6	25.3	30.4
Local H ₂ O Temperature	*	73.9	51.8	*	*	*	34.1
Slug Position	*	50	17	*	*	*	13
Gaining Date	*	4-23-53	4-6-53	4-7-53	3-24-53	3-24-53	5-5-53
Type Metal	*	Reprocess	Reg.	Reprocess	Reg.	Reg.	Reg.
Manufacturing Truck No. and Line No.							
Lot Number	*	G	H-5	B-15	G-3	G-7	G-7
Metal Group Number	8	ZR-13	F-551	ZR-19	F-40	F-66	F-77
Days up Since Last Startup	10	PT-313-105-174	10	10	11	11	11
Total Number of Shutdowns	62	<1	<1	<1	<1	<1	7
Number of Rapid Shutdowns	54	33	34	36	39	39	44
Tube Zone	.318	.313	.318	.318	.318	.318	.318
Type of Failure	Split	Slide	Split	Split	Split	Non Class.	Non Class.
Downtime Due to Rupture	16.0	125.1	3.4	3.5	13.0	13.0	26.0

(1) This was a regular metal piece used to center the "C" Metal in an enrichment column.

* Data not available.

RUPTURED SLUG DATA - OCTOBER 1953 (Cont'd)

Tube Number	3662-C	1585-B	2590-C	3372-B	3486-F
Failure Number	284	285	286	287	288
Date Failed	10-21-53	10-23-53	10-24-53	10-27-52	10-30-53
Date Charged	5-19-53	7-1-53	5-19-53	5-21-53	5-5-53
Days in Pile	155	114	158	159	178
Days of Operation	136	98	138	137	153
Tube Exposure	561	303	577	382	478
Tube Power at Failure	593	408	592	289	421
Tube Power Average	528	396	535	357	400
Slug Power	*	23.8	10.7	15.3	26.6
Local H ₂ O Temperature	*	60.3	15.7	52.9	*
Slug Position	*	19	2	46	*
Canning Date	4-6-53	Data End Badly Marred in Discharging	4-29-53	4-18-53	3-13-53
Type Metal	Reg.		Reprocess	Reprocess	Rework Rod End
Manufacturing Truck No. and Line No.	B-2	Data End Badly Marred in Discharging	G-3	G-2	H-1
Lot Number	F-56	10	F-70	ZR-10	RW-5
Metal Group Number	9	12	11	8	8
Days up Since Last Startup	47	22	1	2	41
Total Number of Shutdowns	44	12	48	28	13
Number of Rapid Shutdowns	.318	.240	.318	.240	.240
Tube Zone	Split	Non Class.	Split	Non Class.	Cap
Type of Failure	Split	Non Class.	Split	Non Class.	Cap
Downtime Due to Rupture	10.6	28.0	27.0	25.4	24

* Data not available

RUPTURED SLUG DATA - NOVEMBER-DECEMBER 1953 (Cont'd)

Tube Number	3271-C	3956-F	4266-B	4166-D	0862-G	0161-H
Failure Number	289	290	291	292	293	294
Date Failed	11-12-53	11-29-53	12-2-53	12-3-53	12-3-53	12-6-53
Date Charged	10-6-53	3-14-53	6-15-53	5-15-53	6-12-53	4-12-52
Days in Pile	37	260	170	202	174	603
Days of Operation	29	219	144	180	131	496
Tube Exposure	137	392	312	486	626	593
Tube Power at Failure	680	234	264	423	480	214
Tube Power Average	605	229	277	345	531	153
Slug Power	40.8	14.9	16.0	*	23.1	1.1
Local H ₂ O Temperature	45.5	38.8	*	*	*	*
Slug Position	16	29	*	*	*	*
Canning Date	8-21-53	1-9-53	1-17-53	*	*	2-20-52
Type Metal	Reg.	Reprocess	Reg.	*	*	Reg.
Manufacturing Truck No. and Line No.	B-5	G-7	H-8	*	*	G-3
Lot Number	76	ZR-216	F-11	*	*	29
Metal Group Number	9	8	8	8	10	8
Days up Since Last Startup	<1	25	1	<1	12	<1
Total Number of Shutdowns	33	28	32	40	62	87
Number of Rapid Shutdowns	31	17	18	24	58	78
Tube Zone	.318	.175	.200	.240	.285	.175
Type of Failure	Non Class.	Non Class.	Cap	Split	Side	Comp. Cap
Downtime Due to Rupture	22.7	22.4	24.3	40.0	26.8	0.7

* Data not available.

Extracted from ANDERSON 1954a, page 16.

RUPTURED SLUG DATA - DECEMBER 1953

Tube Number	1977-H	3968-B	2796-F	2189-F
Failure Number	295	296	297	298
Date Failed	12-7-53	12-9-53	12-18-53	12-26-53
Date Charged	6-26-53	4-13-53	4-25-52	6-8-53
Days in Pile	164	210	602	201
Days of Operation	136	210	464	170
Tube Exposure	502	510	537	508
Tube Power at Failure	547	446	167	435
Tube Power Average	472	360	148	382
Slug Power	29.9	23.7	9.6	27.7
Local H ₂ O Temperature	*	*	57.6	51.7
Slug Position	*	*	43	36
Canning Date	4-6-53	2-20-53	4-14-52	*
Type Metal	Reg.	Reprocess	Reg.	*
Manufacturing Truck No. and Line No.	H-3	H-9	B-2	*
Lot Number	F-53	ZR-8	108	*
Metal Group Number	11	8	8	8
Days up Since Last Startup	<1	5	6	6
Total Number of Shutdowns	52	52	98	18
Number of Rapid Shutdowns	46	30	61	11
Tube Zone	.313	.240	.140	.240
Type of Failure	Side	Cap	Non-Class.	Side
Downtime Due to Rupture	6.0	27.0	29.2	24.0

* Data not available.

Extracted from ANDERSON 1954a, page 17.

RUPTURED ALUMINUM-URANIUM-235 ALLOY SLUGS - OCTOBER-DECEMBER 1953

Tube Number	0568-H	0582-H	0582-H	0758-H	0758-H	2292-H	4058-H	4058-H
Failure Number	C-22	C-23	C-24	C-25	C-26	C-27	C-28	C-29
Date Discharged	10-10-53	12-7-53	12-7-53	12-7-53	12-7-53	12-7-53	12-7-53	12-7-53
Date Charged	12-22-52	11-25-52	11-25-52	11-25-52	11-25-52	12-22-52	1-18-53	1-18-53
Days in Pile	292	377	377	377	377	350	323	323
Days of Operation	222	301	301	301	301	274	250	250
Tube Exposure (U235 Depletion)	17.8%	23.9%	23.9%	22.0%	22.0%	20.7%	19.5%	19.5%
Tube Exposure (MWD/AT)	605	868	868	800	800	705	664	664
Tube Power Near Discharge	363	513	513	269	269	529	365	365
Tube Power Average	349	369	369	340	340	329	340	340
Slug Power (KW/ft.)	24.8	*	*	*	*	*	*	24.9
Local H ₂ O Temp.	49.8	*	*	*	*	*	*	46.5
Slug Position with Respect to Upstream Enriched Pc.	17	*	*	*	*	*	*	14
Lot and Piece Number	C-2-1246	C-2-254	C-2-403	C-2-236	C-2-239	C-2-1073	C-2-2493	C-2-2503
Type of Failure	Side Tear	Cap	Slide	Cap	Cap	Slide	Cap	Cap

* Data not available.

RUPTURED ALUMINUM-URANIUM-235 ALLOY SLUGS - OCTOBER-DECEMBER 1953

Tube Number	4264-II	1475-DR	3476-DR
Failure Number	C-30	J-2	J-3
Date Discharged	12-7-53	10-16-53	11-13-53
Date Charged	1-18-53	5-1-53	4-7-53
Days in Pile	323	168	220
Days of Operation	250	156	204
Tube Exposure (U-235 Depletion)	20.8%	9.7%	12.7%
Tube Exposure (MWD/AT)	709	450	590
Tube Power Near Discharge	527	412	413
Tube Power Average	363	369	369
Slug Power (KW/ft.)	27.8	31.1	31.2
Local H ₂ O Temperature	75.2	63	59
Slug Position with Respect to Upstream Enriched Pc.	26	11	11
Lot and Piece Number	C-2-2412	J-2-75	J-2-46
Type of Failure	Cap	Side	Cap

* Data not available.

Extracted from ANDERSON 1954a, page 19

APPENDIX D

FUEL-ELEMENT FAILURE DATA FOR 1954

RUPTURED SLUG DATA - JANUARY 1954

Tube Number	2178-C	0456-C	0978-C	0668-II	2478-C	3486-C
Failure Number	299	300	301	302	303	304
Date Failed	1-3-54	1-7-54	1-8-54	1-17-54	1-18-54	1-20-54
Date Charged	8-3-53	11-18-52	10-5-53	8-2-53	8-3-53	10-24-53
Days in Pipe	154	415	95	168	168	88
Days of Operation	123	362	75	136	135	72
Tube Exposure	703	584	353	525	769	352
Tube Power at Failure	870	383	456	537	877	612
Tube Power Average	732	206	602	494	729	626
Slug Power	40.3	21.9	26.3	*	49.3	36.2
Local H2O Temperature	*	*	*	*	*	*
Slug Position	*	*	*	*	*	*
Canning Date	5-19-53	12-26-51	8-24-53	6-20-53	6-22-53	6-12-53
Type Metal	Reg. B-7	Reg. G-8	Reg. B-4	Reprocess II-6	Reprocess II-11	Reg. B-9
Manufacturing Truck No. and Line No.						
Lot Number	F-94	252-II	70	Z-34	Z-35	F-125
Metal Group Number	11	8	9	11	11	11
Days up Since Last Startup	<1	3	<1	5	8	1
Total Number of Shutdowns	69	126	54	55	73	32
Number of Rapid Shutdowns	66	114	52	47	70	30
Tube Zone	.385	.318	.385	.313	.385	.385
Type of Failure	Split	Cap	Non. Class.	Side	Non Class.	Split
Downtime Due to Rupture	26.7	0.4	27.0	28.2	0.4	31.7

* Data not available.

Extracted from ANDERSON 1954b, page 14.

RUPTURED SLUG DATA - JANUARY-FEBRUARY 1954 (Cont'd)

Tube Number	2375-C	2479-C	3284-II	3684-B	2190-C	4067-D
Failure Number	305	306	307	308	309	310
Date Failed	1-25-54	1-26-54	2-1-54	2-2-54	2-4-54	2-5-54
Date Charged	8-3-53	8-3-53	7-18-53	8-13-53	10-4-53	4-23-53
Days in Pile	175	176	198	173	123	288
Days of Operation	140	140	163	149	98	256
Tube Exposure	837	847	581	487	483	832
Tube Power at Failure	878	925	502	457	663	557
Tube Power Average	765	774	456	418	631	416
Slug Power	34.3	34.6	*	*	27.8	33.8
Local H2O Temperature	*	*	*	*	*	61.6
Slug Position	*	*	*	*	*	40
Canning Date	6-23-53	6-20-53	5-29-53	6-2-53	8-21-53	*
Type Metal	Reg.	Reg.	Reprocess	Reg.	Reg.	*
Manufacturing Truck No.	B-	B-3	II-	G-6	B-7	*
and Line No.						
Lot Number	F-130	F-131	Z-30	F-32	76	*
Metal Group Number	11	11	11	12	9	PT 313-105-13-M
Days up Since Last Startup	2	<1	1	18	8	<1
Total Number of Shutdowns	76	77	67	32	60	53
Number of Rapid Shutdowns	73	74	59	20	58	33
Tube Zone	.385	.385	.313	.240	.385	.283
Type of Failure	Split	Split	Side	Split	Split	Split
Downtime Due to Rupture	32.4	2.2	0.6	27.0	0.6	0.6

Extracted from ANDERSON 1954b, page 15.

RUPTURED SLUG DATA - FEBRUARY 1954 (Cont'd)

Tube Number	2474-C	2471-C	2372-C	2182-C	2672-C	3880-B
Failure Number						
Date Failed	311	312	313	314	315	316
Date Charged	2-6-54	2-6-54	2-7-54	2-7-54	2-8-54	2-9-54
Days in File	8-3-53	6-27-53	8-3-53	8-3-53	8-5-53	6-30-53
Days of Operation	187	224	188	188	187	224
Tube Exposure	151	187	151	151	152	194
Tube Power at Failure	888	1056	885	840	884	487
Tube Power Average	833	755	773	752	701	364
Slug Power	753	723	750	712	744	321
Local H ₂ O Temperature	*	*	*	*	*	22.1
Slug Position	*	*	*	*	*	22.1
Canning Date	*	*	*	*	*	25
Type Metal	6-22-53	5-19-53	6-24-53	6-20-53	6-23-53	1-17-53
Manufacturing Truck No. and Line No.	Reprocess B-1	Reg. H-2	Reg. B-9	Reg. B-6	Reg. B-10	Reg. G-9
Lot Number	Z-35	F-119	F-134	F-131	F-130	F-11
Metal Group Number	11	11	11	11	11	8
Days up Since Last Startup	<1	<1	<1	<1	<1	3
Total Number of Shutdowns	80	83	81	81	83	42
Number of Rapid Shutdowns	77	79	78	78	80	24
Tube Zone	.385	.385	.385	.385	.385	.240
Type of Failure	Split (1)	Split (1)	Non Class. (2)	Split (2)	Split	Non.
Downtime Due to Rupture					0.6	28.0

* Data not available

- (1) These two ruptures were discharged during one outage. A total of 28.0 hours was charged to them.
 (2) These two ruptures were discharged during one outage. A total of 2.1 hours was charged to them.

Extracted from ANDERSON 1954b, page 16.

RUPTURED SLUG DATA - FEBRUARY-MARCH 1954 (Cont'd)

	2473-C	2273-C	2374-C	2472-C	2377-C	(4)	2676-C	(4)
Tube Number								
Failure Number	317	318	319	320	321		322	
Date Failed	2-10-54	2-12-54	2-14-54	2-19-54	2-25-54		3-1-54	
Date Charged	8-3-53	8-3-53	9-3-53	9-3-53	9-3-53		9-3-53	
Days in Pile	191	193	164	169	175		179	
Days of Operation	154	155	131	134	137		141	
Tube Exposure	927	953	793	758	828		831	
Tube Power at Failure	874	766	785	718	818		827	
Tube Power Average	770	787	775	724	774		754	
Slug Power	*	*	*	*	39.0		*	
Local H ₂ O Temperature	*	*	*	*	20.3		*	
Slug Position	*	*	*	*	9		*	
Canning Date	5-19-53	5-19-53	7-22-53	7-16-53	7-21-53		7-16-53	
Type Metal	Reg.	Reg.	Reg.	Reg.	Reg.		Reg.	
Manufacturing Truck No.	H-5	B-8	H-3	H-7	H-2		G-7, 9	
and Line No.								
Lot Number	F-94	F-94	57-H	46-H	53-H		46	
Metal Group Number	11	11	9	9	9		9	
Days up Since Last Startup	2	<1	1	<1	2		<1	
Total Number of Shutdowns	84	86	76	78	82		84	
Number of Rapid Shutdowns	81	83	74	75	78		80	
Tube Zone	.385	.385	.385	.385	.385		.385	
Type of Failure	Split	Split	Split	Split	Split		Split	
Downtime Due to Rupture	29.6	8.0	28.7	3.3	29.0		(3)	

(3) Ruptures in tubes 2676-C and 2874-C were discharged during one outage. A total of 29.4 hours was charged to them.

(4) Metal from these three tubes was mixed in the chutes. Five ruptured pieces were found and were arbitrarily assigned, two to tube 2377, two to tube 2676, and one to tube 2874. All five pieces were split

* Data not available.

RUPTURED SLUG DATA - MARCH 1954 (Cont'd)

Tube Number	2874-C ⁽⁴⁾	3673-D	1183-C	3870-F	2262-C	2674-C
Failure Number	323	324	325	326	327	328
Date Failed	3-1-54	3-2-54	3-4-54	3-5-54	3-7-54	3-8-54
Date Charged	9-3-53	9-21-53	10-6-53	6-21-53	10-10-53	11-10-53
Days in Pile	179	162	149	257	148	118
Days of Operation	141	147	115	218	114	90
Tube Exposure	819	619	589	747	565	446
Tube Power at Failure	807	560	729	476	696	803
Tube Power Average	743	539	656	439	634	634
Slug Power	*	*	*	27.2	*	*
Local H ₂ O Temperature	*	*	*	*	*	*
Slug Position	*	*	*	*	*	*
Canning Date	7-22-53	*	8-21-53	11-18-52	3-10-53	9-10-53
Type Metal	Reg.	*	Reg.	Reg.	Reg.	Reg.
Manufacturing Truck No. and Line No.	G-1	*	B-2	B-3	H-6	H-3
Lot Number	57-H	*	72	333	18-H	F-182
Metal Group Number	9	8	9	8	9	11
Days up Since Last Startup	<1	<1	1	4	1	<1
Total Number of Shutdowns	84	30	79	47	65	51
Number of Rapid Shutdowns	80	19	75	31	61	49
Tube Zone	.385	.283	.385	.313	.385	.385
Type of Failure	Split	Comp. Cap	Split	Side	Split	Split
Downtime Due to Rupture	(3)	0.6	29.0	30.6	27.5	12.2

(3) Ruptures in tubes 2676-C and 2874-C were discharged during one outage. A total of 29.4 hours was charged to them.

* Date not available.

Extracted from ANDERSON 1954b, page 18.

RUPTURED SLUG DATA - MARCH 1954 (Cont'd)

	(5)				
Tube Number	3666-B	4085-D	3666-D	2664-D	3860-B
Failure Number	329	330	331	332	333
Date Failed	3-8-54	3-18-54	3-18-54	3-18-54	3-19-54
Date Charged	7-6-53	8-19-53	6-19-53	9-21-53	9-10-53
Days in File	245	211	272	178	190
Days of Operation	205	188	241	160	144
Tube Exposure	674	565	872	592	384
Tube Power at Failure	518	413	598	537	318
Tube Power Average	421	382	463	474	341
Slug Power	*	*	*	*	*
Local H ₂ O Temperature	*	*	*	*	*
Slug Position	*	*	*	*	*
Canning Date	5-28-53	6-26-53	*	8-4-53	6-4-53
Type Metal	Reg.	Reprocess	*	Reg.	Re-work
Manufacturing Truck No. and Line No.	G-3	G-7	*	C-5	G-2
Lot Number	F-19	ZR-21	*	F-170	RW-6
Metal Group Number	8	8	PT 313-105-3-M	PT 313-105-25M	8
Days up Since Last Startup	1	4	<1	<1	10
Total Number of Shutdowns	46	43	52	37	39
Number of Rapid Shutdowns	26	27	31	24	24
Tube Zone	.313	.240	.238	.283	.250
Type of Failure	Split	Cap	*	Split	Side
Downtime due to Rupture	27.0	0.8	(6)	(6)	27.0
					30.6

(5) The ruptured piece from this tube was mixed with discharged metal and was lost.

(6) These two tubes were discharged during one outage. A total of 26.0 hours was charged to them.

* Data not available.

RUPTURED SLUG DATA - MARCH 1954 (Cont'd)

Tube Number	4366-C	2378-II	4362-F	2051-B
Failure Number	335	336	337	338
Date Failed	3-21-54	3-28-54	3-28-54	3-30-54
Date Charged	8-3-53	6-26-53	5-5-53	3-2-52
Days in Pile	230	275	327	758
Days of Operation	180	228	271	616
Tube Exposure	663	900	519	510
Tube Power at Failure	597	603	292	150
Tube Power Average	470	505	245	106
Slug Power	*	34.6	14.8	*
Local H2O Temperature	*	63.5	*	*
Slug Position	*	20	*	*
Canning Date	6-23-53	5-19-53	1-7-53	*
Type Metal	Reg.	Special	Reprocess	*
Manufacturing Truck No. and Line No.	H-6, 7, 9	*	B-9	*
Lot Number	F-130	Special	ZR-218	*
Metal Group Number	11	11	8	8
Days up Since Last Startup	<1	8	8	<1
Total Number of Shutdowns	101	88	55	152
Number of Rapid Shutdowns	96	75	35	90
Tube Zone	.385	.313	.221 - .316	.149 - .182
Type of Failure	Split	Side	Comp. Gap	*
Downtime due to Rupture	1.4	26.0	49.0	29.0

* Data not available.

Extracted from ANDERSON 1954b, page 20.

RUPTURED ALUMINUM-URANIUM-U235 ALLOY SLUGS - JANUARY 1954

Tube Number	0579-II	0579-II	0686-II	1955-II	4159-H	2966-DR
Failure Number	C-31	C-32	C-33	C-34	C-35	J-4
Date Discharged	1-6-54	1-6-54	1-6-54	1-6-54	1-6-54	1-13-54
Date Charged	12-22-52	12-22-52	1-18-53	11-25-52	12-22-52	7-1-53
Days in File	380	380	353	407	380	196
Days of Operation	304	304	278	329	304	188
Tube Exposure (U235 Depletion)	26.5%	26.5%	23.2%	23.9%	23.1%	11.2%
Tube Exposure (MWD/AT)	976	976	855	880	851	552
Tube Power Near Discharge	462	462	463	459	380	410
Tube Power Average	376	376	361	340	324	372
Slug Power (KW/ft.)	30.3	31.6	30.3	*	24.2	31.3
Local H ₂ O Temp.	50.7	44.7	32.0	*	49.0	*
Slug Position with Respect to Upstream Enriched Piece	20	17	11	*	21	7
Lot and Piece Number	C-2;1089	C-2;1092	C-2;1387	C-2;42	C-2;392	J-2; R-2-29
Type of Failure	Cap	Cap	Side	Cap	Side	Side Tear

* Data Unavailable.

Extracted from ANDERSON 1954b, page 21.

RUPTURED ALUMINUM-URANIUM-U235 ALLOY SLUGS - JANUARY-MARCH 1954

Tube Number	3186-DR	1967-DR	0573-DR	2964-DR	2955-II	3368-DR	2063-DR
Failure Number	J-5	J-6	J-7	J-8	G-36	J-9	J-10
Date Discharged	1-15-54	3-2-54	3-2-54	3-9-54	3-17-54	3-17-54	3-21-54
Date Charged	4-7-53	6-9-53	5-1-53	5-1-53	12-23-52	3-3-54	3-17-54
Days in File	283	266	305	312	449	14	4
Days of Operation	264	252	286	291	356	12	~1
Tube Exposure (U235 Depletion)	14.2%	16.3%	13.0%	16.6%	20.2%	0.6%	~0
Tube Exposure (MM/AT)	700	803	637	818	1038	32	~0
Tube Power Near Discharge	390	478	417	413	403	492	-----
Tube Power Average	336	405	284	358	342	"	-----
Slug Power (KW/ft.)	29.8	36.4	31.8	31.5	25.7	"	"
Local H ₂ O Temp.	"	50.7	48.6	37.6	48.9	"	"
Slug Position with Respect to Upstream Enriched Piece	3	9	9	7	21	"	"
Lot and Piece Number	J-2; 36-20	J-2; 173-8	J-2; 102-36	J-2; R-19-38	G-2; 916	J-3; 22124	J-3; 308-36
Type of Failure	Side Tear	Side Tear	Side Tear	Side	Side	Gap	(1)

" Data Unavailable.

(1) There was no visible hole in the jacket or weld of this piece. However, it was badly swollen.

Extracted from ANDERSON 1954b, page 22.

TABULATION OF RUPTURED URANIUM SLUGS - APRIL 1954

No.	Tube	Date 1) Charged 2) Ruptured	Days in Pile	Tube Power (KW)	Core Power (KW)	Concentration (mg/l)	Horizontal Position in Tube from Front	Local Temp. (°C)	Assigned Operating Production Loss (kg)	Circumstances of Slugging and Removal	Observations of Slug	Tube Cap Data	References
339	1980-F	1) 6-20-53 2) 7-27-53 3) 9-15-53	198	518	32.3 (22.5)	518			251	High exit water activity - Discharged with quickie discharge equipment - resumed operation within normal recovery period (A)	Pad cap failure	0-277 0-15 F-151 7-27-53 T-313-105-254	
340	3271-F	1) 6-10-53 2) 9-15-53 3) 4-2-54	199	632	20.7 (9.7)	500			75	(A)		F-88 G-2 2H-17 6-10-53 Group 8	
341	0869-H	1) 6-20-53 2) 8-2-53 3) 4-4-54	245			809			1933	High exit water activity - removed rear gunbarrel - tube parted with pushing force of 14,500 lbs. - pushed rear 32" of tube & metal column with 10,000 lb. force. Set up as air channel		F-639 H-1 Z-34 6-20-53 Group 11	
342	3972-B	1) 6-4-53 2) 7-6-53 3) 4-4-54	272			670			1502	High exit water activity - Tube & metal column pushed with max. force of 6000 lbs	Can sidewall failure	F-39 G-4 2H-18 6-4-53 Group 8	
343	3471-F	1) 6-26-53 2) 9-15-53 3) 4-4-54	201	602	22.8 (9.7)	588			3402	High effluent water activity - removed rear gunbarrel - tube parted at 7500 lbs. force - rear 15' of tube & metal pushed out with 1000 lbs. - front section of tube longitudinally split & pushed out with 700 lbs. force.		F-210 B 2H-21 6-26-53 Group 8	

Extracted from PAULOVICH April 1955, page 18.

TABULATION OF RUPTURED URANIUM SLUGS - APRIL 1954 (Cont'd)

No.	Slug Id.	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (HRD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (HRD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	Cap Data
344	2863-H	1) 9-11-53 2) 4-8-54	209			759				2761 1.82	High exit water activity - removed rear gunbarrel - pushed metal column with 1500 lbs. and process tube with 7500 lbs.	Can sidewall failure	Group 11
345	2679-C	1) 12-13-53 2) 4-9-54	117			450				1654 1.41	High exit water activity - removed rear gunbarrel - tube & metal column pushed without difficulty		
346	1889-H	1) 6-4-53 2) 7-18-53 3) 4-11-54	267			788				77 .08	(A)	Brantum split failure	P-452 H-2 P-102 6-4-53 Group 11
347	2560-H	1) 8-7-53 2) 11-5-53 3) 4-11-54	157			568				69 .07	(A)		H-906 E-10 P-153 8-7-53 PT-313-105-25 H
348	4079-B	1) 4-23-53 2) 6-15-53 3) 4-12-54	301			658				810 1.15	High exit water activity - removed rear gunbarrel - pushed tube & metal column out with max. force of 3000 lbs.	-	D-22.5 O-1 28-13 4-23-53 Group 8

Extracted from PAULOVICH April 1955, page 19.

TABULATION OF RUPTURED URANIUM SLUGS - APRIL 1954 (Cont'd)

No.	Tube	Date 1) Carried 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slut Power (KW)	Concentration (HMD/I)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data
										(HMD)	(days)			
349	1087-D	1) 12-16-52 2) 1-7-53 3) 4-14-54	162			1193		18		1156	1.44	High exit water activity - flushed out 14 downstream slugs - dribbled rear 15' of tube - pushed out charge with 2500 lbs. - longitudinally split & pushed out most of tube with 6000 lbs.	Uranium split failure	H-575 B-9 382 12-16-52 PT-313-105-78
350	3477-F	1) 9-15-53 2) 4-16-54	213	554		692				1631	1.99	High effluent water activity & abnormal Panellit increase - removed rear gunbarrel, flushed out 30 downstream slugs - pushed out tube & remaining metal with max. force of 9500 lbs.		
351	0170-DR	1) 9-6-53 2) 4-17-54	588			582				360	.50	Tube would not push during routine discharging operations - flushed out several downstream slugs - tube & remainder of metal column pushed out with 2500 lbs. force		Group 9
352	2878-C	1) 12-3-53 2) 4-17-54	135			589				1611	1.38	High exit water activity & abnormal Panellit increase - removed rear gunbarrel - pushed out tube & charge without difficulty - process tube leaked.		
353	3190-H	1) 8-3-53 2) 11-5-53 3) 4-19-54	165			516				91	.10	(A)	End cap failure	H-822 B-3 F-175 8-3-53 PT-25M

TABULATION OF RUPTURED URANIUM SLUGS - APRIL 1954 (Cont'd)

Sl. No.	Q. No.	Date 1) Carried 2) Charged 3) Ruptured	Days in Pls	Time Power (KW)	Line Power (KW)	Concentration (HMD/T)	Normal Plate Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (KWH/line)	Circumstances of Slugging and Removal	Observations of Slug	Fig. & Cap Data	References
354	3462-F	1) 7-30-53 2) 11-5-53 3) 4-24-54	167			594				1664	High exit water activity - Discharged without difficulty	End cap failure	0-759 B F-156 7-30-53 17-258	1
355	2969-D	1) 8-31-53 2) 10-19-53 3) 4-22-54	185			574				1837	High exit water activity - flushed out 17 downstream slugs removed rear gunbarrel - pushed out charge with 2500 lbs. - longitudinally split & pushed out tube with 4500 lbs. max.	Uranium split failure	B-780 B-9 49 8-31-53 Group 9	
356	3401-F	1) 6-9-53 2) 9-15-53 3) 4-26-54	221	557		657				20	(A)	Can sidewall failure	F-80 0 211-17 6-9-53 Group 8	1
357	3469-F	1) 9-15-53 2) 11-5-53 3) 4-24-54	221	588		655				816	High exit water activity - rear gunbarrel removed - process tube & entire metal column pushed out with 9000 lb. force			
358	2185-II	1) 7-18-53 2) 4-30-54				899				616	High exit water activity - rear gunbarrel removed - process tube & entire metal column pushed out with max. force of 15,000 lbs.			
										19,148	21,78			

TABULATION OF RUPTURED URANIUM SLUGS - APRIL 1954 (Cont'd)

Sl. No.	Tag	Date 1) Charged 2) Ruptured	Days in Pile	Tube Power (MW)	Clad Power (MW)	Concentration (Lb/U)	Normal Pile Power Level	Position in Tube from Front	Local React Temp. (°C)	Assigned Operating Production Loss (MW)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
F-5	2877-C	1) 3-21-54 2) 4-15-54									High exit water activity - removed rear gunbarrel - pushed out tube & charge with 500 lbs. max.	(Thermocouple slug IT-105-532-A)		
E-6	2774-C	1) 3-14-54 2) 4-12-54	57								High exit water activity - removed rear gunbarrel - pushed out tube & charge with 6000 lbs. max.	(IT-105-532-B1)		
J-11	3379-DH	1) 3-3-54 2) 4-20-54									(A)			
10-66	3480-B	1) 4-27-54									High exit water activity & abnormal increase in Panel 10 pressure - removed rear gunbarrel - pushed out tube & metal column with max. force of 8500 lbs.			

Extracted from PAULOVIK April 1955, page 22.

TABULATION OF RUPTURED URANIUM SLUGS - MAY 1954

No.	Type	Date 1) Charged 2) Charged 3) Ruptured	Days in Pile	Thermal Power (KW)	Slut Power (KW)	Concentration (WMD/T)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (WMD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
	2589-B	1) 8-1-53 2) 11-5-53 3) 5-3-54	178	471		556				184 .20	High exit water activity - Discharged with quickie discharge equipment - resumed operations within screen recovery period (A)	End cap failure PT-33-105-25-M	B-104 G-2 P-165 8-7-53 3-105-25-M	
	2772-C	1) 8-10-53 2) 12-4-53 3) 5-3-54	150	786		694				2077 1.70	High exit water activity - Reluctantly discharged with charging machine.		B-115 G-3 P-152 8-10-53 25-M	
	2973-C	1) 7-30-53 2) 12-4-53 3) 5-6-54	153	755		678				204 .17	(A)	Uranium split failure	G-1502 C-6 P-178 7-30-53 25-M	
	2891-F	1) 8-6-53 2) 9-15-53 3) 5-8-54	235	387		574				86 .11	(A)	End cap failure	B-80 G-4 P-159 8-6-53 25-M	
	2584-F	1) 8-6-53 2) 9-15-53 3) 5-11-54	238	507		764				136 .17	(A)		B-1276 C-4 P-144 8-6-53 25-M	

Extracted from PAULOVICH May 1955, page 18.

TABULATION OF RUPTURED URANIUM SLUGS - MAY 1954 (Cont'd)

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in pile	Tube Power (KW)	Slut Power (KW)	Concentration (HMD/T)	Normal pile Power level	Position in tube from front	Local reactor Temp. (°C)	Assigned Operating Production Loss (HMD) (Days)	Circumstances of Shutdown and Removal	Observations of Slug	References
	3188-H	1) 5-8-53 2) 9-11-53 3) 5-11-54	242	476		743				1086 (HMD)	Ruptured slug and water leak indications - Metal column discharged without difficulty - leaking tube removed and replaced.	Can Sidewall Failure.	E-513 H-82 F-82 5-8-53 Group 11 (194)
	1987-F	1) 7-27-53 2) 9-15-53 3) 5-12-54	239	445		601				1184 (Includes 1474 F)	High exit water activity - Discharged without difficulty with charging machine (B)	End cap failure.	277 0-15 F-151 7-27-53 25H
	1474-F	1) 2-13-53 2) 4-7-53 3) 5-12-54	400	280		716				1184 (Includes 1987-F)	(B)	Branium split failure	B-556 H-8 22-7 2-13-53 Group 8
	3061-H	1) 11-5-53 2) 5-13-54	188	56E		692				897	Ruptured slugs & water leak indications - Rear gunbarrel removed - Pushed out tube and entire metal column - Leaking tube replaced.		25H
	14278-H	1) 11-5-53 2) 5-16-54	192	496		612				39	Discharged due to high rear pigtail reading during poison discharge outage		25 H

Extracted from PAULOVICH May 1955, page 19.

TABULATION OF RUPTURED URANIUM SLUGS - MAY 1954 (Cont'd)

No.	Slugs	Date 1) Charged 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slugs Power (KW)	Concentration (H ₂ O/T)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (HWE) (days)	Circumstances of Shutdown and Renewal	Observations of Slug	End Cap Data	References
	2390-H	1) 11-5-53 2) 11-5-53 3) 5-17-54	193	448		597				798 1.33	High exit water activity - Metal column discharged with 3000 lb. force - process tube parted 10' from rear while pushing with 7500 lb. force.		25-M	
	3066-H	1) 9-21-53 2) 9-21-53 3) 5-18-54	239	449		747		15		693 .89	High effluent water activity - Rear gunbarrel removed & 17' downstream slugs flushed out - Tube & remainder of charge pushed out with max. force of 6500 lbs.		25-M	
	3078-C	1) 12-3-53 2) 12-3-53 3) 5-22-54	170	728		734		24		1322 1.13	High exit water activity - Quickie discharge attempt failed when rear face cap would not come off.	Uranium split fallow	25-M	
	2275-D	1) 8-10-53 2) 12-3-53 3) 5-24-54	172	814		827				2374 1.94 (includes 2674-C)	High exit water activity - Discharged without difficulty with charging machine.	End cap failure	H-123 0-11 F-152 8-10-53 25-M	
	2670-D	1) 12-13-53 2) 12-13-53 3) 5-24-54	162	617		612		38		2374 1.94 (includes 2274-C)	High exit water activity - Ruptured slug stuck in rear nozzle - tool dolly used to backseat charge - process tube & remaining column pushed from pile.	Can sidewall failure	FT-105-419-K	

Extracted from PAULOVIK May 1955, page 20.

TABULATION OF RUPTURED URANIUM SLUGS - MAY 1954 (Cont'd)

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (HMD/?)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (HMD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data
	1560-II	1) 11-4-53 2) 11-4-53 3) 5-24-54	201	548		706				1521 1.63	High exit water activity - Rear gunbarrel removed - while pushing tube & charge with 15,000 lbs. tube pulled 16' from rear		25-M
	2261-F	1) 8-1-53 2) 9-15-53 3) 5-27-54	254	394		631				1512 1.99 (includes 303-F)	High exit water activity - Discharged without difficulty with charging machine	End cap failure	H-1212 C-2 F-162 8-1-53 25-M
	3063-F	1) 7-31-53 2) 11-2-53 3) 5-27-54	206	421		540				1512 1.99 (includes 2261-F)			0-340 0-1 F-155 7-31-53 25-M
								Total		44,413 15.44			
0-37	4486-0	1) 9-22-53 2) 9-22-53 3) 5-5-54	225								High effluent water activity Discharged with quick discharge equipment	- End cap failure	C-2 264

Extracted from PAULOVICH May 1955, page 21.

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954

No.	Code	Date 1) Charged 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (GMD/T)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (LWU) (days)	Circumstances of Shutdown and Removal	Observations of Slug	No Cap Data
380	1764-C	1) 4-2-53 2) 1-9-54 3) 6-5-54	147	714		635				27 .02	High exit water activity - Discharged with quickie discharge equipment - operations resumed within scram recovery period (A)	Uranium split failure	D-119 H-2 F-50 4-2-53 Group 11
381	2976-C	1) 12-3-53 2) 12-3-53 3) 6-5-54	164	740		822				1653 1.19	High exit water activity - Removed rear gunbarrel - pushed out tube and entire metal column (B)		25H
382	3470-F	1) 6-11-53 2) 9-15-53 3) 6-6-54	264	620		771				26 (Includes 325P) .04	(A)	Uranium split failure	F-103 G-7 ZP-20 6-11-53 Group 8
383	3269-F	1) 5-24-54 2) 5-24-54 3) 6-6-54	13			27				26 (Includes 3470) .04	(A)		
384	1963-C	1) 7-29-53 2) 3-7-54 3) 6-7-54	92	815		388				194 .14	High exit water activity - Discharged without difficulty with charging machine (C)	Uranium split failure	G-139 B-8 F-179 7-29-53 25-H

Extracted from PAULOVIICH June 1955, page 18.

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

No.	ID	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Cube Power (KW)	Sluc Power (KW)	Concentration (LMD/7)	Nominal Pile Power Level	Position in Tube from Front	Local K&er Temp. (°C)	Assigned Operating Production Loss (LMD) (Lava) 57 .04	Circumstances of Shutdown and Removal (A)	Observations of Slug	End Cap Data
305	0568-0	1) 3-14-53 2) 12-3-53 3) 6-7-54	106	53	798	563						End cap failure	0-1157 B-2 F-176 7-30-53 251
306	0860-C	1) 12-3-53 2) 6-8-54	177	53	563					136	(B)		
307	3505-F	1) 8-31-53 2) 11-3-53 3) 6-12-54	221	570	658 (14.8)					20	(A)	Uranium split failure	194 H-303 F-206 6-31-53
308	1586-C	1) 8-1-53 2) 3-7-54 3) 6-13-54	90	792	52.8 (36.8)	118				1682	(C)	Can Sidelall failure	H-17 F-163 8-1-53 Group 12
309	3572-F	1) 6-10-53 2) 7-15-53 3) 6-14-54	272	619	33.8 (11.8)	811				13	(A)		251 F-70 0-1 ZR-20 6-10-53 Group 8

Extracted from PAULOVIKH June 1955, page 19.

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

No.	Id	Date 1) Charged 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (H ₂ O/T)	Nominal Pile Power Level	Position in Tube from Front	Local Area Temp. (°C)	Assigned Operating Production Loss (H ₂ O) (Days)	Circumstances of Shutdown and Removal	Observations of Slug	Find Cap Data	References
390	2076-D	1) 7-20-53 2) 3-1-54 3) 6-15-54	105	619	33.3 (11.2)	811				177 .12	(A)	Uranium Split failure	G-719 H-7 F-150 7-20-53 25H	
391	2571-C	1) 7-30-53 2) 3-1-54 3) 6-16-54	107	740		1405				51 .04	(A)	End cap failure	G-753 H-6 F-179 7-30-53 25H	
392	2267-C	1) 7-27-53 2) 12-13-53 3) 6-16-54	105	793		506				39 .03	(A)	Uranium split failure	G-1104 B-2 F-150 7-27-53 25H	
393	3174-C	1) 7-20-53 2) 3-7-54 3) 6-10-54	103	786	39.2 (17.7)	745				29 .02	Discharged without difficulty with charging machine - located by rear face pigtail survey during discharge outage.	End cap failure	G-282 G-3 F-150 7-20-53 25H	
394	1857-C	1) 9-23-53 2) 12-13-53 3) 6-19-54	103	702		1473				100 .08	(A)	Uranium split failure	J-1436 F-209 9-23-53 Group 11	

Extracted from PAULOVIICH June 1955, page 20.

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

Tube	Date			Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (HRD/T)	Nominal Pile Power Level	Position in Pile from Front	Local Reactor Temp. (°C)	Assigned Operating Production Loss (HRD) (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
	1) Canned	2) Charged	3) Ruptured												
2383-C	1) 7-29-53	2) 3-1-54	3) 6-19-54	110	737		493				131 (includes 3585)	(A)	Uranium split failure	0-733 F-177 7-29-53 25H	
3585-C	1) 10-26-53	2) 2-7-54	3) 6-19-54	132	702		517				131 (includes 2383)	(A)		7-254 10-2653 Group 11	
2280-C	1) 7-23-53	2) 3-1-54	3) 6-20-54	111	719		507				57 (includes 2669)	(A)	End cap failure	0-743 F-177 7-29-53 25H	
2869-C	1) 3-5-54	2) 3-5-54	3) 6-20-54	107	733		479				57 (includes 2290)	(A)		11-91 7-172 25H	
0980-C	1) 8-1-53	2) 3-7-54	3) 6-21-54	106	700		452				23	(A)	Uranium split failure	8-14 F-163 8-1-53 25H	

Extracted from PAULOVIICH June 1955, page 21.

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

No.	Tube #	Date			Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (H ₂ O/T)	Normal Pile Power Level	Position in Tube from Front	Local Reactor Temp. (°C)	Assigned Operating Production Loss (lb/day)		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		1) Canned	2) Charged	3) Ruptured								(1-100)	(1-100)				
400	2161-C	1) 1-7-54 2) 3-7-54 3) 6-21-54			106	669		432				1522	1.07	(B)		Group 11	
401	3169-C	1) 7-29-53 2) 3-5-54 3) 6-22-54			109	723		478				114	.08	(A)	End cap failure	0-1179 0-4 F-179 7-29-53 25H	
												7285	5.21				

2 uranium slugs found in B (6/8 disch)

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

No.	Id	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Normal Pile Power Level	Position in Tube from Front	Local Reactor Temp. (°C)	Assigned Operating Production Loss (MWD)(days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
J-12	1763-DR	1) 3-7-54 2) 3-7-54 3) 6-17-54				4.15 31.56				55	.04	High exit water activity - Discharged with quickie discharge equipment - resumed operations within scram recovery period. (A)	J-3 306 61-19	20 pr
J-13	1590-DR	1) 6-9-53 2) 6-9-53 3) 6-10-54				15.35 95.95				55	.04	End cap failure	J-2 136	11 pr
J-14	1578-DR	1) 3-3-54 2) 3-3-54 3) 6-19-54				6.15 11.93				74	.05	Can solderall failure		20 pr
	3169-DR	1) 3-3-54 2) 3-3-54 3) 6-23-54				6.84 144.53				30	.03			20 pr
	1116-DR	1) 7-1-53 2) 7-1-53 3) 6-23-54				15.25 95.10				1025	.91	High exit water activity & Pencilit increase - Discharged without difficulty with discharge machine. (H)		11 pr

TABULATION OF RUPTURED URANIUM SLUGS - JUNE 1954 (Cont'd)

No.	Tube	Date 1) Charged 2) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MSD/L)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
										(Lb)	(day)				
J-17	2270-1R	1) 3-10-54 2) 3-10-54 3) 6-30-54								30	.44	(D)			20 1
										1269	1.12	TOTAL			

Extracted from PAULOVIK June 1955, page 24.

TABULATION OF RUPTURED URANIUM SLUGS - JULY 1954

No.	Tube	Date			Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (KWD/3)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (KWD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	Encl. Cap Data
		1) Canned	2) Charged	3) Ruptured											
402	4286-B	1) 6-15-53 2) 6-15-53 3) 7-17-54			367			688				737	High exit water activity - Removed rear gunbarrel - Pushed out tube and entire metal charge.		
403	1777-C	1) 5-10-54 2) 6-8-54 3) 7-21-54			42			185				2192	High exit water activity - Discharged without difficulty with quickie discharge equipment.	Can sidewall failure	E-1235 C-4 B-51 5-10-54
404	1860-B	1) 8-20-53 2) 1-12-54 3) 7-26-54			195			580				2042	High exit water activity - Removed rear gunbarrel - Pushed out metal with 9000 lbs. max. force - longitudinally split and removed tube.		M-1064 B-7 Z-60 8-20-53

Extracted from PAULOVICH July 1955, page 14.

TABULATION OF RUPTURED URANIUM SLUGS - JULY 1954 (Cont'd)

J-18	J-19	J-20	J-21	J-22	Date 1) Charged 2) Ruptured	Days in Pile	Tube Power (KW)	Clad Power (KW)	Concentration (Wt-%)	Nominal Pile Power Level	Position in Tube from Front	Local Axial Temp. (°C)	Assigned Operating Production Loss (LWR) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
J-18	J-18	J-18	J-18	J-18	1) 2-8-54 2) 3-18-54 3) 7-18-54	110	438		7.1% (45.7)				1013 1.66	Panellet pressure increase Removed rear gunbarrel - Pushed out tube & entire metal column.	Can sleeve failure	End cap off & lost	
J-19	J-19	J-19	J-19	J-19	1) 3-17-54 2) 3-17-54 3) 7-17-54	122	430		6.0% (38.0)				51 .08	Panellet pressure increase Discharged without difficulty with quickie discharge equipment during poison discharge outage.		J-3 266 287-24	
J-20	J-20	J-20	J-20	J-20	1) 2-11-54 2) 3-3-54 3) 7-23-54	142	425		8.1% (52.1)				58 .09	High exit water activity - Discharged with quickie discharge equipment - Resumed operations within scram recovery period. (A)	Jacket split	J-3 176 246-16	
J-21	J-21	J-21	J-21	J-21	1) 2-8-54 2) 3-4-54 3) 7-23-54	141	420		7.2% (45.8)				397 .65 (includes 0970-IR)	High exit water activity - Discharged metal column with little difficulty. (C)		J-3 159 113-17	
J-22	J-22	J-22	J-22	J-22	1) 2-25-54 2) 3-17-54 3) 7-23-54	128	360		7.0% (45.2)				397 .65 (includes 1044-IR)	(C)		J-3 283	

Extracted from PAULOVICH July 1955, page 15.

TABULATION OF RUPTURED URANIUM SLUGS - JULY 1954 (Cont'd)

No.	Tube	Date			Days in Pile	Tube Power (KW)	Slur Power (KW)	Concentration (KWD/T)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		1) Canned	2) Charged	3) Ruptured								(KWD)	(Days)				
J-23	3563-IM	1)	2) 3-18-54	3) 7-27-54	131	3 7/4		6.97% (44.6)				850	1.39	(c)	Jetlet split	J-3 295 18-19	
1	1981-C	1)	2) 2-11-54	3) 7-5-54	144		1550 mm/hr					75	.06	(A)	Uranium split failure	Cored E Slug	

Extracted from PAULOVIICH July 1955, page 16.

TABULATION OF RUPTURED URANIUM SLUGS - AUGUST 1954

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (KWD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
										(KWD)	(days)				
1405	1277-B	1. 7-3-54 2. 1-13-54 3. 9-5-54	204	685		624				1887	2.26		Can sidewall failure	0-836 B-2 F-143 7-8-53 Group 9	
1406	2602-F	1. 2-26-54 2. 4-25-54 3. 3-17-54	114	596		370				1470	1.95	Process tube leak		B-727 B-1 A-37 Group 9	
C-38	2394-C	1. 10-5-53 2. 8-13-54	312	1402		23.9% (104.1)		19 from rear		75	.06	C Slugs	End Cap Failure	C-2 1590	
C-39	0656-C	1. 10-5-53 2. 10-5-53 3. 8-13-54	317	1454		19.6% (85.8)				2269	1.89	J Slugs			
J-24	2980-DR	1. 3-3-54 2. 3-3-54	172	339		9.3% (64.2)				56	.08		Can sidewall failure	J-3 222 170-22	
J-25	1672-DR	1. 3-3-54 2. 3-3-54 3. 8-26-54	176	1404		10.8% (71.0)				67	.10			J-3 255	

Extracted from PAULOVIICH August 1955, page 15.

TABULATION OF RUPTURED URANIUM SLUGS - SEPTEMBER 1954

No.	Tube	Date 1) Carried 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (HMD/7)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (LMD)/(days)		Circumstances of Shutdown and Removal	Can Sidewall Failure Observations of Slug	End Cap Data	References
										(LMD)	(days)				
407 (U)	2679-C	1) 12-2-53 2) 5-4-54 3) 9-2-54	121	830	42.1 (29.1)	h32		23	94	75	0.6 Sch. change	Process tube leak	(PT-105-519-E-Increased inlet water temperatures)	N-425 A-7	
3 (Q)	1371-B	1) 3-19-53 2) 3-19-53 3) 9-20-54		175		1230/T				1206	1.49		PT-105-551		
40 (C)	4483-C	1) 12-19-53 2) 12-19-53 3) 9-26-54								75	0.6 Sch. change		Still Suspect		

Extracted from PAULOVIICH September 1955, page 24.

TABULATION OF RUPTURED URANIUM SLUGS - OCTOBER 1954

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slue Power (KW)	Concentration (KMD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (LWR) (Days)		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
										(LWR)	(Days)				
h08	3057-H	1. 3-14-54 2. 3-14-54 3. 10-4-54	204	h43		649				846	1.20				
h09	3058-H	1. 4-19-54 2. 5-15-54 3. 10-6-54	142	h65		h78				282	.40			D-823 B R-29 4-19-54	
h10	2956-H	1. 4-20-54 2. 5-15-54 3. 10-8-54	146	h63		h65				h62	2.00			D-229 A F-29 4-20-54	
h11	3156-H	1. 2-8-54 2. 5-25-54 3. 10-12-54	140	h54		h54				65	.09			B-89 A Z-3 2-8-54	
h12	2956-H	1. 2-8-54 2. 5-25-54 3. 10-12-54	140	h36		h44				980	1.39	3 ruptures		B-898 C Z-3 2-8-54	
h13	2802-H	1. 1-11-54 2. 4-30-54 3. 10-12-54	165	520		581				924	1.31		Uranium Split Failure	A-891 G-43 A-47 1-11-54	

Extracted from PAULOVIICH October 1955, page 27.

TABULATION OF RUPTURED URANIUM SLUGS - OCTOBER 1954 (Cont'd)

No.	Tube	Date			Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (KND/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (KWD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		1) Charged	2) Ruptured	3) Ruptured												
h14	3056-II	1. 2-9-54	2. 5-25-54	3. 10-12-54	140	h49	h49	h49				175 .25	2 ruptures	Uranium split failure	B-10h A 2-3 2-9-54	
h15	3155-II	1. 2-16-54	2. 10-12-54		212	h46		610				315 .65				
h16	3059-II	1. 2-9-54	2. 5-25-54	3. 10-12-54	140	h73		h84				315 .15			E-497 B 2-3 2-8-54	
h17	275R-II	1. 5-25-54	2. 10-15-54		163	h80		h67				1260 1.79				
h18	2756-II	1. 12-1-53	2. 3-15-54	3. 10-17-54	216	h57		638				145 .06	2 ruptures	Uranium split failure	H-1210 A-4 G-3 12-1-53	
h19	3057-II	1. 4-21-54	2. 5-15-54	3. 10-17-54	155	510		510				45 .06	2 ruptures		D-2113 A 13-29 11-21-54	

Extracted from PAULOVICh October 1955, page 28.

TABULATION OF CAPTURED URANIUM SLUGS - OCTOBER 1954 (Cont'd)

No.	Tube	Date 1) Charged 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (KMD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (KMD) (days)		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
420	2954-H	1. 11-6-54 2. 2-24-54 3. 10-17-54	235	369		576				1020	1.45			L-873 C F-296 11-6-53	
421	2864-H	1. 1-11-54 2. 5-1-54 3. 10-23-54	175			592				1321	1.68			A-891 G-43 A-47 1-11-54	
422	3057-H	1. 1-28-54 2. 5-15-54 3. 10-25-54	163			517				72	.10			A-1085 G-46 A-65 1-28-54	
423	2964-H	1. 1-7-54 2. 4-30-54 3. 10-25-54	178			599				70	.10		Uranium split failure	A-854 G-43 A-37 1-7-54	
424	2556-H	1. 2-24-54 2. 2-24-54 3. 10-28-54	246			707				1222	1.74				
	2583-D									10,419			FT-105-514-S1 HMO-107 (Effect of irradiation on dimensional stability of uranium)		
										62	.07				

Extracted from PAULOVICH October 1955, page 29.

TABULATION OF RUPTURED URANIUM SLUGS - OCTOBER 1954 (Cont'd)

No.	Tube	Date			Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (H ₂ O) (%)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (H ₂ O) (days)		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		1) Canned	2) Charged	3) Ruptured								(H ₂ O)	(days)				
J-20	2291-DR	1. 2-18-54	2. 3-31-54	3. 10-20-54	203	344		13.3% (87.1%)				90	.15		Can Split	J-3-251 239-8	
J-27	1576-DR	1. 2-3-54	2. 3-3-54	3. 10-20-54	231	310		14.1% (92.5%)				315	.53			J-3-208 162-21	
J-28	1766-DR	1. 2-14-54	2. 3-10-54	3. 10-20-54	242	360		14.1% (94.5%)				90	.15			J-3-8 1-30	
J-29	1486-DR	1. 2-3-54	2. 3-17-54	3. 10-20-54	211	382		11.5% (75.5%)				90	.15			J-3-225 79-29	
J-30	1076-DR	1. 2-3-54	2. 3-17-54	3. 10-20-54	211	306		11.3% (74.3%)				90	.15			J-3-138 145-3	

TABULATION OF RUPTURED URANIUM SLUGS - NOVEMBER 1954

No	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (KWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Reactor Temp. (°C)	Assigned Operating Production Loss (KWD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
J-31	1884-C	1) 8-19-54 2) 8-19-54 3) 11-9-54	82	514		6.8% (39.2)				1,450 1.14				
J-32	1167-DR	1) 2-6-54 2) 3-4-54 3) 11-17-54	258	450		14.2% (93.5)				25 .04		Can Sideswall split	J-3 162 112-13	
J-33	2276-DR	1) 2-23-54 2) 3-17-54 3) 11-17-54	265	483		15.3% (100.1)				25 .04			J-3 R-28 19-11	
J-34	3075-DR	1) 3-2-54 2) 3-17-54 3) 11-17-54	215	423		14.9% (97.7)				25 .04			J-3 306 361-29	
J-35	3080-DH	1) 2-9-54 2) 3-4-54 3) 11-17-54	258	393		15.5% (101.1)				25 .04			J-3 177 199-8	
425	2472-B	1) 10-2-53 2) 4-29-54 3) 11-27-54	212			810				1170 1.30		FT-105-313-274	K-433-S 227-12 B	

Extracted from PAULOVIK November 1955, page 22.

TABULATION OF RUPTURED URANIUM SLUGS - NOVEMBER 1954 (Cont'd)

No.	Tube	Date			Days In Pile	Tube Power (KW)	Slugs Power (KW)	Concentration (AMD/T)	Normal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (AMD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
C-1	4409-C	1) 10-4-53 2) 11-27-54	44	360	32.2% 110.5								100% LUGS	lan Sewall	C-3 9 25-25	
C-15	0372-C	1) 10-4-54 2) 11-27-54	44	442	31.2% 112.6											
C-16	0608-H	1) 12-22-52 2) 11-20-54	70	348	41.9% 183.6							35			C-2 2807	
C-17	1194-C	1) 10-5-53 2) 11-2-54	393	600	27.5% (120.4)							15		Discontinued - Charge Found	C-2 2384 11-25	
C-18	2594-C	1) 12-10-53 2) 11-5-54	322	391	21.6% (170.1)							15			C-3 1 1h	
C-19	0600-C	1) 10-5-53 2) 11-5-54	396	344	30.9% 134.6							15			C-2 1541	

TABULATION OF RUPTURED URANIUM SLUGS - NOVEMBER 1954 (Cont'd)

No.	Slug	Date 1) Charged 2) Ruptured	Days in Storage	Tube Power (KW)	Slug Power (KW)	Concentration (GMD/L)	Nominal Power Level	Position in Tube from Front	Local Heat Temp. (°C)	Assigned Operating Production Loss (HMD) (days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
C- h2	h191-C	1) Charged 2) 12-18-53 3) 11-27-54	44h	495		29.24 123.2				h5 .04			C-3 27	
C- h3	h101-C	1) Charged 2) 10-4-53 3) 11-27-54	h19	283		27.07 121.1				h5 .04			C-3 h	

Extracted from PAULOVIK November 1955, page 24.

TABULATION OF RUPTURED URANIUM SLUGS - DECEMBER 1954

No.	Tube	(1) Date 1) Cannd 2) Char'd 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (KMD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
										(KMD)	(Days)				
126	35911-II	1) 3-30-54 2) 5-12-54 3) 12-21-54	224	556	36.1	812				38	.04		End Cap Failure	C-809 B-11 5-12-54 Group 14	
127	7672-C	1) 10-27-54 2) 12-30-54	64	846		202				1920	1.47		Stuck in process tube	R-150-W Group 14	
J-36	11490-III	1) 2-26-54 2) 3-17-54 3) 12-15-54	273	377		15.5 (101.4)				30	.04		Jacket Split	J-3 X-3 507-49	

Extracted from PAULOVICh December 1954, page 24.

APPENDIX E

FUEL-ELEMENT FAILURE DATA FOR 1955

TABULATION OF RUPTURED URANIUM SLUGS - JANUARY 1955

Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in pile	Tube Power (KW)	Slur Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD) (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data
1587-DR	1) 3-31-54 2) 3-31-54 3) 1-19-55	294	453		16.04 (104.9)				231 .33		Jacket split	J-3 300
3301-DR	1) 3-31-54 2) 3-31-54 3) 1-19-55	294	347		14.74 (96.6)							J-3 R-44
4267-DR	1) 4-17-54 2) 4-17-54 3) 1-19-55	277	328		11.54 (75.6)							J-3 357
2459-DR	1) 3-31-54 2) 3-31-54 3) 1-19-55	294	435		14.54 (95.4)					CLASSIFICATION CANCELLED OR CHANGED TO UNCL BY AUTHORITY OF <i>AS H. H. H. H.</i> BY PR-24(1.1) DATE 12-15-72		
3374-C	1) 9-4-54 2) 9-4-54 3) 1-19-55	137	934	30.2	598		28	90	1728 1.32		Can sidewall failure Solid hot pressed canned slug (PT-105-577-A)	R-145
4171-H	1) 5-15-54 2) 5-15-54 3) 1-21-55	255	550		908				2145 2.32	Stuck	PT-105-539-E, A-101 metal	
3283-C	1) 3-31-54 2) 3-31-54 3) 1-19-55											

Extracted from PAULOVIK January 1955, page 24.

TABULATION OF RUPTURED URANIUM SLUGS - JANUARY 1955 (Cont'd)

Type	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (WTD/T)	Nominal Pile Power Level	Position in Tube from Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data
									(#)	(days)			
3283-C	1) 1-4-54 2) 9-4-54 3) 1-23-55	139	875		568				2101	1.61	Stack	Solid hot pressed canned slug (PT-105-577-A)	
3573-F	1) 3-2-54 2) 5-24-54 3) 1-29-55	252	683		882				1288	1.44		Uranium split failure	C-433 A-92
2686-C	1) 12-5-54 2) 12-5-54 3) 1-31-55	57	833		264				1004	.77		Solid cold canned slug (PT-105-578-A)	
2781-C	1) 12-5-54 2) 12-5-54 3) 1-11-55	37	1040		206				1547 (Includes 276-C)	1.18	Stack	Cored Canned cold slug PT-105-578-A	
2786-C	1) 12-5-54 2) 12-5-54 3) 1-11-55	37	892		161				1547 (Includes 276-C)	1.18	Stack	Can sidewall failure Cold Solid canned slug PT-105-578-A	
1886-H	1) 1-28-54 2) 5-25-54 3) 1-12-55	232	633		838				1322	1.43		Uranium split failure	A-107 A-65
1988-D	1) 6-29-54 2) 6-29-54 3) 1-14-55	199	733		668				1140	1.25		Can sidewall failure	C-30

CLASSIFICATION CANCELLED
OR CHANGED TO UNCL
BY AUTHORITY OF 216 K. K. K.
DTIC PR-24 (11) DATE 12-15-94

Extracted from PAULOVIICH January 1955, page 25.

TABULATION OF RUPTURED URANIUM SLUGS - JANUARY 1955 (Cont'd)

Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (HMD/l)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data
									(HMD)	(Days)			
2892-B	1) 11-8-53 2) 2-12-54 3) 1-16-55	338	505		847				1280	1.33		Uranium split failure	L-1263 F-286

RUPTURED SLUG DATA - FEBRUARY 1955

Tube Number	0969-D	3787-H	1357-B	2191-B	2092-C	(1) 4060-C
Failure Number	434	435	436	437	438	---
Date Failed	2-11-55	2-6-55	2-7-55	2-7-55	2-18-55	2-22-55
Date Charged	5-19-54	5-12-54	4-28-54	6-7-54	12-31-54	2-19-55
Days in Pile	258	270	285	245	49	3
Days of Operation	226	225	238	204	37	2
Tube Exposure	915	953	786	717	218	10
Tube Power at Failure	775	533	521	542	1000	---
Tube Power Average	515	538	420	446	749	635
Slug Power	*	*	*	*	*	*
Local H ₂ O Temperature	*	*	*	*	*	*
Slug Position	*	*	*	*	*	*
Canning Date	3-9-54	12-18-53	9-10-53	9-16-53	10-20-54	2-7-54
Type Metal	Reg.	Reg.	Reg.	Reg.	Reg.	Reg.
Manufacturing Truck No.	G-523	M-645	J-906	J-974	M-3110	B-572
Lot Number	A-100	A-29	F-183	F-197	L-40	L-52
Metal Group Number	13	13	11	11	17	17
Days Since Last Start-up	13	1	6	6	6	2
Total Shutdowns	50	80	54	46	13	0
Rapid Shutdowns	29	64	25	22	8	0
Flow	31.8	27.5	22.9	25.0	43.5	41.3
Tube Zone	.313	.313	.250-.453	.250-	.385	.385
Type of Failure	Slide	Slide	Split	Slide	Unclass.	---
Downtime Due to Rupture	0.5	33.9	16.0	16.0	45.9	30.9

* Data Not Available.

(1) One slug was apparently damaged while charging. The cap was off. This is not classed as an in-pile rupture.

Extracted from ANDERSON 1955a, page 2.

RUPTURED SLUG DATA - FEBRUARY 1955 (Cont'd)

Tube Number	2587-G	1342-G	5062-G
Failure Number	439	440	441
Date Failed	2-25-55	2-27-55	2-27-55
Date Charged	12-19-54	9-26-54	12-18-54
Days in Pile	68	154	71
Days of Operation	50	111	52
Tube Exposure	318	607	312
Tube Power at Failure	1111	952	947
Tube Power Average	810	710	767
Slug Power	58.6	57.2	53.0
Local H ₂ O Temperature	73.1	53.1	70.3
Slug Position	22	17	44
Canning Date	*	8-25-54	*
Type Metal	"D"	"G" (Corrad, Hot-Pressed)	Mechanically "Bonded"
Manufacturing Truck No.	41-MTD	U-750	A-151126-D
Lot Number	None	None	None
Metal Group Number	PT 105-578-A	PT-105-577-A	PT-105-584-A
Days Since Last Startup	1	<1	<1
Total Shutdowns	18	38	19
Rapid Shutdowns	12	23	13
Flow	43.9	40.6	42.5
Tube Zone	385	385	385
Type of Failure	Slide	Split	Slide
Downtime Due to Rupture	29.4	13.4	4.0

* Data Not Available.

Extracted from ANDERSON 1955a, page 3.

RUPTURED ALUMINUM-URANIUM-235 SLUGS - FEBRUARY 1955

Tube Number	1455-DR
Failure Number	J-41
Date Discharged	2-20-55
Date Charged	3-17-54
Days in File	340
Days of Operation	307
Tube Exposure (U-235 Depletion)	11.5%
Tube Exposure (MWD/Tube)	75.22
Tube Power Near Discharge	284
Tube Power Average	245
Slug Power (kw-ft)	*
Local H ₂ O Temperature	*
Slug Position with Respect to Upstream Enriched Piece	*
Lot and Piece Number	J-3
Type of Failure	98
	Side

* Data Not Available.

Extracted from ANDERSON 1955a, page 4.

RUPTURED SLUG DATA - MARCH 1955

Tube Number	1294-DR	1A79-C	1A75-C	11A9-D	1378-C
Failure Number	442	443	444	445	446
Date Failed	3-12-55	3-14-55	3-16-55	3-23-55	3-23-55
Date Charged	7-1-53	2-8-55	1-19-55	1-15-55	7-29-54
Days in Pile	619	34	58	67	237
Days of Operation	570	28	44	56	173
Tube Exposure	905	148	259	282	1129
Tube Power at Failure	242	810	576	800	555
Tube Power Average	202	671	516	640	441
Slug Power	7.3	*	60.1	*	56.0
Local H ₂ O Temperature	71.5	*	53.5	*	31.9
Slug Position	29	*	38	*	29
Canning Date	2-19-53	1-27-55	*	A-26-54	7-14-54
Type Metal	Reg.	Reg.	Cored Unbonded	Reg.	Drilled Cored
Manufacturing Truck No.	B-257	A-318	AR-127	H-2439	3-B
Lct Number	433	K-74	None	N-3-W	None
Metal Group Number	9	16	PT 105-580-A	19	PT 105-570-A
Days Since Last Start-Up	14	10	< 1	11	< 1
Total Shutdowns	128	9	18	17	62
Rapid Shutdowns	88	9	16	4	39
Flow	13.5	41.5	41.2	31.4	39.4
Tube Zone	.175	.385	.385	.313	.385
Type of Failure	Compound Cap	Slide	Split	Slide	Split
Downtime Due to Rupture	27.0	26.0	60.4	37.7	34.8

*Data Not Available.

Extracted from ANDERSON 1955b, page 2.

RUPTURED ALUMINUM-URANIUM-235 SLUGS - MARCH 1955

Tube Number	4273--H
Failure Number	C-49
Date Discharged	3-18-54
Date Charged	11-25-52
Days in Pile	843
Days of Operation	685
Tube Exposure (U-235 Depletion)	33.8%
Tube Exposure (MMD/Tube)	147.85
Tube Power Near Discharge	378
Tube Power Average	216
Slug Power (KW - ft)	*
Local H ₂ O Temperature	*
Slug Position with Respect to Upstream Enriched Piece	*
Lot and Piece Number	C-8
Type of Failure	115
	Jacket Split

* Data Not Available.

Extracted from ANDERSON 1955b, page 3.

RUPTURED SLUG DATA - APRIL 1955

Tube Number	2380-G	0773-G	1974-G	2061-G	1377-G	1477-G
Failure Number	447	448	449	450	451	452
Date Failed	4-2-55	4-2-55	4-4-55	4-9-55	4-11-55	4-11-55
Date Charged	2-8-55	2-1-55	2-8-55	12-18-54	7-29-54	7-29-54
Days in Pile	53	60	55	112	256	256
Days of Operation	40	45	41	81	188	188
Tube Exposure	237	271	229	483	1128	1158
Tube Power at Failure	853	929	917	948	573	546
Tube Power Average	752	765	709	757	438	415
Slug Power	*	*	*	47.1	61.9	59.0
Local H ₂ O Temperature	*	*	*	16.8	46.5	49.1
Slug Position	*	*	*	17	32	33
Canning Date	1-27-55	12-8-54	1-31-55	10-4-54	6-26-54	6-26-54
Type Metal	Reg.	Reg.	Reg.	Unbonded	Reg. Control	Drilled Cored
Manufacturing Truck No.	A-317	M-131	A-1605	190-27-D	4-B	1-B
Lot Number	K-74	L-39	L-54	None	None	None
Metal Group Number	16	17	17	PT-105-584-A	PT-105-570-A	PT-105-570-A
Days Since Last Startup	<1	<1	<1	<1	<1	<1
Total Shutdowns	24	26	25	40	74	74
Rapid Shutdowns	21	22	22	31	50	50
Flow	40.9	41.9	42.9	40.8	39.9	38.0
Tube Zone	.385	.385	.385	.385	.385	.385
Type of Failure	Split	Side	Side	Un-Classified	Split	(1)
Downtime due to Rupt.	17.4	17.3	29.7	18.3	15.0	14.9

* Data Not Available.

(1) This piece was stuck in the process tube. It is still in a short piece of tubing and is to be removed for examination in the Radiometallurgy Lab.

Extracted from ANDERSON 1955c, page 2.

RUPTURED SLUG DATA - APRIL 1955 (Cont'd)

Tube Number	0988-C	0859-C	3676-D	1880-G	3682-D	1557-C
Failure Number	453	454	455	456	457	458
Date Failed	4-13-55	4-16-55	4-23-55	4-27-55	4-28-55	4-29-55
Date Charged	9-16-54	9-16-54	3-10-55	2-19-55	12-12-54	2-19-55
Days in Pile	209	212	44	67	137	69
Days of Operation	151	154	36	49	108	50
Tube Exposure	922	813	174	252	509	244
Tube Power at Failure	897	761	725	882	721	938
Tube Power Average	775	670	614	653	599	620
Slug Power	55.4	45.6	34.6	*	39.7	*
Local H ₂ O Temperature	67.0	60.3	82.2	*	*	*
Slug Position	43	44	24	*	*	*
Canning Data	7-13-54	6-16-54	1-10-55	2-9-55	9-7-54	2-7-55
Type Metal	Reg. Control	Powder Met.	Drilled Cored	Reg.	Reg.	Reg.
Manufacturing Truck No.	G-1919	F-83-S	A-2640	B-3611	J-75	B-578
Lot Number	None	None	D-11	K-81	N-4	K-78
Metal Group Number	PT-105-576-A	PT-105-576-A	DT-105-588-A	16	19	16
Days Since Last Startup	< 1	3	9	5	2	< 1
Total Shutdowns	63	64	13	31	41	34
Rapid Shutdowns	44	45	3	27	11	30
Flow	40.3	39.6	31.4	42.3	31.2	42.3
Tube Zone	.385	.385	.313	.385	.313	.385
Type of Failure	Split	Split	Side	Side	Side	Split
Downtime due to Rupt.	.7	33.7	24.0	30.3	31.3	.8

* Data Not Available.

Extracted from ANDERSON 1955c, page 3.

RUPTURED ALUMINUM-URANIUM-235 SLUGS - APRIL 1955

Tube Number	1466-C	3280-C
Failure Number	J-42	J-43
Date Discharged	4-7-55	4-18-55
Date Charged	11-28-54	11-28-54
Days in Pile	130	141
Days of Operation	98	105
Tube Exposure (U-235 Depletion)	10.5%	10.8%
Tube Exposure (MWD/Tube)	60.33	61.95
Tube Power Near Discharge	646	805
Tube Power Average	616	590
Slug Power (kw-ft)	*	*
Local H ₂ O Temperature	*	*
Slug Position with Respect to Upstream Enriched Piece	*	*
Lot and Piece Number	J3-424 739-36	J3-371
Type of Failure	Jacket Split	Jacket Split

* Data Not Available.

Extracted from ANDERSON 1955c, page 4.

URANIUM SLUG RUPTURE EXPERIENCE - MAY 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure (MWD/T)</u>	<u>Failure Type</u>
8" Normal U. - "L" lot	2088-H	5-3-55	213	Side
8" Normal U. - "L" lot	0777-H	5-3-55	230	Side
8" Normal U. - "M" lot	2673-F	5-4-55	26	Side
8" Normal U. - Recanned "Z" lot	4177-C	5-7-55	154	Non-classified
8" Normal U. - Cast into zirconium can	3385-C	5-9-55	< 1	Side
Unexamined	1055-B	5-10-55	1011	Unexamined
8" Normal U. - Recanned "Z" lot	0673-C	5-10-55	148	Side
8" Normal U. - Recanned "Z" lot	1271-C	5-11-55	102	Side
8" Normal U. - "B" lot	3578-DR	5-12-55	669	Split
8" Normal U. - "K" lot	1587-H	5-13-55	243	Side
8" Normal U. - Recanned "Z" lot	2580-C	5-14-55	229	Non-classified
8" Normal U. - "N" lot	3279-D	5-19-55	576	Non-classified
8" Normal U. - Recanned "Z" lot	0872-C	5-21-55	149	Side
8" Normal U. - Recanned "Z" lot	0969-C	5-21-55	181	Side
8" Normal U. - "M" lot	1064-C	5-22-55	184	Side
8" Normal U. - Recanned "Z" lot	1473-C	5-22-55	239	Side
8" Normal U. - Recanned "Z" lot	1068-C	5-22-55	132	Side
8" Extruded, Cored, U.	1576-C	5-23-55	797	Split
8" Normal - "Z" lot	3183-C	5-27-55	~120	Side
8" Normal U. - "L" lot	3281-D	5-28-55	615	Side

ALUMINUM-URANIUM-235 ALLOY SLUG RUPTURE EXPERIENCE

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure (MWD/tube)</u>	<u>Failure Type</u>
"J" Metal	2670-C	5-14-55	81.5	Jacket split
"J" Metal	1884-C	5-15-55	77.6	Jacket split
"C" Metal	1594-C	5-15-55	124.5	Side (Chattering)
"C" Metal	2093-C	5-15-55	106.6	Side (Chattering)
"C" Metal	4381-C	5-15-55	93.5	Jacket split
"C" Metal	3393-C	5-19-55	76.9	Side (Chattering)
"J" Metal	2772-H	5-20-55	163.9	Jacket split
"J" Metal	3676-C	5-23-55	104.1	Uninspected

It may be noted from Table I that the majority of the C Pile failures this month occurred in "Z" lot material. However, essentially all of the metal shipped to C for the past few months has been of this type, and the great majority of the slugs in C Pile at the present time is probably reprocessed.

Extracted from HAPO 1955a, page Fb-6.

URANIUM SLUG RUPTURE EXPERIENCE - JUNE 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure (MWD/T)</u>	<u>Failure Type</u>
8" Normal U. - "M" Lot	2880-F	6-1-55	156	Side
8" U. - Zirconium Clad	2582-C	6-2-55	99	Jacket Split
8" Normal U. - "K" Lot	3683-D	6-6-55	726	Side
8" Normal U. - Recanned "Z" Lot	2590-C	6-7-55	264	Side
8" Normal U. - "B" Lot	2283-D	6-9-55	692	Non-Classified
8" Normal U. - "E" Lot	1678-F	6-10-55	198	Side
8" Normal U. - Recanned "Z" Lot	1469-C	6-12-55	250	Side
8" Normal U. - "K" Lot	0769-H	6-13-55	225	Side
8" Normal U. - "K" Lot	3869-C	6-13-55	247	Side
8" Normal U. - "N" Lot	1572-D	6-14-55	704	Split
8" Normal U. - Recanned "Z" Lot	1564-C	6-19-55	232	Side
8" Normal U. - "I" Lot	3573-D	6-19-55	681	Side
8" Normal U. - "I" Lot	3681-D	6-19-55	666	Side
8" Normal U. - "I" Lot	3477-D	6-19-55	693	Side
8" Normal U.	2583-C	6-21-55	868	Split
8" Normal U. - "I" Lot	3586-D	6-26-55	643	Unexamined

ALUMINUM-URANIUM-235 ALLOY SLUG RUPTURE EXPERIENCE

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure (MWD/tube)</u>	<u>Failure Type</u>
"C" Metal	1293-C	6-3-55	113.2	Jacket split
"J" Metal	2573-H	6-4-55	167.5	" "
"J" Metal	3664-C	6-13-55	93.2	" "

*Five ruptured pieces were discharged from this tube

Extracted from HAP0 1955b, page Fb-6.

SLUG RUPTURE EXPERIENCE - JUNE-JULY 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure, MWD/T</u>	<u>Failure Type</u>
8" Normal U - "L" lot	2477-D	6-26-55	709	Side
8" Normal U - "L" lot	3381-D	6-26-55	725	Side
8" Normal U - Control for PT 105-578-A	2579-C	6-27-55	919	Split
8" U - Hot-Press Canned	2276-C	7-1-55	407	Side
8" Normal U - Recanned, "Z" lot	3880-C	7-7-55	284	Side
8" Normal U - "A" lot	2868-F	7-11-55	617	Unclassified
8" Normal U - "A" lot	3480-DR	7-13-55	819	Unclassified
Al-U ²³⁵ Alloy - "J" Sling	4282-DR	7-13-55	135MWD/ tube	Side
8" Normal U - "A" lot	2978-F	7-15-55	678	Unclassified
8" Normal U - "M" lot	2488-C	7-15-55	178	Side
8" Normal U	3676-C	7-18-55	262	Side
8" Drilled, Cored U - "D" lot	3765-C	7-19-55	505	Split
8" Normal U - "M" lot	3089-C	7-19-55	174	Side
8" Normal U	0963-C	7-24-55	218	Unexamined
8" Normal U - "X" lot	3480-D	7-25-55	859	Side
8" Normal U - "X" lot	3675-D	7-25-55	824	Side
8" Normal U - "A" lot	2972-F	7-27-55	673	Compound-cap

Extracted from HAP0 1955c, page Fb-5.

SLUG RUPTURE EXPERIENCE - JULY-AUGUST 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure MWD/T</u>	<u>Failure Type</u>
8" Normal U - "M" Lot	2972-F	7-27-55	673	Compound Cap
8" Normal U - "X" Lot	3376-D	8-5-55	969	Side
8" Normal U - "Z" Lot	3578-D	8-5-55	911	Side
8" Normal U - "M" Lot	3081-F	8-7-55	374	Side
8" Normal U - "G" Lot	2372-F	8-7-55	738	Side
8" Normal U - "A" Lot	2967-F	8-7-55	711	Side
8" Normal U - "Z" Lot	3684-C	8-10-55	92	Side
8" Drilled, Cored U - "D" Lot	3771-C	8-11-55	707	Split
8" Normal U - "X" Lot	2777-D	8-12-55	878	Cap
8" Normal U - "X" Lot	1966-F	8-13-55	696	Cap
A1-U-235 Alloy- "C" Slug	1393-C	8-14-55	108 MWD/ tube	Side (chatter)
A1-U-235 Alloy - "J" Slug	0582-DR	8-16-55	139 MWD/tube	
8" Normal U - "X" Lot	1773-DR	8-19-55	936	
8" Normal U - "N" Lot	3674-D	8-23-55	950	
8" Normal U - "L" Lot	0877-D	8-23-55	939	
8" Normal U - "X" Lot	3284-D	8-25-55		

Extracted from HAP0 1955d, page Fb-11.

SLUG RUPTURE EXPERIENCE - AUGUST-SEPTEMBER 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure</u>	<u>Failure Type</u>
8" Normal U - "A" Lot	2470-F	8-26-55	773	Cap
8" Normal U - "A" Lot	2859-F	8-27-55	788	Side
8" Normal U - "A" Lot	3069-F	8-28-55	733	Side
8" Normal U - "A" Lot	2370-F	8-29-55	762	Cap
8" Normal U - "K" Lot	1574-DR	9-1-55	972	Split
8" Normal U - "A" Lot	3266-F	9-1-55	750	Side
8" Normal U - "A" Lot	3373-F	9-1-55	806	Side
8" Normal U - "E" Lot	3764-D	9-3-55	928	*
8" Normal U - "N" Lot	1379-D	9-3-55	878	*
8" Normal U - Group 9	4562-DR	9-3-55	1066	Side
8" Normal U - "M" Lot	1468-C	9-4-55	154	*
A1-U-235 Alloy - C Slug	2789-DR	9-5-55	168.59	(1)
8" Normal U - *	1382-D	9-7-55	268	Side
8" Normal U - *	2776-E	9-11-55	1386	Cap
8" Normal U - "K" Lot	3666-B	9-12-55	914	Unclass.
8" Normal U - "C" Lot	0773-E	9-17-55	1474	Unclass.
8" Normal U - *	1778-C	9-18-55	84	*
8" Normal U - "L" Lot	2272-F	9-18-55	836	Side

*The metal from these tubes has not been examined; therefore, these data are not yet available.

(1) Two failures were found in the metal from this tube, a side and a cap failure.

Extracted from HAPO 1955e, page Fb-7.

SLUG RUPTURE EXPERIENCE - SEPTEMBER-OCTOBER 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure</u>	<u>Failure Type</u>
Al-U-235 Alloy - "J" Metal	2462-C	9-26-55	152 MWD/tube	Jacket split
8" Normal U - "L" Lot	3170-F	9-28-55	829 MWD/T	Cap
Al-U-235 Alloy - "C" Metal	0579-B	9-30-55	173 MWD/tube	Cap
8" Normal U - "L" Lot	1081-D	10-3-55	393 MWD/T	Side
8" Normal U - "Z" Lot	0969-C	10-4-55	171 MWD/T	Side
8" Normal U - "K" Lot	0873-C	10-7-55	200 MWD/T	Cap
8" Normal U - "A" Lot	1872-F	10-7-55	865 MWD/T	Unclassified
8" Normal U - "L" Lot	3173-F	10-7-55	886 MWD/T	Side
8" Normal U - "L" Lot*	1079-D	10-10-55	411 MWD/T	Side
8" Normal U - "K" Lot	1268-D	10-10-55	478 MWD/T	Side
8" Normal U - "A" Lot	2271-F	10-12-55	888 MWD/T	Split
8" Normal U - "K" Lot	2768-D	10-12-55	574 MWD/T	Split
4" Normal U - Control for PT 105-570-A	2079-F	10-13-55	1547 MWD/T	Split
4" Normal U - Control for PT 105-570-A	2180-F	10-14-55	1484 MWD/T	Unexamined
8" Normal U	2886-C	10-14-55	255 MWD/T	Side
Al-U-235 Alloy - "C" Metal	0470-C	10-14-55	144 MWD/tube	Side (Chattering)
8" Normal U - "L" Lot*	1076-D	10-17-55	435 MWD/T	Side
8" Cored U	2368-D	10-21-55	772 MWD/T	Unexamined
Al-U-235 Alloy - "C" Metal	0657-C	10-22-55	153 MWD/tube	Unexamined
Mint	3378-D	10-21-55		Unexamined
8" Normal U - "M" Lot	1471-C	10-22-55	153 MWD/T	Side

*These pieces were normal production material in every respect with the exception that the uranium had been cooled in air between the beta-transforming and water quench steps for a period longer than normal.

Extracted from HAPO 1955f, page Fb-8.

SLUG RUPTURE EXPERIENCE - OCTOBER-NOVEMBER 1955

<u>Type of Metal</u>	<u>Tube No.</u>	<u>Failure Date</u>	<u>Exposure</u>	<u>Failure Type</u>
8" Normal U.-"K" Lot	0961-H	10-31-55	362 MWD/T	Side
8" Normal U.-"K" Lot	1069-C	11-5-55	219	Side
8" Normal U.-"M" Lot	0677-H	11-6-55	320	Side
8" Normal U.-"M" Lot	0982-H	11-8-55	343	Side
8" Normal U.	1179-F	11-9-55	960	Cap
8" Normal U.-"C" Lot	0462-H	11-9-55	189	Side
8" Normal U.	3562-C	11-10-55	211	Cap
8" Normal U.-"L" Lot*	0983-D	11-12-55	376	Side
8" Normal U.-"M" Lot	3985-H	11-17-55	332	Side
8" Normal U.-"L" Lot*	0781-D	11-19-55	394	Cap
8" Normal U.	3283-C	11-19-55	265	Unexamined
8" Normal U.	1364-C	11-24-55	282	Unexamined
8" Cored with crimped U. end plugs	1879-B	11-25-55	398	Side
8" Cored with aluminum end plugs	2179-C	11-26-55	718	Unexamined
8" Normal U.	3291-H	11-26-55	337	Unexamined
8" Normal U.-"L" Lot*	1083-D	11-28-55	436	Unexamined
8" Normal U.	0681-H	11-28-55	423	Unexamined

*These pieces were normal production material in every respect with the exception that the uranium had been cooled in air between the beta-transforming and water-quench steps for a period longer than normal.

Extracted from HAP0 1955g, page Fb-7.

SLUG RUPTURE EXPERIENCE - NOVEMBER-DECEMBER 1955

<u>Tube No.</u>	<u>Failure Date</u>	<u>Type of Metal</u>	<u>Exposure</u>	<u>Failure Type</u>
1686-D	11/28/55	8" Reg. L-Lot	497	Unexamined
1977-H	11/30/55	8" Reg. K-Lot	461	Side
2079-E	11/30/55	8" Reg. K-Lot	466	Side
0985-DR	12/1/55	8" Reg. N-Lot	581	Side
0777-E	12/2/55	8" Reg. Z-Lot	469	Side
3285-DR	12/4/55	8" Reg. M-Lot	555	Side
1972-F	12/4/55	8" Reg. K-Lot	634	Cap
2764-H	12/3/55	8" Reg. Z-Lot	460	Side
0661-H	12/5/55	8" Reg.	252	Side
2276-C	12/8/55	8" Reg. PT-105-519-E	201	Unexamined
2083-F	12/9/55	8" Reg. L-Lot	577	Side
3284-DR	12/11/55	8" Reg. M-Lot	555	Unclassified
2478-C	12/11/55	8" Reg. K-Lot	246	Split
1072-H	12/13/55	8" Reg. N-Lot	458	Side
1983-F	12/13/55	8" Reg. L-Lot*	594	Side
1776-E	12/16/55	8" Reg. M-Lot	455	Side
1381-E	12/17/55	8" Reg. M-Lot	512	Side
2787-H	12/19/55	8" Reg. M-Lot	482	Side
2281-F	12/20/55	8" Reg. L-Lot*	570	Side
2483-H	12/19/55	8" Reg. M-Lot	478	Side
1974-DR	12/22/55	8" Reg. K-Lot	375	Side
2464-C	12/23/55	8" Reg.	220	Side
1581-H	12/22/55	8" Reg. M-Lot	518	Side
1274-H	12/23/55	8" Reg. M-Lot	557	Cap
3390-F	12/22/55	8" Reg. N-Lot	573	Split
2063-C	12/25/55	PT-105-607	313	Unclassified
0876-D	12/24/55	8" Reg. K-Lot	674	Unexamined
1473-D	12/24/55	8" Reg. D-Lot	64	Unexamined
3575-DR	12/25/55	8" Reg. M-Lot	575	Unexamined
3290-H	12/23/55	8" Reg.	521	Side
2667-E	12/25/55	8" Reg.	519	Unexamined
0769-E	12/26/55	8" Reg.	460	Side
1781-H	12/26/55	8" Reg.	537	Unexamined
0867-H	12/26/55	8" Reg.		Unclassified
0881-H	12/26/55	8" Reg.		Unclassified
2783-F	12/27/55	8" Reg. L-Lot*	643	Side
1683-D	12/27/55	8" Reg. L-Lot*	468	Unexamined
0678-F	12/29/55	8" Reg. L-Lot		Cap
1954-C	12/27/55	"C" Metal	6.41 per tube	Unexamined

* These pieces were normal metal in every respect with the exception that the uranium had cooled in air between the beta-transforming and water quench steps for a period longer than normal.

Extracted from HAPO 1956a, page Fb-8.

APPENDIX F

FUEL-ELEMENT FAILURE DATA FOR 1956

RUPTURED SLUG TABULATION - JANUARY 1956

<u>Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
Regular Production Uranium Ruptures					
1/1/56	2677-F	K-107	8" Reg.	747	Side
1/2/56	2087-B	M-33	8" Reg.	747	Side - Hot Spot
1/5/56	3272-B	X-6	8" Cored (Extruded)	660	Side - Hot Spot
1/6/56	1185-H	M-57	8" Reg.	574	Side
1/7/56	0972-H	M-57	8" Reg.	585	Cap
1/7/56	3173-B	?	8" Cored (?)	661	Side - Hot Spot
1/8/56	2679-C	?	8" Reg. (PT 519 Tube)	485	Side
1/8/56	2987-DR	Z-25	8" Reg. (Reprocessed)	636	Side
1/9/56	3069-DR	K-190	8" Reg.	416	Side - Hot Spot
1/10/56	1981-H	K-164	8" Reg.	626	Side - ER
1/12/56	3681-DR	Z-10	8" Reg. (Reprocessed)	691	Unclassified
1/12/56	1480-F	D-17	8" Cored (Drilled)	673	Split
1/12/56	1378-H	M-57	8" Reg.	600	Side - ER
1/14/56	1177-C	K-217	8" Reg.	201	Side - Hot Spot
1/15/56	0983-H	M-65	8" Reg.	533	Side - ER
1/15/56	1863-H	K-164	8" Reg.	602	Side
1/16/56	3469-DR	Z-10	8" Reg. (Reprocessed)	678	Split
1/19/56	2361-C	Z-93	8" Reg. (Reprocessed)	203	Split
1/20/56	1269-D	L-84	8" Reg.	598	Side - ER
1/20/56	1267-F	D-28	8" Cored (Drilled)	617	Split
1/22/56	0873-DR	K-182	8" Reg.	583	Side - Hot Spot
1/23/56	3869-F	M-26	8" Reg.	701	Unclassified
1/25/56	3574-DR	M-41	8" Reg.	720	Cap
1/26/56	2668-C	Z-74	8" Reg. (Reprocessed)	102	Side - Hot Spot
1/26/56	4071-DR	K-166	8" Reg.	604	Unclassified
1/29/56	2578-DR	K-186	8" Reg.	606	Side
1/29/56	1084-D	L-92	8" Reg.	533	Side
1/29/56	3667-DR	L-52	8" Reg.	687	Side
1/29/56	1079-C	NA	8" Reg.	171	Mixed with other metal
1/29/56	1982-F	L-85	8" Reg.	714	Side - ER
Production Test and C Metal Ruptures					
1/3/56	2164-C	4" Ike	PT 607-A	558	Completely Disintegrated
1/4/56	2065-C	4" Ike	PT 607-A	449	Completely Disintegrated
1/10/56	2073-C	D-94	PT 603-A, Cored drilled with crimped U. end plugs.	577	Split
1/16/56	2082-F	8"	PT 596 (Dingot)	844	5 Pieces**
1/18/56	4380-C		C Metal	54/tube	J.F.

Legend and notes: ER - between ribs
 NA - not yet available but should be later
 ? - unknown
 JF - jacket failure

** More examination necessary. Could be 8" regular.

Side failures not classified as "hot spot" or "ER" could have failed by the following mechanisms: pinhole penetration, "Hot Spot", "ER", unknown mechanism.

Extracted from HAPO 1956b, page Fb-17. Also reported in ANDERSON 1956a.

RUPTURED SLUG TABULATION - FEBRUARY 1956

<u>Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
2/3/56	3581-D	DZ-9	8" Drilled Cored Reprocessed	606	Side - Hot Spot
2/4/56	3666-DR	Z-10	8" Reg. Reprocessed	692	Side
2/4/56	0967-H	M-52	8" Reg.	679	Cap
2/4/56	1482-H	M-57	8" Reg.	652	Cap
2/4/56	2184-H	K-164	8" Reg.	641	Split
2/4/56	2790-H	M-52	8" Reg.	699	Cap
2/4/56	4164-H	Z-12	8" Reg. Reprocessed	659	Cap
2/5/56	3763-D	K-91	8" Reg.	765	N.A.
2/6/56	1063-H	M-57	8" Reg.	613	Jacket Cracked
2/8/56	3665-DR	Z-10	8" Reg. Reprocessed	694	Side - Hot Spot
2/9/56	1965-C	Z-107	8" Reg. Reprocessed	255	Side - Hot Spot
2/10/56	1966-H	M-52	8" Reg.	651	Side
2/11/56	4078-B	N.A.	8" Cored	737	Side
2/11/56	3282-DR	M-41	8" Reg.	752	Cap
2/11/56	3573-DR	M-50	8" Reg. (2 ruptures)	655	1 split 1 unclassified
2/12/56	2689-H	Z-22	8" Reg. Reprocessed	705	Side
2/12/56	2363-H	M-52	8" Reg.	683	Side - Hot Spot
2/13/56	2584-F	L-89	8" Reg.	744	Side - B.R.
2/13/56	3186-F	L-90	8" Reg.	723	Side
2/14/56	4274-H	M-41	8" Reg.	622	Cap
2/16/56	1179-DR	K-182	8" Reg.	638	Side - Hot Spot
2/16/56	2890-H	N.A.	8" Reg.	709	Side - Hot Spot
2/21/56	2489-H	Z-60	8" Reg. Reprocessed	550	Side - Hot Spot
2/21/56	3961-H	Z-40	8" Reg.	597	Side - Hot Spot
2/24/56	3467-DR	N.A.	8" N.A.	N.A.	N.A.
2/24/56	3167-D	N.A.	8" Reg.	N.A.	N.A.
2/25/56	1769-H	M-71	8" Reg.	559	Side - Hot Spot
2/21/56	1475-D	L-84	8" Reg.	661	N.A.
2/21/56	3758-D	M-24	8" Reg.	579	N.A.

Production Test and C Metal Ruptures

2/2/56	0891-C	C Metal	13/tube	Base End
2/2/56	2792-H	C Metal	88/tube	Jacket Cracked
2/3/56	0990-H	C Metal	178/tube	Jacket Cracked
2/11/56	2186-C	PT 593, 8" Reg. Control	568	Side
2/17/56	3393-C	C Metal	118/tube	N.A.
2/23/56	2163-C	PT 607, 8" Reg. (Spacer for Ike)	596	Split

Legend and Notes: B.R. - between ribs
N.A. - not yet available but should be later.

Side failure not classified as "Hot Spot", or "B.R." could have failed by the following mechanisms: Pinhole penetration, "Hot Spot", "B.R.", or unknown mechanism.

Extracted from HAPO 1956c, page Fb-18. Also reported in SOWARDS 1956a.

RUPTURED SLUG DATA - MARCH 1956

Tube Number	2179-F	3381-DR	2558-DR	1691-DR	3480-B	1590-H
Failure Number	671	672	673	674	675	676
Date Failed	3-2-56	3-3-56	3-7-56	3-10-56	3-12-56	3-13-56
Date Charged	9-15-54	9-1-55	6-23-55	8-15-55	9-12-55	7-19-55
Days in Pile	534	184	258	208	182	238
Days of Operation	342	150	210	167	140	173
Tube Exposure	2277	634	774	673	699	686
Tube Power at Failure	542	660	633	581	682	585
Tube Power Average	471	537	468	512	634	504
Slug Power	37.3	30.7	46.5	36.0	40.5	40.1
Local H ₂ O Temp.	23.4	*	*	*	*	*
Slug Position	13	*	*	*	*	*
Canning Date	8-13-54	8-24-55	5-13-55	8-5-55	7-13-55	7-12-55
Type Metal	PT	Reprocessed	Reprocessed	8" Reg.	Cored	8" Reg.
Manufacturing Truck No.	H1972	H1779	E3192	H64	47MTC	G4530
Lot Number	38MT	258	29	K182	D94	M57
Metal Group No.	PT 107-570-A	15	15	16	22	18
Days Since Last Startup	< 1	7	2	1	1	< 1
Total Shutdowns	126	46	61	53	31	97
Rapid Shutdowns	59	40	53	47	16	76
Flow	28.9	28.3	26.5	30.4	29.1	30.7
Tube Zone	.313	.313	.313	.313	.316	.310
Type of Failure	Unclassified	Side	Side H.S.	Side H.S.	Split	Cap
Downtime due to Rupture	63.5	1.5	7.2	36.5	9.3	0.6

* Data Not Available

RUPTURED SLUG DATA - MARCH 1956 (Cont'd)

Tube Number	3672-H	1562-C	1371-DR	2375-H	3564-F	2365-H
Failure Number	677	678	679	680	681	682
Date Failed	3-13-56	3-13-56	3-13-56	3-17-56	3-19-56	3-21-56
Date Charged	8-23-55	1-26-56	10-2-55	8-23-55	4-21-55	8-11-55
Days in Pile	203	47	163	207	333	223
Days of Operation	152	38	135	155	188	178
Tube Exposure	668	227	560	736	749	790
Tube Power at Failure	500	903	663	605	612	659
Tube Power Average	558	613	527	603	507	564
Slug Power	23.6	53.8	59.8	33.2	*	36.1
Local H ₂ O Temp.	*	*	*	*	*	*
Slug Position	*	*	*	*	*	*
Canning Date	8-11-55	1-18-56	8-20-55	8-11-55	4-7-55	7-27-55
Type Metal	Reprocessed	Regular	Regular	Reprocessed	Regular	Regular
Manufacturing Truck No.	H4139	A4123	H744	H3141	D3569	G258
Lot Number	243	V803	K188	Z42	M26	M64
Metal Group No.	15	*	16	15	18	18
Days Since Last Startup	<1	9	1	<1	<1	3
Total Shutdowns	85	9	47	87	85	99
Rapid Shutdowns	68	6	43	70	42	80
Flow	30.0	41.4	29.1	28.6	30.3	29.0
Tube Zone	.310	.385	.313	.310	.313	.310
Type of Failure	Cap	Side H.S.	Side Other	Side H.S.	Side H.S.	Side H.S.
Downtime due to Rupture	0.6	6.5	27.2	0.6	0.7	0.6

* Data Not Available

Extracted from SOWARDS 1956b, page 3.

RUPTURED SLUG DATA - MARCH 1956 (Cont'd)

Tube Number	2479-DR	2560-D	3884-H	2072-C	2273-H
Failure Number	683	684	685	686	687
Date Failed	3-22-56	3-26-56	3-27-56	3-29-56	3-29-56
Date Charged	9-1-55	5-29-55	9-11-55	10-4-55	9-11-55
Days in Pile	203	302	198	177	200
Days of Operation	162	158	145	129	147
Tube Exposure	694	601	682	786	693
Tube Power at Failure	642	659	563	822	635
Tube Power Average	544	489	550	703	598
Slug Power	35.2	*	29.0	*	60.9
Local H ₂ O Temp.	*	*	*	*	*
Slug Position	*	*	*	*	*
Canning Date	8-19-55	5-2-55	8-26-55	*	8-30-55
Type Metal	Regular	Regular	Regular	*	Regular
Manufacturing Truck No.	H3723	E503	H3362	*	H3859
Lot Number	K189	K116	K194	*	K196
Metal Group No.	16	16	16	PT 105-593	16
Days Since Last Startup	1	<1	<1	1	<1
Total Shutdowns	53	81	82	56	83
Rapid Shutdowns	47	73	68	45	69
Flow	28.6	31.0	29.3	39.4	29.8
Tube Zone	.313	.313	.310	.385	.310
Type of Failure	Side	Cap	Side H.S.**	Split	Side H.S.
Downtime due to Rupture	19.0	8.1	1.2	31.0	25.5

* Data Not Available.

** Two Ruptured slugs
in this tube,
one Side, one split

Extracted from SOWARDS 1956b, page 4.

RUPTURED SLUG TABULATION - MARCH-APRIL 1956

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
3/26/56	2560-D	K-116	8" Reg.	601	Cap
3/27/56	3884-H	K-194	8" Reg. (2 ruptured pieces)	682	1 Split-transverse 1 side-HS
3/29/56	2273-H	K-196	8" Reg.	693	Side-HS
4/6/56	3367-D	D-14-A	8" Cored	729	N.A.
4/7/56	2172-DR	K-190	8" Reg.	736	Side-HS
4/14/56	2993-H	K-139	8" Reg.	780	Cap
4/18/56	2970-DR	K-187	8" Reg.	731	Side-HS
4/21/56	1072-C	M-105	8" Reg.	276	Side-HS
4/23/56	3288-H	M-69	8" Reg.	795	Side-HS
4/24/56	1360-DR	Z-148	8" Reg., Reprocessed	786	Split-transverse
4/24/56	0975-C	N.A.	8" Reg.	158	Side-HS
4/24/56	1387-B	D-94	8" Cored	842	Side-HS

Production Test Ruptures

3/29/56	2072-C	N.A.	8" Reg. (PT 593-A control pieces)	786	Split-longitudinal
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Legend:

- N.A. - Information not available.
- Side-RR - Failure caused by reduced rib height in the tube.
- Side-HS - Failure caused by a hot spot, probably due to misalignment or warp.
- Side-Other - Failure probably caused by some mechanism other than RR or HS such as pin hole penetration or other unknown mechanism.
- Cap - Failure caused by loss of cap.
- Unclassified - Failure cause or mechanism unknown.
- Split-Longitudinal - Lengthwise or diagonal split.
- Split-Transverse - Split perpendicular to axis of slug.

Extracted from HAPO 1956d, page Fb-6. Also reported in SOWARDS 1956c.

RUPTURED SLUG TABULATION - APRIL-MAY 1956

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
4/28/56	1973-DR	K-190	8" Reg.	795	Split-transverse
4/29/56	3585-KW	K-226	8" Reg.	595	Split-longitudinal
5/5/56	1767-C	Z-110	8" Reg., Reprocessed	196	Split-longitudinal
5/5/56	1087-D	L-84	8" Reg. (53-MT)	792	Side-other
5/5/56	3777-B	D-78	8" Cored	840	Split-longitudinal
5/6/56	0986-KW	K-219	8" Reg.	668	Split-longitudinal
5/7/56	2168-C	K-228	8" Reg.	198	Side-ES
5/11/56	0990-KW	M-55	8" Reg.	753	Split-longitudinal
5/12/56	1877-H	M-78	8" Reg.	700	Cap
5/19/56	0986-B	D-15	8" Cored	604	Side-other
5/22/56	2587-H	K-289	8" Reg.	121	Side-other

Production Test Ruptures:

5/23/56	1372-D	N.A.	8" Solid (PT 601-A-53-MT)	564	N.A.
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Legend:

N.A. - Information not available.
Side-RR - Failure caused by reduced rib height in the tube.
Side-ES - Failure caused by a hot spot.
Side-other - Failure probably caused by some mechanism other than RR or ES such as pin hole penetration or other unknown mechanism.
Cap - Failure caused by loss of cap.
Split-longitudinal - Lengthwise or diagonal split.
Split-transverse - Split normal to axis of slug.
Unclassified - Failure cause or mechanism unknown.

Extracted from HAP0 1956e, page Fb-6. Also reported in SOWARDS 1956d.

RUPTURED SLUG DATA - JUNE 1956

Tube Number	3082-KE	1475-D	3951-KW	1371-D	Suspect 2778-D	2672-C
Failure Number	711	712	713	714	715	716
Date Failed	6-3-56	6-3-56	6-5-56	6-9-56	6-10-56	6-10-56
Date Charged	2-1-56	3-23-56	11-11-55	9-29-55	8-23-55	4-21-55
Days in Pile	123	72	207	254	292	50
Days of Operation	104	63	181	119	145	41
Tube Exposure	506	210	794	591	691	218
Tube Power at Failure	744	652	704	643	635	849
Tube Power Average	735	423	662	631	605	675
Slug Power	*	*	*	26.6	*	52.0
Local H ₂ O Temp.	*	*	*	62.8	*	*
Slug Position	*	*	*	18	*	*
Canning Date	12-23-55	1-11-56	11-1-55	5-55	*	3-28-56
Type Metal	Reprocessed	Reprocessed	8" Reg.	PT 601 53MT	8" Drilled Cored	8" Reg.
Manufacturing Truck No.	DN0894	A3583	L3513	(20C) (43H)	*	JC3168
Lot Number	2114	2117	M90	#	D80	M136
Metal Group No.	15	15	18	*	22	18
Days Since Last Startup	1	1	1	4	---	11
Total Shutdowns	32	5	50	53	64	8
Rapid Shutdowns	26	5	37	31	37	4
Flow	45.8	29.0	46.8	29.5	28.1	40.7
Tube Zone	.369	.313	.369	.313	.313	.385
Type of Failure	Split Long.	Uncl.	Split Long.	Side H.S.	None	Uncl.
Downtime due to Rupture	19.4	0.5	9.6	9.7	.75	7.9

Pushed as Suspect
No Rupture Found

* Information Not Available.

RUPTURED SLUG DATA - JUNE 1956 (Cont'd)

Tube Number	1081-C	1674-D	1970-C	2484-C	2046-KW
Failure Number	717	718	719	720	721
Date Failed	6-21-56	6-22-56	6-22-56	6-23-56	6-28-56
Date Charged	5-15-56	9-29-55	5-15-56	5-15-56	8-22-55
Days in Pile	37	267	38	39	311
Days of Operation	33	131	33	34	262
Tube Exposure	206	648	204	208	872
Tube Power at Failure	951	627	946	888	746
Tube Power Average	793	628	785	777	503
Slug Power	32.0	*	*	*	*
Local H ₂ O Temp.	75.5	*	*	*	*
Slug Position	21	*	*	*	*
Canning Date	4-27-56	*	4-25-56	3-27-56	8-18-55
Type Metal	8" Drilled Cored	Cored	8" Reg.	Dingot	8" Reg.
Manufacturing Truck No.	D2073	*	D4697	C-821	H714
Lot Number	M155	DT588(1)	M153	V34	K185
Metal Group No.	18	*	18	49	16
Days Since Last Startup	8	11	<1	<1	5
Total Shutdowns	3	55	4	5	64
Rapid Shutdowns	2	32	3	4	44
Flow	42.3	27.5	44.0	41.3	48.7
Tube Zone	.385	.313	.385	.385	.369
Type of Failure	Side H.S.	*	Side H.S.	Side H.S.	Split
Downtime due to Rupture	16.6	64.3	3.4	20.0	13.7

* Information Not Available.

(1) Development Test.

Extracted from SOWARDS 1956e, page 3.

RUPTURED ALUMINUM-URANIUM-235 SLUG - JUNE 1956

Tube Number	1155-C
Failure Number	C-65
Date Discharged	6-22-56
Date Charged	5-15-56
Days in Pile	38
Days of Operation	34
Tube Exposure U-235 Depletion	23.2%
Tube Exposure MWD/Tube/	1012.61
Tube Power Near Discharge	656
Tube Power Average	681
Slug Power	*
Local H ₂ O Temp.	*
Slug Position with Respect to Upstream Pieces	*
Lot & Piece Number	13
Type of Failure	Side H.S.
Downtime due to Failure	.5

* Data Not Available.

Extracted from SOWARDS 1956e, page 4.

RUPTURED SLUG TABULATION - JUNE-JULY 1956

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
6/28/56	2046-KW	K-185	8" Regular	872	Split
7/7/56	1176-D	N.A.	8" Cored	571	N.A.
7/15/56	3792-C	M-134	8" Regular	387	Side - H.S.
7/19/56	2494-C	V-32	8" Regular	407	Side - H.S.
7/19/56	2482-KW	M-90	8" Regular	729	Split
7/24/56	1790-KZ	M-111	8" Regular	685	N.A.

"C" METAL RUPTURES

7/20/56	0475-C	10	"C" Metal	47/tube	N.A.
---------	--------	----	-----------	---------	------

Legend: N.A. - Information not available.
Side - H.S. - Failure caused by a hot spot.
Side - R.R. - Failure caused by reduced rib height in the tube.
Side - Other - Failure probably caused by some mechanism other than R.R. or H.S. such as pin hole penetration or other unknown mechanism.
Cap - Failure caused by loss of cap.
Split - Split or fracture parallel to or at an angle to the axis.
Unclassified - Failure type does not fit into any of the above categories.

Extracted from HAPO 1956f, page Fb-7. Also reported in BLOOMSTRAND 1956a.

RUPTURED SLUG TABULATION - JULY-AUGUST 1956

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
7/27/56	2677-H	K-289	8" Regular	334	Side - Other
7/29/56	3457-D	N-40	8" Regular	813	Side - HS
8/4/56	0370-DR	Z-36	8" Regular - Reprocessed	839	Side - HS
8/4/56	2784-KE	K-259	8" Regular	728	Split - Longitudinal
8/6/56	0568-C	M-155	8" Regular	418	Unclassified
8/11/56	3556-D	K-110	8" Regular	767	Side - HS
8/18/56	2855-DR	Z-25	8" Regular - Reprocessed	877	Side - HS
8/20/56	4783-KE	K-247	8" Regular	730	N.A.
8/22/56	0683-C	N.A.	8" Regular	437	Side - H.S.

Legend:

N.A.	- Information not available.
Side - HS	- Failure caused by a hot spot.
Side - RR	- Failure caused by reduced rib height in the tube.
Side - Other	- Failure probably caused by some mechanism other than RR or HS such as pin hole penetration or other unknown mechanism.
Cap	- Failure caused by loss of cap.
Split - Longitudinal	- Lengthwise or diagonal split.
Split - Transverse	- Split normal to axis of slug.
Unclassified	- Failure type does not fit into any of the above categories.

Extracted from HAPO 1956g, page Fb-6. Also reported in BLOOMSTRAND 1956a.

RUPTURE EXPERIENCE - AUGUST-SEPTEMBER 1956

Production Ruptured Slug Tabulation

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure MWD/T</u>	<u>Type Failure</u>
8-30-56	0688-C	M-155	8 th Reg.	490	Unclass.
9-1-56	4872-KB	Z-127	8 th Reg. Reprocessed	657	N.A.
9-2-56	4570-KB	Z-129	8 th Reg. Reprocessed	685	Split- Longitudinal
9-2-56	4573-KB	Z-152	8 th Reg. Reprocessed	560	Split- Longitudinal
9-2-56	4771-KB	M-130	8 th Reg.	664	Split- Longitudinal
9-4-56	4372-KB	Z-119	8 th Reg. Reprocessed	694	Split- Longitudinal
9-6-56	1587-H	Z-137	8 th Reg.	376	Side-HS
9-7-56	2788-KB	K-249	8 th Reg.	743	Side-HS
9-14-56	4870-KB	Z-127	8 th Reg. Reprocessed	671	Unclass.
9-16-56	1267-C	V-816	8 th Reg.	248	N.A.
9-27-56	2486-C	K-335	8 th Reg.	363	Side-HS

Production Test Ruptures

9-6-56	*4863-KB	Z-114	8 th Reg. Reprocessed	479	Split- Longitudinal
9-23-56	**1080-C	K-276	8 th Reg.	836	N.A.

*1706 Corrosion Study Tube, PT 105-550-MT

**PT 105-615A-63 MT Control Tube for I&E Production Test.

Legend:

N.A.	- Information not available.
Side - HS	- Failure caused by hot spot.
Side - RR	- Failure caused by reduced rib height in the tube.
S - Other	- Failure, probably caused by some mechanism other than RR or HS such as pin hole penetration or other unknown mechanism.
Cap	- Failure caused by loss of cap.
Split-Longitudinal	- Lengthwise or diagonal split.
Split-Transverse	- Split normal to axis of slug.
Unclassified	- Failure type does not fit into any of the above categories.

Extracted from HAPO 1956h, page B-20

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

SEPTEMBER 1956

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Quick Mach.	Chg. Hyd. Jack	Tube & Piece	
8" Reg.	4872-KZ	Still in Tube	43.4	4-2-56	9-1-56	657	Z-127			x	
8" Reg.	4573-KZ	Split	0.5	5-2-56	9-1-56	560	Z-152	x			
8" Reg.	4771-KZ	Split	0.5	4-2-56	9-1-56	664	M-130	x			
8" Reg.	4570-KZ	Split	0.5	4-2-56	9-1-56	685	Z-129	x			
8" Reg.	4372-KZ	Split	16.1	4-2-56	9-4-56	694	Z-119		x		
8" Reg.	1587-H	Side Failure	8.5	4-27-56	9-6-56	376	Z-137	x			
8" Reg.	2788-KZ	Side Failure	12.2	3-7-56	9-9-56	743	K-249	x			
8" Reg.	4870-KZ	Split	5.3	4-3-56	9-14-56	671	Z-127	x			
8" Reg.	1267-C	Slug Damaged During Removal	37.2	8-1-56	9-16-56	248	V-816			x	
8" Reg.	2486-C	Side Failure	24.0	7-15-56	9-27-56	363	K-335		x		
PT-105- 550-MT	4863-KZ	Split	3.1	5-2-56	9-6-56	479	Z-144	x			Reg. Metal
PT-105- 615A-63MT	1080-C	Unclassified	38.2	5-16-56	9-23-56	836	K-276			x	Reg. Metal

Extracted from HAPO 1956h, page Cg-2.

RUPTURE EXPERIENCE - OCTOBER 1956

Production Ruptured Slug Tabulation

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure Hr/D/T</u>	<u>Type Failure</u>
10-2-56	2077-B	N.A.	8" Reg.	699	Side-Other
10-8-56	2067-DB	Z-157	8" Reg. Reprocessed	628	Side-H.S.
10-19-56	5067-KE	Z-172	8" Reg. Reprocessed	598	Split- Longitudinal
10-26-56*	3373-D	K-222	8" Reg.	947	Side-Other

*8" regular metal slug in a tube containing Dingo metal slugs alternated with regular metal slugs; PT 105-608-456-KI.

Legend:

N.A.	- Information not available.
Side-H.S.	- Failure probably caused by local overheating (hot spot) and possible intergranular corrosion.
Side-Other	- Failure probably caused by some mechanism other than H.S. such as pin hole penetration or other unknown mechanism.
Split-Longitudinal	- Slug split lengthwise or diagonally.

Extracted from HAP0 1956i, page B-17. Also reported in BLOOMSTRAND 1956b.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

OCTOBER 1956

Type Material	Tube No.	Type Rupture	Remov. Charge		Rupture Date	Act. Conc.	Lot	Removal Method		
			Hrs.	Date				Quic Mch.	Jck & Pc.	Remarks
8" Reg.	2077-H	Side Failure	0.8	2-16-56	10-2-56	699	Available	x		
8" Reg.	2067-DR	Side Failure	26.1	5-2-56	10-8-56	628	Z-157		x	Caused Tube Leak
8" Reg.	5067-KZ	Split (Long)	9.8	5-31-56	10-19-56	598	Z-172	x		
8" Reg.	3373-D	Side Failure	29.1	12-1-55	10-26-56	947	K-222		x	

* Regular metal charge 1 on PT. 105-608A "Irradiation of Dingot Uranium". A broken slug, in addition to the rupture, was found after the tube was discharged. This piece was assumed broken during discharge.

Extracted from HAP0 1956i, page Cg-2. Also reported in BLOOMSTRAND 1956b.

RUPTURE EXPERIENCE - NOVEMBER 1956

Ruptured Slug Tabulation

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
11-2-56	2566-KW	M-171	8" Reg.	383	Side Other
11-4-56	1286-KW	Z-155	8" Reg. Reprocessed	695	Unclass.
11-5-56	2282-H	K-289	8" Reg.	725	Side H.S.
11-6-56	3075-DR	Z-150	8" Reg. Reprocessed	726	Side Other
11-7-56	*4387-KE	D-167	8" Cored Drilled	413	Side H.S.
11-13-56	3985-H	M-162	8" Reg.	447	Side Other
11-19-56	0463-C	Z-85	8" Reg. Reprocessed	**	Split Trans.
11-21-56	2168-D	K-254	8" Reg.	667	N.A.
11-22-56	3571-KE	M-180	8" Reg.	407	Split Long.
11-22-56	1976-H	M-162	8" Reg.	510	Side Other
11-23-56	***1075-C	N.A.	8" Reg.	1255	N.A.
11-24-56	3593-DR	K-321	8" Reg.	338	N.A.

* 3/8 - inch cored, PT 105-519-A

** Tube contained 30 C-metal pieces and 5 reg. metal pieces. A reg. metal piece failed. Burn out of the C-metal was 38.0 per cent

*** Control tube for PT 105-615-A-63MT.

Extracted from HAP0 1956j, page B-14. Also reported in BLOOMSTRAND 1956c.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

NOVEMBER 1956

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Chge. Date	Rupt. Date	Act. Conc.	Lot No. End Cap Data	Removal Method			Remarks
								Chg.	Hyd.	Tube & Mech. Jack Piece	
8" Reg	2566 KV	Side Failure	25.4	8-15-56	11-2-56	383	M-171			X	
8" Reg	2282 H	Side Failure	0.9	4-8-56	11-5-56	701	K-289				
8" Reg	1286 KV	Unclassified	21.6	5-22-56	11-4-56	695	Z-155			X	Tube Leak
8" Reg	3075 DR	Side Failure	11.0	5-2-56	11-6-56	726	Z-150			X	
8" Cored (1)	4387 KB	Split	10.7	8-9-56	11-7-56	413	D-167				PT 105-591-A
8" Reg	3985 H	Side Failure	0.8	7-1-56	11-13-56	447	M-162				
8" Reg	0463 C	Split	1.1	11-23-55	11-19-56	681	Z-85				
8" Reg	2168 D	Split	21.4	4-15-56	11-21-56	667	K-254			X	Tube Leak
8" Reg	1976 H	Side Failure	0.9	7-1-56	11-22-56	510	M-162			X	
8" Reg	3571 KB	Split	4.0	8-20-56	11-22-56	407	M-180			X	
8" Reg (2)	1075 C	Unclassified	26.2	5-15-56	11-23-56	1255	10 0 C 2151-86 D				X PT 105-615A
8" Reg	3593 DR	Side Failure	2.5	7-19-56	11-24-56	338	K 227 C-14-24			X	Tube Leak
9" Metal (3)	0468 C	Side Failure	1.9	12-11-55	11-29-56	165.55	Piece Nos. 25-29-2			X	

(1) PT-105-591-A Irradiation of cored slugs in production quantities.

(2) PT-105-615 Evaluation of I & E cooled slugs canned by the lead dip process.

(3) Three "C" metal ruptures were found in this tube.

Extracted from HAP0 1956j, page Cg-2. Also reported in BLOOMSTRAND 1956c.

RUPTURE EXPERIENCE - NOVEMBER-DECEMBER 1956

Ruptured Slug Tabulation

Ruptures occurred in fifteen charges during December. Fourteen of the ruptures were eight-inch regular metal, and included one regular metal failure in a C-metal (U-235 Al Alloy) column. One dingot material slug (PT 105-608-A-56MT, Supplement A) failed at C Reactor. Pertinent data are tabulated below:

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
11-29-56	0468-C*	C-14	C-Metal	37.9% (U-235 Depletion)	Side Chatter
12-2-56	1078-R	K-290	8" Reg.	761	Side H.S.
12-2-56	2992-R	I-22	8" Reg.	239	Cap
12-5-56	3654-KE	K-384	8" Reg.	422	N.A.**
12-7-56	2576-C***	V-64	8" Dingot	356	Split L.
12-9-56	2878-C	I-35	8" Reg.	373	Side H.S.
12-13-56	3279-D	K-315	8" Reg.	705	Side - Other
12-17-56	2584-C	Z-223	8" Reprocessed	146	Side H.S.
12-18-56	0777-KW	K-201	8" Reg.	****	Unclass.
12-20-56	3181-KW	Z-196	8" Reprocessed	408	Unclass.
12-20-56	2482-C	M-213	8" Reg.	349	Unclass.
12-21-56	2176-C	Z-232	8" Reprocessed	150	N.A.
12-23-56	2469-R	K-342	8" Reg.	587	Side - Other
12-25-56	1478-R	M-167	8" Reg.	565	Unclass.
12-25-56	3085-R	M-197	8" Reg.	N.A.	Side - Other
12-31-56	4263-P	K-354	8" Reg.	N.A.	N.A.

* Previously unreported. Tube contained three ruptures.

** Rupture caused post-discharge operational difficulties due to gas evolution. Rupture is being examined by Radiometallurgy Operation.

*** Irradiated under PT 105-608-A-56MT, Supplement A.

**** Tube contained 36 C-metal pieces and six regular metal pieces. A regular metal piece failed. The depletion of U-235 in the C-metal was 45 per cent.

Extracted from HAP0 1957a, page B-17. Also reported in BLOOMSTRAND 1957a.

RUPTURE EXPERIENCE - NOVEMBER-DECEMBER 1956

Ruptured Slug Tabulation (Cont'd)

Legend:

N. A.	-	Information not available.
Side H.S.	-	Failure probably caused by local overheating (hot spot) and possibly intergranular corrosion.
Side - Other	-	Failure probably caused by a localized corrosion penetration, e.g. pin hole penetration, or other unknown mechanism.
Split	-	Slug split longitudinally, diagonally, or transversely.
Cap	-	Failure caused by loss of cap or penetration at the cap.
Unclassified	-	Failure type does not fit into any particular category.
Side Chatter	-	Failure probably caused by mechanical damage due to slug vibration or chatter.

Extracted from HAPO 1957a, page B-18.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

DECEMBER 1956

Material	Tube No.	Type Rupture	Remov. Hrs.	Chge. Date	Rupt. Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Quic.	Char. Mach.	Used. Tube Piece	
8" Reg.	2991 H	Cap Failure	11.7	10-9-56	12-2-56	239	Z-22			X	Water Leak
8" Reg.	1078 H	Side Failure	2.5	4-27-56	12-2-56	761	K-290		X		
8" Reg.	3654 KE	Split	20.6	9-6-56	12-5-56	422	K-384		X		
8" Reg.	2576 C	Split	23.6	9-16-56	12-7-56	356	J-64		X		
8" Reg.	2878 C	Side Failure	4.2	9-16-56	12-9-56	373	Y-35		X		
8" Reg.	3279 D	Side	15.8	5-27-56	12-13-56	705	K-315		X		
8" Reg.	2584 C	Side Failure	23.9	11-14-56	12-17-56	146	Z-233			X	Water Leak
8" Reg.	0777 KV	Unclassified	16.4	9-18-55	12-18-56	854	K-201			X	C Metal Tube
8" Reg.	3181 KV	Unclassified	2.0	9-28-56	12-20-56	408	Z-196	X			
8" Reg.	2482 C	Unclassified	20.5	10-11-56	12-20-56	349	M-213			X	
8" Reg.	2176 C	Unclassified	2.5	11-14-56	12-21-56	150	Z-232	X			
8" Reg.	2469 H	Side Failure	0.9	7-27-56	12-23-56	587	K-342	X			
8" Reg.	1473-H	Unclassified	8.5	7-27-56	12-25-56	565	M-167			X	
8" Reg.	3085-H	Side Failure	---	7-27-56	12-25-56	598	M-179			X	
8" Reg.	4263 P	Side Failure	21.1	7-14-56	12-31-56	375	K-354			X	

* Removed during regular charge-discharge.

Extracted from BLOOMSTRAND 1957a, page 2.

APPENDIX G

FUEL-ELEMENT FAILURE DATA FOR 1957

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JANUARY 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Chge. Date	Rupt. Date	Act. Conc.	Lot No.	Removal Method		
								Chg.	Hyd. Tube & Mach. Jack Piece	Remarks
8" Reg	2572 H	Side Failure	0.8	7-27-56	1-4-57	625	Z-180	X		2 Ruptures
8" Reg	1161 H	Unclassified	7.4	12-2-56	1-6-57	135	Z-222		X	
8" Reg	2877 B	Split	4.2	8-19-56	1-12-57	250	K-362		X	
8" Reg	1273 C	Unclassified	17.0	12-5-56	1-26-57	248	M-245		X	

Extracted from HAP0 1957b, page Ch-2. Also reported in Bloomstrand 1957b, ruptures 780-783.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

FEBRUARY 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot. No.	Removal Method			Remarks
								Chg. Mach.	Hyd. Jack	Tube Piece	
8" Reg	4369 C	Split	15.1	12-31-55	2-6-57	744	M-103		X		C Metal Tube
8" Reg	4373 C	Split	31.5	12-31-55	2-7-57	707	M-103			X	C Metal Tube
8" Reg	4383 C	Split		12-31-55	2-7-57	756	M-92			X	C Metal Tube
8" Reg	2375 F	Side	36.8	11-20-56	2-8-57	294	Z-192	X			
8" Reg	4355 KE	Split	10.5	10-12-56	2-9-57	580	N-116	X			PT105-550MT
8" Reg	3165 C	Split	0.8	11-14-56	2-10-57	402	C-165				
8" Reg	1165 C	Side	20.1	12-17-56	2-11-57	214	M-215			X	
8" Reg	2160 C	Split	15.9	12-5-56	2-12-57	302	M-239			X	
8" Reg	2967 C	Split	6.0	11-14-56	2-14-57	399	C-165		X		
8" Reg	3180 C	Side	0.7	12-5-56	2-16-57	338	Y-40	X			
8" Reg	0971 H	Side	0.9	12-2-56	2-16-57	299	K-119	X			
8" Reg	2389 KW	Split	8.4	11-18-56	2-24-57	513	K-154		X		
8" Reg	3689 F	Side	8.4	7-14-56	2-25-57	656	K-354	X			
8" Reg	2262 C	Split	9.8	12-5-56	2-26-57	398	M-239	X			

Extracted from HAPO 1957c, page Ch-2. Also reported in Bloomstrand 1957c, ruptures 784-797.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

MARCH 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
8" Reg	2275 II	Unclassified	1.0	11-7-56	3-3-57	505	M-225	Chg. Much		
" "	2485 DR	Unclassified	2.0	11-24-56	3-5-57	269	M-244	X		
" "	3665 C	Split	10.3	11-23-56	3-11-57	469	K-421	X		2 Ruptures
" "	2461 C	"	0.6	12-17-56	3-15-57	406	K-480			
" "	3664 C	"		11-14-56	3-15-57	500	Z-233	X		
" "	3662 C	"		1-3-57	3-16-57	274	K-477			
" "	3659 C	"		10-31-56	3-16-57	520	Z-220	X		
" "	3557 C	"	13.4	12-5-56	3-16-57	385	M-239	X		
" "	3666 C	"		1-3-57	3-16-57	303	K-485	X		
" "	3759 C	"		10-31-56	3-16-57	537	Z-230	X		
" "	3256 C	"	3.8	10-31-56	3-17-57	546	Z-226	X		1 1/2" core
8" Cored	4181 KE	Cap failure	9.6	12-27-56	3-17-57	529	D-222	X		
8" Reg	1964 F	Side Failure	25.2	1-4-57	3-21-57	303	Z-245	X		
8" Reg	2670 KE	Split	8.8	12-27-56	3-28-57	495	K-455	X		Water Leak
8" Reg	0983 II	Side failure	15.3	11-7-56	3-28-57	605	M-234	X		
" "	2466 C	Split	1.6	1-3-57	3-30-57	405	K-478	X		
" "	2361 C	Split	1.3	12-17-56	3-30-57	464	K-480	X		
" "	2359 C	Split	17.6	12-17-56	3-30-57	446	K-480	X	X	
" "	2464 C	Split		1-3-57	3-30-57	395	K-497			
PT-IP-42A	0973 C	Unclassified	26.6	2-3-57	3-4-57	117	-		X	Regular meta control ploc (water leak)
PT-IP-30A	1080 C	Unclassified	17.8	3-11-57	3-23-57	132	-		X	5/8" core-E
PT-IP-30A	1587 C	Unclassified	0.9	3-11-57	3-25-57	137	-	X		5/8" core-E
PT-IP-30A	3472 C	Unclassified	11.3	3-11-57	3-28-57	195	-			5/8" core-E
PT-IP-30A	Determinat	on of optimum	core hole	size.	characteristics of ni			alloy in 33	slugs	jacke s.
PT-IP-42A	Evaluation	of general co	rosion ch							

Extracted from HAP0 1957d, page Ch-2. Also reported in Bloomstrand 1957d, failures 798-820.

RUPTURES EXPERIENCE - APRIL 1957

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
4-1-57	3072-DR	M-220	8" Regular	455	Side H.S.
4-9-57	5067-KW	K-536	8" Regular	219	Side H.S..
4-13-57	2660-B	Y-34	8" Regular	477	Unclassified
4-17-57	3280-C	TK-503*	8" Regular	331	Side H.S.
4-18-57	2856-C	Z-243	8" Reprocessed	490	Split L.
4-18-57	3270-C	TK-503*	8" Regular	298	Split L.
4-19-57	0872-H	Y-51	8" Regular	446	Side H.S.
4-20-57	2663-DR	C-220	8" Regular	247	Side H.S.
4-28-57	1664-C	M-265	8" Regular	370	N.A.
4-29-57	1264-D	C-173	8" Regular	518	Side Other
4-30-57	1480-KE	D-232	8"-1/2" Cored	532	Unclassified
4-30-57	2185-C	TK-489*	8" Regular	357	Split L.
4-30-57	1880-C	TK-539*	8" Regular	269.	Split L.

* Truline - small button design.

Legend:

- Side - Hot Spot - Failure probably caused by local overheating (Hot Spot) and possibly intergranular corrosion.
- Split - Failure probably caused by cleavage of the uranium core. Slug split longitudinally (L), diagonally (D), or transversely (T).
- Side Other - Failure probably caused by a localized corrosion penetration, e.g. pin hole penetration or unknown mechanism.
- Unclassified - Failure types does not fit into any particular category.
- N.A. - Information not available.

Extracted from HAPO 1957e, page B-21. Also reported in Bloomstrand 1957d, failures 821-833.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

APRIL 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Qulc. Mach	Chg. Hyd. Tube & Jack Piece	Remarks
8" Reg.	3072 DR	Side Hot Spot	11.3	11-6-56	4-1-57	455	M220		X	
8" Reg.	5067 KW	Side Hot Spot	10.6	3-7-57	4-9-57	219	K536		X	
8" Reg.	2660 B	Unclassified	6.2	9-22-56	4-13-57	477	Y-34		X	
8" Reg.	3280 C	Side Hot Spot	19.7	2-3-57	4-17-57	331	TK-503			X Stuck
8" Reg.	2056 C)	Split)		12-17-56	4-18-57	490	Z-243	X		
8" Reg.	3270 C)	Split)	2.8	2-11-57	4-18-57	298	TK-583	X		
8" Reg.	0872 H	Side Hot Spot	10.2	1-10-57	4-19-57	446	Y-51		X	
8" Reg.	2663 DR	Side Hot Spot	9.6	3-5-57	4-20-57	247	O-220		X	
8" Reg.	1664 C	Side Hot Spot	19.1	2-3-57	4-20-57	370	M-265		X	Tube Leak
8" Reg.	1264 D	Side Other	1.0	11-12-56	4-29-57	518	O-173		X	
8" Corad	1480 KE	Split Hot Spot	6.3	1-31-57	4-30-57	532	D-232		X	
8" Reg.	2185 C	Split	1.0	2-11-57	4-30-57	357	TK-489	X		
8" Reg.	1880 C		1.1	2-26-57	4-30-57	269	TK-539	X		

Extracted from HAP0 1957e, page Ch-2.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

MAY 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Pulc.	Chg. Mach	Hyd. Jack	
8" Reg.	0782DR	Side hot spot	16.5	11-16-56	5-4-57	441	K-3021		X		Leaker
8" Reg.	1273DR	unclassified	10.5	1-3-57	5-6-57	375	M-207			X	
8" Reg.	5166 KW	Side hot spot	9.2	3-7-57	5-6-57	384	K-559		X		
8" Reg.	1881-II	Side hot spot	11.8	1-10-57	5-8-57	545	M-249		X		
8" Reg.	1859-II	Split	2.7	1-6-57	5-10-57	449	Y-51	X			
1 1/2" cored	1969-B	unclassified	18.8	12-26-56	5-11-57	841	PTIP21				X
1 1/2" cored	1984-KB	Cap failure	9.6	3-6-57	5-11-57	414	D-243		X		
8" Reg.	2570-KB	Not available	31.2	3-28-57	5-13-57	238	K-564				X
8" Reg.	2466-B	Split	6.1	2-3-57	5-15-57	418	Z-260		X		
8" Reg.	4002-D	Cap failure	0.7	11-12-56	5-16-57	470	M-218	X			
8" Reg.	2164-R	Split	16.8	12-26-56	5-17-57	781	-				X
1 1/2" core	1876-KB	Not available	3.6	3-17-57	5-25-57	449	D-250		X		
8" Reg.	2078-KW	Side hot spot	4.8	3-25-57	5-25-57	350	K-526		X		
8" Reg.	2080-KW	Side hot spot		3-7-57	5-25-57	469	K-550		X		
1 1/2" core	2081-KB	Split	10.7	3-1-57	5-29-57	537	-		X		
8" Reg.	1783-DR	Side hot spot	20.0	3-20-57	5-31-57	322	2284			X	

Extracted from HAP0 1957f, page Ch-2. Also reported in Bloomstrand 1957e.

RUPTURE EXPERIENCE - JUNE 1957

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
6-5-57	3081-KE	D-242	8 ^m -1/2 ^m Cored	558	N.A.
6-6-57	3272-KE	D-249	8 ^m -1/2 ^m Cored	475	Side H.S.
6-7-57	0877-KW	---	Doe Metal	33.5*	Cap (Mechanical Damage)**
6-26-57	1164-B	V-818	8 ^m Dingot	490	Side H.S.
6-26-57	2871-C	K-561	8 ^m Regular	500	Side H.S.

* Per cent depletion of U235.

** Failure caused by slug chattering. Process tube leaked.

Legend:

Side H.S. - Failure probably caused by local overheating (Hot Spot) and possibly intergranular corrosion.

N.A. - Not Available.

Extracted from HAP0 1957g, page B-22.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JUNE 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Quic.	Chg. Nucl	Hyd. Jack	Tube Piece	Remarks
1/2" Core	3081KE	*Not available	15.6	3-1-57	6-5-57	558	D242				X	(Leaker)
1/2" Core	3272KE	Side Hot Spot	8.3	3-17-57	6-6-57	475	D249			X		
C Metal	0877KW	End Cap	16.8	9-28-56	6-7-57	169.94	cl-22-33		X			(Leaker)
8" Reg.	1164B	Side Hot Spot	14.3	3-8-57	6-26-57	4496	V018		X			
8" Reg.	2871C	Side Hot Spot	4.0	3-28-57	6-26-57	491	K561		X			

* Piece could not be removed from tube

Extracted from HAP0 1957g, page Ch-2. Also reported in Bloomstrand 1957e.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JULY 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Chg. Mach.	Hyd. Jack	Tube & Piece	
8" Reg.	2479-C	Charge Machine Damage	9.2	6-6-57	7-2-57	148	PZ 299	X			
PT-IP-43A	3578-D	Side Hot Spot	11.3	4-29-57	7-4-57	295	PT-IP		X		
8" Reg.	1868-B	Unclassified	25.7	4-6-57	7-14-57	371	M-273		X		
8" Reg.	1587-DR	Side Hot Spot	1)12.3	6-18-57	7-17-57	136	A-121	X			Leaker
8" Reg.	1464-O	Side Hot Spot	8.7	5-20-57	7-18-57	278	A-103		X		
8" Reg.	2372-KE	Side Hot Spot	38.6	3-28-57	7-19-57	607	PT-IP	43A		X	PT-IP-43A
3PT-IP-1A	1461-C	Unclassified	9.7	3-4-57	7-21-57	1226	11-66	X			Solid E
3PT-IP-1A	2663-O	Side Hot Spot	13.0	3-31-57	7-24-57	1053	15-98	X			Solid E
8" Reg.	3285-DR	Side Hot Spot	9.6	6-18-57	7-28-57	207	Z-343		X		
8" Reg.	3572-DR	In Chute Gate	2)14.8	6-18-57	7-30-57	208	A-125	X			Leaker
8" Reg.	2747-KE	Split	20.2	4-18-57	7-30-57	461	K-595			X	Leaker
8" Reg.	2380-DR	Side Hot Spot	12.2	6-18-57	7-31-57	213	A-125	X			
(1) Includes additional time of 6.6 for retubing on 7/29/57.											
(2) Includes additional time of 2.0 for retubing on 7/31/57.											
(3) Run-to-rupture.											

Extracted from HAP0 1957h, page Ch-2. Also reported in Bloomstrand 1957f.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

AUGUST 1957

Type Material	Tube No.	Type Rupture	Remov. Wts.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Remarks
8" Reg.	2640KE	Split	6.3	4-18-57	8-5-57	491	K-595	Chg. Jack	
8" Reg.	2178C	Side hot spot	14.1	5-20-57	8-5-57	371	TK505		
8" Reg.	2054C	Split	1.0	8-16-56	8-7-57	149.90			
8" Reg.	3553KE	Split	6.7	6-3-57	8-7-57	332	K6A0		
8" Reg.	3153KE	Split	68.5	6-3-57	8-8-57	327	K620		
8" Reg.	2383C	Unclassified	1.8	6-6-57	8-10-57	280	TK608		
8" Reg.	3477DR	Side hot spot	5.1	6-18-57	8-10-57	270	A125		
8" Reg.	2387C	Side hot spot	10.7	6-6-57	8-12-57	292	TK114		
8" Reg.	1178KE	Split	4.1	6-21-57	8-12-57	236	K664		
8" Reg.	0986KE	Side hot spot	1.0	3-28-57	8-12-57	91.19			
8" Reg.	3166D	Not available	12.6	6-14-57	8-13-57	316	M284		
8" Reg.	2671C	Side hot spot	3.1	5-20-57	8-14-57	400	TK500		
8" Reg.	3387KE	Not available	19.9	6-21-57	8-15-57	235	K611		
8" Reg.	0778KE	Split	14.8	6-21-57	8-16-57	228	K615		
8" Reg.	0775KE	"		4-30-57	8-17-57	468	K598		
8" Reg.	4968KE	"		6-21-57	8-18-57	245	K610		
8" Reg.	5365KE	"		4-30-57	8-18-57	468	K615		
8" Reg.	1484KE	Split		6-21-57	8-18-57	254	K614		
8" Reg.	1376KE	Split	10.7	6-21-57	8-18-57	246	K616		
8" Reg.	0978KE	"		6-21-57	8-18-57	255	K615		
8" Reg.	0979KE	"		6-21-57	8-18-57	248	K615		
8" Reg.	1979D	Side hot spot	17.2	6-26-57	8-18-57	226	A135		
8" Reg.	2078B	Unclassified	17.3	6-1-57	8-19-57	344	A107		
8" Reg.	1265D	Side hot spot	4.3	6-14-57	8-20-57	400	G255		
8" Reg.	3062KE	Split	21.3	5-11-57	8-20-57	443	K609		
8" Reg.	1980B	Side hot spot	16.9	6-1-57	8-21-57	332	2305		
8" Reg.	5360KE	Not available	3.8	5-11-57	8-21-57	350	K617		
8" Reg.	1172KE	Not available	15.3	6-21-57	8-22-57	240	K614		
8" Reg.	1182DR	Side hot spot	7.8	6-18-57	8-22-57	335	A121		
8" Reg.	1364DR	Side hot spot	9.0	6-18-57	8-24-57	340	A121		
8" Reg.	0474C (1)	Split	3.1	4-14-57	8-15-57	52.02			
8" Reg.	2773-H	Side hot spot	4.2	3-2-57	8-26-57	526	Y58		
8" Reg.	4863KE	Split	6.8	4-30-57	8-28-57	462			
8" Reg.	5464KE	Not available	4.3	4-18-57	8-31-57	459	K580		
8" Reg.	4150KE	"		7-8-57	8-31-57	168	K651		
8" Reg.	2480C	"	15.9	6-6-57	8-31-57	390	G239		
(1)	Discharged is metal rupture	is rupture suspected on 8/5/57; during metal				Inspection on 8/26/57		was confirmed to have a doe	

Extracted from HAP0 1957i, page Ch-2. Also reported in Bloomstrand 1957f.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

SEPTEMBER 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
8" Reg.	236C	Not available	1.9	5-6-57	9-2-57	398	TK600			
8" Reg.	2472C	Split	31.0	6-6-57	9-2-57	384	TA114			
8" Reg.	1780D	Side Hot Spot	8.0	5-30-57	9-2-57	471	Q-251			car
8" Reg.	2879DR	Side Hot Spot	13.7	6-18-57	9-2-57	386	Z-343			car
8" Reg.	1571C	Side Hot Spot	11.4	6-6-57	9-5-57	407	TK521			
8" Reg.	2476KV	Unclassified	7.3	7-28-57	9-6-57	212	A136			car
8" Reg.	2477DR	Side Hot Spot	81.8	1-10-57	9-11-57	108	A149			"
8" Reg.	1467D	Not available	4.3	7-28-57	9-11-57	229	A136			"
8" Reg.	0775F	Not available	9.1	1-8-57	9-12-57	137	Z397			"
8" Reg.	0874B	Side Hot Spot	12.9	7-2-57	9-15-57	59	A166			"
8" Reg.	2780C	Side Hot Spot	7.6	6-6-57	9-16-57	453	A312			
8" Reg.	2476B	Split	21.1	6-1-57	9-18-57	473	A107			
8" Reg.	4058F	Not Available	30.4	6-11-57	9-19-57	319	K596			
I & E	1965C	Not available	45.4	3-4-57	9-26-57	2186				PT-IP-1A
8" Reg.	1170B	Side other	40	6-30-57	9-27-57	398	CU57			
8" Reg.	1858H	Split	24.6	7-22-57	9-27-57	267	Q270			
8" Reg.	1665H	Split		5-12-57	9-29-57	392	A103			Leaker
8" Reg.	1160H	Split	47.1	7-9-57	9-29-57	352	A134			
8" Reg.	1264H	Split		5-12-57	9-29-57	362	Q242			
8" Reg.	2956H	Split		5-12-57	9-29-57	304	Z357			
*Evaluation of *Removed during		[& E Slugs Operating at charge-discharge,		High Spg	File Pow	rs				

Extracted from HAP0 1957j, Page Ch-2. Also reported in Bloomstrand 1957g and 1957h.

RUPTURE EXPERIENCE - OCTOBER 1957

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
10-1-57	2361-DR	A-149	8" Regular ⁽¹⁾	330	Side - H.S.
10-6-57	0874-B	Y-068	8" Regular	89	N.A.
10-8-57	2077-R	C-242	8" Regular	436	Charge Machine Damage
10-9-57	1272-F	A-161	8" Regular	267	N.A.
10-9-57	2278-R	M-285	8" Regular	341	Side - H.S.
10-12-57	1484-DR	A-174	8" Regular	38	Charge Machine Damage
10-12-57	1972-B	A-135	8" Regular	475	Side - H.S.
10-13-57	0667-H	M-238	8" Regular	445	Split L.
10-15-57	2886-DR	M-288	8" Regular	331	Side - H.S.
10-17-57	2847-KE	—	6" 1/2" Cored E-Metal ⁽²⁾	416	Side - H.S.
10-21-57	3562-F	C-292	8" Regular	168	Charge Machine Damage
10-24-57	1561-F	M-293	8" Regular	304	Charge Machine Damage
10-26-57	0470-C	—	6" Solid E-Metal ⁽²⁾	371	Split L.
10-27-57	2682-F	A-161	8" Regular	341	Side - H.S.
10-28-57	2280-H	M-288	8" Regular	427	Side - Other
10-28-57	0572-C	A-139	8" Regular	478	Split L.
10-12-57	0979-B	—	Doe	23.8 ⁽³⁾	Mechanical Damage
10-25-57	5162-KE	--	Doe	28.9 ⁽³⁾	(Chattering) Side - Other

(1) Hunter Douglas Can

(2) 0.94 per cent U-235 enriched uranium

(3) Per cent U-235 depletion of Doe metal in the column

Legend:

Side - H.S. - Failure probably caused by local overheating (hot spot) and possibly intergranular corrosion.

Split - Slug split longitudinally (L), diagonally (D), or transversely (T).

Unclassified - Failure does not fit into any particular category.

Side - Other - Failure probably caused by localized corrosion penetration, e.g. pinhole penetration, or other unknown mechanism.

N.A. - Information not available.

Extracted from HAPD 1957k, page B-18. Also reported in Bloomstrand 1957h and 1958a.

OCTOBER 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Chg. Mach	Hyd. Jack	Tube & Piece	
8" Reg.	2361 DR	Side HotSpot	13.8	7-31-57	10-1-57	330	A149	X		X	Hunter-Doug. Car
8" Reg.	0874-B	Not available	16.8	9-15-57	10-6-57	89	Y-068				
8" Reg.	2077-II	Chg. Mch. Damage	5.4	5-12-57	10-8-57	436	C-242	X			
8" Reg.	1272-F	Split	25.9	8-8-57	10-9-57	267	A-161	X			
8" Reg.	2278-II	Side HotSpot	6.9	7-22-57	10-9-57	341	M-288	X			
8" Reg.	1972-B	" "	21.2	6-26-57	10-12-57	475	A-135			X	
8" Reg.	1484-DR	Chg. Mch. Damage	15.5	10-1-57	10-12-57	38	TA174	X			
8" Reg.	0667-II	Side HotSpot	21.9	5-12-57	10-13-57	445	C-233		X		
8" Reg.	2886-DR	Side HotSpot	23.3	8-10-57	10-15-57	321	S-048			X	Tube leak
Cored "E"	2847-KE	" "	11.3	7-8-57	10-17-57	46.44	Emetal	X			
8" Reg.	3562-F	Chg. Mch. Damage	24.5	9-8-57	10-21-57	168	C-292	X			
8" Reg.	1561-F	" "	0.9	8-8-57	10-24-57	304	M-293	X			
"C" metal	5162-KE	Split	1.0	3-1-57	10-25-57	129.37	C-met.	X			0.94% enrich
Solid "E"	0470-C	Split	3.0	9-10-57	10-26-57	447	E-met.	X		X	
8" Reg.	0572-C	Split	23.4	7-7-57	10-27-57	478	A-139			X	
8" Reg.	2602-F	Side HotSpot	27.0	8-8-57	10-27-57	341	A-161				
8" Reg.	2280-II	Side other	5.2	7-22-57	10-27-57	427	M-288	X			
"C" metal	0979-B	Chattering	0	4-6-57	10-12-57	91.64	U-803	X			

Extracted from HAP0 1957k, page Ch-2. Also reported in Bloomstrand 1957/h and 1958a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

NOVEMBER 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Remarks
PT-IP-87I 8" Reg.	2074-C	Slide Not Spot	8.7	9-5-57	11-1-57	300	Z-398	Chg. Mach. X	8" regular
8" Reg.	1170-B	Unknown	10.0	9-26-57	11-5-57	229	-	X	
8" Reg.	0363-C	Slide Split	5.1	7-7-57	11-6-57	412	Z-139	X	
8" Reg.	1174-F	Slide Not Spot	10.8	8-8-57	11-6-57	307	A-161	X	
PT-IP-87I	1774-C	Split	DN0	6-6-57	11-7-57	685	A-120	Operational discharge	
Solid Eng.	0475-G(1)	Split	23.6	6-26-57	11-7-57	493	-	Operational discharge	Two slugs rpt.
PT-IP-87I	2175-C	Split	(3) DN0	5-20-57	11-10-57	854	TK505	Operational discharge	8" Reg.
PT-IP-87I	2169-C	Split-Not Spot	30.1	6-26-57	11-10-57	602	TK610	X	8" Reg.
8" Reg.	2165-DR	Slide Not Spot	4.0	8-24-57	11-13-57	408	A-149	X	Hunter-Doug. car
PT-IP-87I	1573-C	Split	0.6	5-20-57	11-14-57	878	TK-52	X	8" Reg.
Doe Metal	3575-KE	Slide-Jacket Split	1.0	3-1-57	11-14-57	138.72	-	X	
8" Reg.	2987-B	Slide Other	9.4	8-5-57	11-20-57	526	A-150	X	
8" Reg.	1371-II	Chg. Mach. Dem.	8.3	10-13-57	11-26-57	240	Z-431	X	
Doe Metal	1760-B	Can Split	(2) ---	4-6-57	11-1-57	101.44	-	X	
8" Reg.	2255-II	Split	8.6	6-24-56	11-28-57	169.89	-	X	Doe Metal Tub
PT-IP-87I	"Evaluation of CG-651 Rupture Discharge Capabilities"								
	(1) Tube 0475-G contained 2 ruptures.								
	(2) Discharged on schedule.								
	(3) Discharged while operating.								

Extracted from HAP0 19571, page Ch-2. Also reported in Bloomstrand 1958a.

RUPTURE EXPERIENCE - DECEMBER 1957

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
12-2-57	3673-F	M-293	8" Regular (1)	514	Side H.S.
12-3-57	2569-H	Y-064	8" Regular	486	Cap
12-5-57	3467-KW	K-706	8" Regular	389	Side H.S.
12-7-57	3748-KE	KE-005-A	6" Solid E-Metal (2)	257	N.A.
12-12-57	1875-C	TK-614	8" Regular (3)	174	Side Other
12-13-57	1365-DR	M-290	8" Regular (4)	411	Side H.S.
12-18-57	2359-DR	A-176	8" Regular (5)	421	Split L.
12-18-57	2459-DR	Z-426	8" Reprocessed (5)	419	Split L.
12-18-57	2463-DR	K-709	8" Regular (5)	357	Split L.
12-18-57	2358-DR	C-294	8" Regular (5)	310	Split L.
12-18-57	2360-DR	KA-002-A	8" Regular (5)	310	Split L.
12-18-57	2361-DR	C-294	8" Regular (5)	349	Split L.
12-18-57	2362-DR	KA-002-A	8" Regular (5)	322	Split L.
12-18-57	2458-DR	K-709	8" Regular (5)	305	Split L.
12-19-57	1671-C	M-297	8" Regular	223	N.A.
12-20-57	2357-H	A-171	8" Regular	478	Split L.
12-20-57	5285-KW	KE-002-A	6" Solid E-Metal (2)	282	Side Other
12-24-57	2561-H	D-268	8" Cored	471	Unclassified
12-25-57	3249-KE	KG-014-A	6" I & E E-Metal (2)	184	Side H.S.
12-29-57	1277-DR	M-290	8" Regular (4)	414	Side H.S.
12-30-57	2663-F	Z-421	8" Reprocessed	511	N.A.

- (1) M-388 Alloy Can
- (2) 0.94 Per Cent Enriched
- (3) Small-Button Design Truline
- (4) Hunter-Douglas Can
- (5) Associated With Crossheader Valving Difficulty (During Shutdown)

Legend:

- Side H.S. - Failure probably caused by local overheating (hot spot) and possibly intergranular corrosion.
- Cap - Failure occurred at the cap (weld end) of the slug.
- Split - Slug split longitudinally (L), diagonally (D) or transversely (T).
- Side - Other - Failure probably caused by localized corrosion penetration, e.g. pinhole penetration, or other unknown mechanism.
- Unclassified - Failure does not fit into any particular category.
- N.A. - Information not available.

Extracted from HAPO 1958a, page B-22. Also reported in Bloomstrand 1958a. and 1958b.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

DECEMBER 1957

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Quic. Mach	Chg. Mach	Hyd. Jack	
8" Reg.	3673-F	Side Hot Spot	12.9	8-8-57	12-2-57	514	M-293				
PT-IP-39A	2569-II	Side Hot Spot	0.6	8-25-57	12-3-57	486	IP-39A	X			8" Reg.
8" Reg.	3467-KW	Side Hot Spot	7.2	9-28-57	12-5-57	389	K706.		X		
Solid E	3748-KE	Unclassified	7.0	10-25-57	12-7-57	*297	KE0057		X		*EFT-MHD/T
8" Reg.	1875-C	Side other	11.4	11-11-57	12-12-57	174	K-314		X		
8" Reg.	1365-DR	Side Hot Spot	9.1	6-23-57	12-13-57	411	M-290				
8" Reg.	2359-DR	Split	1.1	6-3-57	12-18-57	421	A-176	X			
8" Reg.	1671-C	Unknown	46.2	11-11-57	12-19-57	223	M-297				
8" Reg.	2463-DR	Split		10-1-57	12-18-57	337	K-709				
8" Reg.	2459-DR	"		6-3-57	12-18-57	419	Z-426				
8" Reg.	2362-DR	"		10-12-57	12-19-57	322	KA0027		X		
8" Reg.	2360-DR	"	112.4	10-12-57	12-19-57	310	KA0027			X	
8" Reg.	2361-DR	Split		10-1-57	12-19-57	349	P-294				
8" Reg.	2458-DR	Split		10-1-57	12-19-57	305	K-709				
8" Reg.	2358-DR	Split		10-1-57	12-19-57	310	P-294				
8" Reg.	2357-II	Split	46.7	8-25-57	12-20-57	478	A-171				
Solid E	5285-KW	Side other	9.9	11-3-57	12-20-57	*282	KE0024		X		*EFT-MHD/T
8" Reg.	2561-II	Unclassified	21.9	9-29-57	12-24-57	471	D-268				
IAE E met.	3249-KE	Side Hot Spot	9.0	11-24-57	12-25-57	4184	KG0147				
8" Reg.	1277-DR	Side Hot Spot	22.5	10-1-57	12-29-57	414	M-290		X		
8" Reg.	2663-F	Unclassified	1.5	8-8-57	12-30-57	511	Z-421				
C Metal	3747-KE	Split	0	3-28-57	11-24-57	143.78			X		
		(1) PT-IP-39-A	Measure of	Slug Jac	et Corro	ion Na	es				
		(2) November full	ture not	reviously	reported						

Extracted from HAP0 1958a, page Ch-2. Also reported in Bloomstrand 1958b.

APPENDIX H

FUEL-ELEMENT FAILURE DATA FOR 1958

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JANUARY 1958

Type Material	Tube No.	Type Rupture	Remov. Wt.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
8" Reg.	2786-II	Side Other	16.5	10-13-57	1-1-58	472	D919	Chg. Mach		Leaker
8" Reg.	2974-DH	Split	18.4	9-11-57	1-4-58	503	C298	X		
8" Cored	4385-KE	Side HotSpot	2.9	10-25-57	1-6-58	453	KD-80	X		
8" Reg.	3581-B	Side HotSpot	16.0	12-6-57	1-7-58	185	24818A	X		
E Solid	0472-C	Not available	29.6	11-7-57	1-14-58	391	W411		X	NEET/AMD/T
8" Reg.	0970-DH	Side HotSpot	10.8	10-1-57	1-14-58	470	M-290	X		
8" Reg.	4074-KE	Side HotSpot	3.7	10-25-57	1-23-58	1165	Z-331	X		
8" Reg.	3873-B	Not available	12.5	1-7-58	1-30-58	118	MA-11A		X	
8" Reg.	5063-KW	Hot available	9.0	11-25-57	1-30-58	352	KA-19A	X		
C Metal	2048-KW	Unclassified	1.0	4-24-57	1-31-58	167.46	-	X		

Extracted from HAP0 1958b, page Ch-2. Also reported in NEEF 1958a.

RUPTURE EXPERIENCE - FEBRUARY 1958

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
2-7-58	2791-H	E-300-B	6" Cored E Metal (1)	505	Unclass.
2-8-58	2766-DR	CA-051-A	8" Regular	168	Side E.S.
2-14-58	3583-KE	KD-015-D	8" Cored (5)	425	Side E.S.
2-22-58	4058-H	KE-023-A	6" E Metal (1)	187	Side E.S.
2-22-58	5359-KW	KA-036-A	8" Regular	352	Unclass.
2-25-58	3748-KE	KG-014-A	6" I & E E Metal (1) (2)	528	N.A.
2-27-58	4858-KW	KA-044-A	8" Regular	317	Unclass.
1-31-58	1249-KW	N.A.	Doe Metal (3)	27.7 (4)	Side (Jacket Split)
1-31-58	2048-KW	N.A.	Doe Metal (3)	30.8 (4)	Side E.S.
2-12-58	0462-C	U-10	Doe Metal	34.4 (4)	Side (Jacket Split)
2-27-58	3054-C	U-7	Doe Metal	36.0 (4)	Side (Jacket Split)

- (1) 0.94% Enrichment
(2) Second Failure in this Lot -- Previous Charge in this Tube Failed 12-25-57.
(3) Previously Unreported
(4) Per cent U²³⁵ Depletion of the Doe Metal in this Column
(5) M-388 Alloy Jacket

Legend:

- Side E.S. - Failure probably caused by local overheating (Hot Spot) and possibly intergranular corrosion.
Unclassified - Failure does not fall into any particular category.
N.A. - Not Available.

Extracted from HAPO 1958c, page B-21. Also reported in NEEF 1958a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

FEBRUARY 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
Cored E	2791-II	Unclassified	40.6	11-17-57	2-7-58	*505	-	Chg. Mach	x	REMOVED
8" Reg.	2766-DR	Hot Spot	23.7	1-14-58	2-8-58	168	CA51A	x		
8" Cored	3583-KE	Hot Spot	0.5	12-7-57	2-14-58	425	KD0151	x		
Doe Metal	0462-C	Split	0.5	3-28-57	2-12-58	132.20	-	x		
8" Reg.	3665-KE	Not available	0.2	12-4-57	2-14-58	337	AAQ001	x		
Solid E	4058-II	Hot Spot	12.9	1-20-58	2-22-58	*187	KE23A	x		*EFT/MVD
8" Reg.	5359-KV	Unclassified	7.1	12-5-57	2-22-58	352	KA30A	x		
IRE-E	3748-KE	Side failure	55.1	12-7-57	2-25-58	*528	KD-14A	x	x	6" Piece
Doe Metal	3054-C	Split	1.5	3-11-57	2-26-58	138.16	-			
8" Reg.	4858-KV	Split	14.6	12-20-57	2-27-58	317	KA-44A		x	
DI	DISCHARGED IN JANUARY AND NO CHATTERING		PREVIOUSLY REPORTED							
Doe Metal	1249-KV	Chattering	0	4-24-57	1-31-58	136.9	V-20	x		Removed during charge-discharge

Extracted from HAP0 1958c, page Ch-2. Also reported in NEEF 1958a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

MARCH 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
8" Reg.	1264-B	Hot spot	18.4	12-19-57	3-2-58	373	AD24A	Chg. Mach	x	
8" Reg.	3475-B	Hot spot	12.0	12-19-57	3-3-58	381	AD18A		x	
8" Reg.	3780-B	Hot spot	17.9	1-7-58	3-5-58	267	AD-11		x	
8" Reg.	1552-KV	Split length	15.7	12-5-57	3-8-58	387	AO37A	x		Tru-line#388
8" Reg.	3376-DR	Hot spot	5.2	12-29-57	3-10-58	410	AO55D	x		Tru-line#388
8" Cored	1967-KE	Hot spot	11.8	1-6-58	3-12-58	408	AO13D	x		
8" Reg.	2553-KV	Split	5.3	12-5-57	3-14-58	438	AO30A	x		
8" Reg.	0871-II	Hot spot	8.7	1-20-58	3-19-58	*375	FE21A	x		2 slugs rupt
8" Reg.	3366-DR	Hot spot	7.7	12-13-57	3-20-58	470	KA26D	x	x	4-388
8" Reg.	3892-KV	Hot spot	15.2	12-20-57	3-20-58	*511	0027A			
8" Reg.	5088-KE	Unclassified	4.7	1-29-58	3-21-58	*313	FE22A	x		
8" Reg.	1660-II	Hot spot	20.1	1-20-58	3-22-58	303	KA51A		x	
8" Reg.	0565-II	Hot spot	3.1	1-20-58	3-23-58	*357	KE801	x		
8" Reg.	3489-II	Hot spot	18.4	12-24-57	3-24-58	462	KA36A	x		
8" Reg.	3370-B	Hot spot	18.9	12-19-57	3-26-58	487	AD24A		x	
8" Cored	2576-KE	Hot spot	30.8	1-16-58	3-28-58	409	AD-14D		x	Tru-line#388
8" Reg.	5158-KV	Hot spot	13.8	1-26-58	3-29-58	*293	AD2A		x	
					*EFT/MU					

Extracted from HAP0 1958d, page Ch-2. Also reported in NEEF 1958a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

APRIL 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method	Tube & Piece	Remarks
8" Reg.	3281-DR	Hot Spot	9.0	2-8-58	4-2-58	278	VA5A			
8" Reg.	3157-II	Hot Spot	0.7	1-1-58	4-2-58	458	CA50A			
8" Reg.	2269-KE	Hot Spot	16.4	1-23-58	4-2-58	332	CA832-II		x	M-300 Deaker
8" Reg.	3158-II	Hot Spot	17.8	1-1-58	4-3-58	471	CA50A			
8" Reg.	2650-KE	Hot Spot	4.7	1-23-58	4-5-58	333	CA63B			M-308
8" Reg.	2966-KE	Split	10.6	1-29-58	4-7-58	311	CA832B		x	M-300 Deaker
8" Reg.	2076-F	unknown	6.4	12-30-58	4-9-58	504	2457			
8" Reg.	1206-B	unknown	23.4	1-7-58	4-9-58	453	CA050A		x	
1&E "E"	2350-KV	Slide other	17.7	1-13-58	4-9-58	416	CA007A			
Solid E	0767-B	Hot spot	5.7	3-26-58	4-11-58	495	CA28A		x	
1&E "E"	2477-C	Hot spot	33.8	11-14-58	4-11-58	4129	CA017A			PT-IP-109AC
1&E "E"	3564-KE	Hot spot	18.0	12-13-58	4-13-58	4639	CA23A			
Cored "E"	1955-II	unclassified	34.8	11-17-58	4-16-58	4809	CA00A			
1&E "E"	1881-KE	Hot spot	6.4	2-25-58	4-17-58	4279	CA020A		x	
8" Reg.	3565-DR	Hot yet avail	19.5	3-6-58	4-22-58	237	CA050A			2 ruptures
8" Reg.	1956-II	Slide other	0	1-20-58	4-17-58	400	CA51-A		x	
Solid "E"	4066-B	Hot spot	8.7	3-26-58	4-23-58	4185	CA028A		x	
8" Reg.	3504-D	Hot spot	14.2	2-5-58	4-25-58	451	CA83A		x	
8" Reg.	1265-DR	Split	5.1	2-8-58	4-25-58	379	CA52A		x	PT-IP-121A M308
8" Reg.	3876-B	Split	23.3	1-30-58	4-26-58	436	CA16A			
8" Reg.	1165-DR	Split	11.8	2-8-58	4-26-58	375	CA16A			
Solid E	1659-DR	Split	22.1	2-8-58	4-27-58	4412	CA005A			
8" Reg.	4752-KE	unclassified	0.2	1-23-58	4-27-58	4457	CA16A		x	
8" Reg.	3676-DR	not yet avail	17.1	2-8-58	4-28-58	374	PT			PT-IP-56A
8" Reg.	0962-II	Slide other	0	1-20-58	4-16-58	432	CA010A		x	
					*EFT/MII					

Extracted from HAP0 1958e, page Ch-2. Also reported in NEEF 1958b.

RUPTURE EXPERIENCE - MAY 1958

<u>Date</u> <u>Failed</u>	<u>Tube</u> <u>Number</u>	<u>Lot</u> <u>Number</u>	<u>Type</u> <u>Metal</u>	<u>Exposure</u>	<u>Type</u> <u>Failure</u>
5-2-58	2573-DR	VA-007-A	8" Regular	398	N.A.
5-6-58	0781-B	KE-043-A	6" Solid E-Metal	268	Side E.S.
5-7-58	3051-KE	AJ-003-A	8" I&E Natural	428	Side E.S.
5-13-58	2481-DR	KA-083-A	8" Regular	309	Side E.S.
5-15-58	3655-KE	KJ-052-A	8" I&E Natural	611	Side Other
5-16-58	3162-E	K-533	8" Cold Pressed (PT-IP-112-A)	263	Side E.S.
5-17-58	4153-KE	AJ-003-A	8" I&E Natural	494	Side Other
5-20-58	3849-KE	KJ-052-A	8" I&E Natural	627	Side E.S.
5-21-58	3159-B	KE-027-A	6" Solid E ⁽¹⁾	326	Side E.S.
5-22-58	1680-C	KG-062-E	6" I&E E-metal ⁽¹⁾⁽³⁾	261	Side Other
5-24-58	1984-DR	KA-104-D	8" Regular ⁽²⁾	109	Unclassified
5-27-58	2184-DR	KA-082-A	8" Regular	380	N.A.
5-28-58	2664-D	KA-097-A	8" Regular	291	N.A.
5-29-58	2774-DR	VA-003-D	8" Regular ⁽²⁾	794	Side Other

(1) 0.94% Enrichment

(2) Clad with M-388 blunt-nose tru-line components.

(3) "Thin skin" 1.454 inch O.D.

Side E.S. - Failure probably caused by accelerated corrosion in a localized region of high surface temperature.

Side Other - Failure probably caused by localized corrosion penetration, e.g., pinhole penetration.

Unclassified - Failure did not fit any particular category

N.A. - Information not available

Extracted from HAPO 1958f, page B-23. Also reported in NEEF 1958c.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JUNE 1958

Type Material	Tube No.	Type Rupture	Remov. lirs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Clig. Mach.	Hyd. Jack	Tube & Piece	
E solid	0863-II	Hot spot	15.4	4-2-58	6-2-58	*315	KE0437		X		
1"Reg.met.	3184-D	Unknown	16.2	3-25-58	6-10-58	437	KA80A	X			
1"Reg.met.	1064-B	Unknown	15.9	4-23-58	6-12-58	251	KAL10A			X	
1"Reg.met.	2863-DR	Not available	18.0	3-6-58	6-12-58	485	CA063A			X	
1"Reg.met.	1363-D	Reg.mach.damaged	8.3	5-24-58	6-17-58	122	KAL02A	X			
E solid	0573-II	Wide Hot Spot	3.0	5-16-58	6-22-58	*264	KE052A	X			
E solid	2992-II	Wide Hot Spot	11.0	3-10-58	6-25-58	*510	KE32A	X			
1"Reg.met.	3465-B	Unknown	6.2	6-9-58	6-29-58	110	KAL24A		X		

Extracted from HAP0 1958g, page Ch-2. Also reported in NEEF 1958c.

RUPTURE EXPERIENCE - JULY 1958

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
7-2-58	2559-B	KE-052-A ⁽²⁾	6-inch E	280	Side - Hot-Spot
7-5-58	4055-C ⁽¹⁾	CA-039-A	8-inch Reg.	656	Split L.
7-6-58	0957-C	KG-813-E	6-inch E ²	865	Split L.
7-6-58	0661-C	KG-036-E	6-inch E ²	915	Side - Hot-Spot
7-6-58	3066-KW	J-3	Re ⁽³⁾	198	Side - Jacket Split
7-7-58	3360-F	KE-052-A ⁽²⁾	6-inch E	373	Side - Hot-Spot
7-8-58	2678-DR	KA-082-A	8-inch Reg.	508	Side - Hot-Spot
7-10-58	3276-D	KA-098-C	8-inch Reg. ⁽⁴⁾	417	Unknown ^(C)
7-12-58	0560-E	KE-808-A	6-inch E	435	Side - Hot-Spot
7-14-58	0572-E	KE-052-A ⁽²⁾	6-inch E	273	Side - Hot-Spot
7-15-58	2169-DR	IP-039-A ⁽⁵⁾	8-inch Reg.	371	Not Available
7-16-58	0774-B	KE-052-A ⁽²⁾	6-inch E	360	Side - Other
7-17-58	1183-DR	KA-108-A	8-inch Reg.	393	Not Available
7-27-58	3976-F	KE-052-A ⁽²⁾	6-inch E	144	Side - Hot Spot
7-29-58	2563-D	KA-102-C ⁽⁶⁾	8-inch Reg. ⁽⁴⁾	241	Not Available
7-31-58	2563-DR	CA-106-A	8-inch Reg. ⁽⁷⁾	85	Not Available

- (1) Two ruptured slugs in this tube
- (2) Multiple failure lot
- (3) PT IP-110-A (18-J, 11-Regular and 18-N Loading)
- (4) Bluntnose Truline
- (5) Contained 1245 and M-388 jacketed slugs. Rupture piece stuck and removed with tube.
- (6) Second rupture at D Reactor from this lot. Cause of first rupture was charging machine damage.
- (7) Heat treated at HAPO with Nu-Sal.
- (8) Metal discharged on top of a previous discharge - Unable to locate ruptured piece.

Legend:

Side - E.S. - Failure probably caused by accelerated corrosion in a localized region of high surface temperature.

Split L. - Uranium cleaved along the axis of the slug.

Unknown - Ruptured piece was not located.

Not Available - Information not available.

Side - Other - Failure probably caused by localized corrosion penetration; e.g. pinhole penetration or other unknown mechanism.

Extracted from HAPO 1958h, page B-24. Also reported in NEEF 1958d.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JULY 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Tube & Piece	Remarks
E solid	2559-B	Side Hot Spot	36.9	5-21-50	7-2-50	1200	KE52A				x	
Reg. solid	1055-C	Spill	1.7	1-14-50	7-5-50	656	CA 39A	x				PF-IP-108AC
E - I&E	0657-C	Spill	1.7	2-26-50	7-6-50	865		x				PF-IP-108AC
E - I&E	0661-C	Side Hot Spot	7.5	2-26-50	7-6-50	915			x			PF-IP-110A
J Metal	3066-KV	Spill	10.0	10-14-57	7-7-50	190.44						
Reg. Solid	2670-DR	Side Hot Spot	4.9	4-2-50	7-8-50	508	KAU2A	x				
E solid	3360-F	Side Hot Spot	8.1	5-14-50	7-8-50	1373	KE52A	x				
Reg. solid	3276-D	Unknown	9.1	4-25-50	7-10-50	417	KA9UC			x		
E solid	0560-II	Side Hot Spot	3.0	4-16-50	7-13-50	1435	KEUOU			x		
Reg. solid	2169-DR	Not available	18.7	5-2-50	7-14-50	371					x	PF-IP-039A
E solid	0572-II	Side Hot Spot	7.3	6-2-50	7-14-50	1273	KE52A			x		
E solid	0774-B	Side other	7.6	5-21-50	7-16-50	1360	KE2A	x				
Reg. solid	1183-DR	Not available	12.0	5-2-50	7-16-50	393	KA100U				x	
E solid	3776-F	Side Hot Spot	6.9	7-7-50	7-27-50	1144	KE0527	x				
Reg. solid	2563-B	Not available	2.3	6-12-50	7-29-50	241	KA1027	x				
Reg. solid	2563-DR	Unknown	13.9	7-0-50	7-31-50	U5	KA1007			x		
					NEFT							

Extracted from HAPO 1958h, page Ch-2. Also reported in NEEF 1958d.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

AUGUST 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No.	Removal Method			Remarks
								Chg. Mach	Hyd. Jack	Tube & Piece	
IAE - Reg.	1077-KW	Side Hot Spot	11.3	3-29-58	8-4-58	799	KJ02A			X	
Solid E	1554-II	Split	10.6	1-20-58	8-4-58	881	KE21A	X			
IAE Reg.	0981-C	Side Other	31.7	5-23-58	8-5-58	436	CJ052			X	
Solid E	1454-II	Split	16.8	1-20-58	8-7-58	881	KE12	X			
Solid Reg	3579-B	Side Hot Spot	4.5	5-21-58	8-8-58	1115	KAI2W	X			
Solid Reg	1275-F	Side Hot Spot	12.0	6-14-58	8-8-58	315	KAI3A	X			
IAE - E	2582-C	Inside Other	0.8	5-10-58	8-9-58	4661	KD55E				PT-IP-132AC
Solid Reg	3776-F	Side Hot Spot	10.6	6-14-58	8-10-58	310	KAI2G	X			
Solid Reg	2366-DR	Side Hot Spot	31.6	6-12-58	8-12-58	206	KAI27			X	
Solid E	0569-II	Hot Spot	1.6	6-23-58	8-13-58	4265	KE57A	X			
Solid Reg	2680-D	Unknown	29.8	5-24-58	8-14-58	440	KAI01			X	
IAE Reg.	2715-C	Side Other	20.3	5-10-58	8-15-58	583	KJ90E	X			
IAE Reg.	4985-KW	Inside Other	7.1	4-9-58	8-15-58	770	CJ42A		X		
Solid Reg	1465-DR	Unclassified	17.2	6-12-58	8-16-58	298	KAI2W		X		
Solid Reg	2162-B	Side Hot Spot	15.8	6-9-58	8-17-58	350	KAI3A			X	
Solid Reg	3566-DR	Side Hot Spot	16.8	5-24-58	8-18-58	421	CAD49				PT-IP-132AC
IAE E	2176-C	Side Hot Spot	8.5	7-20-58	8-19-58	215	KGI1A	X			
IAE Reg.	4259-KF	Inside Other	6.8	4-26-58	8-23-58	729	SJ61W	X			
IAE E	1676-C	Side Hot Spot	6.7	7-20-58	8-26-58	254	KGI1A	X			PT-IP-132AC
Solid Reg	3672-F	Unknown	9.1	6-14-58	8-20-58	425	KAI2G	X			
Solid Reg	3463-B	Side Other	8.9	6-9-58	8-20-58	425	KAI2W			X	Tube Leak
IAE E	2480-C	Side Other	4.5	5-10-58	8-31-58	478	---	X			PT-IP-132AC

Extracted from HAP0 1958i, page Ch-2. Also reported in NEEF 1958e.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

SEPTEMBER 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No	Removal Method			Remarks
								Chg. Mach.	Hyd. Jack	Tube Piece	
Solid Reg.	3361-B	Unknown	17.5	6-9-58	9-1-58	428	GA-101-A-		X		
I&E-E	2978-C	Side Hot-Spot	13.0	5-23-58	9-5-58	699	KI-096-E	X			PT-IP-132-AC
I&E-E	2747-KE	Side Hot-Spot	17.1	5-5-58	9-8-58	778	KG-80-E	X			
Depleted	2079-C	Split	22.2	3-17-58	9-15-58	567	KP-001-A		X		PT-IP-132-AC
Solid-Reg.	3279-F	Unknown	9.0	7-7-58	9-18-58	404	KA-142-A		X		
I&E-E	4259-C	Side-Hot-Spot	10.5	5-10-58	9-28-58	875	KG-814-B	X			
Solid-Reg.	2681-DR	Side-Other	2.0	7-8-58	9-29-58	386	VA-012-A	X			
Solid-Reg.	3277-B	Unknown	7.0	8-17-58	9-30-58	201	KA-152-A	X			

Extracted from HAP0 1958j, page Ch-2. Also reported in NEEF 1958f.

RUPTURE EXPERIENCE - OCTOBER 1958

<u>Date Failed</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
10-1-58	2080 H	MA-021-A	8" Solid Nat.	366	Side Other
10-2-58	0471 KW	CJ-816-A	8" I&E Nat.	523	Inside Other
10-3-58	5175 KE	KG-087-E	6" I&E E ⁽¹⁾	749	Inside Other
10-5-58	3789 C	KP-001-A	7" I&E Depl. (2)	666	Unclassified
10-6-58	2289 H	YA-004-A	8" Solid Nat. (3)	351	Side Other
10-11-58	0984 C	KP-001-A	7" I&E Depl. (2)	743	Unclassified
10-12-58	2078 H	KA-140-A	8" Solid Nat.	411	Side Other
10-14-58	0471 H	KE-063-A	6" Solid E ⁽¹⁾	342	Side Hot Spot
10-18-58	4263 KE	CK-013-B ⁽⁴⁾	8" I&E Nat.	643	Inside Other
10-20-58	3062 B	CA-093-A	8" Solid Nat.	396	Split Long.
10-21-58	1090 C	KP-001-A	7" I&E Depl. (2)	673	Unclassified
10-22-58	2676 H	KA-130-A	8" Solid Nat.	452	Split Long.
10-24-58	2877 C	KG-107-E	6" I&E E ⁽¹⁾	596	Side Other
10-25-58	2486 DR	CA-112-A	8" Solid Nat.	361	Side Hot Spot
10-26-58	3276 DR	KA-109-A	8" Solid Nat.	361	Split Long.
10-27-58	4460 KE	CK-013-B ⁽⁴⁾	8" I&E Nat.	755	Inside Other
10-28-58	1959 B	KE-064-A	6" Solid E	485	Unknown
10-31-58	2777 C	KP-001-A	7" I&E Depl. (2)	733	Side Hot Spot
10-31-58	3584 DR	KA-109-A	8" Solid Nat.	481	Inside Other

(1) 0.94% U-235

(2) I & E depleted being irradiated under IP-132-AC

(3) Extruded ingot material

(4) Material from reprocessed lot SK-600-B

Legend:

Side Hot Spot - Failure probably caused by accelerated corrosion in a localized region of high temperature.

Side Other - Failure probably caused by corrosion or water penetration of the can wall or other unknown mechanism.

Inside Other - Similar to side other except occurring on the inside surface of an I & E slug.

Split L. - Failure caused by uranium cleavage along the axis of the core.

Unclassified - Failure did not logically fall into any of the above types.

Unknown - Ruptured piece was lost among other metal.

Extracted from HAPO 1958k, page B-21. Also reported in NEEF 1959a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

OCTOBER 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Gone	Lot No	Removal Method			Remarks
								Chg. Mach	Hyd. Jack	Tube Place	
Solid Reg.	2080-II	Side Other	4.7	7-26-58	10-1-58	366	MA-21-A	X			
ISE Reg.	0471-KV	Inside Other	3.5	5-27-58	10-1-58	523	CJ-816-A	X			
ISE - E	5175-KE	Inside Other	5.1	6-28-58	10-3-58	749	KD-087-B	X			
ISE Depl.	3789-C	Split	12.0	3-9-58	10-5-58	666	KP-001-A		X		PT-IP-132 AC
Solid Reg.	2209-II	Side Other	19.6	7-20-58	10-6-58	351	YA-004-A		X		
ISE Depl.	0584-C	Split	22.3	3-17-58	10-11-58	688	KP-001-A			X	PT-IP-132 AC
Solid Reg.	2078-II	Side Other	3.1	7-20-58	10-12-58	411	KA-140-A	X			
Solid E	0471-II	Side Hot Spot	2.3	8-7-58	10-14-58	342	KE-063-A	X			
ISE Reg.	4263-KE	Inside Other	7.2	6-28-58	10-18-58	643	CK-013-B	X			
Solid Reg.	3062-B	Split	26.9	7-25-58	10-20-58	396	CA-093-A			X	
ISE Depl.	1090-C	Inside Other	9.2	3-17-58	10-21-58	673	PF-001-A	X			IP-132-AC
Solid Reg.	2676-II	Split	9.9	7-20-58	10-22-58	452	KA-130-A	X			
ISE - E	2877-C	Side Other	22.0	7-20-58	10-24-58	596	K3-107-B			X	IP-IP-132-AC
Solid Reg.	2426-DR	Hot Spot	27.6	7-31-58	10-25-58	361	CA-112-A			X	
Solid Reg.	3276-DR	Split	6.4	7-31-58	10-26-58	361	KA-109-A	X			
ISE Reg.	4460-KE	Inside Other	7.4	6-28-58	10-28-58	755	CK-013-B	X			
Solid E	1959-B	Unclassified	8.7	7-25-58	10-28-58	485	KE-064-A	X			
ISE Depl.	2777-C	Internal Rupt. Unclassified	5.6	3-17-58	10-31-58	733	KP-001-A	X			PT-IP-132-AC
Solid Reg.	3584-DR	Side Hot Spot	6.6	7-8-58	10-31-58	481	KA-109-A	X			
* EFT											
** From the SK-600 Unit (Reprocessing)											

UNCLASSIFIED

RUPTURE EXPERIENCE - NOVEMBER 1958

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
11/3/58	0988-C	KP-001-A	7" I&E Depl. (1)	778	Inside-Other
11/3/58	3093-KW	SK-601-B	8" I&E Nat. (2)	671	Inside-Other
11/6/58	1453-C	KA-123-B	8" Solid Nat. (3)	483	Cap
11/8/58	1547-KE	SG-020-F	6" I&E E (4)	925	Inside-Other
11/9/58	1490-C	KP-001-A	7" I&E Depl. (1)	762	Unclassified
11/15/58	3590-C	KP-001-A	7" I&E Depl. (1)	826	Unclassified
11/17/58	4268-KE (5)	Unknown	Doe	32.5% (6)	Unclassified
11/17/58	1269-DR	KA-155-A	8" Solid Nat. (4)	448	Unclassified
11/17/58	3057-C	SG-027-E	6" I&E E (4)	589	Unclassified
11/17/58	2954-B	CA-120-A	8" Solid Nat.	404	Side-Hot Spot
11/18/58	1358-B	KA-084-A	8" Solid Nat.	533	Side-Other
11/24/58	2579-C	KP 001-A	7" I&E Depl. (1)	682	Inside-Other
11/30/58	1176-C	KP-001-A	7" I&E Depl. (1)	748	Inside-Other

- (1) I&E depleted being irradiated under IP-132-AC
 (2) Failure piece reprocessed from lot MK-003-B
 (3) Failure piece reprocessed from lot KG-070-E
 (4) 0.94% U-235
 (5) Doe metal being irradiated in KER loop #4 under IP-190-A
 (6) U-235 per cent burnout

Legend:

Side Hot Spot - Failure probably caused by accelerated corrosion in a localized region of high temperature.

Side Other - Failure probably caused by corrosion or water penetration of the can wall or other unknown mechanism.

Inside Other - Similar to side other except occurring on the inside surface of an I & E slug.

Unclassified - Failure did not logically fall into any of the above types.

Cap - Rupture probably caused by water penetration through the weld.

Extracted from HAP0 19581, page B-21. Also reported in NEEF 1959a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

NOVEMBER 1958

Type Material	Tube No.	Type Rupture	Remov. Hrs.	Charge Date	Rupture Date	Act. Conc.	Lot No	Removal Method				Remarks
								Quic. Mach	Chg. Mach	Hyd. Jack	Tube Piece	
I&E Deplt.	0988-C	Hole failure	8.4	3/17/58	11/3/58	778	KP-001-A		X			PT-IP-132AC
I&E Reg.	3093-KW	Inside Other	1.0	6/30/58	11/3/58	671	SK-601-B		X			
Solid Reg.	1453-C	Cap failure	5.0	6/10/58	11/6/58	1483	KA-123-B		X			
I&E E	1547-KE	Hole failure	6.6	5/25/58	11/8/58	1925	SG-020-E		X			
I&E Deplt.	1490-C	Unclassified	26.0	3/17/58	11/9/58	762	KP-001-A				X	PT-IP-132AC
I&E Deplt.	3590-C	Unclassified	31.1	3/9/58	11/15/58	826	KP-001-A			X		PT-IP-132AC
Doe Metal	4268-KER	Unknown	7.7	8/4/58	11/17/58	32.49	--		X			PT-IP-190A
Solid Reg.	2964-B	Hot Spot	9.2	8/17/58	11/17/58	104	CA-120A		X			
I&E - E	3957-C	Unclassified	15.4	8/5/58	11/17/58	589	KG-070-E			X		
Solid Reg.	1269-DR	Side Other	9.6	7/31/58	11/17/58	148	KA-155-A		X			
Solid Reg.	1868-II	Side Other	9.5	8/4/58	11/18/58	533	KA-084-A		X			
I&E Deplt.	2579-C	Inside Other	0.8	4/11/58	11/24/58	682	KP-001-A		X			PT-IP-132AC
I&E Deplt.	1176-C	Inside Other	22.1	3/28/58	11/30/58	748	KP-001-A				X	PT-IP-132AC
						WEFT						

Extracted from HAP0 19581, page Ch-2. Also reported in NEEF 1959a.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

DECEMBER 1958

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV HRS.	CHANGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	REMOVAL QUIC.	REMOVAL CHG. MACH.	REMOVAL HYD. JACK	TUBE PIECE	REMARKS
I&E E	0485-C	Side Hotspot	9.1	5-23-58	12-3-58	*956	KG-090-E		X			
Solid E	4070-DR	Unknown	9.2	9-1-58	12-5-58	*409	Unknown		X			
Solid E	4271-DR	Unknown	9.2	9-1-58	12-5-58	*363	KE-016-A		X			
Solid Reg.	4176-DR	Split	9.4	9-1-58	12-5-58	342	VA-016-A				X	
Solid E	4466-DR	Split	9.2	2-8-58	12-6-58	*850	KE-012-A		X			
I&E Reg.	4063-KV	Inside-other	3.2	8-15-58	12-8-58	555	SK-601-B		X		X	
Solid Reg.	2453-C	Split	21.7	6-10-58	12-11-58	602	KA-123-B		X			
I&E E	4067-D	Inside-other	2.4	9-12-58	12-13-58	*688	KH-003-C		X			
I&E Depl.	3189-C	Inside-other	7.9	5-1-58	12-27-58	733	KP-001-A		X			PT-IP-132AC
I&E Reg.	3593-KE	Inside-other	6.4	8-4-58	12-28-58	743	CK-032-B		X			
* EFT												
** The first I&E		"O" size rupture.										

Extracted from HAP0 1959a, page Ch-2. Also reported in NEEF 1959b.

APPENDIX I

FUEL-ELEMENT FAILURE DATA FOR 1959

JANUARY 1959

Extracted from HAPO 1959b, page Ch-2. Also reported in NEEF 1959b.

[illegible]

1.2

MARCH 1959

"O" type I&E reg. rupture at an old reactor.

1.3

APRIL 1959

Extracted from HAPO 1959e, page Ch-2.

RUPTURE EXPERIENCE - MAY 1959

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
5/9/59	3778-H	CL-069-D(1)	8" I&E Natural	412	Side-Hot Spot
5/10/59	1279-C	CJ-081-C	8" I&E Natural	566	Side-Hot Spot
5/12/59	1165-C	CJ-097-C	8" I&E Natural	568	Hole
5/19/59	3572-KW	KK-082-D	8" I&E Natural	527	Hole
5/26/59	3757-H	CL-069-D(1)	8" I&E Natural	607	Hole
5/27/59	1587-H	CL-830-D	8" I&E Natural	657	Unclassified

(1) Multiple failure lot.

Legend:

Side-Hot Spot - Failure probably caused by accelerated corrosion in a localized region of high temperature.

Hole - Failure on the internal surface of an I & E piece probably caused by water penetration through a weld or other unknown mechanism.

Unclassified - Failure mechanism could not be determined.

Extracted from HAPO 1959f, page B-20.

RUPTURE EXPERIENCE - JUNE 1959

<u>Failure Date</u>	<u>Tube No.</u>	<u>Lot No.</u>	<u>Type Metal</u>	<u>Exposure</u>	<u>Type Failure</u>
6/1/59	1195E	YA-005-A	8" Solid	83	Unclassified ⁽⁴⁾
6/1/59	1778C	CJ-086-D	8" I&E Natural	792	Unclassified
6/6/59	3781KW	KK-117-D	8" I&E Natural	715	Hole
6/13/59	3252C	SJ-072-C ⁽¹⁾	8" I&E Natural	642	Side Other
6/15/59	2276F	SL-070-D ⁽²⁾	8" I&E Natural	497	Hole
6/20/59	4062D	KL-107-D ⁽³⁾	8" I&E Natural	785	Hole
6/22/59	1278E	CL-067-D	8" I&E Natural	754	Hole
6/29/59	2793B	KL-061-C	8" I&E Natural	851	Hole

- (1) CJ-097-C was the parent lot.
- (2) KL-150-D was the parent lot.
- (3) 2 ruptures in tube.
- (4) Probably damaged during charging.

Legend:

Unclassified - Failure mechanism could not be determined.

Hole - Failure on the internal surface of an I & E piece probably caused by water penetration thru a weld or other unknown mechanism.

Side Other - Failures probably caused by corrosion or water penetration of the can wall or other unknown mechanism.

Extracted from HAPO 1959g, page B-18.

JULY 1959

Extracted from HAPO 1959h, page Ch-2.

AUGUST 1959

Extracted from HAPO 1959i, page Ch-2.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

SEPTEMBER 1959

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV. HRS.	CHARGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	QUIC.	REMOVAL METHOD CIG. MACH. JACK	TUBE PIECE	REMARKS
IAE Reg.	0778-KB	Wole failure	11.1	2-28-59	9-7-59	845	KK-090-D	X			
IAE Reg.	1609-DR	Side other	12.9	2-30-59	9-14-59	632	KI-195-D		X		Leaker
IAE Dep.	1001-G	Unclassified	30.9	11-24-50	9-17-59	1151	PT-IP-2314			X	

Extracted from HAPO 1959j, page Ch-2.

OCTOBER 1959

Extracted from HAPO 1959k, page Ch-2.

NOVEMBER 1959

Extracted from HAPO 19591, page Ch-2.

DECEMBER 1959

Extracted from HAP0 1960a, page Ch-2.

APPENDIX J

FUEL-ELEMENT FAILURE DATA FOR 1960

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JANUARY 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV HRS.	CHARGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	REMOVAL METHOD CHG. HYD. TUBE MACH. JACK PIECE	REMARKS
I&E Reg.	2168-C	Hot Spot	16.5	11-7-59	1-3-60	361	KJ-182-C	X	
I&E Reg.	3075-K	Hot Spot	10.1	10-30-59	1-4-60	512	KR-100-B	X	
I&E Reg.	3268-B	Hot Spot	7.3	10-20-59	1-10-60	563	KI-304-B	X	
I&E Reg.	1570-D	Hot Spot	13.1	10-12-59	1-10-60	564	KI-342-B	X	
Solid Reg.	4345-K	Not Available	26.2	8-24-59	1-11-60	651	KA-245-A	X	
I&E Reg.	2171-C	Hot Spot	14.5	11-17-59	1-14-60	446	8J-031-B	X	Ball Valve
I&E Reg.	2981-H	Hot Spot	11.3	11-4-59	1-20-60	552	KI-339-D	X	
I&E Reg.	1686-B	Hot Spot	42.5	10-4-59	1-21-60	709	KI-285-B	X	
I&E Reg.	2576-C	Hot Spot	18.1	11-7-59	1-21-60	498	KJ-179-D	X	
I&E Reg.	3066-K	Hot Spot	20.5	11-29-59	1-22-60	424	KR-173-B	X	
I&E Reg.	1182-F	Side Other	10.8	10-23-59	1-23-60	550	KI-294-B	X	
I&E Reg.	2676-B	Hot Spot	15.9	11-27-59	1-24-60	365	KI-352-B	X	Leaker
I&E Reg.	3061-C	Unknown	19.0	11-7-59	1-24-60	545	KJ-177-D	X	
I&E Reg.	2052-K	Hot Spot	18.8	11-16-59	1-25-60	537	K-002-C	X	
I&E Reg.	1575-B	Hot Spot	9.8	11-27-59	1-31-60	417	KI-356-B	X	

Extracted from HAP0 1960b, page Ch-2.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

FEBRUARY 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV. HRS.	CHARGE DATE	RUPTURE DATE	ACT. COHC.	LOT NO.	REMOVAL QUC.	REMOVAL GIG. MACH.	METHOD HYD. JACK	TUBE PIECE	REMARKS
IAE Reg.	2075-C	Hot spot	10.6	12-14-59	2-4-60	316	KJ-193-C			X		
IAE Reg. KII	3890-KV	Hot spot	21.7	12-19-59	2-5-60	394	KR-120-D		X			
IAE Reg.	2276-C	Side other	33.1	12-9-59	2-6-60	344	KJ-190-D		X		X	
Solid Reg.	0755-H	Hot spot	7.4	11-4-59	2-8-60	427	KA-278-A					
IAE Reg.	1478-C	Unknown	42.2	12-14-59	2-10-60	343	KJ-186-C			X	X	
IAE Reg.	3880-B	Hot spot	15.4	11-27-59	2-11-60	423	KI-356-D					
IAE Reg.	3661-H	Hot spot	15.3	11-28-59	2-11-60	219	KI-364-C		X		X	Leaker
IAE Reg.	0770-H	Side other	0.3	12-28-59	2-8-60	275	KI-389-D					
IAE Reg.	0884-H	Hot spot	3.8	11-28-59	2-13-60	532	KI-366-C			X		
IAE Reg.	0765-C	Hot spot	19.0	12-9-59	2-14-60	416	KJ-186-C			X		
IAE Reg.	2978-H	Hot spot	8.3	11-28-59	2-15-60	561	KI-366-C				X	Leaker
Solid Reg.	5526-KE	Split	9.0	11-16-59	2-21-60	478	KA-274-A		X			
IAE Reg.	2673-H	Hot spot	12.6	11-28-59	2-22-60	569	KI-340-C		X		X	Leaker
Solid Reg.	4645-KE	Split	7.1	10-30-59	2-22-60	500	KA-274-A					
IAE Reg.	4651-KE	Hot spot	Time	12-7-59	2-23-60	563	KB-149-D		X		X	Leaker
IAE Reg.	2459-KV	Hole	20.9	11-29-59	2-23-60	689	KR-119-D					
IAE Reg.	1985-F	Hot Spot	7.8	12-8-59	2-25-60	529	KL-360-C				X	
IAE Reg.	2483-KV	Hot spot	23.3	12-19-59	2-26-60	531	KR-108-D				X	
IAE Reg.	3284-B	Unknown	48.0	11-27-59	2-26-60	592	KL-343-D					
IAE - E	1151-KE	Hot Spot	0.7	1-11-60	2-26-60	363EFT	KS-117-E	X				
IAE Reg.	3087-C	Hot Spot	9.4	11-7-59	2-29-60	715	KJ-179-C		X			
Cluster Fuel Element	2160-KE Loop #1	Jacket Split	16.6	8-24-59	2-7-60	2846	PT-IP-226 Suppl. B		X			

Extracted from HAP0 1960c, page C-9.

RUPTURE EXPERIENCE - MARCH 1960

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Metal</u>	<u>Exposure</u>	<u>Type of Failure</u>
3/1/60	2369-F	KL-364-C ⁽¹⁾	8" I&E Natural	376	Side Hot Spot
3/11/60	2060-KW	KR-108-D ⁽¹⁾	8" I&E Natural	661	Unknown
3/13/60	2184-B	KL-369-D	8" I&E Natural	571	Unknown
3/13/60	2562-KW	KR-140-D	8" I&E Natural	373	Unknown
3/17/60	3557-KW	KR-141-D	8" I&E Natural	387	Unknown
3/17/60	0566-C	KG-244-E	6" I&E Enriched ⁽²⁾	442	Side Hot Spot
3/21/60	3563-D	CL-892-D	8" I&E Natural	548	Side Other
3/22/60	3877-DR	KL-418-D	8" I&E Natural	212	Side Other
3/23/60	2044-KB	MA-279-A	8" Solid Natural	402	Split Long
3/25/60	0859-DR	SE-017-C ⁽³⁾	6" I&E Enriched ⁽²⁾	377	Side Hot Spot
3/25/60	1463-D	VL-009-D	8" I&E Natural	557	Uncl.
3/28/60	3873-F	KL-378-C	8" I&E Natural	553	Side Other
3/29/60	2567-C	KJ-197-C	8" I&E Natural	429	Side Hot Spot
3/31/60	1464-E	CL-891-D	8" I&E Natural	659	Unknown

- (1) Multiple Failure Lot
- (2) .94 per cent U-235
- (3) Parent lot KR-134-C

Legend:

Side Hot Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Side Other - Failure probably caused by corrosion of water penetration of the external can wall or other unknown mechanism.

Split Long - Failure caused by uranium cleavage along the axis of the core.

Unclassified - Failure did not logically fall into any of the usual types.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

Extracted from HAPO 1960d, pages B-14 & B-15.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

MARCH 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	MEMO INS.	CRACK DATE	RUPTURE DATE	AST. CONC.	LOT NO.	QUIC.	CIG. MACH	CIG. MACH	JACK	TUBE MISC.
IAE Reg.	2369-F	Hot Spot	27.2	1-3-60	3-1-60	376	KI-364-C					X
IAE Reg.	2060-KW	Unknown	11.5	12-19-59	3-11-60	661	KI-108-D					X
IAE Reg.	2184-B	Unknown	17.4	12-14-59	3-13-60	571	KI-369-D					X
IAE Reg.	2562-KW	Unknown	18.3	1-22-60	3-13-60	373	KI-140-D					X
IAE Reg.	3277-KW	Unknown	19.6	1-22-60	3-16-60	387	KI-141-D					X
IAE Reg.	0566-C	Hot Spot	5.0	1-21-60	3-17-60	442	KI-243-E					X
IAE Reg.	3563-D	Side Other	28.0	1-4-60	3-21-60	548	CI-B92-D			X		X
IAE Reg.	3677-DR	Side Other	23.5	2-18-60	3-22-60	212	KI-118-D					X
Solid Reg.	2044-KE	Split	25.7	12-7-59	3-23-60	402	MA-279-A			X		
IAE Reg.	0859-DR	Hot Spot	14.5	2-1-60	3-25-60	377	KI-134-C				X	
IAE Reg.	1463-D	Unclassified	27.9	1-4-60	3-25-60	557	VI-009-D (IP-280-A)					X
IAE Reg.	3873-F	Side Other	12.2	1-4-60	3-28-60	553	KI-378-C					X
IAE Reg.	2567-C	Hot Spot	13.0	1-24-60	3-29-60	429	KI-197-C			X		
IAE Reg.	1464-II	Unclassified	7.4	12-28-59	3-31-60	659	CI-891-D			X		

Extracted from HAP0 1960d, page C-6.

APRIL 1960

Extracted from HAPO 1960e, page C-6.

MAY 1960

Extracted from HAPO 1960f, page C-4.

RUPTURE EXPERIENCE - JUNE 1960

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Metal</u>	<u>Exposure</u>	<u>Type of Failure</u>
6/1/60	1583-H	KL-458-C	I&E Natural	424	Side-Other
6/2/60	2471-F	KL-441-D	I&E Natural	466	End -Male
6/3/60	3553-H	MA-282-A	Solid Natural	588	Split-Long.
6/9/60	3964-D	KH-150-C	I&E Enriched ⁽¹⁾	807	Side-Hot Spot
6/16/60	2178-H	KL-458-C ⁽²⁾	I&E Natural	468	Side-Hot Spot
6/17/60	2155-DR	MA-285-A	Solid Natural	554	Side-Hot Spot
6/18/60	2456-C	KG-256-E	I&E Enriched ⁽¹⁾	697	Side-Hot Spot
6/20/60	1889-C	KJ-222-D	I&E Natural	488	Side-Hot Spot
6/26/60	3277-B	KL-433-D	I&E Natural	683	Unknown

(1) 0.94 per cent U-235

(2) Multiple failure lot

Legend:

Side Hot Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Side Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Split-Long. Failure caused by uranium cleavage along the axis of the core.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

End - Failure on the end of an I & E piece, probably caused by water penetration through a weld.

Extracted from HAP0 1960g, page B-16.

JUNE 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV MRB.	CHARGE DATE	RUPTURE DATE	AUT. CONC.	LOT NO.	MARKING CHG. MACHINE	DATE OF TEST	REMARKS
I&E Reg.	1583-H	Side-Other	13.2	3-31-60	6-1-60	424	KL-458-C			
I&E Reg.	2471-F	End Failure	2.8	3-28-60	6-2-60	466	KL-441-D	X		Leaker
Solid-Reg.	3553-H	Split	8.2	1-9-60	6-3-60	588	MA-282-A	X		
I&E-E	3964-D	Hot Spot	14.6	3-21-60	6-9-60	807	KH-150-C			
I&E Reg.	2178-H	Hot Spot	10.0	3-31-60	6-16-60	468	KL-458-C	X		
Solid-Reg.	2155-DR	Side Hot Spot	7.6	2-11-60	6-17-60	554	MA-285-A	X		
I&E-E	2456-C	" " "	8.2	3-29-60	6-18-60	697	KQ-256-E	X		
I&E Reg.	1889-G	" " "	17.8	4-9-60	6-20-60	488	KJ-222-D			Leaker
I&E Reg.	3277-B	Unknown	2.5	3-27-60	6-26-60	683	KL-433-D	X		
		(N) Male								

Extracted from HAPO 1960g, page C-4.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

JULY 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV. INS.	CHARGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	QUIC.	REMOVAL CHG. MACH.	REMOVAL JACK	REMOVAL PIECE	REMARKS
I&E Reg.	2974-KI	Hot Spot	18.6	5-17-60	7-4-60	377	KI-223-D				X	
I&E-E	2072-C	"	7.5	6-3-60	7-9-60	387	KI-270-E		X			
I&E Reg.	1265-B	"	10.8	5-30-60	7-10-60	305	KI-404-D			X		
I&E-E	0677-DI	"	29.7	5-28-60	7-12-60	426	KI-155-D				X	
Solid Reg.	2352-II	Split	14.4	12-20-59	7-14-60	686	MA-282-A			X		
I&E Reg.	1383-B	Unknown	14.0	5-10-60	7-23-60	532	KI-471-D				X	
Solid Reg.	2252-C	Split	2.5	2-10-60	7-28-60	616	MA-289-B	X				
I&E-E	3660-D	Hot Spot	17.3	6-9-60	7-29-60	461	KI-186				X	
I&E Reg.	2665-DI	Not Available	10.7	5-28-60	7-31-60	473	KI-485-D		X			
Thermocouple												
Slug	2160-KE	Not Available	24.2	5-14-60	7-7-60	856	PI-IP-314-A		X			
Tube in Tube	2864-KE	Jacket Split	9.9	1-11-60	7-3-60	3320	PI-IP-292-A		X			

Extracted from HAPD 1960h, page C-4.

REACTOR OPERATIONS STATISTICS - SLUG RUPTURES

AUGUST 1960

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV. HRS.	CHARGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	REMOVAL QUIC.	REMOVAL MACH.	METHOD HYD. JACK	TUBE PIECE	REMARKS
1AE-E	0770-D	Mech. Damage	0.7	6-9-60	8-1-60	463	KH-180-D	X				
1AE-E	1548-KE	Unknown	18.1	5-14-60	8-3-60	790	KS-172-F				X	
1AE-E	2060-D	Slide-Other	22.4	7-9-60	8-7-60	340	IP-262-A		X			
1AE-E	2262-D	Hot Spot	18.8	7-9-60	8-9-60	372	IP-262-A		X			
1AE-E	1578-C	Hot Spot	12.1	5-20-60	8-10-60	769	KG-270-B		X			
1AE-Reg.	2558-II	Unknown	20.4	5-11-60	8-11-60	547	CL-930-D		X		X	
1AE-Reg.	3271-KE	Unknown	21.2	6-6-60	8-19-60	542	CR-042-D		X			
1AE-E	0845-KW	Hot Spot	11.1	7-4-60	8-19-60	423	KS-163-F		X			
Solid Reg.	1844-KE	Split	2.1	1-25-60	8-23-60	0.8	MA-282-A		X			
Solid Reg.	4243-KE	Split	20.7	12-7-59	8-24-60	643	MA-282-A		Y			
KER-2	2864-KE	Unknown	23.7	8-3-60	8-7-60	No Con.	IP-309-A		X			
KER-1	2160-KE	Unknown	28.9	8-3-60	8-7-60	142	IP-315-A		X			

Extracted from HAP0 1960i, page C-3.

SEPTEMBER 1960

Extracted from HAPO 1960j, page C-3.

OCTOBER 1960

Extracted from HAPO 1960k, page C-6.

RUPTURE EXPERIENCE - OCTOBER 1960

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
10/6/60	0661-DR	KE-211-D	I&E E (0.94%)	186	Mech. Damage
10/9/60	1656-C	KG-273-E	I&E E (0.94%)	597	Hole
10/13/60	4585-KW	KS-818-F	I&E E (0.94%)	134	Hole
10/15/60	2864-KW	NR-005-D	I&E N	285	Unknown
10/22/60	3292-H	KE-204-D	I&E E (0.94%)	620	Side Hot Spot
10/22/60	1260-H	KL-594-H	I&E N	42	Unknown
10/23/60	0776-F	KE-201-D	I&E E (0.94%)	461	Side Hot Spot

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

Mechanical Damage - The failure was probably caused by mechanical damage of the fuel element before irradiation.

Side Hot Spot - The failure was probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Hole - Failure occurred on the internal surface of an internally and externally cooled fuel element. The failure was probably caused by water penetration through a weld or other unknown mechanism.

Unknown - The fuel element failure could not be located or had not been examined at the time the report was written.

Extracted from HAPO 1960k, pages B-14 & B-15.

RUPTURE EXPERIENCE - NOVEMBER 1960

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
11/6/60	1361-B	KL-491-D	I&E N	662	Side Hot Spot
11/6/60	2180-C	CJ-855-C	I&E N	651	Hole
11/11/60	1559-KE	KR-284-D	I&E N	532	Unknown
11/11/60	3275-KW	KS-209-F	I&E E (0.94%)	668	Side Hot-Spot
11/12/60	1366-D	KO-108-C(1)	I&E N	635	Side-Other
11/14/60	1166-B	KL-536-D	I&E N	500	Side Hot-Spot
11/20/60	1192-DR	CA-161-H	SN	457	Split-Long
11/22/60	2455-DR	CA-902-H	SN	614	Split-Long
11/27/60	1471-KE	KR-279-D	I&E N	667	Hole
11/30/60	3566-B	KL-561-D	I&E N	633	Side-Other
11/30/60	1677-F	KL-512-D	I&E N	599	Unknown

(1) Six inch fuel element with attached water mixer spool.

Legend:

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

SN - This is the symbol for production reactor fuel elements having a solid cylindrical core of natural uranium.

Extracted from HAPO 19601, page B-12.

NOVEMBER 1960

Extracted from HAP0 19601, page C-3.

RUPTURE EXPERIENCE - DECEMBER 1960

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
12/4/60	5359 KW	KS-227-F	I&E E (0.94%)	619	Side Hot-Spot
12/7/60	5369-KE	KS-821-F	I&E E (0.94%)	603	Hole
12/9/60	3565-KE(1)	IP-309-A	KSN-1	2173	Unclassified
12/10/60	3476-KE	KR-277-D	I&E N	495	Hole
12/11/60	4090-DR	CA-903-H	SN	793	Split-Long.
12/14/60	0957-C	KG-278-F	I&E E (0.94%)	590	Hole
12/15/60	4351-KE	KR-321-D	I&E N	530	Hole
12/17/60	2861-F	KL-560-D	I&E N	499	Unknown
12/18/60	1559-B	KL-559-D	I&E N	603	Side-Other
12/21/60	5261-KW	KS-232-F	I&E E (0.94%)	426	Side Hot-Spot
12/21/60	5055-KE	KR-221-D	I&E N	535	Side Hot-Spot
12/25/60	2276-C	KG-856-A	I&E E (0.94%)	514	Side Hot-Spot
12/26/60	1472-H	KL-521-D	I&E N	524	Side-Other

(1) KER Loop #3

Legend:

I&E N - This is the symbol of internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

SN - This is the symbol for production reactor fuel elements having a solid cylindrical core of natural uranium.

Extracted from HAP0 1961a, page B-15.

DECEMBER 1960

Extracted from HAPO 1961a, page C-3.

APPENDIX K

FUEL-ELEMENT FAILURE DATA FOR 1961

RUPTURE EXPERIENCE - JANUARY 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
1/2/61	0868-F	KL-534-D	I&E N	614	Unknown
1/9/61	3781-H	KL-550-H	I&E N	648	Unclassified
1/13/61	1366-D	CL-951-A	I&E N	512	Side Hot Spot
1/13/61	3167-KE	KR-249-D	I&E N	642	Unknown
1/21/61	2676-D	KL-530-D	I&E NB	957	Side-Other
1/23/61	3090-KW	KS-228-F	I&E E (0.94%)	841	Side Hot-Spot
1/23/61	0982-H	KO-108-C(1)	I&E N	523	Side-Other
1/23/61	5384-KW	CR-865-A	I&E N	621	Hole
1/26/61	2878-D	KL-530-D	I&E NB	966	Side-Other
1/28/61	2657-DR	KH-219-D	I&E E (0.94%)	775	Side-Other
1/31/61	3379-H	KL-596-A	I&E N	757	Hole

(1) Six inch element with attached water mixer spool.

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

Unclassified - The failure did not logically fall into any of the usual types.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Hole - Failure occurred on the internal surface of an internally and externally fuel element. The failure was probably caused by water penetration through a weld.

Extracted from HAPO 1961B, page B-15.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

JANUARY 1961

TYPE MATERIAL	TUBE NO.	TYPE RUPTURE	REMOV HRS.	CHANGE DATE	RUPTURE DATE	ACT. CONC.	LOT NO.	REMOVAL		METHOD	REMARKS
								QUIC.	CHG. MACH.	HYD. JACK	TUBE PIECE
I&E Reg.	0868-F	Unknown	0.5	10-1-60	1-2-61	614	KL-534-D		X		
I&E Reg.	3781-H	Unclassified	15.2	10-10-60	1-9-61	648	KL-550-II			X	
I&E Reg.	1366-D	Hot Spot	12.9	11-12-60	1-13-61	512	CL-951-A		X		
I&E Reg.	3167-KF	Not Available	18.0	10-26-60	1-13-61	642	KR-249-D		X		
I&E Reg.	2676-D	Side Other	7.2	9-11-60	1-21-61	957	KL-530-D		X		Bumper Slug IP-262-A
I&E E	3090-KW	Hot Spot	6.9	11-1-60	1-23-61	841	KS-228-F		X		
I&E Reg.	0982-II	Side Other	11.2	11-10-60	1-23-61	523	KO-108-G		X		IP-216-A-Mixer
I&E Reg.	5384-KW	Hole	6.9	11-11-60	1-23-61	621	CR-865-A		X		
I&E Reg.	2878-D	Side Other	14.6	9-11-60	1-26-61	966	KL 530-D			X	Bumper Slug IP-262-A
I&E E	2657-DR	Side Other	27.2	10-24-60	1-28-61	775	KL-219-D				
I&E Reg.	3379-II	Hole	1.1	10-10-60	1-31-61	757	KL-596-A		X		

Extracted from HAP0 1961b, page C-3.

RUPTURE EXPERIENCE - FEBRUARY 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
2-2-61	3275-C	KM-023-E(1)	I&E N	706	Hole
2-11-61	1686-KW	KS-263-A	I&E E (0.94%)	583	Side Hot-Spot
2-12-61	4072-D	KH-201-D	I&E E (0.94%)	638	Unclassified
2-12-61	4173-H	KH-234-D	I&E E (0.94%)	825	Side Hot-Spot
2-21-61	1686-B	VL-035-D	I&E N	774	Side Hot-Spot
2-25-61	2361-C	CJ-865-A	I&E N	702	Side Hot-Spot

(1) Six-inch fuel element with attached water mixer spool.

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U235. The weight per cent U235 in the core material is stated.

Hole - Failure occurred on the internal surface of an internally and externally fuel element. The failure was probably caused by water penetration through a weld.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unclassified - The failure did not logically fall into any of the usual types.

Extracted from HAP0 1961c, page B-16.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

FEBRUARY 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF GOAL						
I&E Reg	3275C	Hole	2-4-60	11-6-60	2-2-61	706	114	1.156	1275	KM023B	X8001F	8.0	Mixer
I&E-E	1686KW	Hot Spot	11-10-60	12-21-60	2-11-61	583	92	1.232	1724	KH263A	X8001F	9.3	
I&E-E	4072D	Unclassified	6-15-60	12-12-60	2-12-61	638	78	1.266	1226	KH201A	X8001F	46.0	
I&E-E	4173H	Hot Spot	8-22-60	11-7-60	2-12-61	825	102	1.101	1105	KH234D	X8001F	5.9	
I&E Reg	1686B	Hot Spot	9-2-60	11-6-60	2-21-61	774	115	1.231	1222	V1035D	X8001F	18.2	
I&E Reg	2361C	Hot Spot	11-14-60	12-4-60	2-25-61	702	116	1.171	1231	CJ065A	X8001F	12.0	

Extracted from HAP0 1961c, page C-3.

RUPTURE EXPERIENCE - MARCH 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
3/5/61	1467-DR	KH-234-D	I&E E (0.94%)	960	Side Hot-Spot
3/5/61	4177-KW	KR-316-A	I&E N	672	Unknown
3/8/61	2776-KE	CR-878-A	I&E N	424	Side Hot-Spot
3/8/61	0571-H	KH-234-D	I&E E (0.94%)	598	Side Hot-Spot
3/8/61	2892-H	KH-211-D	I&E E (0.94%)	447	Side Hot-Spot
3/10/61	2178-KW	KS-262-A	I&E E (0.94%)	499	Unknown
3/19/61	5684-KE	KR-295-D	I&E N	785	Hole
3/20/61	3764-B	KL-587-H	I&E N	517	Unclassified
3/27/61	3183-KW	KS-253-A	I&E E (0.94%)	649	Side Hot-Spot
3/28/61	3362-B	CL-964-H	I&E N	554	Side Hot-Spot
3/28/61	0572-H	KH-816-D	I&E E (0.94%)	634	Unknown
3/28/61	2991-H	KH-242-A	I&E E (0.94%)	507	Side Hot-Spot

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

Hole - Failure occurred on the internal surface of an internally and externally fuel element. The failure was probably caused by water penetration through a weld.

Unclassified - The failure did not logically fall into any of the usual types.

Extracted from HAPO 1961d, pages B-13 & B-14.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

MARCH 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. CONC.	2 OF 3 OF GOAL	FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
I&E-E	1467DR	Hot Spot	8-22-60	12-11-60	3-5-61	960	131	1.30	11350	KH234D	X8001F	X	16.7	
I&E-Reg	4177KW	Unknown	11-23-60	12-21-60	3-5-61	672	104	1.14	11578	KH316A	X8001F	X	17.7	
I&E-E	0571H	Hot Spot	8-22-60	12-26-60	3-8-61	598	87	1.29	1292	KH234D	X8001F	X	1.0	
I&E-E	2892H	Hot Spot	7-18-60	1-9-61	3-8-61	447	64	1.25	1110	KH211D	X8001F	X	13.0	
I&E-Reg	2776KB	Hot Spot	12-27-60	1-13-61	3-8-61	424	65	1.12	11538	CR878A	X8001F	X	12.6	
I&E-E	2178KW	Unknown	11-9-60	1-23-61	3-10-61	499	89	1.32	11636	K3262A	X8001F	X	27.5	
I&E-Reg	5684KE	Hot Spot	9-21-60	10-4-60	3-19-61	785	94	1.75	923	KR295D	X8001F	X	21.5	
I&E-Reg	3764-B	Unclass.	12-9-60	1-8-61	3-20-61	517	90	1.25	11282	K1587H	X8001F	X	23.8	
I&E-E	3183KW	Hot Spot	10-14-60	1-23-61	3-27-61	649	101	1.24	11680	K3253A	X8001F	X	18.1	
I&E-E	2991H	Hot Spot	12-14-60	2-5-61	3-28-61	507	84	1.32	11247	KH242A	X8001F	X	15.2	
I&E-E	0572H	Unknown	7-21-60	1-9-61	3-28-61	634	88	1.27	11590	KH816-D	X8001F	X	0.5	
I&E-Reg	3362B	Hot Spot	12-7-60	1-8-61	3-28-61	554	98	1.26	11195	K1565H	X8001F	X	19.1	

Extracted from HAP0 1961d, page C-3.

RUPTURE EXPERIENCE - APRIL 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
4-4-61	2486-H	CL-955-A	I&E N	386	Hole
4-6-61	3272-B	ML-005-H	I&E N	623	Side Hot-Spot
4-7-61	0893-D	OL-010-D	I&E N	745	Unclassified
4-8-61	4286-KE ⁽¹⁾	IP-377-A	NIN & NIE	820	Unknown
4-10-61	2461-KE	KS-264-A	I&E E (0.94%)	422	Side Hot-Spot
4-19-61	5653-KE	MA-315-A	SN	622	Split-Long.
4-21-61	2269-C	KJ-188-C	I&E N	382	Side-Other
4-22-61	1065-B	ML-001-A	I&E N	639	Side Hot-Spot
4-24-61	1989-H	KL-608-A	I&E N	542	Side Hot-Spot
4-25-61	5045-KW	KR-304-A	I&E N	744	Hole
4-26-61	2857-H	CL-956-A	I&E N	536	Unclassified
4-28-61	0460-D	OL-010-D	I&E N	761	Hole
4-30-61	2270-C	KJ-188-C	I&E N	444	Unknown

(1) KER Loop #4

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent in the core material is stated.

SN - This is the symbol for production reactor fuel elements having a solid cylindrical core of natural uranium.

NIN - This is the symbol for NPR inner tube fuel elements of natural uranium.

NIE - This is the symbol for NPR inner tube fuel elements of enriched uranium.

Hole - Failure on the internal surface of an I & E piece probably caused by water penetration through a weld or other unknown mechanism.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

Unclassified - The failure did not logically fall into any of the usual types.

Split-Long. - Failure caused by uranium cleavage along the axis of the core.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Extracted from HAP0 1961e, pages B-13 & 14.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

APRIL 1961

TUBE MATERIAL	TUBE NUMBER	TYPE OF FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. CONC.	% OF GOAL	FACTOR AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
1 F Reg	2486-B	Hole	11-8-60	2-5-61	4-4-61	386	57	1.12	CL-955-A	X8001F	X	0.5	
1 E Reg	3272-B	Hot Spot	12-7-60	1-8-61	4-6-61	623	102	1.24	ML-005-A	X8001F	X	15.9	
1 E Reg	0693-B	Uncl.ass.	9-1-60	9-16-60	4-7-61	745	82	0.60	OL-010-D	X8001F	X	8.8	
1 E-E	2461-B	Hot Spot	12-3-60	2-23-61	4-10-61	422	72	1.27	KS-264-A	X8001F	X	22.4	
1 E Reg	2653-B	Split	10-10-60	11-11-60	4-19-61	622	85	0.67	MA-315-A	C-64-F	X	1.9	
1 E Reg	2269-C	Side Other	11-20-59	2-25-61	4-21-61	302	52	1.08	KJ-188-C	C-64-F	X	9.3	
1 E Reg	1065-B	Hot Spot	12-8-60	1-26-61	4-22-61	639	105	1.21	ML-001-A	X8001F	X	3.4	
1 F Reg	1989-B	Hot Spot	12-1-60	2-5-61	4-24-61	542	80	1.12	KL-608-A	X8001F	X	5.6	
1 F Reg	2857-B	Uncl.ass.	10-27-60	2-5-61	4-26-61	536	78	1.05	KL-956-A	X8001F	X	6.8	
1 E Reg	5045-F	Hole	10-26-60	11-11-60	4-25-61	744	83	.56	KR-304-A	X8001F	X	26.8	
1 E Reg	0460-D	Hole	9-1-60	10-19-60	4-28-61	761	84	.65	OL-010-D	X8001F	X	1.5	
1 E Reg	2273-C	Unknown	11-20-59	2-25-61	4-30-61	444	59	1.04	KJ-188-C	C-64-F	X	4.9	
1 E Reg	4268-B			1-13-61	4-8-61	820	23	.500	IP-377-A			7.0	

Extracted from HAP0 1961e, page C-4.

RUPTURE EXPERIENCE - MAY 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
5/1/61	2370-B	IZ-500-A	I&E N	491	Side Hot-Spot
5/2/61	1959-B	IZ-500-A	I&E N	450	Unclassified
5/13/61	2160-KR ⁽¹⁾	IP-314-A	KSRN-2	Less than 1	Unclassified
5/17/61	2657-DR	KR-252-A	I&E E (0.94%)	890	End-Male

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

KSRN-2 - This is the symbol for K Reactor single-tube fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unclassified - The failure did not logically fall into any of the usual types.

End-Male - Failure on the end of the fuel elements probably caused by water penetration through a weld.

WATER TREATMENT

Alum feed rates of 18 ppm have been accomplished at 100-F during the month. Although water is difficult to treat during this period, good water quality has been maintained and no reduction in flow to the reactor has been required.

(1) KER Loop #1.

Extracted from HAPO 1961f, page B-16.

MAY 1961

Extracted from HAPO 1961f, page C-3.

RUPTURE EXPERIENCE - JUNE 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
6/5/61	3766-C	CJ-863-A	I&E N	727	Side Hot-Sps
6/9/61	2986-DR	UZ-014-A	I&E N	305	Split-Trans.
6/9/61	2352-C	CA-909-A	SN	723	Split-Long.
6/12/61	3457-F	KH-8290-A	I&E E (0.94%)	716	End-Female
6/17/61	0967-B	VZ-006-B	I&E N	252	End-Male
6/18/61	2867-H	KH-289-D	I&E EB (0.94%)	314	End-Male
6/24/61	2264-F	UZ-015-H	I&E N	208	Unknown

Legend:

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

SN - This is the symbol for production reactor fuel elements have a solid cylindrical core of natural uranium.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Split-Transverse - Failure caused by uranium cleavage across or at an angle to the axis of the core.

Split-Longitudinal - Failure caused by uranium cleavage along the axis of the core.

End - Failure on the end of the fuel element probably caused by water penetration through a weld.

Unknown - Failure caused by uranium cleavage along the axis of the core.

Extracted from HAP0 1961g, pages B-16 & B-17.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

JUNE 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. COMC.	% OF GOAL	FACTOR AT RUPTURE	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
I&E Reg	3766-C	Hot Spot	10-13-60	25-61	6-5-61	727	112	1.055	1147	CJ-863-A	X-8001-F	X	2.7	
Sol. Reg	2352-C	Split	10-6-60	12-4-60	6-9-61	723	106	.636	585	CA-909-A	C-64-F	X	23.8	
I&E Reg	2986DR	Split	3-27-61	4-24-61	6-9-61	305	44	1.218	977	VZ-014-A	X-8001-F	X	14.5	
I&E-E	3457-F	End-Female	3-2-61	3-29-61	6-12-61	716	87	1.136	1079	KH-829-A	X-8001-F	X	61.8	Leaker
I&E Reg	0967-B	End-Male	4-24-61	5-16-61	6-17-61	252	40	1.242	1171	VZ-006-B	X-8001-F	X	2.2	
I&E-E	2867-III	End-Male	3-9-61	5-3-61	6-18-61	314	31	1.192	1107	EN-KH-289D	X8001-F	X	4.0	Bumper
I&E Reg	2264-F	Unknown	4-25-61	5-25-61	6-24-61	208	33	1.226	1237	VZ-015-H	X-8001-F	X	2.4	

Extracted from HAPO 1961g, page C-4.

RUPTURE EXPERIENCE - JULY 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
7/1/61	2485-F	UZ-015-H	I&E N	419	Split- Transverse

Legend:

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

Split-Transverse - Failure caused by uranium cleavage across or at an angle to the axis of the core.

Extracted from HAP0 1961h, page B-13.

REACTOR OPERATION STATISTICS - SLUG RUPTURESJULY 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. CONC.	CONCENTRATION % OF SOAL	FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
I&E Reg	2485F	Split	4-21-61	5-4-61	7-1-61	419	66	1.230	1172	U2 015H	X 8001F	X	1.0	

 Extracted from HAP0 1961h, page C-4.

RUPTURE EXPERIENCE - AUGUST 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
8-8-61	2476-H	KH-289-D	I&E EB (0.94%)	663	Hole
8-24-61	1363-KW	KK-081-A	I&E E (0.94%)	554	Side Hot-Spot
8-29-61	1163-D	KZ-064-E	I&E NB	795	Hole
8-30-61	1379-H	KH-273-A	I&E EB (0.94%)	745	Hole
8-31-61	2470-DR	CZ-814-A	I&E N	768	Hole
8-31-61	2478-DR	PZ-010-A	I&E N	786	Hole

Legend:

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

Hole - Failure on the internal surface of an I&E piece probably caused by water penetration through a weld or other unknown mechanism.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Extracted from HAP0 1961i, page B-15.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

AUGUST 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. COMC.	% OF GOAL	FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
I&E-E	2476H	Hole	3-9-61	5-3-61	8-7-61	663	66	1.120	1016	BN-KH289H	X-8001-F	X	16.2	
I&E-E	1363KW	Hot Spot	5-6-61	5-27-61	8-24-61	554	86	1.207	1402	KK-081-A	X-8001-F	X	3.1	
I&E Reg	1163D	Hole	3-22-61	4-28-61	8-29-61	792	91	1.297	1152	KZ-064-E	X-8001-F	X	1.0	
I&E-E	1379H	Hole	12-14-60	5-21-61	8-30-61	745	74	1.166	1020	KH-273	X-8001-F	X	2.5	
I&E Reg	2470DR	Hole	3-24-61	4-24-61	8-31-61	768	130	1.298	936	CZ-814-A	X-8001-F	X	5.4	
I&E Reg	2478DR	Hole	3-24-61	4-24-61	8-31-61	786	138	1.284	1025	PZ-010-A	X-8001-F	X	0.6	

Extracted from HAP0 1961i, page C-4.

RUPTURE EXPERIENCE - SEPTEMBER 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure</u>	<u>Type of Failure</u>
9/2/61	2667-H	KH-274-A	I&E EB (0.94%)	843	Hole
9/3/61	1465-D	KZ-067-E	I&E NB	13	Mechanical Damage
9/5/61	2178-F	KY-006-A	I&E E (0.94%)	338	Side Hot-Spot
9/6/61	1581-H	KY-081-D	I&E EB (0.94%)	544	Side-Other
9/15/61	4072-D	KY-024-D	I&E EB (0.94%)	986	Hole
9/15/61	2384-F	KY-062-A	I&E E (0.94%)	434	Side Hot-Spot
9/18/61	2561-DR	KY-096-A	I&E E (0.94%)	93	Side Hot-Spot
9/19/61	2795-F	KH-221-D	I&E E (0.94%)	1098	Side-Other
9/26/61	0766-DR	KY-096-A	I&E E (0.94%)	154	Mechanical Damage

Legend:

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

Hole - Failure on the internal surface of an I&E piece probably caused by water penetration through a weld or other unknown mechanism.

Mechanical Damage - Failure probably caused by mechanical damage to the fuel element prior to irradiation.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Extracted from HAPO 1961j, page B-15.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

SEPTEMBER 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION ACT. COM.	% OF GOAL	FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
I&E-E	2667H	Hole	12-16-61	5-3-61	9-2-61	843	84	1.140	950	KH-274-A	X-8001-F	X	6.6	
I&E Reg	1465D	Chg. Mach.	6-12-61	8-29-61	9-3-61	13	0	1.329	1076	KZ-067-B	X-8001-F	X	35.7	
I&E-E	2178F	Hot Spot	4-10-61	7-27-61	9-5-61	338	40	1.198	1153	KY-006-A	X-8001-F	X	12.9	
I&E-E	1581H	Side Other	5-22-61	6-18-61	9-6-61	544	54	1.067	990	KY-081-D	X-8001-F	X	6.1	Leaker
I&E-E	4072D	Hole	3-17-61	5-20-61	9-15-61	986	99	1.358	1096	KY-024-D	X-8001-F	X	9.4	
I&E-E	2381F	Hot Spot	5-16-61	7-31-61	9-15-61	434	54	1.310	971	KY-062-A	X-8001-F	X	4.9	
I&E-E	2561DR	Hot Spot	8-12-61	9-5-61	9-18-61	93	17	1.371	1116	KY-096-A	X-8001-F	X	9.0	
I&E-E	2795F	Side Other	9-15-60	10-1-60	9-19-61	1098	80	.585	751	KH-221-D	X-8001-F	X	19.4	
I&E-E	0766DR	Chg. Mach.	8-12-61	9-5-61	9-26-61	154	17	1.252	1163	KY-096-A	X-8001-F	X	1.2	

Extracted from HAPO 1961j, page C-4.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

OCTOBER 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD - Q, P, H, R, P	REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF GOAL							
IAE-E	197BH	Chg. Mech.	5-11-61	9-10-61	10-5-61	109	11	1.126	857	KY-057-D	X-8001-F	X	2.0	
IAE-E	3985DR	Hot Spot	4-18-61	7-27-61	10-10-61	582	74	1.312	1219	KY-029-A	X-8001-F	X	17.9	
IAE Reg	2762D	Hole	3-16-61	6-11-61	10-10-61	758	104	1.351	1106	KZ-24B	X-8001-F	X	1.4	
IAE-E	2576C	Hot Spot	7-21-61	9-16-61	10-12-61	230	40	1.219	1217	KC-081-A	X-8001-F	X	17.1	
IAE-E	1460DR	Chg. Mech.	8-12-61	9-5-61	10-15-61	285	29	1.191	1141	KY-096-A	X-8001-F	X	0.8	
IAE-E	2658DR	Side Other	4-10-61	8-14-61	10-20-61	498	57	1.222	1170	KY-006-A	X-8001-F	X	24.8	
IAE-E	4173DR	Hole	5-12-61	5-28-61	10-23-61	1017	89	1.189	1151	KY-056-D	X-8001-F	X	9.6	
IAE-E	2271C	Hot Spot	7-21-61	9-16-61	10-26-61	386	46	1.207	1242	KC-081-A	X-8001-F	X	24.1	Leaker
IAE-E	2987DR	Side Other	8-12-61	9-5-61	10-27-61	389	52	1.360	1274	KY-096-A	X-8001-F	X	17.5	
IAE Reg	2377F	Split	8-23-61	9-12-61	10-29-61	274	37	1.154	1139	WZ-046-B	X-8001-F	X	3.4	
IAE Reg	2369F	Split	6-21-61	9-5-61	10-31-61	337	51	1.195	1118	PZ-019-H	X-8001-F	X	1.8	

Extracted from HAP0 1961k, page C-3.

RUPTURE EXPERIENCE - NOVEMBER 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure (MWD/T)</u>	<u>Type of Failure</u>
11/27/61	0774-D	KY-059-D	I&E EB (0.94%)	499	End

Legend:

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

End - Failure on the end of the fuel element probably caused by water penetration through a weld.

Extracted from HAP0 19611, page B-12.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

NOVEMBER 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		FACTORY	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CUADDING	REMOVAL METHOD	REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF SOL.							
I&E-E	0774-D	End Failure	5-12-61	9-30-61	11-27-61	499	46	1.263	184	KY-059-D	K-8001-F	K	1.0	

Extracted from HAP0 19611, page C-3.

RUPTURE EXPERIENCE - DECEMBER 1961

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure (MWD/T)</u>	<u>Type of Failure</u>
12/8/61	3762-C	KC-087-A	I&E E (0.94%)	595	Side Hot Spot
12/13/61	2864-H	KY-087-D	I&E EB (0.94%)	605	Split-Long.
12/14/61	3264-DR	HZ-036-H	I&E N	780	Side Hot Spot
12/23/61	4177-H	KY-030-D	I&E EB (0.94%)	1050	Side Other
12/27/61	0867-DR	KZ-083-A	I&E N	750	Side Hot Spot
12/28/61	2872-H	KH-830-D	I&E EB (0.94%)	760	Hole
12/31/61	2667-H	KH-831-D	I&E EB (0.94%)	793	Hole

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

I&E EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Split-Long. - Failure caused by uranium cleavage along the axis of the core.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Hole - Failure on the internal surface of an I&E piece probably caused by water penetration through a weld or other unknown mechanism.

Extracted from HAPO 1962a, pages B-14 & B-15.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

DECEMBER 1961

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		FACTOR	TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHODS		REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF GOAL					O	W		
IAE-E	3762C	Hot Spot	9-8-61	10-12-61	12-8-61	595	93	1.27	1416	MC087A	X 8001F	X		2.1	
IAE-E	2864H	Split	7-6-61	9-10-61	12-13-61	605	75	1.14	1171	XY087D	X 8001F	X		2.1	
IAE-Reg	3264DR	Hot Spot	7-14-61	8-14-61	12-14-61	780	128	1.21	1223	HZ036H	X 8001F			9.0	
IAE-E	4177H	Side Other	4-18-61	8-3-61	12-23-61	1050	100	1.10	1086	KY030D	X 8001F	X		1.8	
IAE-Reg	2667DR	Hot Spot	6-9-61	9-5-61	12-27-61	750	125	1.21	1256	KZ083A	X 8001F			6.7	
IAE-E	2872H	Hole	7-19-61	9-2-61	12-28-61	760	94	1.05	1052	KH830D	X 8001F	X		5.9	
IAE-E	2667H	Hole	7-19-61	9-2-61	12-31-61	793	99	1.14	1063	KH831D	X 8001F	X		2.5	

Extracted from HAP0 1962a, page C-3.

APPENDIX L

FUEL-ELEMENT FAILURE DATA FOR 1962

RUPTURE EXPERIENCE - JANUARY 1962

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure (MWD/T)</u>	<u>Type of Failure</u>
1/5/62	3271-C	KC-880-A	I&E E (0.94%)	511	Side Hot-Spot
1/7/62	2086-B	UZ-057-H	I&E N	208	Unclassified
1/7/62	2580-H	KY-097-D	I&E EB (0.94%)	746	Hole
1/9/62	2773-D	EZ-043-E	I&E NB	253	Unclassified
1/9/62	2576-H	KY-097-D	I&E EP (0.94%)	738	Hole
1/10/62	4463-C	IP-381-A ⁽¹⁾	I&E N ⁽¹⁾	631	Side-Other
1/16/62	1968-H	KY-057-D	I&E EB (0.94%)	890	Hole
1/21/62	2669-H	KH-830-D	I&E EB (0.94%)	880	Hole
1/21/62	2779-KW	KK-885-A	I&E E (0.94%)	540	Side Hot-Spot
1/23/62	4667-KE	CF-004-A	I&E N	254	Hole
1/24/62	2571-KW	KK-885-A	I&E E (0.94%)	540	Unknown
1/25/62	3174-H	KH-831-D	I&E EB (0.04%)	829	Hole
1/30/62	2371-D	VZ-032-D	I&E NB	976	Split

Legend

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E EP - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

Unclassified - The failure did not logically fall into any of the usual types.

Hole - Failure on the internal surface of an I&E piece probably caused by water penetration through a weld or other unknown mechanism.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

⁽¹⁾ Production test of internally and externally cooled oversized self-supported fuel elements in an overbored channel.

Extracted from HAP0 1962b, pages B-15 & B-16.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

JANUARY 1962

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		FACTOR	TUBE AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHODS O D H J P	REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF SOAL							
TEE-E	3271C	Hot Spot	9-11-61	11-7-61	1-5-62	511	75	1.222	1424	KC880A	K8001F	X	3.2	
TEE-Reg	2088B	Unclass.	9-5-61	11-26-61	1-7-62	208	29	1.106	195	U2057H	K8001F	X	30.4	
TEE-E	2580H	Hole	8-11-61	9-10-61	1-7-62	746	93	1.105	113	KY097D	K8001F	X	4.4	
TEE-Reg	2773D	Unclass.	8-15-61	11-20-61	1-9-62	253	27	1.221	148	H2043E	K8001F	X	27.4	
TEE-E	2576H	Hole	8-11-61	9-10-61	1-9-62	738	92	1.155	1035	KY097D	K8001F	X	1.0	
TEE-E	1968H	Hole	5-11-61	9-10-61	1-16-62	890	111	1.177	1157	KY057D	K8001F	X	1.9	
TEE-E	2669H	Hole	7-19-61	9-2-61	1-21-62	880	110	1.107	1034	KH830B	K8001F	X	3.2	
TEE-E	2779KW	Hot Spot	11-14-61	12-4-61	1-21-62	540	86	1.274	1763	KH885A	K8001F	X	8.6	
TEE-Reg	4667KE	Hole	12-13-61	12-26-61	1-23-62	254	40	1.103	1596	CF004A	K8001F	X	1.4	
TEE-E	2571KW	Unknown	11-14-61	12-4-61	1-24-62	540	78	1.208	1724	KH885A	K8001F	X	1.8	
TEE-E	3174H	Hole	7-19-61	9-2-61	1-25-62	829	105	1.164	1143	KH831D	K8001F	X	1.5	
TEE-Reg	2371D	Split	6-20-61	8-18-61	1-30-62	976	111	1.233	1107	YZ032D	K8001F	X	19.5	
Oversize TEE Mat	4463C	Side-Other	2-14-61	8-1-61	1-16-62	631	79	1.204	1488	IP431A		X	4.1	

Extracted from HAP0 1962b, page C-3.

RUPTURE EXPERIENCE - FEBRUARY 1962

<u>Failure Date</u>	<u>Tube Number</u>	<u>Lot Number</u>	<u>Type of Material</u>	<u>Exposure MWD/T</u>	<u>Type of Failure</u>
2/3/62	2289-C	KT-019-A ⁽¹⁾	I&E N ⁽¹⁾	1003	Side-Other
2/18/62	3775-D	CZ-806-E	I&E NB	1158	Split-Trans.
2/26/62	2463-B	KY-082-A	I&E E (0.94%)	270	

Legend

I&E N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

I&E NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

I&E E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

Side-Other - Failure probably caused by corrosion or water penetration of the external can wall or other unknown mechanism.

Split-Trans. - Failure caused by uranium cleavage across or at an angle to the axis of the core.

-
- (1) This rupture occurred in a normal size natural self-supported fuel element charged in a ribless zirconium process tube. This charge was being irradiated under the auspices of Production Test IP-272-A.

Extracted from HAPO 1962c, page B-16.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

FEBRUARY 1962

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD			REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF GOAL				Q	D	H		
I&E Reg	2289C	Side-Other	6-6-61	9-16-61	2-3-62	1003	122	2501494	KT019A	X8001F	X			0.5	
I&E Reg	3775D	Split	2-13-61	8-6-61	2-18-62	1158	128	2561172	CZ306E	X8001F			X	14.0	
I&E-E	2463B	Hot Spot	7-12-61	1-13-62	2-26-62	270	38	2971273	K'082A	X8001F	X			12.5	

Extracted from HAP0 1962c, page C-3.

REACTOR OPERATION STATISTICS - SLUG RUPTURES

MARCH 1962

TYPE MATERIAL	TUBE NUMBER	TYPE FAILURE	CANNING DATE	CHARGE DATE	RUPTURE DATE	CONCENTRATION		TUBE POWER AT RUPTURE	LOT OR PT. NUMBER	CLADDING	REMOVAL METHOD - O 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100	REMOVAL HOURS	REMARKS
						ACT. CONC.	% OF GOAL						
I&E Reg	2378B	End	10-20-61	1-13-62	3-9-62	289	52	1.24	U2060D	X8001F	X	1.8	
I&E Reg	1078DR	Hot Spot	10-17-61	12-30-61	3-11-62	167	84	1.17	K2152H	X8001F	X	1.6	
I&E Reg	1372H	Male End	10-31-61	1-27-62	3-12-62	263	44	1.16	K2135D	X8001F	X	10.3	
I&E-E	3446KW	Unclassified		8-14-61	3-12-62	1647	196	1.11	IP397AFP		X	9.6	Coextruded Zircaloy Clad
I&E Reg	1584DR	Hot Spot	10-17-61	12-30-61	3-15-62	486	89	1.20	C2884H	X8001F	X	5.1	
I&E-E	2091KE	Hole	11-15-61	1-23-62	3-28-62	695	81	1.17	K2126A	X8001F	X	1.2	
I&E-E	4162H	Chg. Mach. Damage	2-6-62	3-12-62	3-29-62	157	21	1.28	KY138D	X8001F	X	12.2	

Extracted from HAP0 1962d, page C-3.

RUPTURE EXPERIENCE - MARCH-APRIL 1962

Failure Date	Tube Number	Lot Number	Type of Material	Tube Power at Failure (kw)	Exposure MWD/T	Type of Failure
3/28/62 ⁽¹⁾	2091-KE	KK-126-A	IAE E (0.94%)	1729	695	Hole
3/29/62 ⁽¹⁾	4169-E	KY-138-D	IAE EB (0.94%)	1194	157	Mech. Damage
4/4/62	2160-KE ⁽²⁾	IP-448-A	KERE ⁽²⁾ (1.6%)		796	Uncl.
4/5/62	2955-C	KC-097-A	IAE E (0.94%)	1585	752	Side Hot-Spot
4/14/62	2281-D	CZ-889-D	IAE NB	1246	77	End
4/16/62	1684-D	HZ-065-D	IAE NB	1267	79	Hole
4/16/62	3062-C	IP-381-A	IAE N(3)	1439	671	Split-Long
4/20/62	1064-DR	HZ-068-A	IAE N	1167	121	Hole
4/21/62	1962-D	HZ-065-D	IAE NB	1179	118	End
4/26/62	3879-DR	UZ-082-A	IAE N	1183	221	Unknown

Legend

IAE E - This is the symbol for internally and externally cooled production reactor fuel elements with uranium cores enriched in U-235. The weight per cent U-235 in the core material is stated.

IAE EB - This is the symbol for internally and externally cooled production reactor fuel elements which have projections (bumpers) welded to the fuel element jackets. The uranium cores are enriched in U-235 and the weight per cent U-235 in the core material is stated.

IAE NB - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium which have projections (bumpers) welded to the fuel element jacket.

IAE N - This is the symbol for internally and externally cooled production reactor fuel elements of natural uranium.

Hole - Failure on the internal surface of an IAE piece probably caused by water penetration through a weld or other unknown mechanism.

Mechanical Damage - Failure probably caused by mechanical damage to the fuel element prior to irradiation.

Unclassified - The failure did not logically fall into any of the usual types.

Side Hot-Spot - Failure probably caused by accelerated corrosion of the external can wall in a localized region of high temperature.

End - Failure on the end of the fuel element probably caused by water penetration through a weld.

Split-Long - Failure probably caused by uranium cleavage along the axis of the core.

Unknown - Failed piece could not be located or had not been examined at the time of writing.

(1) These failures, which occurred near the end of March, were not included in the March list.

(2) KER test facility No. 1. This failure occurred in a special fuel element containing thermocouples. A complete description of the element can be obtained from Production Test Authorization IP-448-A.

(3) Production test of internally and externally cooled oversized self-supported fuel elements in an overbored channel.

Extracted from HAPO 1962e, pages C-13 & 14.

RUPTURED SLUG DATA - MAY 1962

Tube Number	1265-DR	1384-C	0576-H	3072-DR	1159-C	1068-B	2166-D
Failure Number	1467	1468	1469	1470	1471	1472	1473
Date Failed	5-1-62	5-5-62	5-6-62	5-8-62	5-11-62	5-12-62	5-26-62
Date Charged	3-15-62	3-10-62	10-28-61	3-15-62	3-10-62	1-13-62	1-31-62
Days in Pile	47	56	190	54	62	119	133
Days of Operation	21	37	126	26	39	66	101
Tube Exposure	197	425	1294	226	423	627	811
Tube Power at Failure	1194	1389	1087	1022	1116	1166	1155
Tube Power Average	1168	1359	931	1033	1278	1207	1193
Slug Power	X	X	X	X	X	X	X
Slug Position	X	X	5-R	X	X	17-R	10-R
Canning Date	3-7-62	11-7-61	5-11-61	3-5-62	11-10-61	11-29-61	9-27-61
Lot Number	UZ-082-A	KJ-347-A	KY-068-D	HZ-069-A	KJ-349-A	KZ-142-H	KD-034-D
Type of Metal	I&E N	I&E N	I&E EB (0.94%)	I&E N	I&E N	I&E N	I&E NB
Days Since Last Start-up	3	16	12	4	Less than 1	10	22
Total Shutdowns	7	7	46	8	13	15	13
Rapid Shutdowns	7	4	38	8	9	5	7
Flow	48.3	51.6	46.9	47.4	51.6	48.4	46.0
Type of Failure	End	Unknown	Split-Long.	End	Side Hot Spot	Unclassified	Side-Other
Downtime Chargeable to Failure (hrs)	7.2	19.6	3.6	1.1	46.9	12.6	3.0

Extracted from NEWELL 1962, Page 6.

RUPTURED SLUG DATA - JUNE-JULY 1962

Tube Number	3065-D	3378-D	2272-F	1268-DR	3958-F	2059-F	1692-C
Failure Number	1474	1475	1476	1477	1478	1479	1480
Date Failed	6-14-62	6-18-62	6-25-62	6-26-62	7-1-62	7-7-62	7-9-62
Date Charged	4-2-62	4-2-62	4-6-62	3-15-62	6-26-62	4-27-62	3-27-62
Days in Pile	73	77	80	103	5	71	104
Days of Operation	57	59	55	73	5	56	61
Tube Exposure	533	600	486	455	9	468	838
Tube Power at Failure	1107	1232	1168	910	1159	1242	1175
Tube Power Average	1153	1243	1136	943	1147	1136	1249
Slug Power	X	X	X	X	X	X	83.2
Slug Position	X	X	11-R	X	X	13-R	19-R
Canning Date	1-18-62	1-18-62	3-14-62	11-17-61	3-28-62	4-4-62	2-13-62
Lot Number	HZ-060-D	HZ-060-D	KZ-307-A	UZ-068-B	KY-160-D	KY-195-A	KC-112-A
Type of Metal	I&E NB	I&E NB	I&E N	I&E N	I&E EB (0.94%)	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Start-up	1	1	10	41	1	41	3
Total Shutdowns	11	12	4	12	1	7	20
Rapid Shutdowns	6	7	0	10	1	4	11
Flow	47.2	46.9	44.3	45.3	49.4	51.0	55.4
Type of Failure	Unclassified	Side-Other	Side Hot-Spot	Unknown	Mech. Damage	Side Hot-Spot	Side Hot-Spot
Downtime Chargeable to Failure (hrs)	31.3	15.3	49.9	2.1	12.3	12.8	27.1

Extracted from NEWELL 1962, page 7.

RUPTURED SLUG DATA - JULY-AUGUST 1962

Tube Number	4078-B	3562-C	3868-B	0359-II	1285-DR	0989-B	2583-D	3162-C
Failure Number	1481	1482	1483	1484	1485	1486	1487	1488
Date Failed	7-23-62	7-27-62	8-13-62	8-15-62	8-17-62	8-22-62	8-27-62	8-29-62
Date Charged	5-16-62	5-25-62	6-13-62	4-4-61	5-1-62	4-13-62	5-2-62	4-16-62
Days in Pile	68	63	61	498	108	131	117	135
Days of Operation	55	49	44	316	75	109	96	72
Tube Exposure	661	412	404	1193	948	1024	902	640
Tube Power at Failure	1154	1280	1134	429	1134	1090	1122	1243
Tube Power Average	1147	1299	1111	404	1118	1032	1164	1422
Slug Power	51.4	82.0	67.0	X	X	35.4	X	X
Slug Position	X	X	13-R	X	X	5-R	X	X
Canning Date	2-1-62	2-13-62	5-24-62	1-20-61	3-22-62	3-28-62	2-13-62	10-4-61
Lot Number	KY-145-A	KC-112-A	KZ-367-A	KII-254-D	KY-155-D	KY-165-D	KZ-247-DWP-004-A ¹	
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E N	I&E E (0.94%)	I&E EB (0.94%)	I&E EB (0.94%)	I&E NB	I&E N
Days Since Last Start-up	7	7	3	7	23	7	13	41
Total Shutdowns	6	9	8	103	11	15	14	24
Rapid Shutdowns	3	4	5	58	6	8	6	15
Flow	55.4	47.2	45.4	34.3	47.3	47.7	46.9	57.9
Type of Failure	Side-Other	Unclassified	Side Hot-Spot	Hole	Hole	Unclassified	Hole	Split-Trans.
Downtime Chargeable to Failure (hrs)	15.8	13.7	24.3	13.0	0.9	22.1	4.2	32.2

¹ Production test of I&E oversized self-supported fuel elements in an overbored channel.

RUPTURED SLUG DATA - SEPTEMBER 1962

Tube Number	1494-C	1175-B	2969-C	2068-B	2890-II
Failure Number	1489	1490	1491	1492	1493
Date Failed	9-3-62	9-5-62	9-6-62	9-8-62	9-13-62
Date Charged	1-16-62	6-13-62	4-5-62	7-8-62	5-12-62
Days in Pile	230	84	154	62	124
Days of Operation	134	70	81	48	79
Tube Exposure	710	588	661	385	685
Tube Power at Failure	1201	1157	1265	1018	982
Tube Power Average	1345	1133	1288	1037	1023
Slug Power	X	70.1	X	56.0	X
Slug Position	1-R	X	17-R	X	2-R
Canning Date	9-14-61	5-22-62	10-4-61	6-14-62	3-2-62
Lot Number	WP-003-A	KZ-355-A	WP-004-A	CZ-019-II	KZ-270-D
Type of Metal	I&E N	I&E N	I&E N	I&E N	I&E NB
Days Since Last Start-up	3	12	Less than 1	1	1
Total Shutdowns	38	7	30	8	17
Rapid Shutdowns	22	5	18	6	8
Flow	48.5	49.4	57.9	46.7	43.6
Type of Failure	Side-Other	Side Hot-Spot	Split-Long.	Side Hot-Spot	Slide-Other
Downtime Chargeable to Failure (hrs.)	16.4	6.3	7.4	9.6	23.6

¹Production Test of I&E oversized self-supported fuel elements in an overbored channel.

Extracted from NEWELL 1963a, page 6.

RUPTURED SLUG DATA - SEPTEMBER-OCTOBER 1962

Tube Number	3989-DR	3680-C	3086-DR	3768-B	3885-DR
Failure Number	1494	1495	1496	1497	1498
Date Failed	9-16-62	9-23-62	9-28-62	9-29-62	10-2-62
Date Charged	9-11-62	5-26-62	7-16-62	7-8-62	6-9-62
Days in Pile	5	120	74	83	115
Days of Operation	4	62	59	67	79
Tube Exposure	45	522	698	810	874
Tube Power at Failure	1038	1262	1037	1183	1016
Tube Power Average	1038	1227	1076	1167	1034
Slug Power	X	X	X	42.5	X
Slug Position	17-R	5-R	3-R	X	X
Canning Date	7-18-62	X	3-27-62	5-8-62	5-1-62
Lot Number	KY-235-D	IP-490-A ²	KY-171-D	KY-202-D	KY-200-D
Type of Metal	I&E EB (0.94%)	I&E N	I&E EB (0.94%)	I&E EB (0.94%)	I&E EB (0.94%)
Days Since Last Start-up	3	16	2	12	2
Total Shutdowns	0	19	10	11	16
Rapid Shutdowns	0	11	7	9	11
Flow	48.5	50.0	45.3	47.5	45.9
Type of Failure	Mech. Damage	Side-Other	Hole	Side-Other	Unclassified
Downtime Chargeable to Failure (hrs.)	19.7	6.7	4.8	0.9	4.2

²Production Test of diffusion bonded I&E self-supported fuel elements.

Extracted from NEWELL 1963a, page 7.

RUPTURED SLUG DATA - OCTOBER 1962

Tube Number	2970-C	3967-DR	3063-B	2260-KW	2879-C
Failure Number	1499	1500	1501	1502	1503
Date Failed	10-5-62	10-7-62	10-10-62	10-12-62	10-13-62
Date Charged	8-9-62	7-16-62	7-8-62	9-17-62	8-9-62
Days in Pile	57	83	94	25	65
Days of Operation	28	65	75	22	33
Tube Exposure	316	791	858	268	413
Tube Power at Failure	1117	1056	1181	1687	1364
Tube Power Average	935	1126	1085	1455	1288
Slug Power	67.9	X	X	X	93.8
Slug Position	X	1-R	X	17-R	27-R
Canning Date	5-15-62	3-28-62	5-8-62	6-26-62	2-9-62
Lot Number	KC-126-A	KY-165-D	KY-202-D	KK-241-A	KC-114-A
Type of Metal	I&E E (0.94%)	I&E EB (0.94%)	I&E EB (0.94%)	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Start-up	7	3	8	21	3
Total Shutdowns	7	13	12	2	9
Rapid Shutdowns	6	10	10	2	7
Flow	51.4	47.0	48.3	68.4	52.3
Type of Failure	Side-Other	Hole	Side-Other	Side Hot-Spot	Side-Other
Downtime Chargeable to Failure (Hrs.)	37.3	4.9	11.2	3.4	39.1

Extracted from NEWELL 1963a, page 8.

RUPTURED SLUG DATA - OCTOBER 1962 (Cont'd)

Tube Number	2166-D	3677-C	3284-D	3857-C	1677-F
Failure Number	1504	1505	1506	1507	1508
Date Failed	10-15-62	10-18-62	10-19-62	10-20-62	10-24-62
Date Charged	5-27-62	5-25-62	5-27-62	7-19-62	8-24-62
Days in File	141	146	145	93	61
Days of Operation	92	79	95	54	45
Tube Exposure	877	656	868	659	416
Tube Power at Failure	1169	1319	1182	1257	1018
Tube Power Average	1154	1231	1134	1221	1005
Slug Power	X	42.3	X	90.9	X
Slug Position	X	6-R	X	X	X
Canning Date	2-15-62	X	3-1-62	6-20-62	7-30-62
Lot Number	KZ-249-D	IP-490-A ²	KZ-289-D	KC-142-A	KZ-444-H
Type of Metal	I&E NB	I&E N	I&E NB	I&E E (0.94%)	I&E N
Days Since Last Start-up	7	3	2	Less than 1	14
Total Shutdowns	19	24	20	19	2
Rapid Shutdowns	7	15	8	15	0
Flow	46.2	49.5	45.9	45.9	55.4
Type of Failure	Hole	Side-Other	Hole	Unclassified	Side Hot-Spot
Downtime Chargeable to Failure (hrs.)	-1.8	4.2	1.0	10.4	4.3

² Ibid.

Extracted from NEWELL 1963a, page 9.

RUPTURED SLUG DATA - OCTOBER-NOVEMBER 1962

Tube Number	3959-C	3180-D	3266-D	4167-F	1888-C
Failure Number	1509	1510	1511	1512	1513
Date Failed	10-27-62	10-27-62	11-2-62	11-3-62	11-4-62
Date Charged	8-9-62	6-18-62	6-14-62	8-24-62	8-9-62
Days in Pile	79	131	141	71	87
Days of Operation	42	86	91	51	48
Tube Exposure	404	779	736	593	605
Tube Power at Failure	1209	1172	1153	998	1373
Tube Power Average	1204	1112	1083	1092	1277
Slug Power	82.5	X	X	X	90.6
Slug Position	18-R	X	X	X	22-R
Canning Date	5-14-62	1-4-62	2-14-62	5-3-62	2-9-62
Lot Number	KJ-392-A	KZ-170-D	CA-894-D	SY-014-A	KC-114-A
Type of Metal	I&E N	I&E NB	I&E NB	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Start-up	6	4	2	2	6
Total Shutdowns	16	17	22	4	17
Rapid Shutdowns	14	8	13	1	15
Flow	46.4	49.5	47.4	46.0	53.6
Type of Failure	Unclassified	Hole	Hole	Side-Other	Side Hot-Spot
Downtime Chargeable to Failure (Hrs.)	40.3	0.9	1.8	35.3	3.7

Extracted from NEWELL 1963a, page 10.

RUPTURED SLUG DATA - NOVEMBER 1962

Tube Number	3648-KW	1675-DR	1364-F	1282-C	3867-F
Failure Number	1514	1515	1516	1517	1518
Date Failed	11-11-62	11-13-62	11-14-62	11-14-62	11-22-62
Date Charged	9-17-62	7-16-62	8-24-62	8-9-62	8-24-62
Days in Pile	55	120	82	97	90
Days of Operation	40	85	60	56	66
Tube Exposure	416	950	539	523	591
Tube Power at Failure	1662	1137	1241	1296	1085
Tube Power Average	1461	1040	1102	1175	1095
Slug Power	X	X	X	53.8	X
Slug Position	X	X	5-R	15-R	X
Canning Date	6-8-62	6-14-62	5-10-62	3-5-62	7-12-62
Lot Number	KF-365-A	KY-887-D	KZ-342-A	KI-032-A	KZ-440-A
Type of Metal	I&E N	I&E EB (0.94%)	I&E N	I&E N	I&E N
Days Since Last					
Start-up	12	13	8	7	6
Total Shutdowns	6	19	5	20	6
Rapid Shutdowns	6	14	2	17	3
Flow	68.2	46.4	48.9	49.9	46.6
Type of Failure	Side Hot-Spot	Hole	Side-Other	Unclassified	Side-Other
Downtime Chargeable to Failure (Hrs.)	12.8	1.5	0.8	52.5	1.0

Extracted from NEWELL 1963a, page 11.

RUPTURED SLUG DATA - NOVEMBER-DECEMBER 1962

Tube Number	1458-C	2777-D	1478-D	0674-F	3465-B
Failure Number	1519	1520	1521	1522	1523
Date Failed	11-26-62	11-27-62	12-7-62	12-7-62	12-13-62
Date Charged	8-9-62	7-10-62	8-27-62	8-24-62	9-8-62
Days in Pile	109	140	102	105	96
Days of Operation	65	87	57	78	64
Tube Exposure	778	783	736	910	591
Tube Power at Failure	1262	1214	1261	1130	1281
Tube Power Average	1194	1119	1196	1090	1159
Slug Power	81.2	X	X	X	X
Slug Position	25-R 15	X	4-R	X	13-R
Canning Date	5-15-62	6-25-62	5-3-62	7-26-62	5-28-62
Lot Number	KC-126-A	KZ-411-D	KY-885-D	KY-237-D	KZ-364-A
Type of Metal	I&E E (0.94%)	I&E NB	I&E EB (0.94%)	I&E EB (0.94%)	I&E N
Days Since Last Start-up	8	5	8	11	14
Total Shutdowns	21	25	20	8	13
Rapid Shutdowns	18	13	12	4	6
Flow	53.0	47.3	49.3	47.6	49.9
Type of Failure	Side Hot-Spot	Hole	Hole	Side-Other	Side Hot-Spot
Downtime Chareable to Failure (Hrs.)	20.1	2.3	1.1	1.3	10.8

Extracted from NEWELL 1963a, page 12.

RUPTURED SLUG DATA - DECEMBER 1962

Tube Number	1064-D	3265-D	3162-B	1077-D	0658-F
Failure Number	1524	1525	1526	1527	1528
Date Failed	12-22-62	12-22-62	12-23-62	12-27-62	12-30-62
Date Charged	7-31-62	7-31-62	9-29-62	8-31-62	8-24-62
Days in Pile	144	144	85	118	128
Days of Operation	90	90	52	69	98
Tube Exposure	831	836	459	657	1180
Tube Power at Failure	1277	1279	1134	1240	1020
Tube Power Average	1138	1142	1071	1165	936
Slug Power	X	X	X	X	X
Slug Position	X	X	X	3-R	X
Canning Date	6-22-62	7-16-62	7-31-62	8-6-62	7-26-62
Lot Number	K2-416-D	K2-450-D	K2-446-A	K2-453-D	KY-237-D
Type of Metal	I&E NB	I&E NB	I&E N	I&E NB	I&E EB (0.94%)
Days Since Last Start-up	6	6	8	3	20
Total Shutdowns	27	27	11	23	9
Rapid Shutdowns	16	16	4	15	5
Flow	46.5	46.6	48.0	47.5	47.8
Type of Failure	Hole	Hole	Unknown	Side-Other	Side-Other
Downtime Chargeable to Failure (Hrs.)	1.7	1.7	1.4	7.1	1.5

Extracted from NEWELL 1963a, page 13.

APPENDIX M

FUEL-ELEMENT FAILURE DATA FOR 1963

RUPTURED SLUG DATA - JANUARY 1963

Tube Number	3786-D	1180-II	1975-II	1987-DR	1167-D
Failure Number	1529	1530	1531	1532	1533
Date Failed	1-2-63	1-6-63	1-9-63	1-14-63	1-17-63
Date Charged	8-31-62	9-19-62	9-19-62	10-12-62	8-27-62
Days in Pile	124	109	112	94	143
Days of Operation	73	67	68	70	88
Tube Exposure	672	837	605	826	840
Tube Power at Failure	1177	1138	1101	1053	1329
Tube Power Average	1113	1134	1043	1047	1163
Slug Power	X	X	27.9	X	X
Slug Position	4-R	X	X	X	5-R
Canning Date	9-4-62	7-30-62	3-14-62	7-24-62	7-16-62
Lot Number	KZ-473-D	KY-246-D	KZ-303-D	KY-239-D	KZ-450-D
Type of Metal	I&E NB	I&E EB (0.94%)	I&E NB	I&E EB (0.94%)	I&E NB
Days Since Last Start-up	4	4	1	13	13
Total Shutdowns	24	12	13	11	26
Rapid Shutdowns	16	6	7	8	17
Flow	43.9	47.0	43.9	42.5	46.7
Type of Failure	Side-Other	Side-Other	Side-Outer	Hole	Hole
Down-time Chargeable to Failure (hrs.)	9.9	4.1	13.5	0.2	1.6

RUPTURED SLUG DATA - JANUARY-FEBRUARY 1963

Tube Number	4075-D	1468-DR	1362-F	2473-DR	1362-DR
Failure Number	1534	1535	1536	1537	1538
Date Failed	1-17-63	1-28-63	1-29-63	1-30-63	2-2-63
Date Charged	8-27-62	10-12-62	11-3-62	10-12-62	10-12-62
Days in Pile	143	108	87	110	113
Days of Operation	88	81	62	81	83
Tube Exposure	794	724	569	743	963
Tube Power at Failure	932	1102	1263	1013	1005
Tube Power Average	1101	1059	1176	1074	968
Slug Power	X	X	X	X	X
Slug Position	5-R	X	12-R	10-R	X
Canning Date	7-16-62	8-2-62	9-4-62	X	6-8-62
Lot Number	KZ-450-D	KZ-443-D	KZ-092-A	X	KY-211-D
Type of Metal	1&E NB	1&E NB	1&E N	1&E NB	1&E EB (0.94%)
Days Since Last Start-up	13	10	12	Less than 1	2
Total Shutdowns	26	14	8	16	18
Rapid Shutdowns	17	10	6	12	14
Flow	44.8	41.4	47.0	42.7	48.1
Type of Failure	Hole	Hole	Slide Hot-Spot	Split-Long.	Hole
Downtime Chargeable to Failure (hrs.)	1.6	7.7	14.4	17.1	5.4

Extracted from NEWELL 1963b, page 7.

RUPTURED SLUG DATA - FEBRUARY 1963

Tube Number	1475-DR	2466-D	4065-KE	3457-II	3584-C
Failure Number	1539	1540	1541	1542	1543
Date Failed	2-2-63	2-3-63	2-6-63	2-9-63	2-10-63
Date Charged	10-12-62	8-27-62	12-12-62	1-11-63	9-23-62
Days in File	113	160	56	29	140
Days of Operation	83	99	44	10	81
Tube Exposure	756	927	589	84	738
Tube Power at Failure	969	1244	1883	1107	1349
Tube Power Average	1048	1137	1802	1101	1235
Slug Power	X	X	X	X	X
Slug Position	X	X	17-R	X	7-R
Canning Date	9-13-62	6-22-62	10-15-62	11-20-62	3-22-62
Lot Number	KZ-493-G	KZ-416-D	KK-893-A	KY-340-E	CT-912-D
Type of Metal	1&E NB	1&E NB	1&E E (0.94%)	1&E EB (0.94%)	1&E N ¹
Days Since Last Start-up	2	11	2	9	2
Total Shutdowns	18	29	8	0	23
Rapid Shutdowns	14	19	7	0	16
Flow	41.2	45.8	69.5	43.1	52.1
Type of Failure	Hole	Hole	Side Hot-Spot	Mech. Damage	Split-Long.
Downtime Chargeable to Failure (hrs.)	5.4	1.2	2.4	19.6	10.2

¹ Self-supported elements.

RUPTURED SLUG DATA - FEBRUARY-MARCH 1963

Tube Number	2079-DR	0682-D	4272-C	2759-D	1275-F
Failure Number	1544	1545	1546	1547	1548
Date Failed	2-14-63	2-19-63	2-24-63	2-26-63	3-4-63
Date Charged	9-10-62	9-29-62	11-29-62	8-31-62	1-3-63
Days in Pile	157	143	87	179	60
Days of Operation	115	104	48	115	41
Tube Exposure	999	878	625	1030	411
Tube Power at Failure	1226	1189	1370	1263	1229
Tube Power Average	993	1042	1249	1047	1168
Slug Power	X	X	84.6	X	X
Slug Position	X	X	X	X	X
Canning Date	8-6-62	8-7-62	10-26-62	8-8-62	12-10-62
Lot Number	KZ-452-D	KZ-455-D	KC-172-A	KZ-456-G	KZ-573-U
Type of Metal	I&E NB	I&E NB	I&E E (0.94%)	I&E NB	I&E H
Days Since Last Start-up	10	12	12	6	8
Total Shutdowns	27	27	8	30	4
Rapid Shutdowns	20	19	4	20	3
Flow	43.1	45.3	57.5	45.8	47.6
Type of Failure	Hole	Side-Other	Side Hot-Spot	Hole	Mech. Damage
Downtime Chargeable to Failure (hrs.)	8.5	11.3	2.8	16.4	9.2

Extracted from NEWELL 1963b, page 9.

RUPTURED SLUG DATA - MARCH 1963

Tube Number	3868-KVI	2476-B	0473-II	3660-B	3976-DR
Failure Number	1549	1550	1551	1552	1553
Date Failed	3-7-63	3-11-63	3-11-63	3-23-63	3-26-63
Date Charged	1-9-63	1-24-63	9-19-62	1-24-63	1-14-63
Days in File	57	46	173	58	71
Days of Operation	39	25	108	35	43
Tube Exposure	562	288	869	453	380
Tube Power at Failure	1733	1231	1017	1243	1182
Tube Power Average	1753	1180	925	1217	1098
Slug Power	X	71.7	X	77.0	X
Slug Position	X	16-R	X	X	13-R
Canning Date	11-6-62	10-24-62	9-13-62	1-14-63	1-10-63
Lot Number	CK-005-B	KY-300-A	KY-279-A	KY-896-B	KZ-591-A
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)	I&E H
Days Since Last Start-up	15	17	28	10	10
Total Shutdowns	3	1	17	2	12
Rapid Shutdowns	1	0	10	1	11
Flow	69.8	45.9	44.9	49.8	44.0
Type of Failure	Side Hot-Spot	Side Hot-Spot	Side-Other	Unclassified	Side Hot-Spot
Downtime Chargeable to Failure (hrs.)	2.8	14.7	0.2	5.7	32.0

Extracted from NEWELL 1963b, page 10.

RUPTURED SLUG DATA - MARCH-APRIL 1963

Tube Number	0678-II	2774-B	0661-D	2681-B	2490-B
Failure Number	1554	1555	1556	1557	1558
Date Failed	3-31-63	4-1-63	4-14-63	4-16-63	4-20-63
Date Charged	1-11-63	1-24-63	8-31-62	1-24-63	1-24-63
Days in Pile	79	67	226	82	86
Days of Operation	61	62	143	75	76
Tube Exposure	584	485	1062	551	699
Tube Power at Failure	1083	1168	925	1201	1183
Tube Power Average	1108	1082	880	1208	1165
Slug Power	X	X	X	X	X
Slug Position	X	18-R	X	X	9-R
Canning Date	12-12-62	10-2-62	8-6-62	7-31-62	1-14-63
Lot Number	KY-889-E	KY-292-A	KZ-453-D	KZ-446-A	KY-895-B
Type of Metal	I&E EB (0.94%)	I&E E (0.94%)	I&E HB	I&E N	I&E E (0.94%)
Days Since Last Start-up	22	7	26	13	Less than 1
Total Shutdowns	3	3	32	4	5
Rapid Shutdowns	2	2	21	3	4
Flow	44.1	45.5	44.9	47.0	48.8
Type of Failure	Split-Long.	Side Hot-Spot	Side-Other	Unclassified	Side-Other
Downtime Chargeable to Failure (hrs.)	12.2	20.9	6.9	28.3	14.8

Extracted from NEWELL 1963b, page 11.

RUPTURED SLUG DATA - MAY-JUNE 1963

Tube Number	2077-C	3960-DR	3565-KE	2080-B	0773-B
Failure Number	1559	1560	1561	1562	1563
Date Failed	5-7-63	5-10-63	5-12-63	5-22-63	6-6-63
Date Charged	2-26-63	4-21-63	11-9-62	5-14-63	4-16-63
Days in Pile	70	19	184	8	51
Days of Operation	50	14	137	6	43
Tube Exposure	709	162	2536	46	544
Tube Power at Failure	1417	1129	754	1130	1148
Tube Power Average	1344	1142	X	1105	1155
Slug Power	82.6	X	X	X	X
Slug Position	X	X	X	11-R	X
Canning Date	2-9-62	2-5-63	X	2-25-63	3-25-63
Lot Number	KC-100-A	GY-028-D	IP-486-D	KZ-656-B	GY-069-A
Type of Metal	I&E E (0.94%)	I&E EB (0.94%)	I&E H	I&E N	I&E E (0.94%)
Days Since Last Start-up	17	7	29	4	13
Total Shutdowns	5	2	33	0	3
Rapid Shutdowns	3	1	22	0	2
Flow	54.0	50.4	60.0	49.2	48.3
Type of Failure	SH	SD	U	ED	UH
Downtime Chargeable to Failure (hrs.)	1.0	4.7	52.2	3.3	28.2

Extracted from NEWELL 1963c, page 6.

RUPTURED SLUG DATA - JUNE-JULY 1963

Tube Number	2458-C	1762-B	3689-DR	1958-D	2468-D
Failure Number	1564	1565	1566	1567	1568
Date Failed	6-18-63	6-20-63	6-24-63	7-1-63	7-12-63
Date Charged	4-18-63	4-20-63	4-21-63	6-14-63	3-2-63
Days in Pile	61	61	64	17	132
Days of Operation	54	44	55	2	90
Tube Exposure	742	541	667	16	843
Tube Power at Failure	1323	1162	1164	1142	1085
Tube Power Average	1294	1170	1135	1153	1135
Slug Power	99.4	X	X	X	X
Slug Position	16-R	11-R	7-R	X	X
Canning Date	9-11-62	3-25-63	11-16-62	3-22-63	11-1-62
Lot Number	KC-141-A	GY-069-A	KD-045-D	KD-058-D	KZ-533-G
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E NB	I&E NB	I&E NB
Days Since Last Start-up	14	<1	18	2	8
Total Shutdowns	3	4	5	1	10
Rapid Shutdowns	2	3	2	0	6
Flow	53.8	50.7	46.5	48.0	43.9
Type of Failure	SH	SH	SU	SD	SU
Downtime Chargeable to Failure (hrs.)	12.6	20.7	8.9	16.4	2.6

Extracted from NEWELL 1963c, page 7.

RUPTURED SLUG DATA - JULY-AUGUST 1963

Tube Number	4050-KE	3868-KW	3977-KE	3062-C
Failure Number	1569	1570	1571	1572
Date Failed	7-22-63	7-30-63	8-5-63	8-25-63
Date Charged	5-12-63	5-2-63	5-12-63	6-18-63
Days in Pile	71	89	85	68
Days of Operation	65	60	77	58
Tube Exposure	503	801	574	490
Tube Power at Failure	1694	1711	1558	950
Tube Power Average	1759	1633	1504	1260
Slug Power	X	X	X	X
Slug Position	X	X	X	12-R
Canning Date	4-12-63	4-16-63	4-17-63	X
Lor Number	KK-362-A	KK-375-A	CP-014-B	CP-804-D
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E N	I&E NS
Days Since Last Startup	6	12	12	1
Total Shutdowns	5	8	6	9
Rapid Shutdowns	4	7	5	7
Flow	72.0	71.4	66.3	60.1
Type of Failure	SH	SM	CP	SU
Downtime Chargeable to Failure (hrs.)	11.1	6.1	20.9	7.5

Extracted from NEWELL 1963c, page 8.

RUPTURED SLUG DATA - SEPTEMBER 1963

Tube Number	2761-D	3778-C	3965-KE	3562-B	3366-D
Failure Number	1573	1574	1575	1576	1577
Date Failed	9-5-63	9-13-63	9-18-63	9-20-63	9-21-63
Date Charged	6-14-63	8-12-63	2-13-63	8-4-63	6-14-63
Days in Pile	83	32	217	47	99
Days of Operation	62	25	144	44	75
Tube Exposure	545	308	1618	414	660
Tube Power at Failure	1068	1195	1513	1145	1087
Tube Power Average	1079	1074	1499	1152	1100
Slug Power	X	63.9	X	X	X
Slug Position	X	X	X	X	7-R
Canning Date	5-1-63	4-23-63	11-1-62	6-19-63	3-22-63
Lot Number	CZ-0411-Q	KC-227-B	KF-498-A	PZ-045-A	KD-058-D
Type of Metal	I&E NB	I&E E (0.94%)	I&E N	I&E N	I&E NB
Days Since Last Startup	31	9	2	29	12
Total Shutdowns	10	5	22	2	11
Rapid Shutdowns	9	4	14	1	10
Flow	46.5	53.3	63.8	48.3	46.5
Type of Failure	SL	SD	SH	UN	SG
Downtime Chargeable to Failure (hrs.)	1.5	4.0	24.6	25.2	2.8

Extracted from NEWELL 1964a, page 6.

RUPTURED SLUG DATA - OCTOBER 1963

Tube Number	1489-DR	1260-D	3359-B	1464-D	2787-F
Failure Number	1578	1579	1580	1581	1582
Date Failed	10-1-63	10-2-63	10-8-63	10-11-63	10-13-63
Date Charged	6-3-63	6-14-63	8-19-63	6-14-63	8-5-63
Days in Pile	120	110	50	119	69
Days of Operation	103	84	45	90	55
Tube Exposure	1178	734	546	793	476
Tube Power at Failure	1015	1095	1227	1191	1104
Tube Power Average	1044	1068	1175	986	1027
Slug Power	X	X	79.8	X	X
Slug Position	X	7-R	X	6-R	1-R
Canning Date	12-5-62	10-4-62	6-14-63	4-9-63	7-9-63
Lot Number	KY-361-U	KD-053-D	KY-499-B	CZ-040-D	KZ-687-C
Type of Metal	I&E EB (0.94%)	I&E NB	I&E E (0.94%)	I&E NB	I&E H
Days Since Last Startup	27	9	15	7	2
Total Shutdowns	7	12	2	13	5
Rapid Shutdowns	3	11	1	12	3
Flow	46.6	47.1	52.9	47.1	46.6
Type of Failure	UH	SG	SH	HG	SD
Downtime Chargeable to Failure (hrs.)	0.8	1.3	0.3	1.4	6.2

Extracted from NEWELL 1964a, page 7.

RUPTURED SLUG DATA - OCTOBER 1963 (Cont'd)

Tube Number	3670-KW	1063-D	3784-B	2178-B	1464-C
Failure Number	1583	1584	1585	1586	1587
Date Failed	10-16-63	10-21-63	10-23-63	10-25-63	10-29-63
Date Charged	7-30-63	7-12-63	8-19-63	8-19-63	9-21-63
Days in Pile	78	101	65	67	38
Days of Operation	48	89	58	58	29
Tube Exposure	613	795	729	538	269
Tube Power at Failure	1634	1183	1246	1196	1374
Tube Power Average	1598	1108	1199	1152	1223
Slug Power	X	X	76.1	77.8	X
Slug Position	X	7-R	X	X	X
Canning Date	6-26-63	10-4-62	4-9-63	6-17-63	4-9-63
Lot Number	KK-409-II	KD-053-D	KY-898-A	WZ-095-A	CP-804-D
Type of Metal	I&E E (0.94%)	I&E NB	I&E E (0.94%)	I&E N	I&E NS
Days Since Last Startup	12	8	12	<1	8
Total Shutdowns	4	8	5	6	2
Rapid Shutdowns	1	8	5	6	2
Flow	71.1	47.2	49.2	46.8	58.4
Type of Failure	SH	SG	SH	SH	EM
Downtime Chargeable to Failure (hrs.)	4.3	1.1	2.7	10.8	2.9

Extracted from NEWELL 1964a, page 8.

RUPTURED SLUG DATA - NOVEMBER-DECEMBER 1963

Tube Number	3272-D	3890-F	1979-C	1558-DR	2886-II
Failure Number	1588	1589	1590	1591	1592
Date Failed	11-4-63	11-19-63	11-21-63	11-26-63	12-4-63
Date Charged	7-12-63	8-5-63	9-21-63	10-1-63	9-13-63
Days in File	115	106	61	56	82
Days of Operation	99	85	45	45	69
Tube Exposure	863	917	415	570	730
Tube Power at Failure	1214	1060	1161	1212	1147
Tube Power Average	1096	1005	1046	1118	1085
Slug Power	X	X	X	X	X
Slug Position	7-R	12-R	X	X	X
Canning Date	3-22-63	1-16-63	9-4-63	5-17-63	6-19-63
Lot Number	KD-058-D	GY-023-D	CJ-116-A	KY-907-E	CY-028-B
Type of Metal	I&E NB	I&E E (0.94%)	I&E N	I&E EB (0.94%)	I&E E (0.94%)
Days Since Last Startup	6	8	1	7	54
Total Shutdowns	11	10	7	2	4
Rapid Shutdowns	10	6	5	1	4
Flow	46.5	49.6	47.6	50.1	46.0
Type of Failure	SG	SU	UN	UN	SH
Downtime Chargeable to Failure (hrs.)	0.7	12.9	2.2	5.0	20.1

Extracted from NEWELL 1964a, page 9.

RUPTURED SLUG DATA - DECEMBER 1963

Tube Number	2676-F	3481-II	2490-B	2088-DR	2969-C
Failure Number	1593	1594	1595	1596	1597
Date Failed	12-21-63	12-24-63	12-27-63	12-26-63	12-30-63
Date Charged	11-4-63	9-13-63	11-4-63	11-16-63	12-4-63
Days in Pile	47	102	53	40	26
Days of Operation	36	86	48	33	21
Tube Exposure	436	863	459	307	227
Tube Power at Failure	1281	1154	1204	1223	1428
Tube Power Average	1209	1076	1155	1195	1306
Slug Power	X	X	X	X	X
Slug Position	11-R	8-R	X	16-R	X
Canning Date	8-2-63	2-28-63	10-28-63	10-22-63	11-15-63
Lot Number	KY-541-B	CD-884-A	U2-109-B	K2-756-C	CP-805-D
Type of Metal	I&E E (0.94%)	I&E N	I&E N	I&E N	I&E NS
Days Since Last Startup	7	7	15	11	7
Total Shutdowns	7	6	1	5	3
Rapid Shutdowns	3	5	0	4	2
Flow	47.2	43.8	46.8	47.3	59.5
Type of Failure	SU	SG	UN	SH	EM
Downtime Chargeable to Failure (hrs.)	32.0	29.8	25.7	7.1	2.0

Extracted from NEWELL 1964a, page 10.

APPENDIX N

FUEL-ELEMENT FAILURE DATA FOR 1964

RUPTURED SLUG DATA - JANUARY 1964

Tube Number	1265-IR	3663-DR	0678-F	3366-C	2181-B
Failure Number	1598	1599	1600	1601	1602
Date Failed	1-6-64	1-10-64	1-14-64	1-18-64	1-21-64
Date Charged	11-16-63	11-16-63	10-10-63	12-4-63	12-9-63
Days in Pile	51	55	96	45	43
Days of Operation	39	41	79	36	34
Tube Exposure	405	394	969	315	362
Tube Power at Failure	1278	1242	1226	1475	1302
Tube Power Average	1221	1189	1158	1322	1269
Slug Power	X	X	X	X	78.0
Slug Position	17-R	X	X	X	X
Canning Date	4-10-63	10-22-63	8-2-63	11-15-63	4-4-63
Lot Number	KZ-696-D	KZ-728-B	KY-541-B	CP-805-D	UZ-104-A
Type Metal	I&E N	I&E N	I&E E (0.94%)	I&E NS	I&E N
Days Since Last Startup	5	3	21	6	11
Total Shutdowns	7	8	10	7	2
Rapid Shutdowns	5	6	5	6	1
Flow	44.9	47.6	47.5	59.6	45.2
Type of Failure	SH	SH	UN	EM	SH
Downtime Charged to Failure	19.5	14.9	6.4	2.0	9.0

Extracted from NEWELL 1964b, page 7.

RUPTURED SLUG DATA - JANUARY-FEBRUARY 1964

Tube Number	1888-C	2263-DR	3781-F	3465-C	3473-D
Failure Number	1603	1604	1605	1606	1607
Date Failed	1-24-64	1-31-64	2-7-64	2-9-64	2-20-64
Date Charged	12-4-63	11-16-63	12-9-63	12-4-63	12-11-63
Days in Pile	51	76	60	67	71
Days of Operation	36	61	40	51	62
Tube Exposure	538	616	535	680	694
Tube Power at Failure	1394	1322	1283	1340	1234
Tube Power Average	1391	1234	1199	1226	1202
Slug Power	X	X	X	85.6	X
Slug Position	X	X	16-R	X	X
Canning Date	11-20-63	10-22-63	10-21-63	11-20-63	10-18-63
Lot Number	KC-279-A	KZ-758-C	KY-564-V	KC-279-A	KZ-699-B
Type Metal	1&E E (0.94%)	1&E N	1&E E (0.94%)	1&E E (0.94%)	1&E N
Days Since Last Startup	1	19	9	14	23
Total Shutdowns	9	9	3	11	2
Rapid Shutdowns	8	7	2	10	0
Flow	53.7	45.6	48.7	51.1	46.8
Type of Failure	SH	UN	SH	SH	SH
Downtime Charged to Failure	8.5	5.9	8.7	9.2	14.7

Extracted from NEWELL 1964b, page 8.

RUPTURED SLUG DATA - FEBRUARY-MARCH 1964

Tube Number	1377-H	1987-H	2257-F	2888-H	2167-F
Failure Number	1608	1609	1610	1611	1612
Date Failed	2-22-64	2-23-64	2-24-64	3-1-64	3-5-64
Date Charged	12-31-63	12-31-63	12-4-63	12-31-63	12-9-63
Days in Pile	53	54	82	61	87
Days of Operation	34	32	58	38	62
Tube Exposure	351	343	741	425	847
Tube Power at Failure	1270	1320	1277	1290	1388
Tube Power Average	1240	1321	1200	1273	1284
Slug Power	X	X	X	X	X
Slug Position	8-R	12-R	X	9-R	X
Canning Date	12-11-63	12-5-63	10-17-63	12-18-63	7-31-63
Lot Number	KY-585-B	KY-586-B	CY-029-V	KY-580-B	KY-527-B
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Startup	31	<1	15	6	7
Total Shutdowns	3	4	5	5	6
Rapid Shutdowns	2	3	3	4	5
Flow	45.5	47.3	48.0	48.7	51.9
Type of Failure	SH	SH	SH	SH	UN
Downtime Charged to Failure	30.1	12.8	4.7	15.3	6.1

Extracted from NEWELL 1964b, page 9.

RUPTURED SLUG DATA - MARCH 1964

Tube Number	2876-C	3975-DR	2464-DR	2181-B	3773-II
Failure Number	1613	1614	1615	1616	1617
Date Failed	3-5-64	3-9-64	3-11-64	3-11-64	3-14-64
Date Charged	1-24-64	12-26-63	12-13-63	1-21-64	12-31-63
Days in Pile	41	74	89	50	74
Days of Operation	34	62	76	43	50
Tube Exposure	499	646	1044	445	547
Tube Power at Failure	1542	1232	1278	1377	1296
Tube Power Average	1396	1225	1288	1270	1237
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	10-R
Canning Date	11-15-63	7-22-63	5-17-63	12-10-63	12-24-63
Lot Number	KC-260-B	KZ-71E-A	KY-463-V	OZ-008-B	KY-602-B
Type of Metal	I&E E (0.94%)	I&E N	I&E EB (0.94%)	I&E N	I&E E (0.94%)
Days Since Last Startup	<1	32	<1	16	12
Total Shutdowns	5	6	8	2	6
Rapid Shutdowns	4	3	5	0	5
Flow	53.7	45.4	47.1	44.9	46.5
Type of Failure	SII	SII	SU	SII	SII
Downtime Charged to Failure	7.7	10.9	19.2	6.2	17.2

Extracted from NEWELL 1964b, page 10.

RUPTURED SLUG DATA - APRIL 1964

Tube Number	3486-II	3059-II	2962-II	2057-II	2056-II
Failure Number	1618	1619	1620	1621	1622
Date Failed	4-3-64	4-4-64	4-4-64	4-4-64	4-5-64
Date Charged	12-31-63	12-31-63	12-31-63	12-31-63	12-31-63
Days in Pile	94	95	95	95	96
Days of Operation	69	68	68	68	69
Tube Exposure	785	759	776	790	788
Tube Power at Failure	1326	1255	1267	1273	1322
Tube Power Average	1293	1247	1276	1298	1360
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	16-R
Canning Date	11-27-63	12-2-63	12-19-63	12-16-63	12-20-63
Lot Number	KY-589-B	KY-912-B	KY-604-B	KY-595-B	KY-578-B
Type of Metal	18E E (0.94%)	18E E (0.94%)	18E E (0.94%)	18E E (0.94%)	18E E (0.94%)
Days Since Last					
Startup	18	<1	<1	<1	<1
Total Shutdowns	7	8	8	8	9
Rapid Shutdowns	6	7	7	7	8
Flow	48.4	48.6	46.7	48.3	49.2
Type of Failure	SII	SII	SII	SII	SII
Downtime Charged to Failure	9.0	3.3	3.3	3.3	9.6

Extracted from NEWELL 1964b, page 11.

RUPTURED SLUG DATA - APRIL 1964 (Cont'd)

Tube Number	2058-II	1785-II	0678-F	1681-C	3960-C
Failure Number	1623	1624	1625	1626	1627
Date Failed	4-5-64	4-5-64	4-6-64	4-13-64	4-15-64
Date Charged	12-31-63	12-31-63	1-14-64	3-25-64	3-25-64
Days in Pile	96	96	83	19	21
Days of Operation	69	69	51	16	16
Tube Exposure	809	785	621	244	239
Tube Power at Failure	1309	1320	1249	1357	1270
Tube Power Average	1328	1289	1164	1342	1354
Slug Power	X	X	X	X	94.4
Slug Position	8-R	X	6-R	X	20-R
Canning Date	10-24-63	12-4-63	6-12-63	2-5-64	2-4-64
Lot Number	KP-075-B	KY-572-B	KY-497-B	KC-284-A	KC-285-A
Type of Metal	TEE H	ISE E (0.94%)	ISE E (0.94%)	ISE E (0.94%)	ISE E (0.94%)
Days Since Last Startup	<1	<1	3	16	<1
Total Shutdowns	9	9	5	0	1
Rapid Shutdowns	8	8	4	0	1
Flow	48.7	49.1	47.4	51.3	51.6
Type of Failure	SH	SH	SH	SH	SH
Downtime Charged to Failure	9.6	9.6	7.7	5.9	7.0

Extracted from NCWELL 1964b, page 12.

RUPTURED SLUG DATA - APRIL 1964 (Cont'd)

Tube Number	1189-F	3257-DR	1958-D	2058-DR	2361-D
Failure Number	1628	1629	1630	1631	1632
Date Failed	4-15-64	4-15-64	4-16-64	4-22-64	4-22-64
Date Charged	1-14-64	3-11-64	2-20-64	3-11-64	3-31-64
Days in Pile	92	35	56	42	22
Days of Operation	58	26	33	27	5
Tube Exposure	555	349	485	357	50
Tube Power at Failure	1261	1223	1362	1223	1257
Tube Power Average	1148	1216	1348	1243	1257
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	12-26-63	1-16-64	9-23-63	1-20-64	10-29-63
Lot Number	KZ-044-B	KY-606-B	KY-517-B	KY-603-B	KZ-763-C
Type of Metal	IRE N	IRE E (0.94%)	IRE E (0.94%)	IRE E (0.94%)	IRE N
Days Since Last Startup	7	27	<1	<1	5
Total Shutdowns	6	0	2	1	1
Rapid Shutdowns	5	0	2	1	1
Flow	43.9	46.2	50.1	49.5	46.4
Type of Failure	UN	SH	SH	SH	SN
Downtime Charged to Failure	8.1	7.5	15.3	1.6	19.9

Extracted from NEWELL 1964b, page 13.

RUPTURED SLUG DATA - APRIL 1964 (Cont'd)

Tube Number	2772-B	3357-DR	3181-C	3788-DR
Failure Number	1633	1634	1635	1636
Date Failed	4-23-64	4-24-64	4-28-64	4-29-64
Date Charged	2-15-64	3-11-64	3-25-64	3-11-64
Days in Pile	68	44	34	49
Days of Operation	41	29	29	33
Tube Exposure	419	376	419	439
Tube Power at Failure	1278	1202	1373	1265
Tube Power Average	1298	1243	1356	1277
Slug Power	67.5	X	X	X
Slug Position	X	X	X	15-R
Canning Date	1-24-64	9-24-63	2-4-64	1-20-64
Lot Number	CZ-058-U	KY-537-B	KC-285-A	KY-603-B
Type of Metal	1&E N	1&E E (0.94%)	1&E E (0.94%)	1&E E (0.94%)
Days Since Last Startup	13	1	13	4
Total Shutdowns	4	2	2	4
Rapid Shutdowns	2	2	2	4
Flow	46.0	48.1	51.0	49.5
Type of Failure	SH	SH	SH	SH
Downtime Charged to Failure	2.7	21.6	13.7	13.4

Extracted from NEWELL 1964b, page 14.

RUPTURED SLUG DATA - MAY 1964

Tube Number	1290-F	2958-DR	1281-D	3173-C	0662-F
Failure Number	1637	1638	1639	1640	1641
Date Failed	5-2-64	5-2-64	5-2-64	5-4-64	5-5-64
Date Charged	3-4-64	3-11-64	3-20-64	3-25-64	3-4-64
Days in Pile	59	52	72	40	62
Days of Operation	40	43	46	31	41
Tube Exposure	379	402	501	405	501
Tube Power at Failure	811	1170	1362	1403	1141
Tube Power Average	1010	1171	1311	1324	1163
Slug Power	X	X	X	X	X
Slug Position	X	14-R	X	X	12-R
Canning Date	1-22-64	9-24-63	1-23-64	6-6-63	1-22-64
Lot Number	KY-596-V	KY-537-B	KZ-050-II	KC-242-A	KY-596-V
Type Metal	I&E E (0.94%)	I&E E (0.94%)	I&E N	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Startup	8	1	8	1	41
Total Shutdowns	6	5	4	3	7
Rapid Shutdowns	3	5	4	3	4
Flow	46.6	48.8	48.3	50.9	46.4
Type of Failure	SH	SH	SH	SH	SH
Downline Charged to Failure	8.1	14.3	2.9	5.1	8.2

Extracted from NEWELL 1964c, page 7.

RUPTURED SLUG DATA - MAY 1964 (Cont'd)

Tube Number	1179-DR	3960-C	1184-DR	3688-B	3361-C
Failure Number	1642	1643	1644	1645	1646
Date Failed	5-5-64	5-10-64	5-15-64	5-19-64	5-20-64
Date Charged	3-11-64	4-15-64	3-11-64	3-19-64	3-25-64
Days in Pile	55	27	65	61	56
Days of Operation	45	20	52	38	45
Tube Exposure	348	282	436	493	426
Tube Power at Failure	1274	1384	1262	1327	1229
Tube Power Average	1204	1291	1236	1306	1183
Slug Power	X	X	X	112.2	67.2
Slug Position	10-R	X	X	X	15-R
Canning Date	11-11-63	2-4-64	11-11-63	1-16-64	1-31-64
Lot Number	KZ-033-B	KC-286-A	KZ-033-B	KY-606-B	KI-069-A
Type of Metal	I&E E N	I&E E (0.94%)	I&E N	I&E E (0.94%)	I&E N
Days Since Last Startup	1	5	8	3	6
Total Shutdowns	6	2	7	4	6
Rapid Shutdowns	6	2	7	3	6
Flow	45.6	51.0	45.6	50.1	50.5
Type of Failure	SH	SH	SH	SH	SH
Downtime Charged to Failure	7.5	15.7	4.9	13.9	5.5

Extracted from NEWELL 1964c, page 8.

RUPTURED SLUG DATA - MAY-JULY 1964

Tube Number	4071-B	2676-H	3679-DR	3363-C	4755-KW
Failure Number	1647	1648	1649	1650	1651
Date Failed	5-27-64	5-28-64	6-3-64	6-15-64	7-2-64
Date Charged	3-19-64	4-5-64	4-15-64	5-20-64	5-11-64
Days in Pile	69	53	49	26	52
Days of Operation	45	38	43	19	45
Tube Exposure	593	422	321	166	630
Tube Power at Failure	1240	1206	1155	1224	1855
Tube Power Average	1234	1247	1182	1238	1858
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	1-22-64	2-7-64	2-21-64	4-15-64	8-12-64
Lot Number	KY-596-V	KY-609-B	KZ-072-A	CP-806-M	KK-413-H
Type of Metal	I&E E (0.94%)	I&E E (0.94%)	I&E N	I&E NS	I&E E (0.94%)
Days Since Last Startup	6	33	1	<1	13
Total Shutdowns	5	3	8	5	2
Rapid Shutdowns	4	2	7	3	2
Flow	44.0	47.2	48.0	59.7	71.1
Type of Failure	UN	SH	UN	EM	SH
Downtime Charged to Failure	45.9	26.2	14.7	5.9	10.7

Extracted from NEWELL 1964c, page 9.

RUPTURED SLUG DATA - JULY-AUGUST 1964

Tube Number	3160-DR	4174-F	1858-DR	1459-C	1583-DR
Failure Number	1652	1653	1654	1655	1656
Date Failed	7-13-64	7-19-64	7-31-64	7-31-64	8-11-64
Date Charged	6-1-64	6-6-64	5-2-64	4-28-64	7-31-64
Days in Pile	42	43	90	94	11
Days of Operation	37	37	79	63	6
Tube Exposure	356	445	965	477	50
Tube Power at Failure	1146	1139	1162	1011	1142
Tube Power Average	1151	1147	1140	1106	1148
Slug Power	X	X	X	X	X
Slug Position	17-R	X	X	X	X
Canning Date	4-27-64	4-16-64	3-2-64	4-15-64	6-15-64
Lot Number	KZ-103-A	KY-634-B	SY-044-B	CP-807-M	KZ-115-A
Type of Metal	18E N	18E E (0.94%)	18E E (0.94%)	18E NS	18E W
Days Since Last Startup	11	12	16	3	5
Total Shutdowns	3	4	7	13	0
Rapid Shutdowns	2	3	5	10	0
Flow	47.4	44.7	48.0	56.0	47.8
Type of Failure	SH	SH	SH	EU	SD
Downtime Charged to Failure	14.3	8.4	86.5	4.7	8.9

Extracted from NEWELL 1964c, page 10.

RUPTURED SLUG DATA - AUGUST 1964

Tube Number	0863-B	3776-B	0788-F
Failure Number	1657	1658	1659
Date Failed	8-16-64	8-23-64	8-31-64
Date Charged	6-17-64	6-16-64	7-18-64
Days in File	60	68	44
Days of Operation	47	53	41
Tube Exposure	439	472	462
Tube Power at Failure	1140	1088	1088
Tube Power Average	1106	1065	1063
Slug Power	X	70.0	X
Slug Position	13-R	15-R	X
Canning Date	5-15-64	5-15-64	4-22-64
Lot Number	KZ-1C7-A	KZ-107-A	KY-633-V
Type of Metal	I&E N	I&E N	I&E EB (0.94%)
Days Since Last Startup	17	5	24
Total Shutdowns	2	3	1
Rapid Shutdowns	1	2	0
Flow	43.5	41.7	49.7
Type of Failure	SH	SH	IM
Downtime Charged to Failure	14.7	30.4	7.2

Extracted from NEWELL 1964c, page 11.

RUPTURED SLUG DATA - SEPTEMBER 1964

Tube Number	3880-B	2362-DR	3566-B	3261-II	2378-II
Failure Number	1660	1661	1662	1663	1664
Date Failed	9-2-64	9-10-64	9-18-64	9-20-64	9-22-64
Date Charged	6-16-64	6-30-64	7-18-64	7-5-64	7-5-64
Days in Pile	78	72	62	77	79
Days of Operation	60	61	43	70	71
Tube Exposure	570	563	392	739	664
Tube Power at Failure	1148	1166	1164	1164	1147
Tube Power Average	1092	1143	1078	1157	1118
Slug Power	X	X	X	X	X
Slug Position	X	X	18-R	X	X
Canning Date	4-1-64	5-13-64	4-30-64	6-10-64	6-10-64
Lot Number	KZ-086-A	KZ-102-A	KZ-098-A	KY-665-Q	KY-665-Q
Type Metal	I&E N	I&E N	I&E N	I&E EB (0.94%)	I&E EB (0.94%)
Days Since Last Startup	5	28	13	70	<1
Total Shutdowns	5	4	5	1	2
Rapid Shutdowns	4	4	5	1	2
Flow	44.4	45.8	46.5	47.5	47.3
Type of Failure	SH	SH	SH	IM	IM
Downtime Charged to Failure	21.6	1.5	47.4	25.3	15.9

Extracted from NEWELL 1965a, page 7.

RUPTURED SLUG DATA - SEPTEMBER-OCTOBER 1964

Tube Number	0868-DR	2561-DR	1360-DR	3259-D	1161-DR
Failure Number	1665	1666	1667	1668	1669
Date Failed	9-26-64	10-2-64	10-7-64	10-8-64	10-10-64
Date Charged	6-30-64	7-31-64	7-31-64	9-7-64	7-31-64
Days in Pile	88	63	68	31	71
Days of Operation	74	52	55	27	57
Tube Exposure	917	493	694	235	689
Tube Power at Failure	1234	1159	1252	1095	1214
Tube Power Average	1140	1140	1200	1047	1166
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	5-20-64	5-5-64	7-24-64	7-27-64	7-24-64
Lot Number	CY-037-Q	CD-888-A	KY-682-Q	KZ-138-A	KY-682-Q
Type Metal	I&E EB (0.94%)	I&E N	I&E EB (0.94%)	I&E N	I&E EB (0.94%)
Days Since Last Start-up	13	6	3	27	2
Total Shutdowns	5	4	5	0	6
Rapid Shutdowns	5	4	5	0	6
Flow	47.8	44.8	43.1	47.9	47.5
Type of Failure	UE	SG	SG	SH	IG
Downtime Charged to Failure	9.5	38.0	19.8	2.6	25.9

Extracted from NEWELL 1965a, page 8.

RUPTURED SLUG DATA - OCTOBER 1964

Tube Number	1374-B	0886-D	0576-II	1364-DR	2763-C
Failure Number	1670	1671	1672	1673	1674
Date Failed	10-11-64	10-13-64	10-14-64	10-19-64	10-21-64
Date Charged	7-18-64	8-9-64	7-5-64	7-31-64	9-1-64
Days in Pile	85	65	101	80	50
Days of Operation	62	58	84	64	41
Tube Exposure	628	754	776	586	527
Tube Power at Failure	1214	1256	1175	1156	1354
Tube Power Average	1182	1225	1097	1115	1263
Slug Power	X	X	X	X	X
Slug Position	18-R	11-R	6-R	X	X
Canning Date	5-25-64	7-20-64	6-16-64	5-22-64	6-24-64
Lot Number	KZ-113-A	KY-676-Q	KY-670-Q	KZ-110-A	CC-008-A
Type Metal	I&E N	I&E EB (0.94%)	I&E EB (0.94%)	I&E N	I&E E (0.94%)
Days Since Last Start-up	19	4	10	7	6
Total Shutdowns	6	2	6	7	2
Rapid Shutdowns	6	1	5	7	1
Flow	46.2	49.6	46.9	46.3	62.9
Type of Failure	SH	SU	SG	UN	SH
Downtime Charged to Failure	22.2	10.7	5.6	12.7	8.2

Extracted from NEWELL 1965a, page 9.

RUPTURED SLUG DATA - OCTOBER-NOVEMBER 1964

Tube Number	0964-B	2774-C	1560-B	2585-II	2078-F
Failure Number	1675	1676	1677	1678	1679
Date Failed	10-24-64	10-24-64	11-4-64	11-4-64	11-6-64
Date Charged	9-2-64	9-21-64	9-2-64	9-20-64	8-31-64
Days in Pile	52	33	63	45	67
Days of Operation	40	26	45	34	58
Tube Exposure	389	368	427	341	708
Tube Power at Failure	1274	1376	1309	1168	1153
Tube Power Average	1136	1340	1111	1201	1096
Slug Power	86.6	78.7	X	X	X
Slug Position	X	X	X	13-R	X
Canning Date	7-29-64	6-24-64	4-30-64	9-8-64	8-14-64
Lot Number	KZ-132-A	CC-008-A	KZ-097-A	KZ-156-C	KY-693-Q
Type Metal	I&E N	I&E E (0.94%)	I&E N	I&E N	I&E EB (0.94%)
Days Since Last Start-up	7	2	3	19	17
Total Shutdowns	3	2	6	5	5
Rapid Shutdowns	3	1	6	4	3
Flow	45.4	58.4	46.6	46.9	44.1
Type of Failure	SH	SH	UN	SU	UE
Downtime Charged to Failure	10.2	20.6	18.6	43.2	2.4

Extracted from NEWELL 1965a, page 10.

RUPTURED SLUG DATA - NOVEMBER 1964

Tube Number	2868-C	0969-D	3161-D	0986-B	31485-D
Failure Number	1680	1681	1682	1683	1684
Date Failed	11-9-64	11-13-64	11-14-64	11-14-64	9-7-64
Date Charged	7-9-64	9-7-64	9-7-64	9-2-64	77
Days in Pile	123	67	68	73	49
Days of Operation	84	62	43	53	473
Tube Exposure	767	415	420	521	
Tube Power at Failure	1467	1286	1277	1305	
Tube Power Average	1315	1158	1137	1134	1137
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	Unknown	4-6-64	7-27-64	7-29-64	7-27-64
Lot Number	Unknown	KZ-087-A	KZ-138-A	KZ-132-A	KZ-127-C
Type Metal	I&E NS	I&E N	I&E N	I&E N	I&E N
Days Since Last Start-up	12	4	<1	8	3
Total Shutdowns	9	1	6	7	8
Rapid Shutdowns	6	1	5	7	7
Flow	56.6	47.8	46.7	46.5	47.5
Type of Failure	UN	SH	SH	UN	SH
Downtime Charged to Failure	2.3	7.1	13.3	16.3	31.4

Extracted from NEWELL 1965a, page 11.

RUPTURED SLUG DATA - NOVEMBER-DECEMBER 1964

Tube Number	1085-II	3674-D	4189-KE	2676-F	3581-B
Failure Number	1685	1686	1687	1688	1689
Date Failed	11-25-64	11-29-64	12-4-64	12-8-64	12-13-64
Date Charged	9-20-64	9-7-64	8-19-64	10-16-64	9-2-64
Days in Pile	66	83	107	53	102
Days of Operation	52	53	77	44	77
Tube Exposure	507	493	962	463	748
Tube Power at Failure	1236	1226	1981	1290	1291
Tube Power Average	1185	1107	1881	1192	1108
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	9-3-64	8-21-64	8-19-64	9-30-64	4-28-64
Lot Number	KZ-160-A	KZ-140-A	KG-117-N	KZ-173-C	KZ-104-A
Type Metal	I&E N	I&E N	I&E NS	I&E N	I&E N
Days Since Last Start-up	18	4	14	14	24
Total Shutdowns	6	9	7	4	8
Rapid Shutdowns	5	8	5	4	8
Flow	46.9	46.4	72.3	45.6	47.1
Type of Failure	SH	SH	SL	SH	UN
Downtime Charged to Failure	13.3	31.1	8.6	2.3	10.3

Extracted from NEWELL 1965a, page 12.

RUPTURED SLUG DATA - DECEMBER 1964

Tube Number	3686-B	2561-DR	1961-DR	1961-B	3369-C
Failure Number	1690	1691	1692	1693	1694
Date Failed	12-16-64	12-21-64	12-23-64	12-25-64	12-31-64
Date Charged	11-14-64	11-20-64	11-20-64	11-14-64	11-23-64
Days in File	32	31	33	41	38
Days of Operation	23	29	29	32	27
Tube Exposure	260	130	133	357	361
Tube Power at Failure	1235	1310	1300	1251	1436
Tube Power Average	1188	1182	1182	1189	1209
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	10-15-64	11-2-64	10-8-64	10-15-64	9-14-64
Lot Number	KZ-183-A	KZ-189-C	KZ-170-U	KZ-183-A	KC-299-A
Type Metal	I&E N	I&E N	I&E N	I&E N	I&E E (0.94%)
Days Since Last Start-up	41	29	41	8	4
Total Shutdowns	1	1	2	2	4
Rapid Shutdowns	1	1	2	2	3
Flow	45.5	51.9	48.0	44.8	60.5
Type of Failure	UN	UN	SH	UN	SH
Downtime Charged to Failure	1.9	44.2	6.5	24.2	13.6

Extracted from NEWELL 1965a, page 13.

APPENDIX O

FUEL-ELEMENT FAILURE DATA FOR 1965

RUPTURED SLUG DATA - JANUARY 1965

Tube Number	2664-D	0880-II	1380-B	3366-C	2264--D
Failure Number	1695	1696	1697	1698	1699
Date Failed	1-2-65	1-6-65	1-7-65	1-13-65	1-13-65
Date Charged	12-9-64	12-5-64	11-14-64	10-10-64	12-9-64
Days in Pile	24	32	54	95	35
Days of Operation	19	27	43	70	28
Tube Exposure	21.1	26.4	49.1	62.6	290
Tube Power at Failure	1374	1333	1398	1598	1261
Tube Power Average	1291	1150	1531	1266	1264
Slug Power	X	X	87.8	109.6	X
Slug Fastion	X	X	X	X	15-R
Examining Date	10-12-64	10-28-64	10-16-64	5-13-64	9-29-64
Vol. Number	KZ-179-C	KZ-186-A	13-079-C	CP-808-M	KZ-175-A
Type Metal	13E N	13E N	13E N	13E NS	13E N
Days Since Last Startup	19	24	11	9	9
Total Shutdowns	1	1	3	11	2
Rapid Shutdowns	1	0	3	6	2
Flow	47.1	47.4	46.9	56.7	48.0
Type of Failure	SH	SH	SH	EM	SH
Downtime Charged to Failure	13.6	18.7	10.6	3.7	8.9

RUPTURED SLUG DATA - JANUARY 1965 (Cont'd)

Tube Number	1563-D	3069-C	3169-C	2661-D	0966-II
Failure Number	1700	1701	1702	1703	1704
Date Failed	1-15-65	1-16-65	1-17-65	1-19-65	1-19-65
Date Charged	12-9-64	10-10-64	11-9-64	12-9-64	12-5-64
Days in File	37	98	69	41	45
Days of Operation	29	72	51	31	38
Tube Exposure	319	615	455	333	389
Tube Power at Failure	1149	1426	1553	1321	1345
Tube Power Average	1359	1274	1370	1349	1283
Slug Power	X	101.6	115.1	X	X
Slug Position	14-R	X	X	17-R	12-R
Canning Date	10-12-64	5-13-64	7-7-64	9-15-64	9-3-64
Lot Number	KZ-119-C	CF-508-M	KE-041-M	KZ-157-A	KZ-160-A
Type Metal	18E N	18E NS	18E NS	18E N	18E N
Days Since Last Startup	1	2	<1	2	11
Total Shutdowns	3	12	9	4	2
Rapid Shutdowns	5	7	5	4	1
Flow	47.5	59.6	58.6	50.2	46.8
Type of Failure	SU	EM	EM	SU	SU
Downtime Charged to Failure	11.9	5.5	4.6	12.9	12.7

RUPTURED SLUG DATA - JANUARY-FEBRUARY 1965

Tube Number	4553-KW	3973-B	0773-II	2674-D	3882-KE
Failure Number	T1	1705	1706	1707	1708
Date Failed	1-19-65	1-31-65	2-6-65	2-10-65	2-13-65
Date Charged	11-29-64	11-14-64	12-6-64	12-9-64	1-24-65
Days in Pile	51	78	62	63	20
Days of Operation	40	62	54	51	15
Tube Exposure	804	597	552	535	174
Tube Power at Failure	202	1245	1311	1250	1615
Tube Power Average	190	1155	1257	1262	1618
Slug Power	X	X	X	X	X
Slug Position	X	X	X	15-R	X
Canning Date	X	10-16-64	10-14-64	10-12-64	10-2-64
Lot Number	TK-1808	CZ-079-G	CZ-079-G	KZ-179-G	CV-018-NX
Type Metal	Solid Thorium	IAE N	IAE N	IAE N	IAE NS
Days Since Last Startup	6	19	17	21	14
Total Shutdowns	5	4	3	6	1
Rapid Shutdowns	3	4	2	6	1
Flow	19.8	45.0	47.2	47.2	66.9
Type of Failure	EM	SH	UN	SH	EM
Downtime Charged to Failure	13.3	6.8	5.1	7.9	9.3

* Expressed as per cent of g.w.

RUPTURED SLUG DATA - FEBRUARY 1965

Tube Number	2967-C	2067-J	5881-KE	1283-F	1865-KW
Failure Number	1709	1710	T2	1711	T3
Date Failed	2-15-65	2-18-65	2-18-65	2-22-65	2-22-65
Date Charged	2-2-65	12-9-64	12-31-64	12-27-64	1-23-65
Days in Pile	13	7	49	57	30
Days of Operation	85	57	40	48	28
Tube Exposure	1148	578	24*	516	63*
Tube Power at Failure	1109	1290	57	1394	159
Tube Power Average	X	1252	62	1306	140
Slug Power	X	X	X	X	X
Slug Position	13-R	X	X	X	X
Canning Date	12-17-64	10-16-64	X	11-30-64	X
Lot Number	CP-809-M	KZ-184-C	TC-2250	KZ-210-A	TK-4340
Type Metal	13E NS	13E N	Solid Thoria	13E N	Solid Thoria
Days Since Last Startup	8	5	3	14	28
Total Shutdowns	1	7	3	2	0
Rapid Shutdowns	0	7	2	1	0
Flow	59.0	49.0	31.1	48.3	19.5
Type of Failure	EM	SU	EM	SH	SM
Downtime Charged to Failure	4.4	5.5	9.1	9.7	0.5

* Expressed as per cent of goal.

RUPTURED SLUG DATA - FEBRUARY-MARCH 1965

Tube Number	3083-KW	3280-II	3098-KE	1476-II	3385-II
Failure Number	T4	1712	T5	1713	1714
Date Failed	2-22-65	2-23-65	3-1-65	3-3-65	3-4-65
Date Charged	1-23-65	2-6-65	12-31-64	2-6-65	2-6-65
Days in Pile	30	17	60	25	26
Days of Operation	28	13	49	19	18
Tube Exposure	63*	127	29*	189	205
Tube Power at Failure	133	1385	62	1397	1331
Tube Power Average	123	1315	60	1364	1253
Slug Power	X	X	X	X	X
Slug Position	X	13-R	X	10-R	13-R
Canning Date	X	1-11-65	X	10-8-64	1-11-65
Lot Number	X	KZ-238-A	TC-2650	KD-096-A	KZ-235-A
Type Metal	Solid Thorata	IRE N	Solid Thorata	IRE N	IRE N
Days Since Last Startup	28	11	8	5	<1
Total Shutdowns	0	1	4	2	3
Rapid Shutdowns	0	1	3	2	3
Flow	18.8	46.7	29.2	46.5	48.1
Type of Failure	SM	SH	UN	SH	SH
Downtime Charged to Failure	0.5	26.5	32.1	31.0	14.5

* Expressed as per cent of gal.

Extracted from NEWELL 1965b, page 11.

RUPTURED SLUG DATA - MARCH 1965

Tube Number	2760-B	3266-C	3988-B	0172-C	1853-KW
Failure Number	1715	1716	1717	T6	T7
Date Failed	3-11-65	3-14-65	3-25-65	3-25-65	3-29-65
Date Charged	12-13-64	1-16-65	1-31-65	12-24-64	1-23-65
Days in Pile	88	57	53	91	65
Days of Operation	68	39	43	66	54
Tube Exposure	761	413	572	52*	115*
Tube Power at Failure	1385	1489	1334	56	136
Tube Power Average	1325	1324	1248	39	151
Slug Power	X	X	X	X	X
Slug Position	X	12-R	X	4-R	X
Canning Date	11-13-64	X	8-10-64	X	X
Lot Number	KV-725-Q	CP-003-M	CY-039-A	TC-1650	TK-4440
Type Metal	1&E EB (0.94%)	1&E NS	1&E E (0.94%)	Solid Thorla	Solid Thorla
Days Since Last Startup	6	10	13	10	24
Total Shutdowns	6	12	3	13	2
Rapid Shutdowns	5	8	2	9	2
Flow	45.5	60.7	47.2	28.4	19.5
Type of Failure	SU	EM	SH	SM	SM
Downtime Charged to Failure	18.1	4.9	7.8	5.2	3.0

* Expressed as per cent of goal.

RUPTURED SLUG DATA - MARCH-APRIL 1965

Tube Number	4265-KW	5885-KE	3263-KE	2886-II	3451-KW
Failure Number	T8	T9	1718	1719	1720
Date Failed	3-29-65	3-31-65	4-3-65	4-4-65	4-8-65
Date Charged	1-23-65	3-1-65	2-14-65	2-6-65	2-22-65
Days in Pile	65	30	48	57	45
Days of Operation	54	26	40	47	29
Tube Exposure	115*	45*	566	481	474
Tube Power at Failure	146.	76.	1378	1266	1876
Tube Power Average	153	58	1860	1272	2006
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	X	X	1-21-65	1-6-65	1-20-65
Lot Number	X	X	KG-176-D	KZ-228-A	KG-173-M
Type Metal	Solid Thoria	Solid Thoria	ISE ES (0.914%)	ISE N	ISE ES (0.94%)
Days Since Last Startup	24	26	<1	26	2
Total Shutdowns	2	0	3	4	4
Rapid Shutdowns	2	0	1	4	4
Flow	19.4	32.1	68.9	47.1	75.1
Type of Failure	EM	UN	EM	SH	EM
Downtime Charged to	3.0	10.6	6.8	30.0	20.0

* Expressed as per cent of goal.

Extracted from NEWELL 1965b, page 13.

RUPTURED SLUG DATA - MAY 1965

Tube Number	4971-KW	3553-KW	2863-C	2582-KE	1196-C
Failure Number	T10	T11	1721	1722	T12
Date Failed	5-3-65	5-3-65	5-8-65	5-9-65	5-12-65
Date Charged	1-23-65	1-23-65	2-15-65	4-9-65	12-24-64
Days in Pile	100	100	82	30	139
Days of Operation	80	80	70	29	103
Tube Exposure	75*	75*	686	372	87*
Tube Power at Failure	225	217	1396	1881	42
Tube Power Average	169	178	1424	1927	32
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	X	X	5-13-64	3-31-65	X
Lot Number	X	TK-6940	CP-808-M	KK-450-A	TC-1550
Type of Metal	Solid Thoria	Solid Thoria	I&E NS	I&E E (0.94%)	Solid Thoria
Days Since Last Startup	23	23	22	21	<1
Total Shutdowns	6	6	7	1	19
Rapid Shutdowns	6	6	4	1	13
Flow	20.2	19.1	52.3	71.4	29.1
Type of Failure	EM	EM	EM	SH	EM
Downtime Charged to Failure	2.4	2.0	2.7	3.4	2.6

* Expressed as per cent of goal.

RUPTURED SLUG DATA - MAY 1965 (Cont'd)

Tube Number	2396-C	3496-C	3074-C	3962-B	1077-B
Failure Number	T13	T14	1723	1724	1725
Date Failed	5-12-65	5-14-65	5-16-65	5-20-65	5-24-65
Date Charged	12-24-64	12-24-64	4-12-65	3-25-65	4-27-65
Days in Pile	139	141	34	56	27
Days of Operation	103	103	23	48	20
Tube Exposure	87*	88*	301	496	214
Tube Power at Failure	63	42	1548	1247	1329
Tube Power Average	48	37	1482	1239	1287
Slug Power	X	X	X	X	X
Slug Position	X	X	X	X	5-R
Canning Date	X	X	3-29-65	1-19-65	4-7-65
Lot Number	TC-1650	TP-0210	KC-322-A	KZ-249-A	CZ-089-Q
Type Metal	Solid Thoria	Solid Thoria	I&E E (0.94%)	I&E N	I&E NB
Days Since Last Startup	<1	<1	2	19	1
Total Shutdowns	19	20	6	2	2
Rapid Shutdowns	13	14	5	1	2
Flow	32.0	34.7	60.4	47.2	48.0
Type of Failure	EM	EM	SH	SH	SD
Downtime Charged to Failure	2.6	3.4	60.5	1.5	10.9

* Expressed as per cent of goal.

Extracted from NEWELL 1965c, page 8.

RUPTURED SLUG DATA - MAY-JUNE 1965

Tube Number	2360-C	3077-C	0358-C	3380-KE	4168-KW
Failure Number	1726	1727	T15	1728	T16
Date Failed	5-26-65	6-17-65	6-23-65	6-23-65	6-26-65
Date Charged	4-12-65	4-12-65	12-24-64	5-9-65	5-3-65
Days in Pile	44	66	181	45	54
Days of Operation	29	50	134	35	45
Tube Exposure	469	815	106*	562	92*
Tube Power at Failure	1477	1526	85	1858	206
Tube Power Average	1424	1514	54	1920	144
Slug Power	80.24	X	X	X	X
Slug Position	X	X	X	X	X
Canning Date	3-26-65	3-29-65	X	3-2-65	X
Lot Number	KC-324-A	KC-322-A	TC-1250	KC-204-N	TK-9240
Type Metal	I&E E (0.94%)	I&E E (0.94%)	Solid Thoria	I&E ES (0.94%)	Solid Thoria
Days Since Last Startup	6	20	1	29	20
Total Shutdowns	7	8	25	1	8
Rapid Shutdowns	6	7	19	0	8
Flow	55.7	63.5	27.7	72.7	20.0
Type of Failure	SH	SH	EM	SM	EM
Downtime Charged to Failure	3.0	2.8	7.3	5.2	22.2

* Expressed as per cent of goal.

RUPTURED SLUG DATA - JULY 1965

Tube Number	4558-KW	3293-B	2668-D	2782-C	2964-KW
Failure Number	1729	1730	1731	1732	1733
Date Failed	7-5-65	7-11-65	7-16-65	7-19-65	7-22-65
Date Charged	6-1-65	5-26-65	5-18-65	5-8-65	6-1-65
Days in Pile	34	46	59	72	51
Days of Operation	29	37	45	50	34
Tube Exposure	404	223	429	761	485
Tube Power at Failure	1443	759	1140	1411	1728
Tube Power Average	1836	751	1165	1418	1768
Slug Power	X	X	X	93.7	X
Slug Position	X	13-R	X	X	X
Canning Date	5-27-65	1-25-65	1-22-65	2-5-65	5-27-65
Lot Number	KK-452-A	KZ-254-A	KZ-252-A	KK-314-A	KK-452-A
Type Metal	I&E E (0.94%)	I&E N	I&E N	I&E E (0.94%)	I&E E (0.94%)
Days Since Last Startup	28	6	15	10	6
Total Shutdowns	7	2	4	13	11
Rapid Shutdowns	7	0	2	11	11
Flow	70.2	46.4	48.2	66.5	68.4
Type of Failure	SH	SD	SH	SH	SH
Downtime Charged to Failure	3.4	24.5	7.4	7.5	10.3

* Expressed as per cent of goal.

Extracted from NEWELL 1965c, page 10.

RUPTURED SLUG DATA - JULY-AUGUST 1965

Tube Number	326h-C	3853-C	3067-C	2865-C	3389-D	1365-D
Failure Number	1734	TL7	1735	1736	1737	1738
Date Failed	7-28-65	7-27-65	8-15-65	8-21-65	8-27-65	3-29-65
Date Charged	3-25-65	12-25-64	7-2-65	5-26-65	8-8-65	7-17-65
Days in Pile	125	214	44	87	19	43
Days of Operation	95	159	34	67	14	32
Tube Exposure	839	114*	196	555	172	388
Tube Power at Failure	1205	112	1119	1375	977	1218
Tube Power Average	1271	106	1067	1296	1100	1252
Slug Power	X	X	X	X	X	X
Slug Position	X	X	X	X	X	2-R
Canning Date	X	X	X	X	7-19-65	X
Lot Number	CP-808-M	TC-1250	KX-046-M**	KX-020-M**	KY-797-Q	40L-2**
Type Metal	I&E NS	Solid Thoria	I&E NS	I&E NS	I&E EB (0.94%)	I&E E (0.94%)
Days Since Last Startup	6	6	13	5	<1	<1
Total Shutdowns	17	31	4	10	3	6
Rapid Shutdowns	13	13	3	8	3	5
Flow	56.4	30.9	59.8	55.5	46.5	48.3
Type of Failure	EM	EM	HM	SL	EM	SG
Downtime Charged to Failure	20.2	0.9	2.5	33.1	15.9	15.4

* Expressed as per cent of goal.

** Oil quenched hot-die-size fuel.

Extracted from NEWELL 1965c, page 11.

FUEL FAILURE DATA - SEPTEMBER 1965

Tube Number	1367-D	3269-C	2898-KE	1464-C	3988-C	4077-B
Failure number	1739	1740	1720	1741	1742	1743
Date failed	9-7-65	9-11-65	9-13-65	9-22-65	9-26-65	9-30-65
Date charged	7-17-65	6-17-65	8-9-65	6-17-65	7-28-65	8-2-65
Days in reactor	52	86	35	97	60	59
Days of operation	39	66	29	75	46	48
Tube exposure	485	568	17*	654	569	455
Tube power average	1242	1337	42	1390	1181	1097
Fuel element power	X	X	X	X	X	X
Fuel element position	5-R	X	X	X	16-R	16-R
Canning date	7-1-65	3-19-65	X	3-19-65	6-18-65	2-1-65
Lot number	PR-781 ¹	IX-004-M	X	IX-004-M	KC-335-A	CZ-088-A
Type of metal	I&E E (0.94%)	I&E NS	Solid thoria	I&E NS	I&E E (0.94%)	I&E N
Days since last start-up	7	19	25	4	3	19
Total shutdowns	7	10	2	12	5	1
Rapid shutdowns	6	8	2	10	5	0
Flow	50.9	58.9	30.0	57.5	53.0	44.1
Type of failure	SG	SL	UN	SU	SH	SU
Downtime charged to failure (hours)	16.3	6.6	18.8	13.8	21.7	18.9
Tube power at failure	1234	1313	X	1470	1282	1161

* Expressed as percent of goal

¹ Oil-quenched hot-die-sized test

Extracted from NEWELL 1966a, page 6.

FUEL FAILURE DATA - OCTOBER 1965

Tube Number	1570-D	4474-B	1568-D	5852-KE	1370-D	4376-KE
Failure number	1744	1745	1746	T-21	1747	1748
Date failed	10-10-65	10-13-65	10-18-65	10-21-65	10-25-65	10-26-65
Date charged	7-16-65	5-24-65	7-16-65	8-9-65	7-16-65	9-13-65
Days in reactor	86	142	94	73	101	43
Days of operation	70	117	75	60	80	31
Tube exposure	874	801	871	30*	1038	346
Tube power at failure	1247	720	1208	65	1214	1656
Tube power average	1225	813	1165	52	1211	1657
Fuel element power	X	X	X	X	X	X
Fuel element position	1-R	X	7-R	X	10-R	X
Canning date	7-1-65	4-7-65	7-1-65	X	7-1-65	7-6-65
Lot number	PT-781 ¹	KY-776-A	PT-781 ¹	TD-3508	PT-781 ¹	CV-029-E
Type of metal	I&E E (0.94%)	I&E E (0.94%)	I&E E (0.94%)	Solid thoria	I&E E (0.94%)	I&E NS
Days since last start-up	16	9	4	30	7	21
Total shutdowns	9	7	10	5	11	6
Rapid shutdowns	7	3	8	3	9	3
Flow	50.2	45.3	47.4	30.9	49.8	70.6
Type of failure	SN	IM	SG	EM	SG	EM
Downtime charged to failure (hours)	32.1	10.8	19.1	7.6	2.7	14.1

* Expressed as percent of goal

¹ Oil-quenched hot-die-sized-test

Extracted from NEWELL 1966a, page 7.

FUEL FAILURE DATA - NOVEMBER 1965

Tube Number	4384-KE	2970-KW	1585-B	0761-KE	2889-C	2783-C
Failure number	1749	1750	1751	1752	1753	1754
Date failed	11-11-65	11-14-65	11-18-65	11-21-65	11-22-65	11-26-65
Date charged	9-13-65	9-20-65	8-2-65	9-13-65	10-9-65	10-9-65
Days in reactor	59	55	108	69	44	48
Days of operation	44	42	91	54	26	28
Tube exposure	507	486	900	589	289	433
Tube power at failure	1764	1761	1270	1728	1368	1491
Tube power average	1746	1697	1197	1565	1203	1295
Fuel element power	X	X	X	X	X	82.8
Fuel element position	X	X	7-R	X	18-R	X
Canning date	7-6-65	8-23-65	5-10-65	8-19-65	9-7-65	9-9-65
Lot number	CV-029-E	KF-761-A	CD-890-Q	KF-757-A	KJ-649-A	KC-346-A
Type of metal	I&E NS	I&E N	I&E N	I&E N	I&E N	I&E F (0.944)
Days since last start-up	41	8	13	9	22	1
Total shutdowns	8	4	4	10	1	2
Rapid shutdowns	4	3	2	6	1	2
Flow	72.7	66.9	46.8	66.1	55.1	59.8
Type of failure	EM	SU	SG	SH	SH	SH
Downtime charged to failure (hours)	2.8	53.5	2.0	1.9	15.5	4.3

Extracted from NEWELL 1966a, page 8.

FUEL FAILURE DATA - NOVEMBER-DECEMBER 1965

Tube Number	1053-KW	4281-C	3579-KW	1378-C	4466-C	4274-KE
Failure number	1755	1756	1757	1758	1759	T-22
Date failed	11-26-65	12-1-65	12-5-65	12-23-65	12-28-65	12-30-65
Date charged	11-13-65	10-9-65	9-20-65	10-9-65	6-17-65	11-21-65
Days in reactor	13	53	76	57	94	39
Days of operation	4	32	55	30	48	31
Tube exposure	37	456	601	541	745	46*
Tube power at failure	1705	1408	1707	1493	1557	187
Tube power average	1700	1318	1630	1374	1306	200
Fuel element power	X	X	X	93.9	X	X
Fuel element position	X	17-R	X	13-R	X	X
Canning date	11-5-65	9-9-65	6-2-65	9-3-65	3-19-65	X
Lot number	KG-261-D	KG-346-A	KF-755-A	KJ-647-A	LX-004-M	TK-9730-A
Type of metal	18E ES (0.944)	18E E (0.944)	18E N	18E N	18E NS	Solid thoria
Days since last start-up	4	4	8	7	3	24
Total shutdowns	0	3	6	6	15	1
Rapid shutdowns	0	3	5	5	13	0
Flow	64.7	59.7	64.0	54.6	61.5	19.5
Type of failure	HU	SH	SH	SH	SG	ED
Downtime charged to failure (hours)	4.6	20.6	4.4	13.5	2.2	7.8

*Expressed as percent of goal

Extracted from NEWELL 1966a, page 9.

APPENDIX P

FUEL-ELEMENT FAILURE DATA FOR 1966

FUEL AND TARGET FAILURE DATA - JANUARY-APRIL 1966

Tube Number	4252-KW	1584-KW	3289-D	3298-KE	3579-XW
Failure Number	1760	1761	1762	T-23	1763
Date Failed	1-12-66	2-11-66	2-14-66	4-13-66	4-30-66
Date Charged	11-14-65	11-14-65	1-15-66	2-27-66	2-11-66
Days in Reactor	59	89	30	51	78
Days of Operation	37	67	22	44	51
Tube Exposure (MWD/T)	467	1357	323	13*	592
Tube Power at Failure (kw)	1308	1050	1474	68	1440
Tube Power Average (kw)	1987	990	1463	58	1737
Slug Power	X	X	X	X	X
Failed Element Position	X	X	21-R	X	X
Canning Date	9-21-56	X	10-18-65	X	1-3-66
Lot Number	KG-239-D	PT-803 ¹	KY-928-Q	TCC-578	KF-765-B
Type of Metal	I&E ES	I&E E	I&E EB	Thoria	I&E N
	(0.94%)	(1.3%)	(0.94%)		
Days Since Last Start-up	<1	29	<1	41	1
Total Shutdowns	6	8	3	1	4
Rapid Shutdowns	3	5	3	0	1
Flow (gpm)	63.5	64.3	55.4	28.7	63.8
Type of Failure	SD	SU	CP	UN	SH
Downtime Charged to Failure (hours)	9.5	9.1	7.3	12.2	20.8

*Expressed as percent of calendar year.

¹ Authorizes irradiation of 1.3 weight percent U-235 enriched uranium oxide fuel elements.

X Information not available.

Extracted from NEWELL 1966b, page 6.

FUEL AND TARGET FAILURE DATA - MAY-SEPTEMBER 1966

Tube Number	2190-D	2864-C	1689-C	1371-D	5791-KE	1568-D
Failure Number	1764	1765	1766	1767	T24	1768
Date Failed	5/13/66	5/26/66	5/31/66	6/28/66	7/1/66	9/3/66
Date Charged	3/18/66	4/29/66	4/29/66	5/27/66	2/22/66	5/26/66
Days in Reactor	56	27	32	32	135	100
Days of Operation	46	24	27	29	115	42
Tube Exposure (hrd/t)	461	225	310	429	72*	610
Tube Power at Failure (kw)	1285	1385	1401	1363	121	1249
Tube Power Average (kw)	1263	1441	1395	1368	79	1284
Failed Element Power	X	X	19.6	X	X	X
Failed Element Position	13-R	X	X	1-R	X	2-R
Canning Date	5/19/65	X	3/31/66	X	X	X
Lot Number	KZ-310-B	LX-023-E ¹	KJ-663-Q	PTA-010 ²	TCC-478	PTA-010 ²
Type of Metal	I&E N	I&E NS	I&E NB	I&E EB (0.95%)	THORIA	I&E EB (0.95%)
Days Since Last Startup	36	24	2	19	14	10
Total Shutdowns	1	0	2	2	6	5
Rapid Shutdowns	1	0	2	2	2	4
Flow (gpm)	50.3	60.4	53.7	50.7	30.6	50.1
Type of Failure	SII	SU	SD	SG	ED	SG
Downtime Charged to Failure (hrs)	10.2	2.3	20.5	31.0	7.0	0.5

X -- Information not available.

1 -- PITA-032 (Oil-quenched hot-die-sized fuel)

2 -- 95 metal canned by hot-die-size process with high silicon (10^W/o) aluminum alloy cladding

* -- Expressed as percent goal

Extracted from NEWELL 1967, page 8.

FUEL AND TARGET FAILURE DATA - SEPTEMBER-DECEMBER 1966 (Cont'd)

Tube Number	4080-KE	5546-KW	2883-KW	4180-D	4469-C	2755-KE
Failure Number	1769	T25	1770	1771	1772	1773
Date Failed	9/9/66	10/17/66	10/21/66	11/24/66	12/8/66	12/21/66
Date Charged	7/8/66	3/11/66	6/5/66	11/1/66	6/4/66	10/5/66
Days in Reactor	63	220	138	22	187	77
Days of Operation	13	130	73	19	109	54
Tube Exposure (Mwd/t)	126	80*	745	192	660	605
Tube Power at Failure (kw)	1678	57	1695	1342	1605	1630
Tube Power Average (kw)	1590	54	1693	1096	1426	1640
Failed Element Power	X	X	X	X	X	X
Failed Element Position	X	X	X	X	X	X
Canning Date	2/9/66	X	4/21/66	7/26/66	X	7/5/66
Lot Number	KV-4111-D	TC-1875	RV-453-D	KZ-304-B	LX-023-E ¹	KF-777-B
Type of Metal	I&E NS	THORIA	I&E NS	I&E N	I&E NS	I&E N
Days Since Last Startup	10	34	2	19	4	17
Total Shutdowns	1	16	13	0	8	3
Rapid Shutdowns	1	8	8	0	1	1
Flow (gpm)	70.0	29.1	64.7	48.5	60.8	65.1
Type of Failure	EM	ED	EM	ED	SU	SH
Downtime Charged to Failure (hrs)	14.9	25.9	11.2	6.4	3.2	25.5

X -- Information not available

1 -- PITA-032 (Oil-quenched hot-die-sized fuel)

* -- Expressed as percent of goal

Extracted from NEWELL 1967, page 9.

APPENDIX Q

FUEL-ELEMENT FAILURE DATA FOR 1967-1970

FUEL AND TARGET FAILURE DATA - JANUARY-MARCH 1967

Tube Number	2086-B	1955-B	4180-KW	3167-D	3687-D
Failure Number	1774	1775	1776	1777	1778
Date Failed	1/18/67	3/6/67	3/20/67	3/27/67	3/29/67
Date Charged	11/4/66	9/23/66	2/21/67	3/3/67	3/3/67
Days in Reactor	75	164	27	24	26
Days of Operation	51	123	20	19	19
Tube Exposure (Mwd/t)	574	985	270	205	300
Tube Power at Failure (kw)	1212	1076	2189	1341	1473
Tube Power Average (kw)	1253	931	1962	1400	1443
Fuel Element Position	7-R	X	X	X	20-R
Canning Date	9/7/66	8/4/66	11/18/66	1/17/67	12/15/66
Lot Number	KD-115-Q	KZ-385-V	KG-308-D	KZ-397-V	QY-932-V
Type of Metal	I&E HB	I&E NB	I&E ES (0.95%)	I&E HB	I&E EB (0.95%)
Days Since Last Startup	32	38	<1	17	<1
Total Shutdowns	2	8	1	2	3
Rapid Shutdowns	2	6	0	2	3
Flow (gpm)	43.0	48.6	76.3	50.8	54.6
Type of Failure	ED	CP	EM	EM	CP
Downtime Charged to Failure (hrs)	3.1	30.2	19.1	9.6	10.3

X -- Information not available.

Extracted from NEWELL 1968, page 9.

FUEL AND TARGET FAILURE DATA - MAY-JULY 1967

Tube Number	4078-D	2584-B	0769-D	4362-KW	2987-B
Failure Number	1779	1780	1781	1782	1783
Date Failed	5/1/67	5/15/67	5/29/67	9/9/67	7/10/67
Date Charged	4/15/67	3/21/67	4/12/67	5/22/67	3/20/67
Days in Reactor	16	55	47	48	112
Days of Operation	13	43	41	39	96
Tube Exposure (Mwd/t)	172	522	427	630	1100
Tube Power at Failure (kw)	1290	1279	1057	2106	1150
Tube Power Average (kw)	1353	1392	1107	1802	1237
Fuel Element Position	17-R	7-R	7-R	11-R	7-R
Canning Date	3/16/67	11/8/66	11/8/66	PT-067 ¹	3/8/66
Lot Number	KY-041-V	KD-117-Q	KD-117-Q	LU-006-E	KD-890-Q
Type of Metal	I&E EB (0.95%)	I&E NB	I&E NB	I&E ES (1.25%)	I&E NB
Days Since Last Startup	1	6	27	31	47
Total Shutdowns	2	4	3	2	6
Rapid Shutdowns	0	1	1	1	2
Flow (gpm)	50.0	46.0	43.5	77.6	44.3
Type of Failure	EM	ED	ED	CP	ED
Downtime Charged to Failure (hrs)	35.0	3.0	55.5	5.6	2.0

1 -- "150 Percent Specific Power Demonstration Test"

Extracted from NEWELL 1968, page 10.

FUEL AND TARGET FAILURE DATA - JULY-SEPTEMBER 1967

Tube Number	1554-KW	3887-B	3789-KW	3761-KW	4189-KW
Failure Number	1784	1785	1786	1787	1788
Date Failed	7/23/67	8/2/67	9/13/67	9/16/67	9/17/67
Date Charged	5/22/67	5/4/67	4/30/67	4/18/67	4/30/67
Days in Reactor	62	90	136	151	140
Days of Operation	51	76	109	118	110
Tube Exposure (Hwd/t)	938	784	1311	1937	1269
Tube Power at Failure (kw)	1773	1230	1825	2181	1820
Tube Power Average (kw)	1732	1131	1852	2173	1790
Fuel Element Position	16-R	X	X	8-R	X
Canning Date	PT-067 ¹	X	3/14/67	PT-054 ²	1/24/67
Lot Number	LU-006-E	KN-073-V	KV-506-D	LX-036-M	QV-802-D
Type of Metal	I&E ES (1.25%)	I&E NB	I&E NS	I&E ES (2.10%)	I&E NS
Days Since Last Startup	11	17	16	<1	<1
Total Shutdowns	4	3	11	14	13
Rapid Shutdowns	3	2	7	9	9
Flow (gpm)	76.9	48.0	74.9	87.4	73.7
Type of Failure	CP	IR4	SH	SH	SH
Downtime Charged to Failure (hrs)	3.7	2.7	31.6	3.0	20.7

1 -- "150 Percent Specific Power Demonstration Test"

2 -- "210 E-N Demonstration Test"

Extracted from NEWELL 1968, page 11.

FUEL AND TARGET FAILURE DATA - SEPTEMBER-OCTOBER 1967

Tube Number	2863-KE	2865-KE	3256-KE	2682-B	3865-KE
Failure Number	1789	1790	1791	1792	1793
Date Failed	9/18/67	9/24/67	9/24/67	9/30/67	10/12/67
Date Charged	7/25/67	7/25/67	7/25/67	5/4/67	6/5/67
Days in Reactor	55	61	61	149	129
Days of Operation	49	50	50	121	113
Tube Exposure (MWD/t)	633	651	821	1237	1047
Tube Power at Failure (kw)	1828	1872	1559	1287	2935
Tube Power Average (kw)	1871	1911	1652	1223	3012
Failed Element Position	X	X	X	1-R	3-R
Canning Date	2/28/67	2/28/67	2/28/67	X	PT-021
Lot Number	QG-829-E	QG-829-E	QG-829-E	KZ-468-Q	LX-030-F
Type of Metal	I&E ES (0.95%)	I&E ES (0.95%)	I&E ES (0.95%)	I&E NB	PT-021
Days Since Last Startup	18	4	<1	12	17
Total Shutdowns	0	3	3	7	5
Rapid Shutdowns	0	2	2	3	3
Flow (gpm)	76.4	75.6	74.9	49.6	110.2
Type of Failure	EM	EM	EM	SG	SG
Downtime Charged to Failure (hrs)	17.0	8.3	13.2	17.7	4.2

3 -- Rod-In-Tube Hot-Die-Size Fuel for One-Inch Overbore

Extracted from NEWELL 1968, page 12.

FUEL AND TARGET FAILURE DATA - OCTOBER-NOVEMBER 1967

Tube Number	1066-B	2265-B	2562-C	3486-B	3262-B	2509-B
Failure Number	1794	1795	1796	1797	1798	1799
Date Failed	10/18/67	10/23/67	10/27/67	11/6/67	11/17/67	11/17/67
Date Charged	5/4/67	5/4/67	3/26/67	5/4/67	5/4/67	5/4/67
Days in Reactor	167	172	215	186	197	197
Days of Operation	136	139	182	151	159	159
Tube Exposure (Mwd/t)	1370	1395	1957	1479	1541	2137
Tube Power at Failure (kw)	1353	1117	1380	1290	1318	1269
Tube Power Average (kw)	1262	1188	1287	1166	1168	1241
Failed Element Position	X	8-R	12-R	7-R	7-R	X
Canning Date	179A-011 ⁴	3/29/67	2/25/67	11/8/66	11/8/66	3/20/67
Lot Number	KZ-001-D	KZ-406-Q	KJ-687-Q	KD-117-Q	KD-117-Q	KY-042-V
Type of Metal	I&E NB	I&E NB	I&E NB	I&E NB	I&E NB	I&E EB (0.95%)
Days Since Last Startup	15	3	26	12	8	8
Total Shutdowns	8	9	14	10	11	11
Rapid Shutdowns	4	5	5	6	7	7
Flow (gpm)	51.1	46.1	50.9	46.2	48.1	51.8
Type of Failure	EM	CP	SU	ED	SG	EM
Downtime Charged to Failure (hrs)	6.5	13.5	212.5	3.3	1.9	1.9

4 -- Fuel canned by the hot-die-size process

Extracted from NEWELL 1968, page 13.

FUEL AND TARGET FAILURE DATA - NOVEMBER-DECEMBER 1967

Tube Number	2890-C	3361-C	4368-KW
Failure Number	1800	1801	1802
Date Failed	11/28/67	12/27/67	12/29/67
Date Charged	6/1/67	3/26/67	10/27/67
Days in Reactor	180	276	63
Days of Operation	150	231	52
Tube Exposure (Hwd/t)	2000	2239	637
Tube Power at Failure (kw)	1307	1477	2020
Tube Power Average (kw)	1290	1186	1996
Failed Element Position	X	14-R	1-R
Canning Date	4/19/67	2/25/67	PF-088 ⁵
Lot Number	KC-383-Q	KJ-687-Q	DV-005-R
Type of Metal	I&E EB (0.95%)	I&E NB	I&E NS
Days Since Last Startup	17	8	14
Total Shutdowns	13	18	4
Rapid Shutdowns	7	8	3
Flow (gpm)	56.0	50.5	76.3
Type of Failure	CP	SG	SG
Downtime Charged to Failure (hrs)	7.4	96.3	37.8

5 -- Fuel canned by the hot-die-size process

Extracted from NEWELL 1968, page 14.

FUEL AND TARGET FAILURE DATA - JANUARY-APRIL 1968

Tube Number	2365-B	1873-KW	4671-KE	2884-KE	4276-KW
Failure Number	1803	1804	1805	1806	1807
Date Failed	1-21-68	2-25-68	3-2-68	4-4-68	4-8-68
Date Charged	7-10-67	1-8-68	2-13-67	2-14-67	10-23-67
Days in Reactor	195	48	383	415	168
Days of Operation	153	42	317	341	137
Tube Exposure (MWD/T)	1514	751	2282	2467	1634
Tube Power at Failure (kW)	1224	1757	1340	1418	1784
Tube Power Average (kW)	1243	1734	1139	1117	1793
Fuel Element Position	X	9-R	19-R	X	23-R
Canning Date	4-7-67	PTA-067 ¹	PITA-048 ²	PITA-048 ²	PTA-105 ³
Lot Number	KZ-409-Q	XU-005-L	DP-015-D	DP-035-D	KG-361-E
Type of Metal	I&E NB	I&E ES (1.25%)	I&E NS	I&E NS	I&E ES (0.95%)
Days Since Last Startup	2	42	1	10	3
Total Shutdowns	14	0	33	38	12
Rapid Shutdowns	8	0	26	30	8
Flow (gpm)	46.6	57.9	64.7	64.0	62.1
Type of Failure	SU	SD	CP	CP	CP
Downtime Charged to Failure (hrs)	9.2	2.9	33.5	23.4	20.3

-
- X -- Information not available
 1 -- "150 Percent Specific Power Demonstration Test"
 2 -- "High Exposure Depleted Uranium (0.14%) Test"
 3 -- "Evaluation of 50 mil Self-Support"

Extracted from NEWELL 1969a, page 10.

FUEL AND TARGET FAILURE DATA - MAY-JUNE 1968

Tube Number	4365-KW	1786-KW	1680-KW	3088-C
Failure Number	1808	1809	1810	1811
Date Failed	5-15-68	5-18-68	5-22-68	6-17-68
Date Charged	1-8-68	2-21-67	2-21-67	1-19-68
Days in Reactor	128	452	456	150
Days of Operation	108	370	372	109
Tube Exposure (MWD/T)	1903	2950	2662	1648
Tube Power at Failure (kW)	1737	1025	1322	1471
Tube Power Average (kW)	1740	1238	1112	1467
Fuel Element Position	12-R	12-R	18-R	20-R
Canning Date	PTA-067 ¹	PTA-048 ²	PTA-048 ²	PTA-098 ⁴
Lot Number	XU-005-L	DP-015-D	DP-015-D	KC-386-Q
Type of Metal	I&E ES (1.25%)	I&E NS	I&E NS	I&E EB (0.95%)
Days Since Last Startup	32	<1	2	15
Total Shutdowns	8	37	39	7
Rapid Shutdowns	6	25	27	4
Flow (gpm)	61.1	68.5	67.6	58.7
Type of Failure	11J	CT	CT	CP
Downtime Charged to Failure (hrs)	6.0	16.0	2.4	13.2

-
- 1 -- "150 Percent Specific Power Demonstration Test"
 2 -- "High Exposure Depleted Uranium (0.14%) Test"
 4 -- "High Exposure C3E Core Alloy Test"
-

Extracted from NEWELL 1969a, page 11.

FUEL AND TARGET FAILURE DATA - JULY-OCTOBER 1968

Tube Number	3079-C	5073-KE	3581-KE	3190-C
Failure Number	1812	1813	1814	1815
Date Failed	7-10-68	8-4-68	9-18-68	10-5-68
Date Charged	1-19-68	5-25-68	5-25-68	1-19-68
Days in Reactor	173	71	116	260
Days of Operation	130	56	87	186
Tube Exposure (MWD/T)	1962	763	1080	2824
Tube Power at Failure (kw)	1331	1816	1755	1221
Tube Power Average (kw)	1457	1952	1811	1350
Fuel Element Position	20-R	X	X	X
Canning Date	PTA-098 ⁴	4-25-68	4-26-68	PTA-098 ⁴
Lot Number	KC-386-Q	KG-443-D	KG-444-D	VC-002-Q
Type of Metal	I&E EB (0.95%)	I&E ES (0.95%)	I&E ES (0.95%)	I&E EB (0.95%)
Days Since Last Startup	20	12	12	13
Total Shutdowns	8	2	9	14
Rapid Shutdowns	5	0	6	7
Flow (gpm)	55.6	76.6	73.2	56.8
Type of Failure	CP	IM	IM	CP
Downtime Charged to Failure (hrs)	2.1	12.8	9.5	3.0

X -- Information not available
 4 -- "High Exposure C3E Core Alloy Test"

Extracted from NEWELL 1969a, page 12.

FUEL AND TARGET FAILURE DATA - OCTOBER-DECEMBER 1968

Tube Number	1664-C	5791-KW	4898-KW	2868-C
Failure Number	1816	T26	T27	1817
Date Failed	10-24-68	11-25-68	12-18-68	12-22-68
Date Charged	4-14-68	5-15-68	6-7-68	5-21-68
Days in Reactor	193	194	196	215
Days of Operation	147	123	129	165
Tube Exposure (MWD/T)	1438	20*	16*	1025
Tube Power at Failure (kw)	1400	69	58	2460
Tube Power Average (kw)	1330	44	46	1776
Fuel Element Position	3-R, 4-R & 5-R	X	X	3-R & 4-R
Canning Date	P7A-0115	5-29-68	5-22-68	P7A-1036
Lot Number	AJ-001-G	TC-109-II	TC-102-II	EH-003-F
Type of Metal	I&E NB	Thoria	Thoria	P7A-103
Days Since Last Startup	17	24	21	25
Total Shutdowns	11	12	9	15
Rapid Shutdowns	6	8	5	8
Flow (gpm)	49.9	28.3	27.8	86.6
Type of Failure	IG	ED	ED	SG
Downtime Charged to Failure (hrs)	2.0	1.0	4.0	26.1

X -- Information not available
 * -- Expressed as percent of goal
) -- "Comparison Between Hot-Die-Size and AISI Canning Process"
 6 -- Hot-Die overbore facility Rod-In-Tube fuel

Extracted from NEWELL 1969a, page 13.

SLUG RUPTURE OR STUCK CHARGE REPORT - JANUARY 1969

Failure No. 1 E/E
(Fill in at 1704-D)

- *1. Area KE
 *2. Tube Number 4456
 *3. Date Failed 1-11-69
 *4. Date Charged 11-03-68
 *5. Lot Number QEE 0198
 *6. Type Failure SH
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only (No Rupture) ☐
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper

Nonbumper

Bumper

Bumper

Self-support

Self-support

Other

8. Charge Make Up 38 KIVN

(Pieces of each type metal, from front end)

9. Production Test No. PTA 030

Stuck ☒
 Not Stuck ☐

10. Slug Position 8+1

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 5.2
 *12. Tube ΔT 91.8
 *13. Tube Flow 56.3
 *14. Tube Orifice Zone 05

15. Did rupture cause a tube leak NO

18. Date Tube

16. Did tube contain a poison spline ND

Installed 5-28-68

17. Mixer Location NDNE

19. CWT 74.7

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)

Gamma monitor went full scale - Gage increased 10 psi

from 1st indication on G.M. until shutdown - 107 Inkt

increased to 150 MR + 75 MR - Riser Differential showed no change

21. Time from first rupture indication to shutdown (minutes) ~ UNK.

22. Rear pigtail reading (units) 52 at rail

Extracted from NEWELL 1969b, page 36.

SLUG RUPTURE OR STUCK CHARGE REPORT - FEBRUARY 1969

Failure No. 1819
(Fill in at 1704-D)

*1. Area 105-C
 *2. Tube Number 2262
 *3. Date Failed 2/21/69
 *4. Date Charged 2/21/69
 *5. Lot Number _____
 *6. Type Failure Minor
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only ☐
 (No Rupture)
 Bubbler ☐

<u>I&E Natural</u>	<u>I&E Enriched</u>
Nonbumper ☐	Nonbumper ☒
Bumper ☐	Bumper ☐
Self-support ☐	Self-support ☐
Other <u>over case</u>	

8. Charge Make-Up 22 CWT
 (Pieces of each type metal, from front end)
 9. Production Test No. PTA-103 Stuck ☒
 Not Stuck ☐
 10. Slug Position Wth

(From latest equilibrium or near-equilibrium operating period)

*11. Inlet Temperature 3.2
 *12. Tube ΔT 199.8
 *13. Tube Flow 24.5
 *14. Tube Orifice Zone 29

15. Did rupture cause a tube leak Yes 18. Date Tube Installed 11/19/68
 16. Did tube contain a poison spline No 19. CWT 22.2
 17. Mixer Location Normal

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
gamma monitor

21. Time from first rupture indication to shutdown (minutes) _____
 22. Rear pigtail reading (units) _____

Extracted from NEWELL 1969b, page 38.

SLUG RUPTURE OR STUCK CHARGE REPORT - MARCH 1969

power level - 2280

tube exposure 2185 min

Failure No. 1820
(Fill in at 1704-D)

- *1. Area 105-C
 *2. Tube Number 2490
 *3. Date Failed 2/26/69
 *4. Date Charged 6/9/68
 *5. Lot Number Q7-125
 *6. Type Failure _____
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only ☐
 (No Rupture)
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper ☒
 Bumper ☒
 Self-support ☐
 Other _____

Nonbumper ☐
 Bumper ☐
 Self-support ☐

8. Charge Make Up 10-03N 5-03NB 1-03W 9-C2NB 1-C2W-7-C2WB
 (Pieces of each type metal, from front end)

9. Production Test No. 127 Stuck ☐
 Not Stuck ☒

10. Slug Position _____

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 4.4
 *12. Tube ΔT 112.6
 *13. Tube Flow 56.5
 *14. Tube Orifice Zone 01

15. Did rupture cause a tube leak _____
 16. Did tube contain a poison spline NO
 17. Mixer Location 8th & 17th

18. Date Tube Installed 05.25-62
 19. CWT WU

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
gamma monitor

21. Time from first rupture indication to shutdown (minutes) 10
 22. Rear pigtail reading (units) _____

Extracted from NEWELL 1969b, page 40.

SLUG RUPTURE OR STUCK CHARGE REPORT - MARCH 1969 (Cont'd)

Power level 1800
tube power 1789

Failure No. 1821
(Fill in at 1704-D)

- *1. Area 105-C
 *2. Tube Number 2864
 *3. Date Failed 3/22/69
 *4. Date Charged 11/9/68
 *5. Lot Number 79 W
 *6. Type Failure _____
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only ☐
 (No Rupture)
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper ☐
 Bumper ☐
 Self-support ☐
 Other _____

Nonbumper ☒
 Bumper ☐
 Self-support ☐

8. Charge Make Up 32 CM2E
 (Pieces of each type metal, from front end)
 9. Production Test No. PT 103 Stuck ☒
 Not Stuck ☐
 10. Slug Position 5th

(From latest equilibrium or near-equilibrium waiting period)

- *11. Inlet Temperature 52
 *12. Tube AT 91.6
 *13. Tube Flow ES O
 14. Tube Orifice Zone 09

15. Did rupture cause a tube leak _____ 18. Date Tube
 16. Did tube contain a poison spline NO Installed 11/9/68
 17. Mixer Location NONE 19. CWT 65

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
gamma monitor

21. Time from first rupture indication to shutdown (minutes) _____
 22. Rear pigtail reading (units) _____

Extracted from NEWELL 1969b, page 42.

SLUG RUPTURE OR STUCK CHARGE REPORT - APRIL 1969

power level 2235
 tube power 2288
 Exposure 1600

Failure No. 1822
 (Fill in at 1704-D)

- *1. Area 105-C
 *2. Tube Number 2F6J
 *3. Date Failed 4-25-69
 *4. Date Charged 5-20-68
 *5. Lot Number _____
 *6. Type Failure _____
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only
 (No Rupture) ☐
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper ☐
 Bumper ☐
 Self-support ☐
 Other _____

Nonbumper ☐
 Bumper ☒
 Self-support ☐

8. Charge Make Up 32 CMIE
 (Pieces of each type metal, from front end)
 9. Production Test No. 103 Stuck ☐
 Not Stuck ☒
 10. Slug Position _____

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 9.4
 *12. Tube ΔT 96.6
 *13. Tube Flow 87.9
 14. Tube Orifice Zone 03

15. Did rupture cause a tube leak NO 18. Date Tube
 16. Did tube contain a poison spline NO Installed 1-19-68
 17. Mixer Location NONE 19. CWT 40.0

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
gamma monitor, filtered sample

21. Time from first rupture indication to shutdown (minutes) 22 min
 22. Rear pigtail reading (units) _____

Extracted from NEWELL 1969b, page 44.

SLUG RUPTURE OR STUCK CHARGE REPORT - JULY 1969

Failure No. 1923
(Fill in at 1704-D)

*1. Area <u>KE</u>		
*2. Tube Number <u>2457</u>	Rupture Confirmed	☐
*3. Date Failed <u>7-2-69</u>	Stuck Charge Only	☐
*4. Date Charged <u>5-27-69</u>	(No Rupture)	
*5. Lot Number <u>PT-155</u>	Bubbler	☐
*6. Type Failure <u>SLUG CHARGE</u>		
*7. Type Metal (Check one) <u>Firing Corrosion</u>		
	<u>I&E Natural</u>	<u>I&E Enriched</u>
	Nonbumper ☐	Nonbumper ☐
	Bumper ☐	Bumper ☐
	Self-support ☐	Self-support ☒
	Other ☐	
8. Charge Make Up <u>KEW 440. K5AFA 700. K5AE</u>		
(Pieces of each type metal, from front end)		
9. Production Test No. <u>159</u>	Stuck	☐
	Not Stuck	☐
10. Slug Position <u>CS</u>		

(From latest equilibrium or near-equilibrium operating period)		
*11. Inlet Temperature <u>1700</u>		
*12. Tube AT <u>90 00</u>		
*13. Tube Flow <u>71.9 gpm</u>		
*14. Tube Orifice Zone <u>101</u>		

15. Did rupture cause a tube leak <u>NO</u>	18. Date Tube	<u>END TUBE</u>
16. Did tube contain a poison spline <u>NO</u>	Installed	
17. Mixer Location <u>NO</u>	19. CWT	
20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)		
<u>Gamma Monitor (R-34) water sample</u>		

21. Time from first rupture indication to shutdown (minutes) <u>~240</u>		
22. Rear pigtail reading (units) <u>100 F / 1000V</u>		

Extracted from NEWELL 1969b, page 46.

SLUG RUPTURE OR STUCK CHARGE REPORT - JULY 1969 (Cont'd)

Failure No. _____
(Fill in at 1704-D)

*1. Area <u>100-KW</u>	
*2. Tube Number <u>2358</u>	Rupture Confirmed ☒
*3. Date Failed <u>7-19-69</u>	Stuck Charge Only ☐
*4. Date Charged <u>6-13-69</u>	(No Rupture)
*5. Lot Number _____	Bubbler ☐
*6. Type Failure <u>Endcap failure</u>	
*7. Type Metal (Check one)	
I&E Natural	I&E Enriched
Nonbumper ☐	Nonbumper ☐
Bumper ☐	Bumper ☐
Self-support ☐	Self-support ☐
Other <u>Neptunium - shrapnel matrix; al. clad.</u>	
8. Charge Make Up <u>16 S.A. dummies, 6 Nep-Shrap, 16 S.A. dummies</u> (Pieces of each type metal, from front end)	
9. Production Test No. <u>PTA-163</u>	Stuck ☐
	Not Stuck ☒
10. Slug Position <u>64-22, -24, -26, -23, -21, -25</u>	
(From latest equilibrium or near-equilibrium operating period)	
*11. Inlet Temperature <u>17.6</u>	
*12. Tube ΔT <u>18.4</u>	
*13. Tube Flow <u>19.5 gpm.</u>	
*14. Tube Orifice Zone <u>46</u>	

15. Did rupture cause a tube leak <u>no</u>	18. Date Tube <u>2 inc Tube</u>
16. Did tube contain a poison spline <u>no</u>	Installed _____
17. Mixer Location <u>none</u>	19. CWT _____
20. How detected (gamma monitor, filtered sample, Panellit increase, etc.) <u>3 noise dividers on gamma monitor - individual sample lines on 2358, 2359; sampled the peaks.</u>	

21. Time from first rupture indication to shutdown (minutes) <u>unknown</u>	
22. Rear pigtail reading (units) <u>unknown</u>	

Extracted from NEWELL, 1969b, no page number.

SLUG RUPTURE OR STUCK CHARGE REPORT - JULY 1969 (Cont'd)

Failure No. _____
(Fill in at 1704-D)

- *1. Area 100-KW
 *2. Tube Number 2359
 *3. Date Failed 7-20-69
 *4. Date Charged 6-13-69
 *5. Lot Number _____
 *6. Type Failure crack failure
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only
 (No Rupture) ☐
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper ☐
 Bumper ☐
 Self-support ☐
 Other Neptunium - Krasht matrix; gr. clad.

Nonbumper ☐
 Bumper ☐
 Self-support ☐

8. Charge Make Up 16 S.A. dummies, 6 Rep. Grash., 1654. dummies
 (Pieces of each type metal, from front end)
 9. Production Test No. PTA-163 Stuck ☐
 Not Stuck ☒
 10. Slug Position G7-36

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 17.6
 *12. Tube ΔT 16.4
 *13. Tube Flow 18.8
 14. Tube Orifice Zone 16

15. Did rupture cause a tube leak no 18. Date Tube 2.16 Tube
 16. Did tube contain a poison spline no Installed _____
 17. Mixer Location no 19. CWT _____

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
Rupture not detected prior to being discharged.

21. Time from first rupture indication to shutdown (minutes) _____
 22. Rear pigtail reading (units) _____

Extracted from NEWELL 1969b, no page number.

SLUG RUPTURE OR STUCK CHARGE REPORT - AUGUST 1969

Failure No. 52-
(Fill in at 1704-D)

*1. Area 105 KE
 *2. Tube Number 28574
 *3. Date Failed 8-12-69
 *4. Date Charged 8-27-69 (105)
 *5. Lot Number 1-1-0150 21E
 *6. Type Failure - 38
 *7. Type Metal (Check one)

<u>I&E Natural</u>	<u>I&E Enriched</u>
Nonbumper ☐	Nonbumper ☐
Bumper ☐	Bumper ☐
Self-support ☐	Self-support ☒
Other ☐	

Rupture Confirmed ☒
 Stuck Charge Only (No Rupture) ☐
 Bubbler ☐

8. Charge Make Up 51 KSAFA 44DS (new style small)
 (Pieces of each type metal, from front end)
 9. Production Test No. 011 Stuck ☐
 Not Stuck ☐ core, thicker cladding
 10. Slug Position C

 (From latest equilibrium or near-equilibrium operating period)

*11. Inlet Temperature 19.2
 *12. Tube ΔT 07
 *13. Tube Flow 25.1
 14. Tube Orifice Zone 0

15. Did rupture cause a tube leak no 18. Date Tube Installed
 16. Did tube contain a poison spline no 19. CWT
 17. Mixer Location none

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
gamma monitor Panellit Pressure was 2 psi

21. Time from first rupture indication to shutdown (minutes) 75 minutes
 22. Rear pigtail reading (units)

Extracted from NEWELL 1969b, no page number.

SLUG RUPTURE OR STUCK CHARGE REPORT - AUGUST 1969 (Cont'd)

Failure No. 1725
(Fill in at 1704-D)

*1. Area <u>DE</u>		
*2. Tube Number <u>2551</u>	Rupture Confirmed	☒
*3. Date Failed <u>8/18/69 2100 hrs</u>	Stuck Charge Only	☐
*4. Date Charged <u>8/12/69</u>	(No Rupture)	
*5. Lot Number <u>1000000000</u>	Subbler	☐
*6. Type Failure <u>EMI</u>		
*7. Type Metal (Check one)		
	<u>I&E Natural</u>	<u>I&E Enriched</u>
	Nonbumper ☐	Nonbumper ☐
	Bumper ☐	Bumper ☐
	Self-support ☐	Self-support ☒
	Other ☐	
8. Charge Make Up <u>51 KSE</u>		
(Pieces of each type metal, from front end)		
9. Production Test No. <u>—</u>	Stuck	☐
	Not Stuck	☒
10. Slug Position <u>—</u>		

(From latest equilibrium or near-equilibrium operating period)		
*11. Inlet Temperature <u>150</u>		
*12. Tube ΔT <u>90</u>		
*13. Tube Flow <u>700</u>		
*14. Tube Orifice Zone <u>01</u>		

15. Did rupture cause a tube leak <u>N/D</u>	18. Date Tube	
16. Did tube contain a poison spline <u>NE</u>	Installed	
17. Mixer Location <u>W0000</u>	19. CWT	
20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)		
<u>1-45 Gamma Monitor - Panellit increase 10 G PSI</u>		
<u>107 inlet in 10 min/hour</u>		

21. Time from first rupture indication to shutdown (minutes)	<u>21 minutes</u>	
22. Rear pigtail reading (units)	<u>250 PSI</u>	

Extracted from NEWELL 1969b, no page number.

SLUG RUPTURE OR STUCK CHARGE REPORT - AUGUST 1969 (Cont'd)

Failure No. 152
(Fill in at 1704-D)

- *1. Area KE
- *2. Tube Number 4451
- *3. Date Failed 9-24-64
- *4. Date Charged 5-24-64
- *5. Lot Number KGC 035E
- *6. Type Failure SI
- *7. Type Metal (Check one)
- I&E Natural
- Nonbumper ☐
- Bumper ☐
- Self-support ☐
- Other _____
- I&E Enriched
- Nonbumper ☒
- Bumper ☐
- Self-support ☒
8. Charge Make Up SI KES
(Pieces of each type metal, from front end)
9. Production Test No. _____ Stuck ☐
Not Stuck ☐
10. Slug Position U.N.K.

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 19.8
 *12. Tube ΔT 95.2
 *13. Tube Flow 72.2
 14. Tube Orifice Zone 01
- 115
 -19.8

15. Did rupture cause a tube leak NO 18. Date Tube
16. Did tube contain a poison spline NO Installed Yes
17. Mixer Location NONE 19. CWT _____
20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
Gamma monitor tripped @ 0630 8-28-68 - Gorr 4051
W. 2 psi - Sample @ 0630 - 0830 Little
Sample 10:1 - No increase noted @ 107 Inlet
21. Time from first rupture indication to shutdown (minutes) 150 min
22. Rear pigtail reading (units) 100 R near bottom side of nozzle

Extracted from NEWELL 1969b, no page number.

SLUG RUPTURE OR STUCK CHARGE REPORT - JUNE 1970

Failure No. _____
(Fill in at 1704-D)

- *1. Area 100 - KE
 *2. Tube Number 0174
 *3. Date Failed 6-2-70
 *4. Date Charged 10-29-69
 *5. Lot Number TC 021 H. Enriching A
 *6. Type Failure _____
 *7. Type Metal (Check one)

Rupture Confirmed ☒
 Stuck Charge Only ☐
 (No Rupture)
 Bubbler ☐

I&E Natural

I&E Enriched

Nonbumper ☐
 Bumper ☐
 Self-support ☐
 Other thoria K&T powder

Nonbumper ☐
 Bumper ☐
 Self-support ☐

8. Charge Make Up 38 smooth thoria K&T
 (Pieces of each type metal, from front end)

9. Production Test No. _____ Stuck ☐
 Not Stuck ☒

10. Slug Position unknown

(From latest equilibrium or near-equilibrium operating period)

- *11. Inlet Temperature 13.1
 *12. Tube ΔT 8.5
 *13. Tube Flow 29.1
 *14. Tube Orifice Zone 14

15. Did rupture cause a tube leak NO 18. Date Tube
 16. Did tube contain a poison spline NO Installed 4-17-55
 17. Mixer Location NONE 19. CWT 52.6

20. How detected (gamma monitor, filtered sample, Panellit increase, etc.)
Water samples taken and sent to 200 area @ 0455
hours. One sample had Krypton 87 and Pu 234. Panellit
had increased 6 sec above like charges. 107 activity no slight

21. Time from first rupture indication to shutdown (minutes) approx. 4 hours
 22. Rear pigtail reading (units) _____

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