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RUPTURED SLUG DATA

JANUARY 1, 1962 THROUGH APRIL 30, 1962

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JANUARY 1, 1962, THROUGH APRIL 30, 1962

June 8, 1962

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June 8, 1962

RUPTURED SLUG DATA
JANUARY 1, 1962, THROUGH APRIL 30, 1962

INTRODUCTION

The purpose of this document is to provide a tabulation of data concerning ruptured slugs for the use of various interested parties. This report presents data for the ruptures that occurred from January 1, 1962, through April 30, 1962, inclusive. Definitions of the terms used in the tabulations are nearly self-explanatory and are documented in the reference document.⁽¹⁾ The possible exceptions to this are the three terms: type of metal, type of failure, and lot number. The legends currently in effect for these three terms are provided in this report.

L. J. Newell

Process Analysis Unit
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

LJ Newell:mf

(1) Newell, L. J., Ruptured Slug Data, May 1, 1961, Through August 31, 1961, HW-71879, November 29, 1961, (Secret).

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CURRENT DEFINITIONS

Lot Number - This is the code presently used to identify fuel element characteristics. The coding system is outlined below.

A. Fuel Element Lot Identification System

Uranium fuel elements fabricated by the lead-dip canning process are identified by a six-character code so that fuel elements can be identified as to: (1) vendor and fabrication history, (2) core size, geometry and enrichment, (3) aluminum component size, alloy and geometry, and (4) a serial number to permit the canning history to be determined.

1. First Character - Vendor and Fabrication.

- J - MCW dingot metal rolled, vacuum outgassed and heat treated at NLO.
- K - Ingot metal cast, rolled and heat treated at NLO.
- M - Ingot metal cast and rolled at NLO and heat treated at MCW.
- N - Ingot metal cast at MCW and rolled and heat treated at NLO.
- T - Ingot metal cast at MCW, rolled at NLO, and heat treated at MCW.
- U - MCW dingot metal rolled at NLO, vacuum outgassed and heat treated at MCW.
- H or V* - MCW dingot metal rolled and heat treated at NLO.
- O - MCW dingot metal rolled at NLO, vacuum outgassed at MCW, and heat treated at NLO.
- P - MCW dingot metal rolled at NLO and heat treated at MCW.
- W - Extruded dingot metal.
- Y - Extruded ingot metal.
- A - Cast cores.
- C - Any unusual type metal or mixed lot.
- S - Reprocess storage lot.
- Z - Striation lot
- L - Large grain lot.

2. Second Character - Core Size, Geometry and Enrichment.

- A - Normal solid - 8"
- B - KIV W.M. - normal I&E watermix - "K" size - 6"
- C - CIIIE - enriched I&E - "C" size - 6"
- D - OIII W.M. - normal I&E watermix - "O" size 6"
- E - CIIIN - normal I&E - "C" size - 8"
- F - KIVN - normal I&E - "K" size - 8"
- G - CIIE - enriched I&E - "C" size - 6"
- H - OIIE - enriched I&E - "O" size - 6"
- I - CIII W.M. - normal I&E watermix - "C" size - 6"
- J - CIIN - normal I&E - "C" size - 8"
- K - KIVE - enriched I&E - "K" size - 6"
- L - OIIN - normal I&E - "O" size - 8"
- M - CII W.M. - normal I&E watermix - "C" size - 6"

* V code is being changed to H due to confusion between V and U in the HAPO record system.

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N - OVN - normal I&E - "O" size - 4"
O - OII W.M. - normal I&E watermix - "O" size - 6"
P - CVIN - normal I&E for overbored tubes - "C" size - 8"
Q - CDBIN - normal I&E for solid state diffusion bonding - "C" size - 8.4"
R - KIIIN - normal I&E - "K" size - 8"
S - KIIIE - enriched I&E - "K" size - 6"
T - CIVN - normal I&E for self-supports - "C" size - 8"
U - CIVE - enriched I&E for self-supports - "C" size - 6"
V - KVN - normal I&E for self-supports - "K" size - 8"
W - CVN - normal I&E for self-supports - "C" size - 8"
Y - OIIIE - enriched I&E - "O" size - 6"
Z - OIIIN - normal I&E - "O" size - 8"
X - Unusual geometry or size not included in above designations.

3. Third, Fourth and Fifth Characters

001 through 799 assigned to virgin fuel core lots. (For large grain lots, "L" lots, 001 through 499 assigned to ingot cores and 500 through 799 to dingot cores.)

800 through 999 assigned to recovered fuel core lots.

4. Sixth Character - Aluminum Component Vendor, Alloy, and Configuration

A - Aluminum Company of America - X-8001 alloy
B - Bridgeport Brass Company - X-8001 alloy
C - Cliff Manufacturing Company - X-8001 alloy
H - Harvey Aluminum - X-8001 alloy

D - Alcoa bumper element - X-8001 alloy
E - Bridgeport bumper element - X-8001 alloy
F - Cliff bumper element - X-8001 alloy
G - Harvey bumper element - X-8001 alloy

L - Alcoa - C-64 alloy
M - Bridgeport - C-64 alloy
N - Cliff - C-64 alloy
P - Harvey - C-64 alloy
U - Any unusual component configuration, vendor P.T., or new alloys
Z - Li-Al alloy core

Type of Metal - This term provides a quick reference to the geometry and enrichment of the fuel element. The legend for the term type of metal is listed below:

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.

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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.

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

KSRN - This is the symbol for a K reactor single rod test fuel element 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.

Type of Failure - The mechanism by which it is believed the failure occurred, as determined by visual examination of the ruptured slug. The legend for the term "type of failure" is listed below:

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.

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

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

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

Unclassified - The 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.

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

RUPTURED SLUG DATA

Tube Number	3271-C	2088-B	2580-H	2773-D	2576-H	4463-C
Failure Number	1436	1437	1438	1439	1440	1441
Date Failed	1-5-62	1-7-62	1-7-62	1-9-62	1-9-62	1-16-62
Date Charged	11-7-61	11-26-61	9-10-61	11-20-61	9-10-61	8-1-61
Days in Pile	59	42	119	50	121	168
Days of Operation	38	24	83	28	82	121
Tube Exposure	511	208	746	253	738	631
Tube Power at Failure	1424	1195	1113	1148	1085	1488
Tube Power Average	1315	1054	1036	1219	909	1282
Slug Power	83.8	60.6	X	X	X	X
Slug Position	X	11-R	3-R	X	X	4-R
Canning Date	9-11-61	9-5-61	8-12-61	8-15-61	8-12-61	2-14-61
Lot Number	KC-880-A	UZ-057-H	KY-097-D	HZ-043-E	KY-097-D	IP-381-A ⁽²⁾
Type of Metal	I&E E (0.94%)	I&E N	I&E EB(0.94%)	I&E NB	I&E EB (0.94%)	I&E N
Days Since Last Start-up	7	3	1	Less than 1	Less than 1	9
Total Shutdowns	7	6	32	10	33	20
Rapid Shutdowns	4	0	19	5	20	13
Flow	54.3	49.1	42.1	48.4	45.1	54.5
Type of Failure	Side Hot-Spot	Unclassified	Hole	Unclassified	Hole	Side-Other
Downtime Chargeable to Failure (hrs.)	3.2	30.4	4.4	27.4	1.0	4.1

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

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RUPTURED SLUG DATA

Tube Number:	1968-H	2669-H	2779-KW	4667-KE	2571-KW	3174-H
Failure Number	1442	1443	1444	1445	1446	1447
Date Failed	1-16-62	1-21-62	1-21-62	1-23-62	1-24-62	1-25-62
Date Charged	9-10-61	9-2-61	12-4-61	12-27-61	12-4-61	9-24-61
Days in Pile	128	141	48	27	51	123
Days of Operation	87	97	41	25	42	86
Tube Exposure	890	880	540	254	540	829
Tube Power at Failure	1157	1034	1763	1596	1724	1143
Tube Power Average	991	1016	1620	1537	1582	1081
Slug Power	X	X	X	X	X	X
Slug Position	X	X	X	11-R	X	X
Canning Date	5-11-61	7-19-61	11-14-61	12-13-61	11-14-61	7-19-61
Lot Number	KY-057-D	KH-830-D	KK-885-A	CF-004-A	KK-885-A	KH-831-D
Type of Metal	I&E EB (0.94%)	I&E EB (0.94%)	I&E E (0.94%)	I&E N	I&E E (0.94%)	I&E EB (0.94%)
Days Since Last Start-up	2	3	11	23	Less than 1	2
Total Shutdowns	38	42	4	1	8	35
Rapid Shutdowns	24	26	3	1	7	22
Flow	42.4	44.4	63.9	58.8	64.3	44.3
Type of Failure	Hole	Hole	Side Hot-Spot	Hole	Unknown	Hole
Downtime Chargeable to Failure (hrs.)	1.9	3.2	8.6	1.4	1.8	1.5

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RUPTURED SLUG DATA

Tube Number	2371-D	2289-C	3775-D	2463-B	2378-B	1078-DR
Failure Number	1448	1449	1450	1451	1452	1453
Date Failed	1-30-62	2-3-62	2-18-62	2-26-62	3-9-62	3-11-62
Date Charged	8-29-61	9-16-61	8-6-61	1-13-62	1-13-62	12-30-61
Days in Pile	154	140	196	44	55	71
Days of Operation	101	100	131	21	28	64
Tube Exposure	976	1003	1158	270	289	467
Tube Power at Failure	1107	1494	1172	1273	1234	1123
Tube Power Average	1118	1279	1122	1229	1235	1106
Slug Power	X	22.8	X	63.4	72.4	X
Slug Position	13-R	X	15-R	X	X	X
Canning Date	6-22-61	6-6-61	2-13-61	7-12-61	10-20-61	10-17-61
Lot Number	VZ-032-D	IP-272-A ⁽³⁾	CZ-806-E	KY-082-A	UZ-060-D	KZ-152-H
Type of Metal	I&E NB	I&E N	I&E NB	I&E E (0.94%)	I&E N	I&E N
Days Since Last Start-up	3	5	Less than 1	Less than 1	7	7
Total Shutdowns	31	18	38	6	7	4
Rapid Shutdowns	15	12	19	1	2	1
Flow	46.6	49.0	48.9	48.3	46.9	43.3
Type of Failure	Split-Long.	Side-Other	Split-Trans.	Side Hot-Spot	End	Side Hot-Spot
Downtime Chargeable to Failure (hrs.)	19.5	0.5	14.0	12.5	1.8	4.6

(3) Production test of normal size I&E self-supported fuel elements charged in a ribless zirconium process tube.

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RUPTURED SLUG DATA

Tube Number	1372-H	3446-KW	1584-DR	2091-KE	4169-H	2160-KE
Failure Number	1454	1455	1456	1457	1458	1459
Date Failed	3-12-62	3-12-62	3-15-62	3-28-62	3-29-62	4-4-62
Date Charged	1-27-62	8-14-61	12-30-61	1-23-62	3-12-62	2-16-62
Days in Pile	44	210	75	64	17	47
Days of Operation	27	179	52	59	14	38
Tube Exposure	263	1647	486	695	157	796
Tube Power at Failure	1148	1623	1056	1729	1194	450
Tube Power Average	1137	1380	1096	1538	1120	X
Slug Power	X	X	X	X	X	X
Slug Position	X	X	X	X	X	X
Canning Date	10-23-61	X	10-17-61	11-15-61	2-6-62	X
Lot Number	KZ-135-D	IP-397-A ⁽⁴⁾	CZ-884-H	KK-126-A	KY-138-D	IP-448-A
Type of Metal	I&E NB	I&E E (0.94%)	I&E N	I&E N	I&E EB (0.94%)	(5)
Days Since Last Start-up	26	14	2	20	9	4
Total Shutdowns	1	22	5	4	4	4
Rapid Shutdowns	0	14	2	3	2	2
Flow	46.5	67.4	40.6	69.0	47.4	42.0
Type of Failure	End	Unclassified	Side Hot-Spot	Hole	Mech. Damage	Unclassified
Downtime Chargeable to Failure (hrs.)	10.3	9.6	5.1	1.2	12.2	3.6

(4) Production test of I&E enriched zirconium-clad co-extruded material.

(5) Failure piece was a special fuel element containing thermocouples and was being irradiated in KER test facility #1.

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RUPTURED SLUG DATA

Tube Number	2955-C	2281-D	1684-D	3062-C	1064-DR	1962-D	3879-DR
Failure Number	1460	1461	1462	1463	1464	1465	1466
Date Failed	4-5-62	4-14-62	4-16-62	4-16-62	4-20-62	4-21-62	4-26-62
Date Charged	1-5-62	4-2-62	4-2-62	12-8-61	3-15-62	4-2-62	3-15-62
Days in Pile	90	12	14	129	36	19	42
Days of Operation	61	8	8	80	14	13	18
Tube Exposure	752	77	79	671	121	118	221
Tube Power at Failure	1585	1246	1267	1439	1167	1179	1183
Tube Power Average	1150	1248	1208	1237	1155	1202	1137
Slug Power	77.4	X	X	X	X	X	X
Slug Positon	18-R	X	X	14-R	X	X	X
Canning Date	12-4-61	1-17-62	3-6-62	7-7-61	3-5-62	3-6-62	3-7-62
Lot Number	KC-097-A	CZ-889-D	HZ-065-D	IP-381-A	HZ-068-A	HZ-065-D	UZ-082-A
Type of Metal	I&E E (0.94%)	I&E NB	I&E NB	I&E N ⁽²⁾	I&E N	I&E NB	I&E N
Days Since Last Start-up	Less than 1	7	Less than 1	Less than 1	2	4	4
Total Shutdowns	10	1	2	18	4	3	6
Rapid Shutdowns	5	1	2	10	4	3	6
Flow	55.8	47.2	47.6	58.4	48.0	48.6	47.8
Type of Failure	Side Hot-Spot	End	Hole	Split-Long.	Hole	End	Unknown
Downtime Chargeable to Failure (hrs.)	7.3	3.3	2.0	19.2	8.1	1.0	22.7

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