OSTI
NV
89

[redacted] UNCLASSIFIED

CLASSIFICATION LEVEL
(S, C, OR U)

ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

M9303168

Do not remove this sheet

[redacted] NAA-SR-MEMO 9030

This document contains 34 pages
This is copy 37 of 44 series A

[redacted]

CLASSIFICATION TYPE
(RD OR DI)

NAA-SR-MEMOs are working papers and may be expanded, modified, or withdrawn at any time, and are intended for internal use only.

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW
DETERMINATION (CIRCLE NUMBER(S))
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO.
4. COORDINATE WITH:
5. CLASSIFICATION CANCELED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY):
1st REVIEW-DATE: 6-12-97 AUTHORITY: ☐ ADC ☐ ADD NAME: Jerry Keyser
2ND REVIEW-DATE: 6-12-97 AUTHORITY: ADD NAME: Ted Davis

This document is
PUBLICLY RELEASABLE
Jerry Keyser
Authorizing Official
Date: 5-5-09

[redacted]

This report may not be published without the approval of the Patent Branch, AEC.

1 3942

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

55960

RECEIVED
JAN - 9 1964
USAEC HEADQUARTERS
LIBRARY

[redacted] UNCLASSIFIED

CLASSIFICATION LEVEL
(S, C, OR U)

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

[redacted]

UNCLASSIFIED

ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

TECHNICAL DATA RECORD

NAA-SR-MEMO NUMBER	9059
PAGE	1 OF 34
APPROVALS	J G Sprant
AUTHOR	R. H. Stone
DEPT & GROUP NO.	735-51
DATE	9/23/63
GO NO.	7622
S/A NO.	2052
TWR	50821
TITLE	SNAP 10A Environmental Test Monthly Report - August, 1963
PROGRAM	SNAP 2
SUBACCOUNT TITLE	Fuel Element Environmental Testing

SECURITY CLASSIFICATION

(CHECK ONE BOX ONLY)

	AEC	DOD
UNCL.	☐	☐
CONF.	☐	☐
[redacted]		☐

(CHECK ONE BOX ONLY)

[redacted] DATA ☐

DEFENSE INFO. ☐

AUTHORIZED CLASSIFIER SIGNATURE: J G Sprant DATE: 9-26-63

DISTRIBUTION

R. F. Atkins
J. K. Balkwill
. D. Calkins
D. C. Campbell
. E. Chandler
. J. Cochran
V. F. Dennison
R. L. Brittsman
. H. Dieckamp
. E. Dunlay
C. J. Engburg
J. V. Fasha
A. J. Fitzgerald
. A. Flynn
R. J. Gimera
R. L. Harman
J. Hawley
R. L. Henry
C. R. Johnson
J. R. Lewis
M. Naki
. V. Marera
. Minor
L. I. Moss
. E. Nagel
. R. Nathan
T. G. Parker, Jr.
L. A. Rash
F. A. Salisbury
J. C. Sypani
. H. Stone
. D. Sturtevant
J. Susnir
. D. Watrous
J. R. Welsh
J. D. Wilde
R. O. Williams
. J. Yesak
Library (10)

STATEMENT OF PROBLEM

Establish the reliability of the SNAP 10A fuel element and its components as a function of the severity of environment, finally yielding the mode of failure and the ultimate capability of the fuel element.

ABSTRACT

Results to date indicate little or no effect of environmental inputs on SNAP 10A fuel elements. Testing is done in accordance with procedures outlined in NAA-22-005, "SNAP 10A Fuel Element Environmental Test Specification." A new criterion for acceptance of fuel elements is given.

Previous Monthly Report

NAA-SR-MEMO-8831 (July)

UNCLASSIFIED

[redacted]

[redacted]

FORM 701-C REV. 10-62

I. INTRODUCTION

The purpose of environmental testing is to establish the reliability of fuel elements by subjecting them to vibration and shock inputs and ramp heating rates in excess of those required for qualification.[1] These inputs simulate launch conditions and reactor start-up. The pre-launch check out and reactor life conditions are also simulated by subjecting the elements to thermal cycling and thermal endurance. The effects of these inputs are evaluated by measuring the hydrogen permeation before and after each of the above inputs, and by chemical and metallographic analysis after endurance testing. The sequence of testing and equipment capability are shown in Figure 1.

II. PROGRAM

A. Test Equipment Status and Operation

1. Permeation Testing: SNAP 10A fuel elements are tested in an eight furnace permeation system capable of testing four elements per day. The elements are tested at 1200°F as per specification.[2] An additional test at 1100°F is also made to allow correlation of environmental and qualification test results. The system is adequate to handle the permeation test needs of the environmental test program.

2. Thermal Cycling: A three furnace system capable of simultaneously testing twenty-four elements is used for thermal cycling. Four days are required for thermal cycling the fuel elements in the environmental test program.

3. Vibration and Shock: The elements are loaded five at a time in a simulated core tank. The tank is filled with water and pressurized to 25 ± 2 psig after loading. The elements are arranged in the core tank in the configuration shown in Figure 2. Inputs are made using a Ling 7500 shaker-slip table system.

4. Ramp Heating: Two induction heating systems are available for ramp heating. Each system can accommodate approximately two elements every three days. The systems require periodic adjustment to insure acceptable temperature profiles and temperature peaks. These two characteristics may cause delays in the program from time to time.

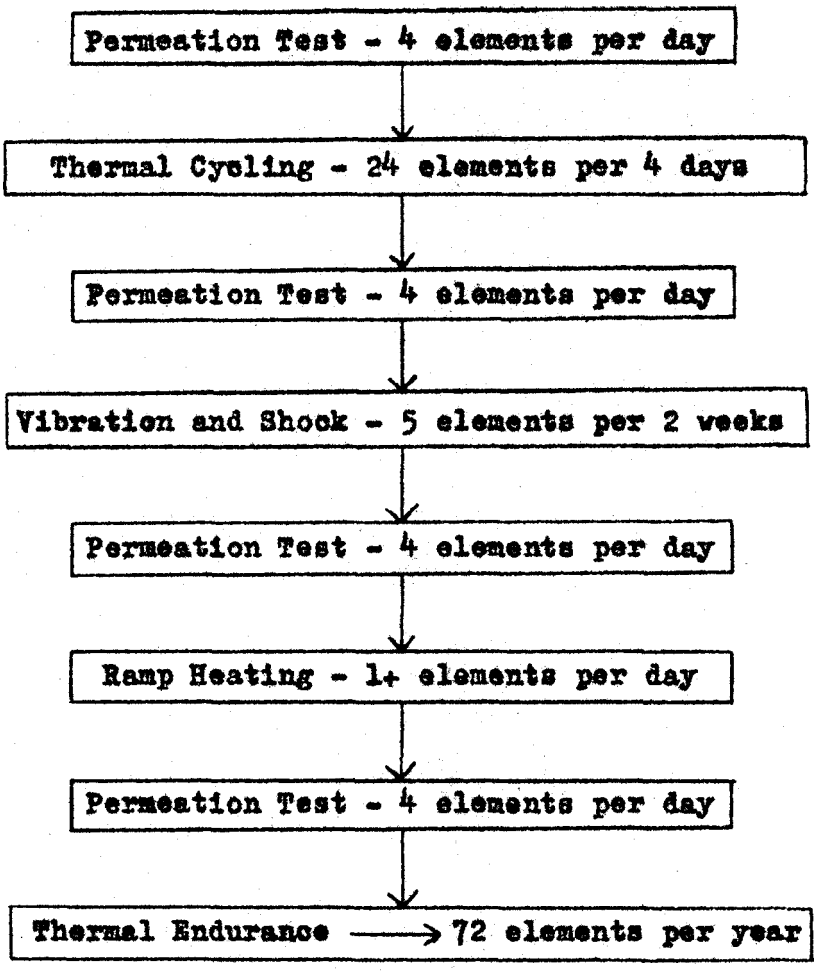
---

[1] NA0422-006, "SNAP 10A Fuel Element Qualification Test Specification," T. G. Parker, Jr., Rev. 5/7/63.

[2] NA0212-007, "Isothermal Hydrogen Permeation Testing of Production SNAP Fuel Elements," J. G. Spraul, Rev. 2/19/63.

UNCLASSIFIED

Figure 1



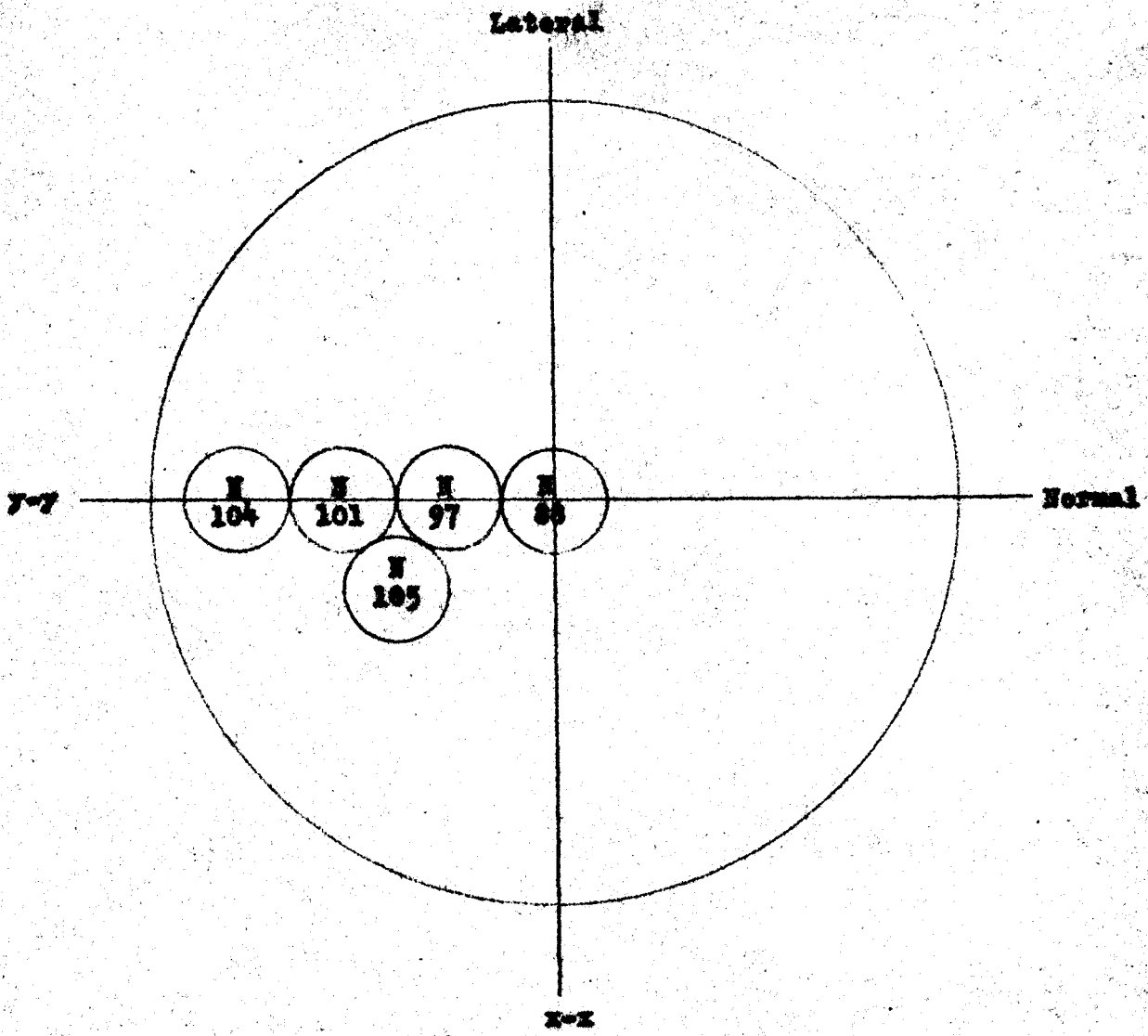
UNCLASSIFIED

[redacted]

UNCLASSIFIED

Figure 2

Location of SNAP 10A Fuel Elements
During Vibration and Shock



[redacted]

UNCLASSIFIED

5. Thermal Endurance: The new system will be able to accommodate up to seventy-two elements. The temperatures of the furnaces are presently being profiled for operation of this system.

The test equipment described above is used for qualification, environmental, and developmental testing of all SNAP 10A and SNAP 2 fuel elements.

III. PROGRAM STATUS

Fifteen fuel elements have been received during August, bringing the total number of environmental test elements to twenty-seven. These fifteen elements had undergone vibration and shock in the 10FS1 core tank before receipt for environmental testing. The present status of these 27 elements is shown in Figure 3. The results of the tests and inputs to date may be seen in Tables I - XXVII. In these tables, ϕ is the measured hydrogen permeation rate reported in units of cc(STP)/hr.

IV. DISCUSSION

A. Inputs

Each element receives three thermal cycles from 400°F to 1200°F with a heating rate of 300°F/hour and a cooling rate of less than 50°F/hr. The element remains at 1200°F for ten hours per cycle.

Elements N-88, N-97, N-101, N-104, and N-105 have undergone vibration and shock inputs of 200 percent of the normal qualification input level. Elements N-137, N-146, N-155, N-159, and N-165 have had inputs of 250 percent of the qualification level. Elements N-140, N-142, N-143, N-152, N-154, N-156, N-158, N-162, N-171, and N-172 will receive qualification level vibration and shock inputs prior to high level ramp heating rates. Elements N-88, N-97, N-101, N-104 and N-105 have undergone ramp heating at 150°F/minute to 1250°F. This is the minimum ramp heating rate for an environmental test element.

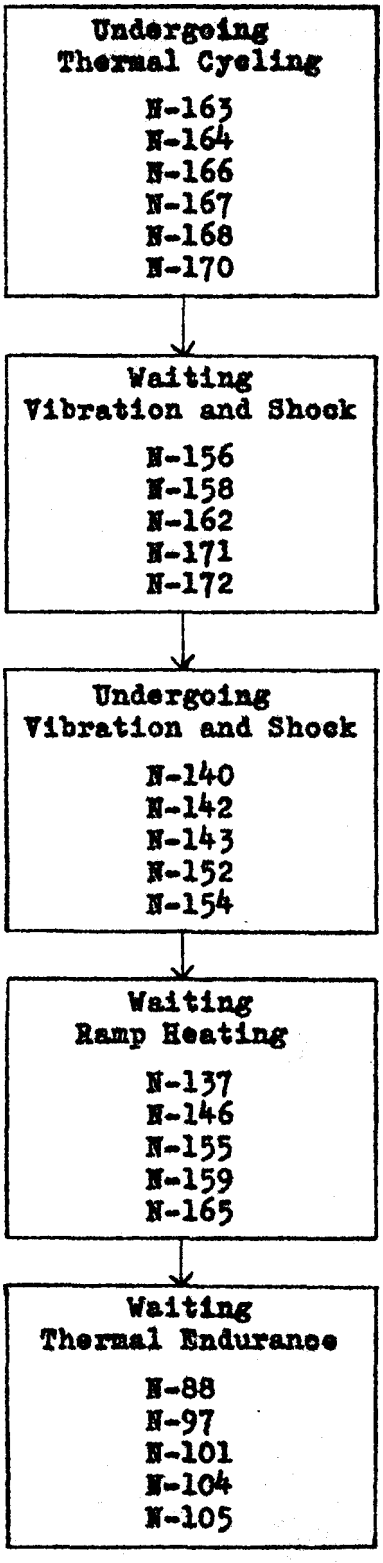
B. Significance of Acceptance Test Data

Element N-169 exceeded the specified failure leak rate of 3.0 cc(STP)/hr. at 1200°F in its pre thermal cycle permeation test. Review of the acceptance test data showed that the leak rate of the element increased from 0.23 cc(STP)/hr. to 0.50 cc(STP)/hr. at 1200°F because of low level acceptance

ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

UNCLASSIFIED

Figure 3



UNCLASSIFIED

[redacted]

Element N-169 was rejected (cf. Section IV B).

vibration. Review of the test data for seventy-two other elements (both normal and enriched uranium) which received similar tests showed that only one other element, N-158, had a larger increase of permeation. The seventy-two elements have a mean increase of 0.01 cc(STP)/hr. due to the low level acceptance vibration. The change in the leak rate of element N-169 is approximately equal to three times the standard deviation of the seventy-two elements. The change in permeation of element N-158 is well above this three-sigma band, but the permeation rate of N-158 did not continue to increase (cf. Table XV). Both these elements were vibrated and shocked in the 10F81 core tank after the acceptance tests. It is recommended that any element which shows an increase in permeation greater than 0.25 cc(STP)/hr. due to low level acceptance vibration be rejected. This is expected to cause no more than 5 elements per 1000 to be rejected.

V. CONCLUSIONS

A. SNAP 10A fuel elements are undamaged by 250% of the vibration and shock required for qualification.

B. Fuel elements which show an increase of more than 0.25 cc(STP)/hr. at 1200°F due to low level acceptance vibration should be rejected.

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE I

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-88	
% CARBON		0.20	
Nw - INITIAL		6.53	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCE TEST	0.06	0.29	
Ø BEFORE THERMAL CYCLING	0.05	0.24	
Ø AFTER THERMAL CYCLING	0.05	0.23	
Ø AFTER VIBRATION & SHOCK	0.05	0.29	
Ø AFTER RAMP HEATING	0.05	0.25	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 200% of design vibration & shock

: Design ramp heat

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE II

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-97	
% CARBON		0.24	
N_H - INITIAL		6.44	
φ TEST TEMPERATURE	1100	1200	
φ ACCEPTANCE TEST	0.04	0.21	
φ BEFORE THERMAL CYCLING	0.05	0.23	
φ AFTER THERMAL CYCLING	0.05	0.27	
φ AFTER VIBRATION & SHOCK	0.04	0.16	
φ AFTER RAMP HEATING	0.03	0.13	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL φ =

HOURS	φ	HOURS	φ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 200% of design vibration & shock

: Design ramp heat

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

UNCLASSIFIED

TABLE III

FUEL ELEMENT NUMBER		N-101	
% CARBON		0.24	
N_H - INITIAL		6.56	
φ TEST TEMPERATURE	1100	1200	
φ ACCEPTANCE TEST TEMP.	0.11	0.54	
φ BEFORE THERMAL CYCLING	0.06	0.40	
φ AFTER THERMAL CYCLING	0.05	0.42	
φ AFTER VIBRATION & SHOCK	0.04	0.30	
φ AFTER RAMP HEATING	0.03	0.23	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL φ =

HOURS	φ	HOURS	φ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 200% of design vibration & shock

: Design ramp heat

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE IV

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-104	
% CARBON		0.21	
N_H - INITIAL		6.50	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCE TEST	0.07	0.35	
Ø BEFORE THERMAL CYCLING	0.05	0.30	
Ø AFTER THERMAL CYCLING	0.05	0.32	
Ø AFTER VIBRATION & SHOCK	0.11	0.37	
Ø AFTER RAMP HEATING	0.08	0.33	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 200% of design vibration & shock

: Design ramp heat

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE V

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-105	
% CARBON		0.21	
N_H - INITIAL		6.64	
∅ TEST TEMPERATURE	1100	1200	
∅ ACCEPTANCE TEST	0.06	0.28	
∅ BEFORE THERMAL CYCLING	0.04	0.27	
∅ AFTER THERMAL CYCLING	0.04	0.23	
∅ AFTER VIBRATION & SHOCK	0.08	0.24	
∅ AFTER RAMP HEATING	0.06	0.18	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 200% of design vibration & shock

: Design ramp heat

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL φ =

HOURS	φ	HOURS	φ

DATE FINISHED

UNCLASSIFIED

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE VI

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-137	
% CARBON		0.21	
N_H - INITIAL		6.52	
ø TEST TEMPERATURE	1100	1200	
ø ACCEPTANCE TEST	-	0.17	
ø BEFORE THERMAL CYCLING	0.02	0.10	
ø AFTER THERMAL CYCLING	0.02	0.09	
ø AFTER VIBRATION & SHOCK	0.02	0.11	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 250% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE VII

UNCLASSIFIED

FUEL ELEMENT NUMBER		E-140	
% CARBON		0.18	
N_H - INITIAL		6.21	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.20	
ϕ BEFORE THERMAL CYCLING	0.05	0.19	
ϕ AFTER THERMAL CYCLING	0.05	0.21	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE VIII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-142	
% CARBON		0.14	
N_H - INITIAL		6.32	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.24	
ϕ BEFORE THERMAL CYCLING	0.08	0.30	
ϕ AFTER THERMAL CYCLING	0.05	0.23	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE IX

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-143	
% CARBON		0.24	
N_H - INITIAL		6.28	
TEST TEMPERATURE °F	1100	1200	
φ ACCEPTANCE TEST		0.12	
φ BEFORE THERMAL CYCLING	0.02	0.10	
φ AFTER THERMAL CYCLING	0.02	0.09	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL φ =

HOURS	φ	HOURS	φ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE X

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-146	
% CARBON		0.21	
N_H - INITIAL		6.52	
ϕ TEST TEMPERATURE	1100	1200	
ϕ ACCEPTANCE TEST	-	0.10	
ϕ BEFORE THERMAL CYCLING	0.01	0.08	
ϕ AFTER THERMAL CYCLING	0.02	0.06	
ϕ AFTER VIBRATION & SHOCK	0.02	0.08	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 250% of design vibration and shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XI

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-152	
% CARBON		0.16	
N_H - INITIAL		6.41	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.14	
ϕ BEFORE THERMAL CYCLING	0.03	0.13	
ϕ AFTER THERMAL CYCLING	0.02	0.13	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-154	
% CARBON		0.14	
N_H - INITIAL		6.46	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.27	
ϕ BEFORE THERMAL CYCLING	0.07	0.25	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XIII UNCLASSIFIED

FUEL ELEMENT NUMBER		N-155	
% CARBON		0.15	
EH - INITIAL		6.52	
ϕ TEST TEMPERATURE	1100	1200	
ϕ ACCEPTANCE TEST	-	0.20	
ϕ BEFORE THERMAL CYCLING	0.02	0.15	
ϕ AFTER THERMAL CYCLING	0.03	0.13	
ϕ AFTER VIBRATION & SHOCK	0.02	0.11	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 250% of design vibration & shock

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XIV

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-156	
% CARBON		0.14	
N_H - INITIAL		6.46	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.40	
ϕ BEFORE THERMAL CYCLING	0.07	0.29	
ϕ AFTER THERMAL CYCLING	0.08	0.26	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XV

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-158	
% CARBON		0.15	
N_H - INITIAL		6.33	
TEST TEMPERATURE °F	1100	1200	
ø ACCEPTANCE TEST		0.69	
ø BEFORE THERMAL CYCLING	0.13	0.53	
ø AFTER THERMAL CYCLING	0.13	0.61	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration
& shock.

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XVI

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-159	
% CARBON		0.21	
N_R - INITIAL		6.47	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCT TEST	-	0.19	
Ø BEFORE THERMAL CYCLING	0.03	0.19	
Ø AFTER THERMAL CYCLING	0.03	0.12	
Ø AFTER VIBRATION & SHOCK	0.03	0.13	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 250% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL EL[redacted] TEST RESULTS

TABLE XVII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-162	
% CARBON		0.17	
N_H - INITIAL		6.26	
TEST TEMPERATURE °F	1100	1200	
∅ ACCEPTANCE TEST		0.15	
∅ BEFORE THERMAL CYCLING	0.03	0.14	
∅ AFTER THERMAL CYCLING	0.02	0.09	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XVIII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-163	
% CARBON		0.14	
N_H - INITIAL		6.43	
TEST TEMPERATURE °F	1100	1200	
∅ ACCEPTANCE TEST		0.15	
∅ BEFORE THERMAL CYCLING	0.05	0.25	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XIX

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-164	
% CARBON		0.13	
Hg - INITIAL		6.45	
TEST TEMPERATURE °F	1100	1200	
ø ACCEPTANCE TEST		0.22	
ø BEFORE THERMAL CYCLING	0.04	0.20	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ =			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10F81 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XX

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-165	
% CARBON		0.14	
N_H - INITIAL		6.58	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCE TEST	-	0.27	
Ø BEFORE THERMAL CYCLING	0.04	0.25	
Ø AFTER THERMAL CYCLING	0.06	0.25	
Ø AFTER VIBRATION & SHOCK	0.06	0.24	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

INPUTS: 250% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXI

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-166	
% CARBON		0.24	
N_H - INITIAL		6.20	
TEST TEMPERATURE °F	1100	1200	
φ ACCEPTANCE TEST		0.13	
φ BEFORE THERMAL CYCLING	0.03	0.25	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL φ =			
HOURS	φ	HOURS	φ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-167	
% CARBON		0.13	
N_H - INITIAL		6.32	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.20	
ϕ BEFORE THERMAL CYCLING	0.03	0.15	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXIII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-168	
% CARBON		0.16	
N_H - INITIAL		6.37	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.18	
ϕ BEFORE THERMAL CYCLING	0.04	0.13	

ENDURANCE TEST DATA			
DATE STARTED			
PRETEST TOTAL ϕ :			
HOURS	ϕ	HOURS	ϕ
DATE FINISHED			

ENDURANCE TEST DATA
SYSTEM
FURNACE
RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXIV

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-169	
% CARBON		0.17	
N_H - INITIAL		6.36	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.50	

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXV

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-170	
% CARBON		0.14	
N_H - INITIAL		6.37	
TEST TEMPERATURE °F	1100	1200	
ϕ ACCEPTANCE TEST		0.22	
ϕ BEFORE THERMAL CYCLING	0.04	0.09	

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

10FS1 Core Element

INPUTS: 100% of design vibration & shock

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXVI

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-172	
% CARBON		0.29	
N_H - INITIAL		6.52	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCE TEST	-	0.29	
Ø BEFORE THERMAL CYCLING	0.04	0.25	
Ø AFTER THERMAL CYCLING	0.07	0.34	
Ø AFTER VIBRATION & SHOCK			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]

[redacted]

SNAP 10A FUEL ELEMENT ENVIRONMENTAL TEST RESULTS

TABLE XXVII

UNCLASSIFIED

FUEL ELEMENT NUMBER		N-172	
% CARBON		0.24	
N_H - INITIAL		6.64	
Ø TEST TEMPERATURE	1100	1200	
Ø ACCEPTANCE TEST	-	0.30	
Ø BEFORE THERMAL CYCLING	0.05	0.39	
Ø AFTER THERMAL CYCLING	0.05	0.17	
Ø AFTER VIBRATION & SHOCK			

ENDURANCE TEST DATA

SYSTEM

FURNACE

RETORT

NOTES

ENDURANCE TEST DATA

DATE STARTED

PRETEST TOTAL ϕ =

HOURS	ϕ	HOURS	ϕ

DATE FINISHED

UNCLASSIFIED

[redacted]