(CLASSIFICATION)

DECLASSIFIED

HW-67492
Page 1

DISTRIBUTION

1-2. AEC-HOO: AT Gifford	31. WK Kratzer
3. AEC-HOO: PM Midkiff	32. LE Kusler
4. FW Albaugh	33. GA Last
5. WK Alexander	34. CG Lewis
6. GS Allison	35. NR Miller
7. TW Ambrose	36. JE Minor
8. ER Astley	37. SL Nelson
9. GR Bailey	38. JW Nickolaus
10. LV Barker	39. R Nilson
11. RS Bell	40. WA Oldham
12. WA Blanton	41. RE Olson
13. RW Bown	42. GF Owsley
14. JH Brown	43. CA Priode
15. JJ Cadwell	44. T Prudich
16. RL Call	45. RW Reid
17. MA Clinton	46. OC Schroeder
18. WA Crossman	47. RJ Shields
19. DR Dickinson	48. RD Shimer
20. RV Dulin	49. WR Smit
21. G Fiorelli	50. HG Spencer
22. JM Fouts	51. JT Stringer
23. GC Fullmer	52. RE Trumble
24. SM Gill	53. FW Van Wormer
25. SM Graves	54. EE Weyerts
26. OH Greager	55. FW Woodfield
27. RE Hall	56. HM Woods
28. AK Hardin	57. 300 Files
29. PC Jerman	58. Record Copy
30. RS Kemper	

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of DS Lewis, 1-28-94
CG PR-2 (PR24), 4-30-94
By Jerric Maly, 4-30-94
Verified By McK Hanson, 4-20-94

RESTRICTED DATA

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

This document classified by

W Ambrose

This document consists of
6 pages.

COPY 1 OF 1, SERIES MA

November 21, 1960

PRODUCTION TEST IP-378-A, EVALUATION OF HEAT TREATMENT VARIABLES DURING HIGH TEMPERATURE IRRADIATION IN THE KER LOOPS

OBJECTIVE

The objective of this production test is to compare the dimensional and structural behavior of fuel elements with various heat treatments during irradiation at conditions similar to those anticipated for the NPR.

SUMMARY

Zircaloy-2 jacketed unalloyed natural uranium fuel elements of the same diametral dimensions as those anticipated for the N Reactor inner fuel tube, incorporating various

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED 872

DECLASSIFIED

HW-67492

Page 2

heat treatments, will be irradiated to about 2000 MWD/T in the KER Loops. The elements will be enclosed in a Zircaloy-2 sleeve to provide a more balanced flow distribution through and around the pieces.

BASIS AND JUSTIFICATION

An optimum heat treatment for N Reactor fuel elements providing minimum fuel distortion through control of uranium grain size and orientation has not been determined. This production test provides for the irradiation of fuel elements nearly equivalent to N Reactor inner tubes in size, geometry, and temperature conditions during irradiation. These elements have been subjected to varying heat treatments providing a range of grain sizes and degrees of orientation. Post-irradiation examination of the elements will show the fuel element distortion associated with each heat treatment and provide information on which to base further irradiation testing in the development of a heat treating procedure for N Reactor fuel elements.

TEST DETAILS

1. Fuel Elements

The fuel elements authorized by this production test are coextruded Zircaloy-2 jacketed tubular elements 1.256 inch O.D., 0.439 inch I.D., with a 0.040 inch jacket on the outer surface and a 0.030 inch jacket on the inner surface (NIN-1)(1). The elements are 15 inches long and contain 14.5 inches of unalloyed natural uranium. The ends are closed with 0.250 inch unbonded electron beam welded end caps. Each element is centered in a 1.84 inch O.D., 1.50 inch I.D., Zircaloy-2 flow distributing sleeve by Zircaloy-2 semi-flexible supports. The sleeves have Zircaloy-2 semi-flexible supports with crimped iron facings to minimize sliding abrasion of the process tube. Details of the support facing are given in HW-67533(2).

The heat treatments being evaluated by the production test are given below:

- (1) Kusler, L. E. and Kratzer, W. K., Method for Designating Experimental Coextruded Zircaloy-2, Jacketed Fuel Elements, HW-67225, October 26, 1960, (CONFIDENTIAL-UNDOCUMENTED)
- (2) Pilger, J. P. Attachment of Non-Galling and Non-Scratching Bearing Surfaces to Fuel Element Supports, HW-67533.

DECLASSIFIED

HW-67492
Page 3

Heat Treatment

Quench Rates at Midwall
Immersion to
Transformation
°C/sec
600-450 C
°C/sec

730 C NUSAL 10 minutes
20 C water quench

50.9

120

730 C NUSAL 10 minutes
Air cooled

2.4

1.2

730 C NUSAL 10 minutes
10 second delay - oil quench

48.6

42.4

730 C NUSAL 10 minutes
20 second delay - oil quench

36.2

42.4

730 C NUSAL 10 minutes
30 second delay - oil quench

22.5

42.4

730 C NUSAL 10 minutes
Quenched to LH980 salt at
590 C - 5 minutes, Air cool

2.4

1.0

DECLASSIFIED

HW-67492

Page 4

All elements have been nondestructively tested for bonding and jacket thickness and have been autoclaved in 400°C steam for 72 hours.

2. Loading

Up to fifteen elements may be charged, depending upon the number available. The precise loading pattern approved by Process and Reactor Development Operation and Process Technology Operation will be provided prior to charging. Coupon holders of a design approved by Process and Reactor Development Operation and Coolant Testing Operation may be included in the charge in positions not affecting the test.

3. Irradiation Facility

The fuel elements may be irradiated in any KER high temperature recirculating loop.

4. Operating Conditions

The coolant will be pressurized water with the pH adjusted to 10.0 ± 0.5 by the addition of LiOH. The low pressure trip will be set at 1500 psig. The desired operating flows and temperatures and the flow and temperature trip settings appropriate to the particular loops and fuel loading pattern will be provided in a document approved by Process and Reactor Development Operation and Process Technology Operation prior to charging.

5. Power and Temperature Limits

The operating conditions will be chosen so that surface boiling will not occur on the fuel elements during normal operation, burnout will not occur at the limiting trip conditions, and the maximum uranium temperature will not exceed 600°C.

6. Exposure

The maximum exposure authorized by this production test is 2000 MWD/T.

7. Special Procedures

The fuel elements from this production test will be discharged into a special tray according to procedures developed by the KE Maintenance Operation.

8. Priority

Additional down-time is authorized if charging or discharging cannot be accomplished during a normal outage.

9. Costs

a. Cost Code - XXX-5R24-XXX-73

b. Time

	Elevator Time, Hours		Manhours
	Front	Rear	
Charge	1	1	4
Discharge	2	4	10
	3	5	14

c. Reactivity change: The test loading will have a reactivity intermediate between that of a dummy charge and a standard charge of normal fuel elements.

DECLASSIFIED

HW-67492
Page 5

10. Data Desired

Routine operating data, including coolant flow, inlet and outlet temperature and pressure, system pressure, and operating time at temperature, will be taken during irradiation.

11. Hazards

The failure probability for the elements authorized by this test should be no greater than for other tubular irradiations in the KER Loops. Some surface bumping and distortion is expected; however containment of the elements in Zircaloy-2 sleeves will prevent the distortion from interfering with discharging. In addition, the sleeves will prevent hydriding damage to the process tube if a failure should occur.

RESPONSIBILITIES

Hanford Laboratories Operation

Reactor and Fuels Research and Development Operation

Fuels Development Operation

Fuels Fabrication Development is responsible for the heat treatment and fabrication of the elements, analysis of data, and issuance of technical reports.

Irradiation Processing Department

Research and Engineering Operation

Component Testing Operation is responsible for post-irradiation examination and testing of components in the test charge.

Coolant Testing Operation is responsible for:

- a. Operation of the KER Loops
- b. Taking basic operating data
- c. Scheduling the loop charge with the concurrence of KE Processing Operation
- d. Reactor safety and production continuity as they are affected by loop operation.

Process and Reactor Development Operation is responsible for:

- a. Technical aspects of the fuel element irradiation
- b. Termination of the production test and issuance of the final report.

KE-KW Reactor Operation

KE Processing Operation is responsible for:

- a. Operational safety
- b. Production continuity, except where inconsistent with provisions of this test.
- c. Special discharges.

W. K. Kratzer
Reactor Fuels Unit

Process and Reactor Development Subsection
IRRADIATION PROCESSING DEPARTMENT

WK Kratzer:gb

DECLASSIFIED

HW-67492

Page 6

APPROVALS

R. Nilson

R. Nilson, Acting Manager
Process and Reactor Development Subsection
IRRADIATION PROCESSING DEPARTMENT

R. W. Reid

R. W. Reid, Manager
Process Technology Subsection
IRRADIATION PROCESSING DEPARTMENT

C. G. Lewis

C. G. Lewis, Manager
Testing Operation
IRRADIATION PROCESSING DEPARTMENT

R. W. Reid acting for

O. H. Greager, Manager
Research and Engineering
IRRADIATION PROCESSING DEPARTMENT

S. L. Nelson

S. L. Nelson, Manager
KE Processing Operation
IRRADIATION PROCESSING DEPARTMENT

R. S. Bell

R. S. Bell, Manager
KE-KW Reactor Operation
IRRADIATION PROCESSING DEPARTMENT

E. R. Colby

E. R. Colby, Manager
Applied Reactor Engineering Operation
IRRADIATION PROCESSING DEPARTMENT

O. C. Schroeder

O. C. Schroeder, Manager
Manufacturing Section
IRRADIATION PROCESSING DEPARTMENT

AIMM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIMM STANDARDS
BY APPLIED IMAGE, INC.

DATE

FILMED

12/13/94

END