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TITLE

KER-2 OPERATING REPORT

TEST K-2-17

PT IP-484-D

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March 26, 1964

KER-2 OPERATING REPORT

TEST K-2-17

PT IP-584-D

IRRADIATION OF TARGET ASSEMBLIES IN KER-2

I. Introduction

The purpose of this test was to evaluate the behavior of LiAl elements at N-Reactor operating conditions. The test was made to determine:

- A. The rate of swelling of the LiAl alloy.
- B. The effect of irradiation on the mass transport of lithium and tritium in the target assembly.
- C. The effect of aluminum surface treatment on the transport of lithium and tritium.

II. Summary

- A. Date charged - June 6, 1963
- B. Fuel elements - The initial fuel charge consisted of four 17-inch NIEl fuel elements having an enrichment of 0.94%. Two NIEl elements were added on July 3. Also included in the fuel charge were two 18.5 inch sleeves containing two 9-inch LiAl elements.
- C. Exposure - The fuel elements were in the reactor 4757 hours. The loop operated at test conditions 2401 hours. The charge reached an exposure of 1956 MWD/T.
- D. Date discharged - December 21, 1963
- E. Reason for discharge - Goal exposure reached

III. Test Details

A. Tube Charge Order

<u>Position From Downstream End</u>	<u>Description</u>
1-3	8" triangular perf
4-23	8" tubular spacers
24	8" triangular perf
25	17" NIEl fuel element
26	8" triangular perf

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Tube Charge Order (Continued)

<u>Position From Downstream End</u>	<u>Description</u>
27	17" NIE1 fuel element
28	8" triangular perf
29	8" coupon holder
30-33	18.5" Al sleeve assembly containing two LiAl elements
34	8" triangular perf
35	8" triangular perf
36	17" NIE1 fuel element
37	8" triangular perf
38	17" NIE1 fuel element
39	8" triangular perf
40	17" NIE1 fuel element
41	17" NIE1 fuel element
42	8" triangular perf

The last three pieces were charged on July 3, 1963.

B. Fuel Elements

Heater elements for test K-2-17 were NIE1 fuel elements as authorized by PT IP-536-A. The NIE1 elements were supported axially in a Zr-2 flow distributing sleeve. The elements were of the following dimensions: OD 1.249 inch, ID 0.438 inch, jacket thickness on the outer surface 0.040 inch, jacket thickness on the inner surface 0.025 inch, end cap thickness 0.200 inch, overall length 17.3 inches. The dimensions of the flow distributing sleeve were: OD 1.90 inch, ID 1.50 inch, overall length 17.3 inches.

LiAl Elements

The LiAl elements consisted of 0.625 inch OD, 0.250 inch ID tubular elements fitted into an aluminum sleeve having a wall thickness of 0.030 inch, and end plugs of 0.375 inch which were welded into each end. The 0.250 inch center hole and the spaces between the LiAl element, the aluminum can and the Zr-4 can were filled with helium gas. Three supports 0.375 inches high were welded to each end of the LiAl element to position it axially in a standard 1.9 inch OD, 1.5 inch ID Zr-2 flow distributing sleeve, such as used for irradiating NIE1 fuel elements in KER-1 or 2. The Zr-2 flow distributing sleeves are 18.5 inches long and contain two 9 inch LiAl assemblies.

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C. Operating Conditions

The desired operating conditions for test K-2-17 were:

1. Pressure - 1600 psi at the tube outlet nozzle.
2. Temperature - 282 C.
3. Flow - 40,000 lbs/hr
4. pH - 10.0 ± 0.5 adjusted with LiOH or NH_4OH .

IV. Loop Operating History

The loop did not operate on single-pass or at minimum temperature at any time during the entire operating period due to the failure of equipment.

A. Fuel Element History

The fuel elements were charged in the reactor 4757 hours and the reactor operated 3204 hours (see Graph No. 1). The loop operated at test conditions 75% of the reactor operating time. Table No. 1 gives a breakdown of the operating times.

B. Water Quality

The quality of the loop coolant was maintained by routing a small portion of the loop flow through one of two ion exchange columns. One column was charged with XE-154 nuclear grade lithium base resin, and the other column contained XE-150, a neutral resin. Loop pH was adjusted by routing flow through the high pH column. Additional pH control was made by adding a LiOH solution directly to the loop by bombing. The pH was maintained at 10.0 ± 0.5 . If the loop was drained, or placed on single-pass operation, the loop water was purified to one megohm-cm by routing the clean-up flow through the neutral ion column.

The quality of the loop water was checked periodically by sampling. Analysis for oxygen was made by the modified Winkler method. Metallic ion concentrations were determined by emission analysis. Concentrations of dissolved gases and other impurities were determined by wet chemical analysis. The quality of the loop water is shown in Table 2 and on the reference graphs in the appendix.

C. Test Termination

The loop was tray discharged on December 21, 1963. At that time the fuel had reached the desired exposure of 1956 MWD/T.

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D. Loop Operation

The previous test, K-2-16, was authorized by PT IP-544-A. Test conditions for this test were similar to those specified for test K-2-17. Test K-2-16 was charged with eight 17-inch KSE5, 1.6% enriched fuel elements.

E. Equipment Experience

July 1, 1963 - Installed a weld-o-let on the clean-up system inlet for the NPR rupture monitor.

July 10, 1963 - The dump valve diaphragm ruptured causing a reactor outage.

July 18, 1963 - The No. 2 neutron monitor failed.

September 29, 1963 - The No. 2 ion exchange column was charged with XE 154 resin for pH control.

December 6, 1963 - The No. 1 primary pump registered a low differential pressure. The instrument technician attempted to clear the trip and accidentally tripped the No. 2 pump low trip causing a reactor outage.

December 11, 1963 - The make-up pump was removed from service. The pump was damaged when a wrist pin came out of its bearing.

December 21, 1963 - Switched the emergency storage tank to route flow through the tank in preparation for the next test. There were no adverse effects on the loop operation.

December 21, 1963 - The test K-2-17 was discharged and test K-2-18 was charged.

GP Christensen
Technician, Coolant Testing

GP Christensen:smc

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References

1. PT IP-584-D, Irradiation of Target Assemblies in the KER Loops, R. Neidner, HW-77579.
2. PT IP-584-D, Loading and Operating Conditions for Additional N-Reactor Inner Fuel Tubes in KER-1 and KER-2, R. Neidner, HW-77977.
3. PT IP-536-A, Irradiation of N-Reactor Inner Fuel Tubes in KER Loops 1 and 2, W. K. Kratzer, HW-75280.
4. PT IP-544-A, Irradiation of 1.6% Enriched Thick Walled Single Tube Elements in KER-1 and KER-2, W. K. Kratzer and M. J. Wise, HW-75456.

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TABLE 1
LOOP OPERATING HISTORY
TEST K-2-17

<u>Loop Operating Condition</u>	<u>Total Hours</u>	<u>Percent of Time Charged</u>	<u>Percent of Reactor. Operating Time</u>
Hours at desired test condition	2401	50	75
Hours on single-pass, reactor up	None	--	--
Hours raising temperature	572	12	18
Hours at elevated temperature less than test condition	109	2	3
Hours recirculating at minimum temperature, reactor up	72	2	2
Hours lowering temperature before a shutdown	50	1	2
Hours on single-pass, reactor down	1099	23	
Hours recirculating at minimum temperature, reactor down	422	9	
Hours lowering temperature after a scram	32	1	

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TABLE 2

WATER QUALITY AVERAGES

Oxygen (Average does not include the period of low temperature operation before the shutdown and discharge, when the oxygen was 14.8 to 18.0 ppm.)	.14 ppm (Graph 6)
Chloride	<.05 ppm
Peroxide	<.10 ppm (Graph 5)
Silica	.088 ppm
Total Solids	6.2 ppm (Graph 3)
Specific Resistance	61,447 ohm-cm (Graph 2)
Turbidity	.40 ppm
pH	9.98 (Graph 4)
Iron	< 10 ppb
Nickel	< 10 ppb
Chromium	< 4 ppb
Copper	< 4 ppb
Aluminum	35 ppb (Graph 7)
Zirconium	< 4 ppb
Manganese	< 1 ppb
Cobalt	< 4 ppb
Zinc	< 20 ppb
Cadmium	< 10 ppb
Lead	< 50 ppb
Magnesium	< 10 ppb

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K-E 6 MONTHS BY DAYS 355-136L
X 90 DIVNS. JUL.-DEC.
KEUFFEL & ESSER CO. MADE IN U.S.A.

NER 2 LOOP TEMP.

—— inlet
—— outlet

Graph No. 1

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March 26, 1964

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K-E 6 MONTHS BY DAYS 358-138L
2 MODIMS JUL-DEC. MADE IN U.S.A.
KEUPPEL & BEER CO.

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Graph No. 2

March 26, 1964

1963

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K-E 6 MONTHS BY DAYS 358-136L
X 60 DIVS. JUL-DEC.
KEUFFEL & ESSER CO. MADE IN U.S.A.

Graph No. 3 and 4

March 26, 1964

1963

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K-E 6 MONTHS BY DAYS 356-138L
 X 80 DIVS. JUL-DEC. MADE IN U.S.A.
 KRUPP & ESSER CO.

Graph No. 5 and 6

March 26, 1964

1963

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K-E 6 MONTHS BY DAYS 358-138L
X 90 DIVS. JUL-DEC.
KEUFFEL & ESSER CO. MADE IN U.S.A.

1963

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