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R. L. Call

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FINAL REPORT: LOW EXPOSURE IRRADIATION OF AN ENRICHED SEVEN-ROD CLUSTER IN KER LOOP 1, PT-IP-246-A

R. L. Call

INTRODUCTION

One of the early candidate fuel elements for the N Reactor was the seven-rod cluster fuel element. An objective of the program to determine the suitability of the seven-rod cluster fuel element for N Reactor use was to evaluate the irradiation performance of coextruded, Zircaloy-2-clad, seven-rod cluster fuel elements over a range of exposures from low exposures to high exposures. This report describes the irradiation testing of an enriched seven-rod cluster fuel element which was irradiated to 520 MWD/T.

SUMMARY AND CONCLUSIONS

The seven-rod cluster was fabricated from 0.593 inch diameter Zircaloy-2-clad rods with 1.6 percent enriched uranium cores. Cladding thickness was 0.030 inch. The cluster was irradiated in KER Loop 1 in 250 C water to an exposure of 520 MWD/T. After discharge, the cluster was examined in the KE view pit and appeared to be in excellent condition. No further examination was made.

DISCUSSION

Fabrication of the Fuel Element

The fuel rods from which the cluster was made were cut from coextruded, Zircaloy-2-clad rod stock fabricated by Nuclear Metals, Inc. (NMI) of Concord, Massachusetts.[1] Cladding thickness was 0.030 inch and the cores were 1.6 percent enriched uranium. The fabrication process for making the rod stock into clusters has been given elsewhere[2] and will not be repeated here.

Irradiation History

The fuel element was charged into KER Loop 1 in May 1959, under the provisions of PT-IP-246-A[3] and Supplement A to the PT.[4] Some additional fuel elements were also charged into Loop 1 along with the enriched seven-rod cluster. These were a natural uranium seven-rod cluster with modified end caps and end supports,[5] a 36-inch long KER-size, tube-in-tube fuel element with uranium-2 wt. % zirconium alloy cores and a 33-inch long KER-size, rod-in-tube fuel element with uranium-2 wt. % zirconium alloy cores. The charge was irradiated until the enriched seven rod cluster had reached an exposure of 520 MWD/T. During the test, the loop conditions were:

Inlet temperature	223 C
Outlet temperature	262 C
Flow	50 gpm

The pH of the loop water was maintained at 10.0 by LiOH additions.

The temperature conditions calculated for the enriched seven-rod cluster are given in Table I.

TABLE I

TEMPERATURE DISTRIBUTION

	Peripheral Rod	Center Rod
Local bulk water temperature	250 C	250 C
Cladding surface temperature	290 C	280 C
Cladding-to-core interface temperature	355 C	335 C
Core center temperature	495 C	450 C

Postirradiation Examination

After the fuel elements were discharged from the loop, they were visually examined in the KE view pit. The rods of the enriched cluster appeared to be in excellent condition and were clean and free of film. No post-irradiation examinations other than the visual examination were made.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the contributions of T. T. Claudson who prepared the seven-rod cluster fuel element for irradiation and W. K. Kratzer who conducted the irradiation testing.

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