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SUPPLEMENTARY E-N LOAD CONVERSION RATIO DATA

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W. S. NECHODOM

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SUPPLEMENTARY E-N LOAD CONVERSION RATIO DATA

W. S. NECHODOM

INTRODUCTION

The interim report¹ included an analysis of those E-N case and blanket loading conversion ratio data which were available at that time, and an extrapolation of those data to expected, optimum, E-N operating conditions. Since issuance of the interim report further tritium yield data have become available from extraction of the tritium from the lithium-aluminum slugs irradiated in the second E-N core loading, and from the large batches of lithium-aluminum slugs irradiated as part of the blanket loading. Since these data complete the planned program of tritium analyses for the E-N demonstration load, it is felt appropriate that they be reported at this time.

No further plutonium yield data have been received since issuance of the interim report and for this reason the plutonium conversion ratio is still tentative. It may be different when data from the second core test loading has been received.

SUMMARY

The tritium yield data from the second E-N core and from the large batches of blanket lithium-aluminum slugs have been integrated into the conclusion expressed in the interim report. Table I summarizes the revised conclusions.

TABLE I

FULL FILE E-N LOAD CONVERSION TEST RESULTS
(Conversion Ratios at 600 MWD/T)

	Pu Yield (gms/MWD)	Total Yield (gms Pu Equiv./MWD)			Total Yield (gms Pu Equiv./MWD)		
		1st Core	2nd Core	Ave.	1st Core	2nd Core	Ave.
E-N Striped Core Load	0.722	0.213	0.189	0.201	0.935	0.911	0.923
Fringe Blanket Load	0.705	0.200*	0.197*	0.197*	0.905	0.902	0.902
Avg. (31.9% Blanket, 68.1% Core)	0.717	0.209	0.192	0.200	0.926	0.908	0.917
Avg. of Normal Load**					0.800	0.800	0.800
Ratio, Over-all E-N plus blanket to over-all normal load					1.157	1.135	1.146

*The value of 0.200 represents data from earlier small-scale testing. Since the value of 0.197 represents much more complete data from large-scale test, it is utilized in computing the final average conversion ratio.

**For a breakdown of the conversion ratios in the normal loading, see Reference 1, page 39.

¹HW-73615, "Technical Evaluation of E-N Demonstration Loading (Interim Report, PT-IP-350-C)," R. D. Carter et al May 11, 1962 (Secret).

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DISCUSSION

It is apparent that the adjusted tritium yield from the second core loading is significantly lower than that obtained from the first core. The unadjusted yield for the first core was 0.192, and for the second core 0.178, or seven per cent lower. This difference is not entirely understood; both sets of data have been carefully reviewed, and no calculational errors or obvious discrepancies in the exposure or yield data have been found. Inspection of reactor operating records does, however, suggest at least a partial explanation. It was expected, and assumed in Reference 1, that the amount of non-productive poisons in the reactor during irradiation of the second core loading would be reduced compared to that present during the first core loading. An increase in the number of lithium-aluminum pieces was made in the striped pattern for the second E-N core loading² which was intended to absorb enough additional excess reactivity to permit removal of the "spike" lithium-aluminum columns and about half of the 20-odd poison splines which were utilized in the first core loading. However, it is apparent from reactor operating records that the adjustment was not large enough; while it did permit removal of the "spike" lithium-aluminum columns, the average amount of non-productive poisons increased, rather than decreased, during the second core loading. This increase is attributable to two factors; a) a long-term reactivity gain in the second core which was apparently larger than in the first core, thus providing additional excess reactivity, and b) the occurrence of tube leak problems which made it necessary to operate the reactor with an excessive number of non-productive channels which absorbed excess reactivity which could otherwise have been absorbed in productive "spike" lithium-aluminum columns when the long-term gains became apparent. The situation was compounded because of the fact that under these operating conditions, when water leaks made it somewhat difficult to predict the operating reactivity status of the pile at equilibrium, it was prudent to utilize the non-productive, but flexible, poison spline system to absorb the remainder of the excess reactivity provided by the long-term gains, rather than the productive, but inflexible, "spike" column approach.

It is apparent that the problem outlined above is not intrinsic to an E-N loading. The water-leak problem was the result of long-term corrosion effects in the H reactor process tubes. Had the E-N loading not been present, the effect of the water leaks, non-productive loadings, and additional supplementary control use would have been reflected in a reduction in the over-all H reactor conversion ratio. This reduction would, however, probably not have been detected, since discharged uranium from all reactors is blended at the separations plants and the resulting over-all plant conversion ratio reduction would be within the precision limits of the output measurements.

The amount of excessive non-productive poisons (dummy and blank channels plus poison splines) in the second core loading was equivalent to about 0.4 to 0.5% $\Delta k/k$. Theoretically, this amount of additional non-productive poison would result in a decrease in tritium yield of about four to five per cent. In future E-N loadings, the tendency to allow excessive non-productive poison loadings would be counteracted by increasing the number of lithium-aluminum target pieces charged in the striped loading, and by absorbing long-term reactivity gains in "spike" columns of lithium-aluminum pieces. Such corrections should cause the tritium yield to approach the value originally reported in Reference 1.

²HW-70740, "Recommended E-N Charge Modification (Second Cycle PT-IP-350-C, E-N Demonstration Load," R. D. Carter, August 15, 1961 (Secret).

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With regard to tritium losses during the extraction process, Reference 3 states:

"Tritium losses were calculated by subtracting the sum of the measured volume of tritium and one-half the measured volume of helium-3 collected from one-half of the measured volume of helium-4 collected. Losses calculated in this manner amounted to 0.55% and are attributed to small quantities remaining in the spent melt, lost to the stack, and absorbed in the process system".

W. S. Nechodom by R. N

Reactor Physics
Process and Reactor Development Subsection

WS Nechodom:eck

³DPSP-62-1536, "Extraction of Tritium From Hanford Slugs," R. A. Scaggs, June 19, 1962 (Secret).

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