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SEMI-FINAL REPORT (REPORT NO. 3)
E-N LOAD CONVERSION RATIOS

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SEMI-FINAL REPORT (REPORT NO. 3)
E-N LOAD CONVERSION RATIOS

INTRODUCTION

Experimental data on plutonium yield and U^{235} burnout are now available on the E metal portion of three central zone striped E-N columns and one fringe blanket E column. These data and an overall E-N load conversion ratio based on experimental data are now reported.

RESULTS AND CONCLUSIONS

With one exception the results reported now do not differ significantly from those previously reported⁽¹⁾. The exception being the conversion ratio assigned to fringe blanket E columns. Previously, due to lack of experimental data, it was recommended that currently accepted E metal conversion ratios be used for these columns,⁽¹⁾ and further, it was suggested that these values were felt to be about 5% low. Experimental data now indicate that the conversion ratio for these columns is slightly lower than currently accepted values. These conclusions are supported by recent theoretical work by C. E. Bowers⁽²⁾.

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TABLE I

E-N LOAD CONVERSION RATIOS*
(746 MWD/T Exposure)

	Central Zone Striped Columns (data from 3)	Fringe Blanket** Li-Al Columns (data from 2)	Outermost Fringe Blanket*** E Columns (data from 1)
Pu Buildup	1.0071 g/MWD	1.407 g/MWD _{adj}	.6792 g/MWD
U ²³⁵ burnout	1.113 g/MWD		1.0449 g/MWD

* Conversion ratios include tritium yields in grams equivalent plutonium.

** MWD_{adj} is the exposure of the adjacent E metal segment of the same length as the lithium-aluminum column.

*** Exposure of the column experimentally analyzed was 358 MWD/T; data has been extrapolated to 746 MWD/T.

DISCUSSION

Striped E-N Load

Data are now available on plutonium and uranium analyses from three striped columns, each containing 38 pieces of I & E E metal; detailed results appear in reference 3. Averaging the analytical results of the three columns gives:

Exposure = 746 MWD/T
 Plutonium Buildup = .7755 gms/MWD
 Pu²⁴⁰ = 5.41%
 Pu²⁴¹ = .54%
 Pu²⁴² = .01%
 U²³⁵ Burnout = 1.1166 gms/MWD

After correcting to a full length striped column of 41 I & E E pieces and combining with previously reported tritium yields, the results are:

Plutonium buildingup = 1.0071 gms/MWD
 U²³⁵ burnout = 1.113 gms/MWD

Fringe Load

Data are now available on plutonium and uranium analyses from one full length I & E column which was irradiated in a lattice location immediately adjacent to the lithium-aluminum blanket. Detailed analytical results appear in reference 3. In summary:

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Exposure = 358 MWD/T
 Plutonium Buildup = .7166 gms/MWD
 Pu²⁴⁰ = 2.53 %
 Pu²⁴¹ = .18 %
 Pu²⁴² = .01 %
 U²³⁵ Burnout = 1.0861 gms/MWD

Tritium yields in the fringe lithium-aluminum blanket have been reported previously⁽¹⁾.

GENERAL DISCUSSION

For purposes of calculating overall pile conversion ratios, it has been generally assumed that the conversion ratio of a particular type loading is independent of its location in the pile. It is recognized that this is true only of unflattened piles; in flattened piles (true of all Hanford reactors) the conversion ratio in the flat zone is considerably higher than that of the fringe (highly buckled) region, and the average pile conversion ratio is slightly lower than that calculated for an unflattened pile⁽²⁾. Briefly, the theory suggests that conversion ratios in the highly buckled fringe region will be significantly lower than the central zone because of a higher fast neutron leakage into the reflector, thus reducing the ratio of epithermal neutron absorption in U²³⁵ to thermal neutron absorption in the fuel. For the entire fringe region of the present H pile loading Bowers calculates a conversion ratio about 8 percent lower than the central zone; current experimental data from the E-N loading indicates that the conversion ratio in the last E-metal lattice is about 12 percent lower than central zone E metal conversion ratios (it would be expected to be lower than the average of the buckled region). C. E. Bowers has been requested⁽⁴⁾ to furnish theoretical calculations of the variation in conversion ratio as a function of location which may be used in conjunction with the experimental data reported here to obtain an overall pile conversion ratio for both the present base case and the E-N load.

Inspection of the analytical results of the U²³⁵ concentration measurement indicate that the probable precision range is at least $\pm .01$ rather than $\pm .004$ as reported in the reference. This is still good precision, but when these results are applied to the calculation of U²³⁵ burnout a precision of about ± 10 percent results. This indicates that a single or small number of analytical determinations of U²³⁵ burnout cannot be used directly in establishing conversion ratios nor for economic analyses, and one must rely instead on theoretical values or a large number of analyses.

This report concludes the immediate analytical work planned for this loading. Several more batches of irradiated uranium have been reserved from the loading for possible further analytical work; however, the press of routine work at the Redox plant precludes further special analyses at this time.

WS Nechodom

Reactor Physics
 Process and Reactor Development
 IRRADIATION PROCESSING DEPARTMENT

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