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FISSION-PRODUCT STRONTIUM ACTIVITY

In response to a request from E. F. Judson I have reviewed the possibility that errors in physical constants or method of calculation might have resulted in an erroneously high theoretical strontium activity which in turn would explain the unexpected low activity found in the strontium recently recovered from Purex wastes. The strontium was recovered from fuel with the following irradiation history:

Avg. Exposure	571 MWD/T
Avg. Specific Power	8 MW/T
Avg. Cooling after Discharge	100 days

The theoretical activity had been calculated to be:

Sr-89	54,400 curies/TU
Sr-90	<u>1,950</u>
Total	56,350 curies/TU

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However, the activity of strontium recovered from a dissolver solution sample by analytical procedures analyzed only 36,800 curies or 65% of theoretical. This activity is reported to be in good agreement with strontium activity in

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the waste stream.

The two active strontium isotopes are Sr-89 and Sr-90 with Sr-89 providing over 95% of the activity in 100-day cooled waste. Physical constants data for these two fission-product isotopes were reviewed and it appears that the only significant change is a revision of the half-life of Sr-89 from 54 days to 51 days. Although this revision indicates more rapid decay during cooling it also results in higher calculated activity at reactor discharge so that the net effect is only about a 4% reduction in calculated activity after 100-days cooling.

Results of the calculations made for this review are summarized in the attached table. Fission yield, decay chain and half-life data for these calculations were taken from the compilation of Katcoff.⁽¹⁾

Composite fission yields for each isotope were calculated using the procedure outlined in HW-32786⁽²⁾ and HW-55049⁽³⁾ to correct for the fraction of fissions occurring in U-238 and Pu-239. This correction results in an additional 7% reduction in calculated activity.

The possibility of Sr-89 or Sr-90 loss by neutron capture during irradiation was checked and found to be negligible.

Several calculations were made to define the effect of errors in irradiation history data. Examples are shown in the attached table. It appears unlikely that this type of error could result in more than a 5 or 10% error in calculated activity.

Conclusions

1. Previous calculations of theoretical strontium activity were indeed high but not enough so to explain the large difference between theoretical and measured strontium activity. The best values for theoretical strontium activity for the conditions cited are:

Sr-89	47,460 curies/T
Sr-90	<u>1,753</u>
Total	49,213 curies/T

This improves accountability from 65% to 75% of theoretical.

(1) Seymour Katcoff. *Nucleonics* Vol. 16, No. 4 76 (1958).

(2) R.D. Gumprecht, "Activity of Ru-103 and Ru-106 in Pile Fission Products". August 17, 1954, HW-32786.

(3) R.W. McKee, "Hanford Fission Product Properties", February 19, 1958 HW-55049.

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2. It is unlikely that the difference between theoretical and measured activity can be explained on the basis of errors in irradiation history. Such a large error is unlikely. However, each day of cooling time is important since one day of cooling will reduce the Sr-89 activity by 1.35%.
- { 3. The possibility of errors in analytical procedures and counting technique should be explored to explain the remaining discrepancy.

R. W. McKee

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Programming

RW McKee:rd

STRONTIUM ACTIVITY IN IRRADIATED NATURAL URANIUM

<u>Isotope</u>	<u>MBD/T</u>	<u>MB/T</u>	<u>Half-Life</u>	<u>Fission Yield</u>	<u>Cooling Time</u>	<u>Curies/Ton U</u>
Sr-89	571	8	54d	4.8% (25 only)	100 d	53,300
Sr-89	571	8	51 d	4.8% (25 only)	100 d	51,200
Sr-89	571	8	51 d	4.45% (comp.)	100 d	<u>47,460*</u>
Sr-89	571	8	51 d	4.45% (comp.)	105 d	44,330
Sr-89	571	8	51 d	4.45% (comp.)	110 d	41,530
Sr-89	571	7	51 d	4.45% (comp.)	100 d	44,950
Sr-90	571	8	28 y	5.77% (25 only)	100 d	1,857
Sr-90	571	8	28 y	5.45% (comp.)	100 d	<u>1,723*</u>

*Best values.

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