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TITLE

CALORIMETRIC ASSAY OF ^{60}Co SOURCES FROM C-OVERBORE FACILITIES

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FROM C-OVERBORE FACILITIES

K. B. Sowa

December 18, 1969

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CALORIMETRIC ASSAY OF ^{60}Co SOURCES
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INTRODUCTION

Cobalt irradiations were completed in two C-Reactor overbore tubes in support of Mission and Program investigations of isotope production. Tubes 1459 and 1464 were each charged with approximately 4015 grams of cobalt in strips similar to BNL pieces described in a separate report.¹ After discharge, the strips were placed in an underwater calorimeter to determine the heat contribution from isotopic decay, thereby allowing an assay of cobalt-60 concentrations. The cobalt-60 produced in tube 1464-C was retained by Douglas United Nuclear for source material in an underwater gamma irradiator at KE-Reactor; the remaining cobalt, from tube 1459-C, was shipped to Battelle-Northwest for further experiments and applications.

SUMMARY OF RESULTS

A total of 396,400 Ci of cobalt-60 was produced in tube 1459-C and 272,700 Ci in tube 1464-C during the irradiations. Production in tube 1459-C occurred at the rate of 0.637 Ci/gm per 100 MWd/T of adjacent tube power; production in tube 1464-C occurred at the rate of 0.670 Ci/gm per 100 MWd/T of adjacent tube power. The total irradiation time was 880.813 full power days for tube 1459-C and 569.010 full power days for tube 1464-C.

TEST DETAILS

The irradiations were authorized in October, 1965 under Production Test² IP-812. The high purity strips, averaging 66.92 grams each, were clad in 0.015 inch thick stainless steel jackets. Each cobalt strip was about 0.06 inch thick by 0.64 inch wide and 12 inches long before cladding. After careful tests and inspections, these strips were canned in aluminum holders that were weld sealed (see Figure I). Total assembled length of each holder was approximately 13-1/4 inches. Four strips were canned in each holder, which resulted in an average loading density of 242.4 grams per foot.

Fifteen can assemblies were charged into tube 1464-C on November 24, 1965 and an additional fifteen into tube 1459-C on December 6, 1965. Both charges were centrally located in the tubes and occupied only 199 inches of a total estimated active zone length of 317 inches. Aluminum dummies were charged in the remaining portions of each tube. Tube 1464-C was discharged on January 19, 1968 and the strips were removed from the cans for application in an underwater gamma irradiator at KE-Reactor. This removal caused a loss of charge position data, and the subsequent calorimeter readings could not be correlated to specific can numbers. Tube 1459-C was discharged over a year later on April 15, 1969 and the cans were preserved intact for charge position and power correlation. In calculating the production rate for ^{60}Co in tube 1464-C, the isotopic heat generation curve was assumed to approximate that measured for tube 1459-C (see Figure III). The calorimetric assays of all strips were complete in July, 1969.

The underwater calorimeter in the 105-C Fuel Examination Facility basin converts 99 per cent of the gamma radiation from cobalt sources to heat by absorption in a lead calorimeter. A surrounding copper thermal shield is automatically heated to maintain a zero temperature differential between itself and the lead, thereby simulating an adiabatic system. Under these conditions, the temperature rise of the lead is linear with time and the amount of power input is determined by measuring the rate of this temperature rise. Total measurement error is less than 3 per cent. Calorimeter data as a function of charge position is plotted in Figure III for tube 1459; all other data is shown in Figure II.

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REFERENCES

- ¹A. Oltman and O. A. Kuhl, Fabrication of BNL Standard Cobalt-60 Source, BNL-848, February, 1964.
- ²T. L. Deobald, Production Test IP-812, Cobalt Pilot Irradiations in the Hanford C Reactor.

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FIGURE I

<u>PIECE NO.</u>	<u>TUBE NO.</u>	<u>CHARGE DATE AND TIME</u>	<u>DISCHARGE DATE AND TIME</u>	<u>FULL POWER DAYS</u>	<u>AVERAGE ADJACENT TUBE POWER KW</u>	<u>WATTS AT DISCHARGE</u>	<u>Ci/gm*</u>	<u>ADJACENT "E" METAL LOADING</u>
(4 cobalt strips per piece)								
1 thru 15	1464	11/24/65-1330	11/19/68-1600	569.0102	1365	4154(total)	67.3(Avg)	6 Columns
16	1459	12/6/65-0350	4/15/69-0400	880.8130	1346	283	68.7	"
17	"	"	"	"	"	331	80.4	"
18	"	"	"	"	"	373	90.6	"
19	"	"	"	"	"	403	97.9	"
20	"	"	"	"	"	413	100.3	"
21	"	"	"	"	"	442	107.3	"
22	"	"	"	"	"	461	111.9	"
23	"	"	"	"	"	467	113.4	"
24	"	"	"	"	"	451	109.5	"
25	"	"	"	"	"	403	97.9	"
26	"	"	"	"	"	438	106.4	"
27	"	"	"	"	"	440	106.8	"
28	"	"	"	"	"	421	102.2	"
29	"	"	"	"	"	383	93.0	"
30	"	"	"	"	"	330	80.1	"

* Conversion Factor; 1 Watt = 65 curies

FIGURE II

Heat Generation of Cobalt-60 in Watts
(267.68 Grams of Cobalt per piece)

FIGURE III

Estimated Distance in Inches from Upstream Edge of Graphite Stack to Center of Cobalt Holders
Tube No. 1459