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FURTHER THOUGHTS ON TRITIUM AND OTHER ITEMS OF CONCERN

by

Stanley N. Davis

September 20, 1992

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OCT 19 1992

D.B. SHIPLER

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Introduction

I was able to spend September 15-18, 1992, looking at various manuscripts in Richland in Building 712, the Reading Room, and the Technical Library. Some interesting unclassified material surfaced which I will summarize in this short memorandum.

Tritium Production at Hanford

Tritium was separated from an irradiated Al-Li matrix in the "P-10 Project Facility" from 1949 through 1951 and later, presumably from the same facility, from 1953 through mid-August, 1954. Rather careful records were kept in the second part of the program. A notebook covering the first part has been destroyed, but estimates of tritium releases to the environment were made prior to destruction of the notebook. The most probable total release of tritium to the atmosphere from tritium production during the period from 1949 through 1954 was roughly 100,000 curies if some ruptured slugs as well as unrecorded minor releases are assumed. This is, of course, a very small amount when compared with releases at the Savannah River Site in South Carolina.

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A program to test the feasibility of tritium production using the N Reactor was authorized in 1967 (see publication BNWL-2097). However, recovery of tritium from the irradiated targets was evidently not done at Hanford, so release of tritium to the atmosphere from this "Coproduct Program" was probably minimal.

#### Tritium from Ternary Fission

Tritium was first identified as a fission product in 1959. Depending on a number of variables, tritium can vary from a yield of  $0.68 \times 10^{-4}$  to  $2.2 \times 10^{-4}$  with higher values associated with fission induced by higher energy (nonthermal) neutrons. In publication HW74536, W. A. Haney et al. (August 1, 1962) estimated that ternary fission produced between 3.8 and 20.3 curies of tritium per ton of irradiated uranium. Of the tritium produced, about 47 to 64% was carried away in the liquid process streams. Most of the balance went into the atmosphere with a small amount ending up in high-level waste tanks.

#### Tritium from Activation of Helium-3

The high escape rate of helium from the reactors was confirmed in publication HW69924 by Perkins and Thomas (June 14, 1961) which mentioned a loss of 5,000 to 6,000 ft<sup>3</sup> per day from one installation. Production of tritium from activation of He-3 would be primarily a function of thermal neutron flux, exposure

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time, and total mass of He-3 available. Because He-3 has a very high capture cross section for thermal neutrons, production could be significant. Taking the worst possible case which assumes a He-3/He-4 ratio of  $10^{-6}$  (roughly, the ratio in the atmosphere) and an infinite exposure time, more than  $10^{-6}$  curies of tritium could be released each year. However, most helium from natural-gas sources should have ratios closer to  $10^{-7}$  or even  $10^{-8}$  (see discussion by Ozima & Podosek, 1983, Noble gas geochemistry, Cambridge Univ. Press, page 130). At this point, an atmospheric release of more than 100,000 curies of tritium per year from a helium activation source seems unlikely.

Helium which was circulated in the reactors was not pure, so activation of  $\text{CH}_4$ , N, Ar, and other impurities may have been more significant than activation of traces of He-3. Gaseous emission of Cl-38 was also likely, judging by recent studies of residual Cl-36 present in the vicinity of reactors in Idaho and South Carolina.

#### Miscellaneous Items of Possible Interest

<u>Number of report</u>	<u>Date</u>	<u>Contents</u>
BNSA-45	6/7/65	Report on human experiment. Seven volunteers ate fish from the Columbia River for 11 weeks. Reports uptake of P-32 and Zn-65.
HW11344	10/25/48	Study of radioactivity of fish, analyses for Na-24 and P-32.

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Specimens ashed but note made that as much as 60% of activity lost by ashing vs drying by heat lamp.

Reported values, therefore, are low by factor of 1.5 to 2.

HW40699

12/28/55

Effects of passing unfiltered water through two tubes in 100-D Reactor. Individual radionuclides studied. Average increase in gross beta was by a factor of 5.2 over filtered water.

BNWL cc 1992

1/13/69

Mention is made of monitoring 6,000 school children. A total of 1,070 whole-body counts were made.

Unnumbered file  
folder in Box  
017751000 in  
Building 712

early  
1960's

Laboratory sheets on experiments on loss of I from unspecified artificial matrix. Recovery of 97% of I with heat-lamp drying. Recovery of only 44% of I using muffle drying at 450-475°C.

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