Nuclear Data for Science and Technology (1988 MITO), 951- 953, Copyright © 1988 JAERI.

PHOTONUCLEAR DATA NEEDED FOR CALCULATING γ RAY INCINERATION OF LONG-LIVED RADIOACTIVE WASTES

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Abstract: The γ ray incineration method is considered to be available to long-lived radioactive wastes such as transuranium nuclides and fission products of ^{90}Sr and ^{137}Cs. It has been seen that the incineration characteristics sensitively depend on photonuclear data such as (γ,n) and (γ,f). This presentation deals with a survey of the γ ray incineration for the transuranium nuclides as well as fission products of ^{90}Sr and ^{137}Cs. And several examples of the calculations are presented. Important photonuclear data are recommended for measurements.

Introduction

The management of the high level radioactive wastes (HLW) is one of the most important problems in the nuclear fuel cycle. The activity of HLW which remains high extremely long in the future is mainly caused by long-lived fission products such as ^{90}Sr and ^{137}Cs, and by some transuranium actinides (TRU).

Recently a new incineration method using high energy γ ray has been proposed, and the incineration characteristics has been calculated for ^{90}Sr and ^{137}Cs by this author[1].

This paper presents a survey of the γ ray incineration for the TRU as well as the fission products of ^{90}Sr and ^{137}Cs. Several calculational results are presented, and photonuclear data are recommended for measurements.

Calculational Model

The depletion-production of nuclides was calculated by a code "GDECAY" which solves a time differential equation by the time-step method. Figure 1 shows a part of the transmutation chain for the γ ray incineration of ^{90}Sr, in which only nuclides with the half-lives longer than 1 day are treated. Figure 2 also shows the case of ^{137}Cs. For TRU, 108 nuclides are considered in the chain, partly shown in Figure 3, which are distributed between Cf and Au.

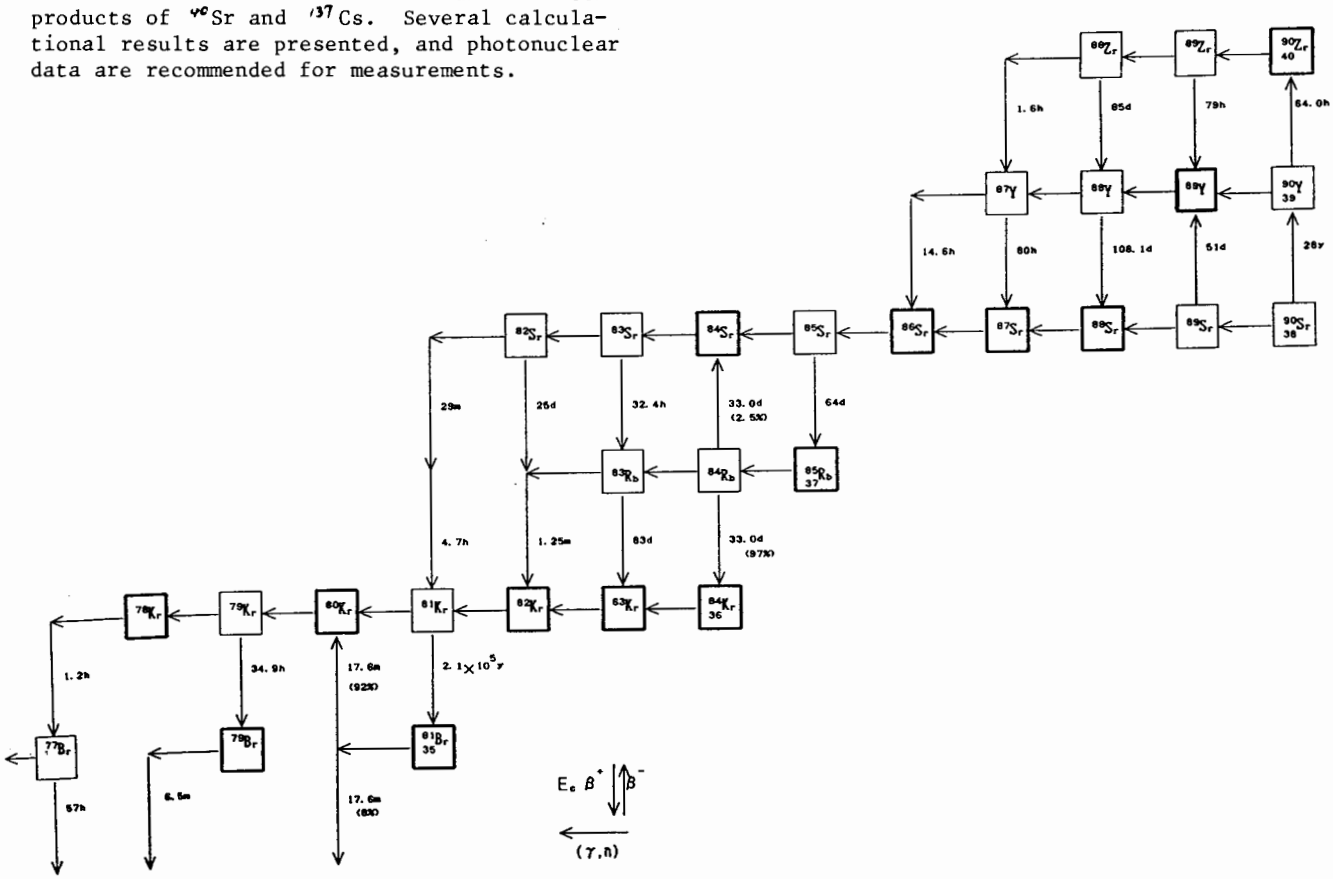

Fig.1 Transmutation Chain for ^{90}Sr

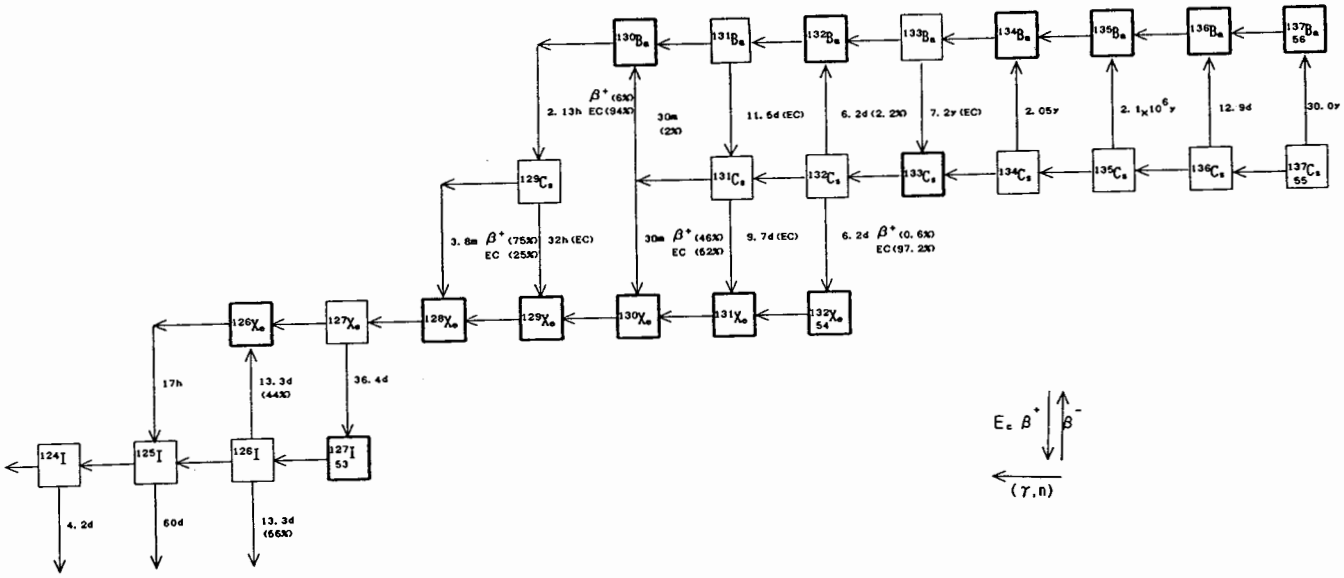

Fig.2 Transmutation Chain for ^{137}Cs

Calculational Results

The previous paper (Ref. 1) describes the calculational results for ^{90}Sr and ^{137}Cs. This paper presents some preliminary results for the γ incineration of TRU. Both of HLWs produced from LWR and FBR spent fuels are calculated. The results are similar. LWR: Figure 4 shows the calculational results for the γ ray incineration of TRU wastes, in which all minor actinides and 0.5% major one are mixed. The (γ,f) reaction as well as (γ,n), $(\gamma,2n)$ and $(\gamma,3n)$ are considered. The effect of the incineration was evaluated by the measure of hazard. The effect sensitively depends on the γ ray flux.

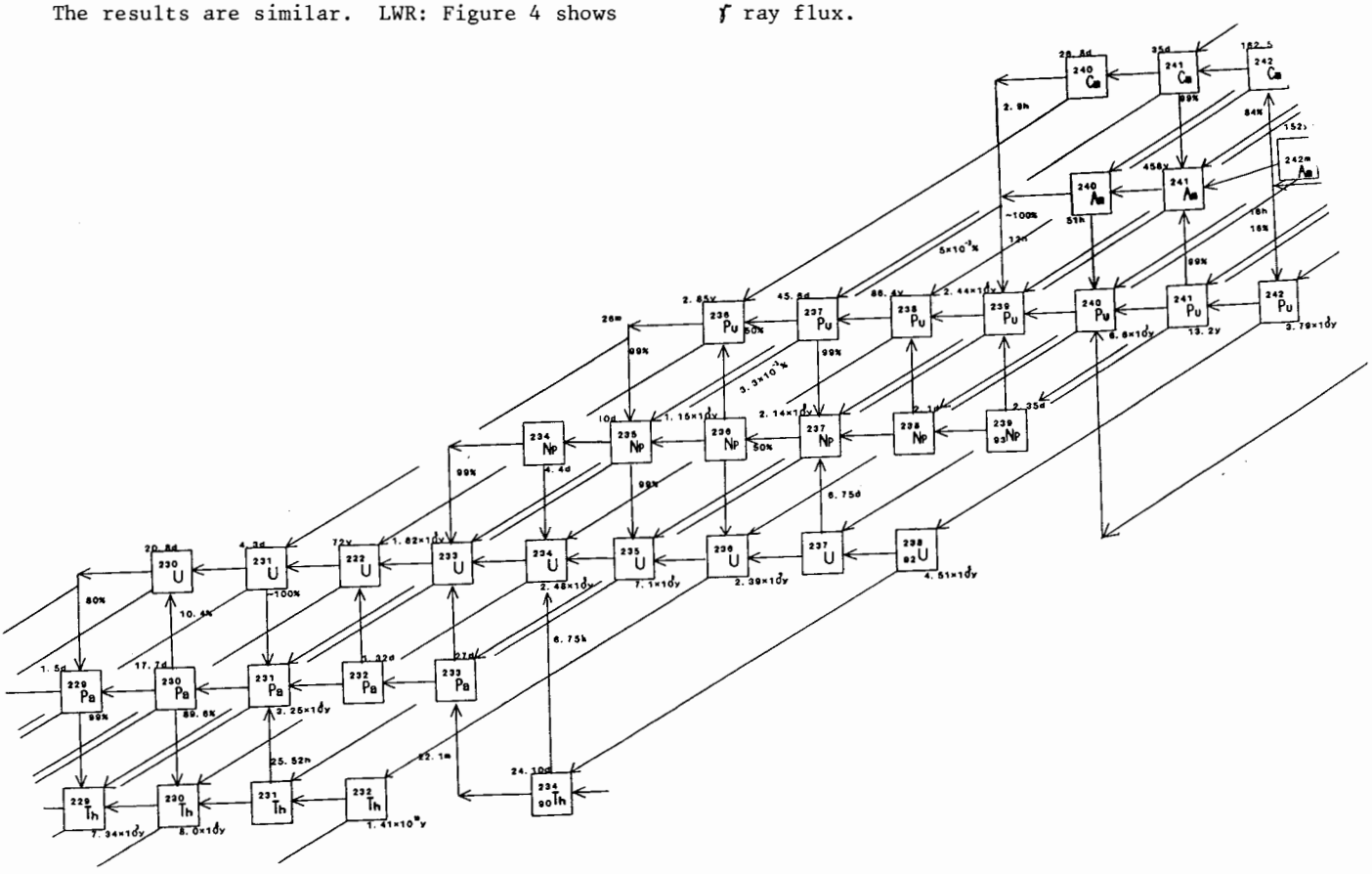

Fig.3 Transmutation Chain for TRU

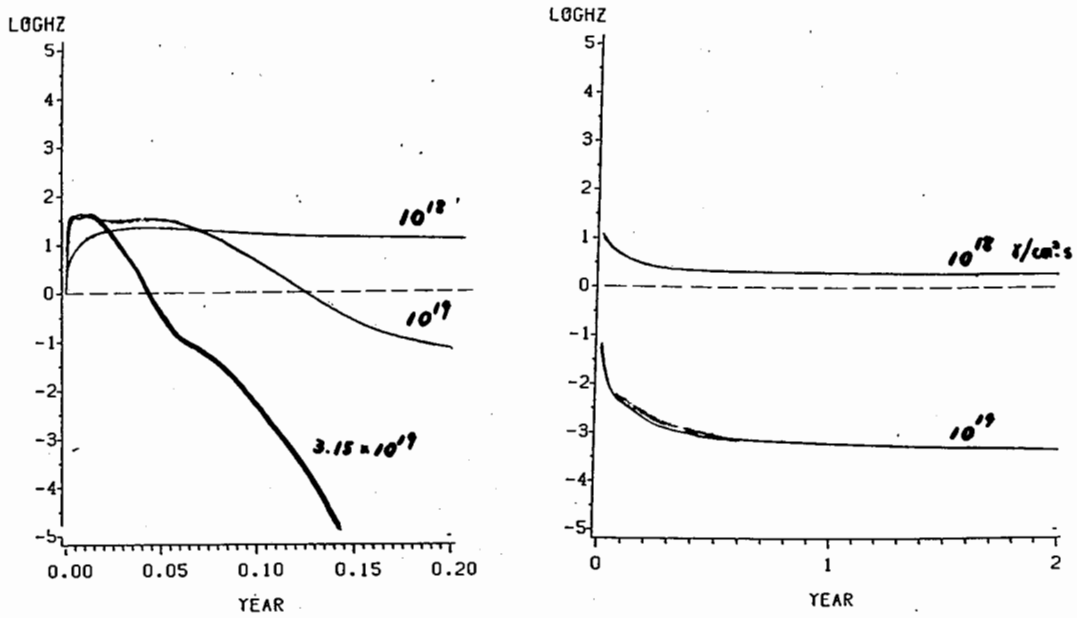

Fig.4 Effect of γ Irradiation

Recommended Cross Sections

The γ ray incineration recommends measurements of the following cross sections:

(1) the most important cross sections;

(γ,n): for ^{90}Sr and ^{137}Cs

(γ,n)
(γ,f) : for main TPU

(2) energy-dependent cross sections;

10 - 20 MeV energy

REFERENCES

1. T. Matsumoto: Nucl. Instr. Meth. A268, 234(1988)