# Memo: Model for fuel fabrication in EG29

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April 29, 2016

## Introduction

This memo presents the modeling results of cases 1.1 to 1.3 of the EG29 scenario, induced by the use of a plutonium equivalent model for the fuel fabrication. Case 1 of the EG29 calculation involves the modeling of a single MOX-PWR at steady-state (see figure 1). Case 1 is subdivided into three sub-cases corresponding to calculations of increasing fidelity:

- 1: without isotopic composition,
- 2: with isotopic composition and no decay,
- 3: with isotopic composition and decay.

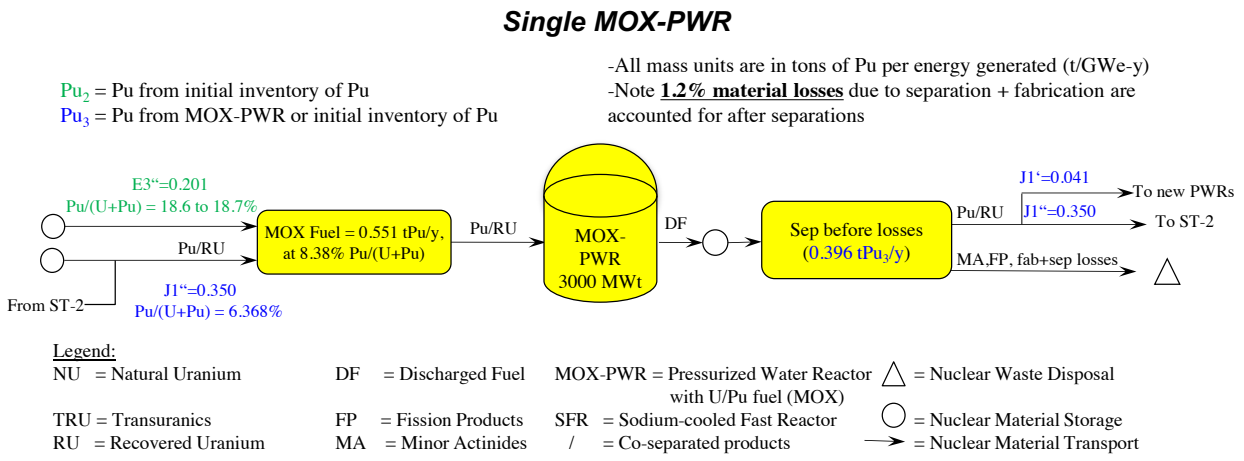


**Figure 1 Schematic of Pu mass flow for Case 1**

## Calculation:

Two variations on fuel-building were calculated for each sub-case (1.1 to 1.3). The first calculation used a standard mixing fab (in Cyclus, the cycamore::mixer). This mixed the E3" and the J1" streams using a constant mixing ratio to build the MOX fuel for the PWR, labeled "M". The second calculation used plutonium equivalent theory to determine the mixing fraction of each stream to build the MOX fuel, labeled "W".

**Results:**

The differences in the plutonium contribution to build the MOX fuel are shown figure 2. Those contributions are normalized by the tPu/y (as in figure 1). As expected, the first set of calculations using the mixer result in a constant contribution of both streams for cases 1.1 and 1.2. The variation observed in case 1.3 is solely due to the decay of 241Pu, which contributes after decay as 241Am.

Concerning the second set of calculations using plutonium equivalence, case 1.1 exactly reproduced the results using the fixed mixing ratio. There is a discrepancy between the results for case 1.2 that is not expected. This is probably due to a rounding variation.

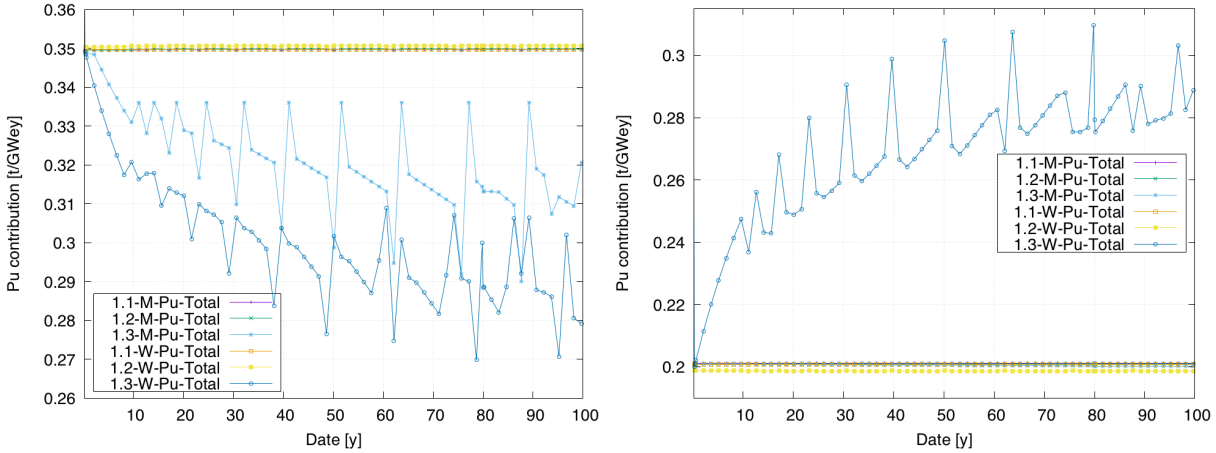


**Figure 2 Evolution of Pu contribution on J1" stream (left figure) and E3" stream (right figure)**

Case 1.3, which includes isotopic compositions and decay, behaves drastically different than the other two sub-cases. For the fixed mixing ratio calculation (M), the fluctuations are caused by the decay of Pu241 in the J1" stream. The E3'' stream, which contains very few short-lived plutonium isotopes, is not impacted by the decay.

For the calculation using the plutonium equivalent model (W), the decay of Pu241 has a cyclic impact on the fabrication of the MOX fuel. As the Pu241 is transmuted to Am241, the plutonium from the J1" stream has a reduced "reactivity potential", forcing the increase of the E3" stream amount in the mix from 0.210 tPu/y to almost 0.3 tPu/y.

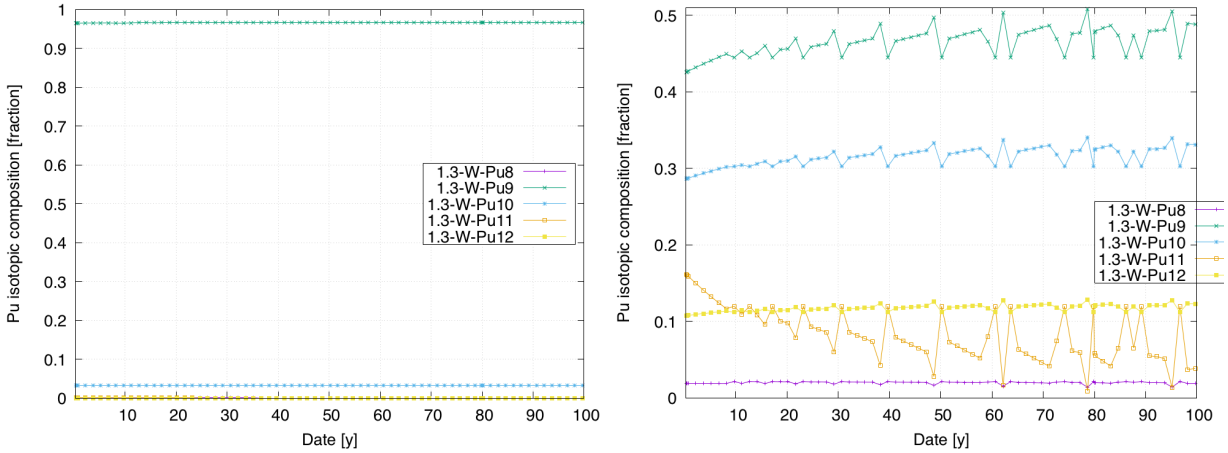


**Figure 3 Evolution of the plutonium composition in Case 1.3**