JEF2.2 / JEFF3.0 Improvements on Spent Fuel Inventory Prediction in LWRs. Trends from Integral Experiments and Proposals for JEFF3.1.

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This paper summarized in a first part the C/E comparison of UOx and MOx spent fuel inventory; improvements on ^{236}U-^{237}Np-^{238}Pu build-up prediction, as well as ^{242}Pu, are pointed out using the recent JEFF3.0 evaluations. In a second part, improvements in JEFF3.0 still required are emphasized; trends on ^{241}Am(n,γ) cross-section are particularly detailed and then an increase by 15% ± 3% in the 0.01eV – 2eV range is recommended.

I. Post Irradiation Experiments Analysis for High Burned UOx and MOx Fuels (up to 70GWd/tHM and 60GWd/tHM respectively)

In order to give some **reliable trends** on JEFF3.0 nuclear data using Post Irradiation Experiments (PIE), we have estimated Calculation/Experiment discrepancies on measured isotopic ratios in French PWR spent fuels; an extensive work was carried out to assess the corresponding actual **uncertainties**.
The accurate transport calculation used (APOLLO2) was validated against continuous energy Monte-Carlo calculations (TRIPOLI4) at the beginning of irradiation and at 40GWd/t.

1) Uncertainties on Fuel Inventory Prediction

Many experimental uncertainties can be distinguished:

- thermal-mechanic and thermal-hydraulic conditions of irradiation (fuel and moderator temperatures, specific pin power and boron concentration),
- rough irradiation follow-up description,
- the burnup of the analysed pin sample is determined using the measured ^{148}Nd, ^{145}Nd, ^{150}Nd concentrations (good burnup indicators because of their small capture cross-sections). The uncertainty on the fission yield of the Nd isotopes has to be taken into account (2% at 1σ),
- technological uncertainties (^{235}U enrichment or Pu load in the fuel rod manufacturing plant),
- chemical uncertainties of the destructive assays,
- decay data knowledge (λ ^{241}Pu mainly, used to deduce the experimental values of ^{241}Am and ^{241}Pu at the End Of Cycle).

All of these uncertainties are estimated using sensitivity coefficients from APOLLO2 calculation (except the chemical one). They are supposed exhaustive and independent.

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2) *Calculation/Experiment discrepancies on fuel inventory prediction using JEF2.2 and JEFF3.0*

The Post Irradiation Experiment database is currently being extended up to 80GWd/tHM for UOx fuels and up to 60GWd/tHM for MOx fuels. Fuel rod cuts have been extracted after 5 and 6 cycles in UOx assemblies from CRUAS PWR, and up to 4 and 5 cycles in MOx assemblies from DAMPIERRE PWR.
As shown in Tables I and II, clear improvements are obtained on the actinide prediction at the End Of irradiation Cycle (EOC) from JEF2.2 to JEFF3.0 (respectively for 3 UOx high burned fuel pins and 5 MOx high burned fuel pins).

	C/E-1 ± δE/E (% 1σ)			
	CYCLE 5		CYCLE 6	
	JEF2.2	JEFF3.0	JEF2.2	JEFF3.0
$^{234}U/^{238}U$	-2.7 ± 2.0	-2.6 ± 2.0	-4.5 ± 2.4	-4.3 ± 2.4
$^{235}U/^{238}U$	-1.7 ± 6.7	-2.5 ± 6.7	3.2 ± 7.0	2.3 ± 7.0
$^{236}U/^{238}U$	-4.8 ± 1.1	-1.4 ± 1.1	-5.4 ± 1.2	-2.1 ± 1.2
$^{237}Np/^{238}U$	-2.2 ± 2.8	1.7 ± 2.8	-4.2 ± 2.6	-0.5 ± 2.6
$^{238}Pu/^{238}U$	-3.3 ± 4.2	0.5 ± 4.2	-4.1 ± 3.6	-0.8 ± 3.6
$^{239}Pu/^{238}U$	7.3 ± 2.8	7.4 ± 2.8	9.4 ± 3.4	9.9 ± 3.4
$^{240}Pu/^{238}U$	1.3 ± 1.4	2.6 ± 1.4	2.0 ± 0.9	3.5 ± 0.9
$^{241}Pu/^{238}U$	2.9 ± 2.4	4.1 ± 2.4	5.0 ± 2.7	6.4 ± 2.7
$^{242}Pu/^{238}U$	-3.9 ± 4.1	2.3 ± 4.1	-6.7 ± 2.9	-0.8 ± 2.9
$^{241}Am/^{238}U$ EOC	28.8 ± 11.6	29.3 ± 11.6	16.8 ± 6.1	17.4 ± 6.1
$^{242M}Am/^{238}U$	-9.6 ± 7.1	-9.1 ± 7.1	-13.1 ± 6.8	-12.5 ± 6.8
$^{243}Am/^{238}U$	0.8 ± 5.5	7.8 ± 5.5	-1.9 ± 4.0	4.4 ± 4.0
$^{243}Cm/^{238}U$	nm	nm	-8.7 ± 6.5	-16.1 ± 6.5
$^{244}Cm/^{238}U$	-1.5 ± 9.9	6.3 ± 9.9	-5.5 ± 6.6	1.5 ± 6.6
$^{245}Cm/^{238}U$	nm	nm	2.6 ± 9.3	17.8 ± 9.3
$^{246}Cm/^{238}U$	nm	nm	-12.3 ± 10.0	-8.3 ± 10.0
$^{247}Cm/^{238}U$	nm	nm	-16.1 ± 12.2	4.6 ± 12.2
$^{143}Nd/^{238}U$	1.4 ± 1.2	-0.4 ± 1.2	3.3 ± 1.2	1.1 ± 1.2
$^{144}Nd/^{238}U$	-2.1 ± 3.1	-1.4 ± 3.1	-2.9 ± 1.9	-2.3 ± 1.9
$^{145}Nd/^{238}U$	-0.4 ± 1.5	-0.7 ± 1.5	-0.9 ± 1.2	-1.2 ± 1.2
$^{146}Nd/^{238}U$	0.9 ± 2.4	0.9 ± 2.4	0.5 ± 2.0	0.5 ± 2.0
$^{148}Nd/^{238}U$	1.5 ± 2.1	1.4 ± 2.1	1.2 ± 1.7	1.1 ± 1.7
$^{150}Nd/^{238}U$	0.7 ± 2.3	0.7 ± 2.3	0.5 ± 1.9	0.5 ± 1.9
$^{133}Cs/^{238}U$	0.5 ± 1.7	1.1 ± 1.7	1.2 ± 1.2	2.1 ± 1.2
$^{134}Cs/^{238}U$	-1.1 ± 5.3	-3.2 ± 5.3	3.9 ± 4.7	1.8 ± 4.7
$^{135}Cs/^{238}U$	4.0 ± 2.3	3.2 ± 2.3	3.5 ± 1.9	2.8 ± 1.9
$^{137}Cs/^{238}U$	0.1 ± 2.1	0.1 ± 2.1	0.2 ± 1.7	0.2 ± 1.7
BU (GWd/tHM)	56.8	56.8	69.2	69.2

Table I- Fuel inventory prediction in UOx spent fuel using JEF2.2 and JEFF3.0 (C/E-1) ± (δE/E) in %

	C/E-1 ± δE/E (% 1σ)			
	CYCLE 4		CYCLE 5	
	JEF2.2	JEFF3.0	JEF2.2	JEFF3.0
$^{234}U/^{238}U$	-0.5 ± 2.0	-1.1 ± 2.0	-0.1 ± 2.2	-0.7 ± 2.2
$^{235}U/^{238}U$	0.5 ± 2.3	-0.2 ± 2.3	0.1 ± 2.5	-0.8 ± 2.5
$^{236}U/^{238}U$	-7.2 ± 1.3	-3.1 ± 1.3	-6.9 ± 1.3	-2.7 ± 1.3
$^{237}Np/^{238}U$	-15.2 ± 2.6	-2.2 ± 2.6	-11.7 ± 2.5	-1.7 ± 2.5
$^{238}Pu/^{238}U$	-2.0 ± 1.4	-2.7 ± 1.4	-0.8 ± 1.9	-1.4 ± 1.9
$^{239}Pu/^{238}U$	2.4 ± 2.2	1.7 ± 2.2	5.2 ± 2.2	4.8 ± 2.2
$^{240}Pu/^{238}U$	0.4 ± 0.9	1.1 ± 0.9	2.6 ± 1.0	3.3 ± 1.0
$^{241}Pu/^{238}U$	-0.2 ± 0.9	0.0 ± 0.9	1.3 ± 1.3	1.6 ± 1.3
$^{242}Pu/^{238}U$	-1.8 ± 1.3	2.1 ± 1.3	-1.3 ± 1.3	3.0 ± 1.3
$^{241}Am/^{238}U$ EOC	16.2 ± 3.9	15.2 ± 3.9	17.2 ± 3.7	16.5 ± 3.7
$^{242M}Am/^{238}U$	-18.1 ± 2.6	-18.9 ± 2.6	-19.6 ± 3.5	-20.2 ± 3.5
$^{243}Am/^{238}U$	1.3 ± 2.0	3.8 ± 2.0	2.9 ± 1.7	5.7 ± 1.7
$^{243}Cm/^{238}U$	-10.4 ± 1.8	-15.2 ± 1.8	-11.2 ± 2.3	-15.8 ± 2.3
$^{244}Cm/^{238}U$	-5.0 ± 3.8	-2.8 ± 3.8	-3.4 ± 3.4	-1.0 ± 3.4
$^{245}Cm/^{238}U$	-1.7 ± 4.2	4.8 ± 4.2	2.1 ± 3.7	10.0 ± 3.7
$^{246}Cm/^{238}U$	-8.7 ± 7.5	-12.5 ± 7.5	-5.4 ± 6.9	-8.7 ± 6.9
$^{247}Cm/^{238}U$	-14.9 ± 9.2	-4.2 ± 9.2	-9.8 ± 8.5	2.7 ± 8.5
$^{143}Nd/^{238}U$	0.6 ± 1.5	-0.2 ± 1.5	1.0 ± 1.6	0.0 ± 1.6
$^{144}Nd/^{238}U$	-2.0 ± 3.0	-1.5 ± 3.0	-1.8 ± 2.2	-1.2 ± 2.2
$^{145}Nd/^{238}U$	-0.3 ± 0.5	-0.5 ± 0.5	-0.5 ± 0.5	-0.7 ± 0.5
$^{146}Nd/^{238}U$	0.5 ± 2.5	0.5 ± 2.5	1.1 ± 2.4	1.1 ± 2.4
$^{148}Nd/^{238}U$	2.1 ± 2.2	2.0 ± 2.2	2.2 ± 2.1	2.1 ± 2.1
$^{150}Nd/^{238}U$	0.3 ± 0.6	0.2 ± 0.6	0.6 ± 0.6	0.5 ± 0.6
$^{133}Cs/^{238}U$	-0.6 ± 1.7	-0.1 ± 1.7	2.5 ± 1.7	3.1 ± 1.7
$^{134}Cs/^{238}U$	0.9 ± 3.7	-1.6 ± 3.7	13.9 ± 5.0	11.3 ± 5.0
$^{135}Cs/^{238}U$	-4.7 ± 2.5	-5.2 ± 2.5	-0.8 ± 2.5	-1.3 ± 2.5
$^{137}Cs/^{238}U$	-1.3 ± 2.1	-1.4 ± 2.1	2.3 ± 2.1	2.3 ± 2.1
BU (GWd/tHM)	52.6	52.6	58.9	58.9

Table II- Fuel inventory prediction in MOx spent fuel using JEF2.2 and JEFF3.0 (C/E-1) ± (δE/E) in %

Owing to ^{235}U resonance integral I_γ increase (by about 6%) [1], the predicted ^{236}U concentration is improved using JEFF3.0. Moreover, the ^{237}Np and ^{238}Pu are increased in agreement with measured isotopic contents. In MOx spent fuel, the ^{237}Np concentration is perfectly calculated using JEFF3.0, due to the $^{238}U(n,2n)$ increase in this new JEFF3.0 evaluation.
Thanks to the increase of the capture integral in the large E_0=0.26eV of ^{241}Pu [2], the longstanding ^{242}Pu underprediction in JEF2-based calculation is cancelled using the JEFF3.0 file.

All the changes of major actinides nuclear data from JEF2.2 to JEFF3.0 improve spent fuel inventory prediction in LWRs up to high burnup. The JEFF3.1 expected ^{238}U from H. Derrien and A. Courcelle [3]*, with effective resonance integral decreased by –0.5%, should reduce the remaining overestimation of the ^{239}Pu prediction.*
There is still C/E discrepancies using JEFF3.0 on some minor actinides prediction: $^{241,242M}Am$ and $^{243,245}Cm$.

II. Trends on minor actinide data and recommendations for ^{241}Am evaluation in JEFF3.1

In this section, four independent integral experiments are analysed in order to give coherent and reliable trends and to recommend accurate modifications for JEFF3.1.

1) First integral trend: Post Irradiation Experiment

In order to avoid some potential spectrum calculation inaccuracy and to emphasize the sensitivity to the unique capture cross-section, we choose to focus on isotopic ratio, between the daughter concentration and the father concentration.
Discrepancies between Calculations and Experiments of the 3 following isotopic ratios will give us information on Nuclear Data:

- ^{241}Am / ^{241}Pu,
- ^{242M}Am / ^{241}Am,
- ^{245}Cm / ^{244}Cm.

a) Sensitivity Method to derive reliable trends on nuclear data

In order to link the C/E values of these isotopic ratios to nuclear data (as neutron XS, and/or branching ratios), we have to introduce the sensitivity coefficient such as:

$$S = \frac{\Delta(^{241}Am/^{241}Pu) \,/\, (^{241}Am/^{241}Pu)}{\Delta\sigma^{241}Am(n,\gamma) \,/\, \sigma^{241}Am(n,\gamma)}$$

- We have assumed that the C/E discrepancy is only linked to the main nuclear parameters of few isotopes (father and daughter).
- We have to assign uncertainties to the calculated sensitivities:

  - The sensitivity value of the ratio (^{241}Am/^{241}Pu) to the ^{241}Am(n,γ) is changing versus burnup, and is therefore dependent on the burnup determination (±2% due to the Neodymium cumulated fission yield knowledge).
  - This sensitivity value is also dependent on the irradiation follow-up description, as shown in Fig. 1
  - It depends slightly on the neutron spectrum irradiation conditions (proximity of water rods, see Fig. 1).
  - It depends (in MOx cases) on the ^{241}Am initial amount in the fresh fuel.

  These uncertainties (assigned to the sensitivity value) are supposed independent and quadratically combined.

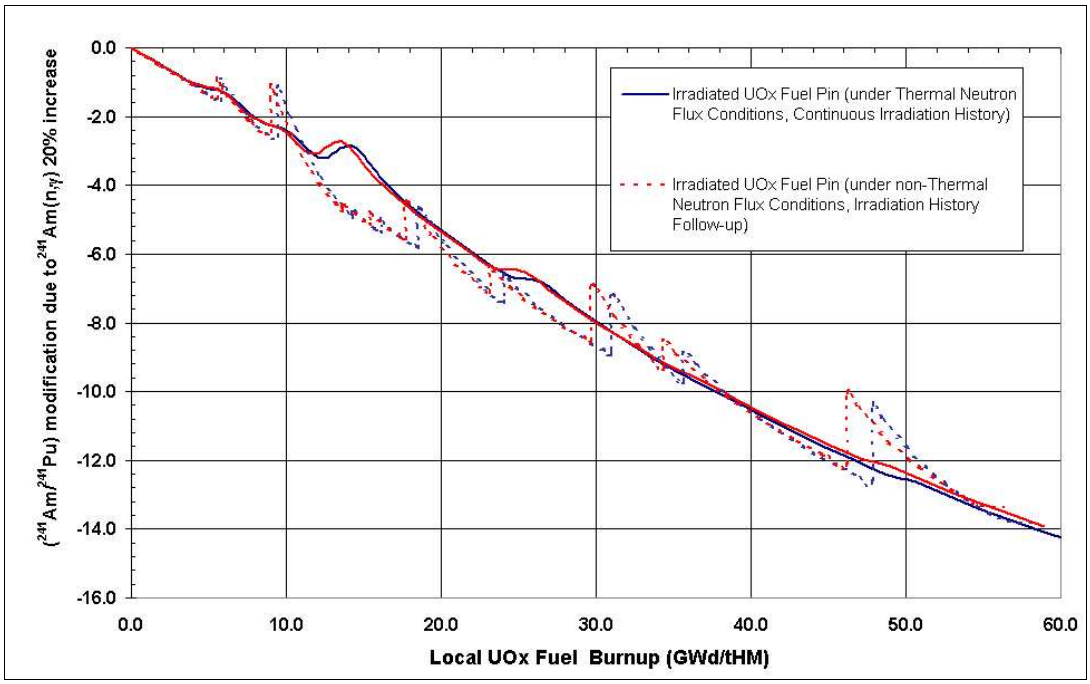

Fig I- Sensitivity of (^{241}Am/^{241}Pu) isotopic concentration ratio (for 2 different UOx fuel pins) to a perturbation of 20% on ^{241}Am(n,γ) XS.

b) <u>Trends for JEFF3.1</u>

Table III shows the C/E discrepancies on (^{241}Am/^{241}Pu), (^{242M}Am/^{241}Am) and (^{245}Cm/^{244}Cm) isotopic ratios for UOx and MOx spent fuels. The C/E values are estimated using High-Burnup Irradiation Experiments <(C/E-1)> and its associated confidence-weighted standard deviation ±<δE/E>.
We remind that nuclear libraries used in P.I.E. calculations are JEF2.2 and JEFF3.0.

<C/E–1> ± <δE/E> (std dev) in %	^{241}Am/^{241}Pu JEF2.2 or JEFF3.0	^{242M}Am/^{241}Am JEF2.2 or JEFF3.0	^{245}Cm/^{244}Cm JEF2.2	^{245}Cm/^{244}Cm JEFF3.0
UOx fuels PIE	+13 ± 8 (3)	-28 ± 7 (2)	+2 ± 7 (3)	+10 ± 7 (3)
MOx fuels PIE	+12 ± 4 (2)	-28 ± 3 (1)	-3 ± 4 (4)	+2 ± 4 (4)

Table III- C/E of isotopic prediction discrepancies using JEF2.2 and JEFF3.0 nuclear data files.

NB: In order to point out a relevant trend on ^{241}Am(n,γ) cross-section, the C/E value for (^{241}Am/^{241}Pu) isotopic ratio is given at the End Of irradiation Cycle and not, as usual, at the chemical analysis date.

Tables IV and V show sensitivity values of minor and major actinides concentrations at the EOC to ^{241}Am(n,γ) XS and to ^{241}Am → ^{242M}Am Branching Ratio respectively.

^{241}Am(n,γ) XS [0eV; 20MeV] + 20%	UOx 20GWd/t	UOx 60GWd/t	MOx 20GWd/t	MOx 60GWd/t
^{234}U	0.0	0.0	0.5	2.7
^{238}Pu	0.4	0.7	4.5	4.0
^{242}Pu	0.1	0.1	0.3	0.1
^{241}Am/^{241}Pu	**- 5.4 ± 0.3**	**-14.5 ± 0.3**	**- 9.8 ± 0.5**	**-18.5 ± 0.5**
^{242M}Am/^{241}Am	**20.5**	**20.3**	**23.1**	**20.8**
^{243}Am	0.2	0.1	0.3	0.2
^{242}Cm	**14.5**	**4.0**	**11.4**	**-0.6**
^{243}Cm	**15.3**	**5.7**	**14.4**	**3.3**
^{244}Cm	0.2	0.1	0.2	0.2
^{245}Cm/^{244}Cm	0.0	0.0	0.0	0.0

Table IV- Sensitivity values of actinide concentrations to ^{241}Am(n,γ) XS (% modification per +20% ^{241}Am(n,γ) increase)

^{241}Am → ^{242M}Am (γ) Branching Ratio (0.115 → 0.145)	UOx 20GWd/t	UOx 60GWd/t	MOx 20GWd/t	MOx 60GWd/t
^{234}U	0.0	0.0	-0.1	-0.9
^{238}Pu	-0.1	-0.4	-1.0	-2.2
^{242}Pu	0.0	0.0	-0.1	-0.2
^{241}Am/^{241}Pu	0.0	0.0	0.0	0.1
^{242M}Am/^{241}Am	**26.1**	**26.1**	**26.1**	**26.1**
^{243}Am	0.2	0.1	0.3	0.2
^{242}Cm	-3.4	-3.4	-3.4	-3.4
^{243}Cm	-3.4	-3.4	-3.4	-3.4
^{244}Cm	0.2	0.1	0.2	0.2
^{245}Cm/^{244}Cm	0.0	0.0	0.0	0.0

Table V- Sensitivity values of actinide concentrations (%) to ^{241}Am → ^{242M}Am Branching Ratio (0.115 → 0.145)

(^{241}Am/^{241}Pu) concentrations ratio becomes more sensitive to ^{241}Am capture cross-section at high burnup (because the equilibrium is reached). Moreover, the calculated value of (^{241}Am/^{241}Pu) is largely overestimated at high burnup and the corresponding experimental uncertainty is lower.
This integral information on ^{241}Am/^{241}Pu averaged in Table III and the sensitivity coefficients summarized in Table IV infer a ^{241}Am(n,γ) increase by +16%±4%. This modification will cancel the recurrent ^{241}Am overprediction and ^{242}Cm, ^{243}Cm underpredictions. This ^{241}Am capture modification will also reduce the ^{242M}Am underprediction.
In order to cancel the remaining underestimation on ^{242M}Am concentration prediction, (~ -13%), we propose a modification of ^{241}Am → ^{242M}Am capture Branching Ratio (current constant value BR=0.115) for the thermal and epithermal region:

BR = 0.11 $E \leq 0.1eV$
BR = 0.14 $0.1eV \leq E \leq 1.5eV$

Concerning ^{245}Cm data, the ^{245}Cm/^{244}Cm isotopic ratio stresses a trend to increase ^{245}Cm absorption cross-section used in JEFF3.0. Furthermore, ^{246}Cm prediction shows a trend to increase ^{245}Cm capture cross-section in JEFF3.0. Therefore, we recommend to select the JENDL3.3 evaluation for JEFF3.1: σ^{c}_{2200}= 359b instead of σ^{c}_{2200}= 346b in JEFF3.0.
The interpretation of spent fuel chemical assays carried out in French PWRs since 20 years allows the following proposal for minor actinide data in JEFF3.1:

^{241}Am(n,γ) modification (Thermal and Epithermal Range)	**$\Delta\sigma$ = +16% ± 4%**
^{241}Am → ^{242M}Am (γ) Branching Ratio (Epithermal Range)	**BR = 0.14 ± 0.01**
^{245}Cm	**JENDL3.3 evaluation**

Table VI- Proposal Values for actinides evaluations in JEFF3.1

In order to confirm the ^{241}Am(n,γ) proposed value, further LWR parameters are analysed.

2) Second integral trend: ^{242}Cm and ^{243}Cm build-up (low burned fuels)

Owing to the large sensitivities of the daughter ^{242}Cm to ^{241}Am(n,γ) XS (see Table VII), we have now to focus on curium build-up in low burned spent fuels to obtain complementary trend on ^{241}Am(n,γ) XS.

Sensitivity of Cm build-up to ^{241}Am(n,γ) XS (in %/%)	UOx 20GWd/t	UOx 60GWd/t	MOx 20GWd/t	MOx 60GWd/t
^{242}Cm build-up	0.73	0.20	0.57	0.01
^{243}Cm build-up	0.77	0.20	0.72	0.17

Table VII- Sensitivity of Curium build-up to ^{241}Am(n,γ) XS

The C/E values (see Table VIII) show large underpredictions of ^{242}Cm [4] [5] and ^{243}Cm at low burnups.

	^{242}Cm	^{243}Cm
UOx fuels	-33% ± 10%	-24% ± 10%
MOx fuels	-26% ± 6%	-26% ± 10%

Table VIII- (C/E-1) ± (δE/E) values of Curium build-up at low burnup

Owing to sensitivities and C/E discrepancies, the proposed value for ^{241}Am(n,γ) XS in the thermal-epithermal range is then:

^{241}Am(n,γ) required modification: +30% ± 15%

3) *Third integral trend: Reactivity Worth in MOx lattices*

The reactivity worth due to the plutonium ageing is negative, roughly -1pcm/day in LWR 100% MOX core, and is defined as follow:

$$\Delta\rho^{MOx} = \rho^{MOX}(t_2) - \rho^{MOX}(t_1) \text{ for the isotopic MOx fuel cooling from } t_1 \text{ to } t_2$$

Using JEF2.2 or JEFF3.0, the averaged C/E value of the Plutonium Ageing (Monte-Carlo and deterministic calculations) in MISTRAL 2 and MISTRAL3 100% MOx cores [6] (LWR mock-up experiments performed in the EOLE facility) is:

$$(C/E-1) \pm \delta E/E = -7\% \pm 3\%$$

The calculated sensitivity of this reactivity worth to the ^{241}Am(n,γ) capture cross-section is about –0.64%/%. That means 1/3 of the reactivity worth is due to the ^{241}Pu decay and 2/3 due to the increase of ^{241}Am concentration.
Owing to this sensitivity and the C/E discrepancy, the proposed value for ^{241}Am(n,γ) XS in the thermal-epithermal range is then:

^{241}Am(n,γ) required modification: +12% ± 4%

4) *Fourth integral trend: Irradiation of the ^{241}Am separated isotope*

The interpretation of the ICARE experiment (irradiation up to 1GWd/t of UOx pellet doped with ^{241}Am into the HCPWR-MOx assembly ICARE at the center of the experimental reactor MELUSINE) supplies the following information on ^{241}Am(n,γ) XS in the epithermal energy range through the measured build-up of ^{242}Cm + ^{242}Am in the irradiated pellet:

^{241}Am(n,γ) required modification: +22% ± 10%

5) ***Synthesis of integral information and proposal for ^{241}Am(n,γ) XS in JEFF3.1***

Four independent integral experiments give the following trends on ^{241}Am(n,γ) XS:

1. ^{241}Am/^{241}Pu isotopic ratio: +16% ± 4%
2. ^{242}Cm and ^{243}Cm build-up : +30% ± 15%
3. Reactivity worth due to Plutonium Ageing: +12% ± 4%
4. Irradiation of ^{241}Am separated isotope: +22% ± 10%

The averaged value of the modification is obtained by combining the four values with the corresponding weight $(\delta E/E)^{-2}$. The proposed modification on ^{241}Am(n,γ) XS in the 0.1eV-1.5eV energy range is then:

^{241}Am(n,γ) modification = +15% ± 3% (1σ)

Reactivity worth measurement of separated actinides, particularly ^{241}Am and Cm samples, will be performed in MINERVE (OSMOSE program 2006) using the accurate oscillation method; this experiment will allow the precise qualification of JEFF3.1 nuclear data for ^{241}Am, ^{244}Cm and ^{245}Cm.

The suggestion by the JEFF group for ^{241}Am neutron XS to implement JENDL3.3 in JEFF3.1 was tested. This quick test did not show significant differences between JEFF3.0 and JENDL3.3, mainly on PIE experiment: for UOx fuels, (C/E-1) is decreased to 11% using JENDL3.3 instead of 13% using JEFF3.0.

A real improvement on C/E reduction will be obtained through the future European evaluation carried out at CEA by O. Bouland [7].

III. Conclusion.

All the changes of major actinides nuclear data from JEF2.2 to JEFF3.0 have improved the prediction of LWR spent fuel inventory up to high burnup.

However, there is still C/E discrepancies using JEFF3.0 on minor actinides prediction mainly on ^{241,242M}Am and $^{243,\ 245}$Cm, and on ^{239}Pu prediction.

The analysis of 4 independent integral experiments carried out at CEA enables the **following recommendations in JEFF3.1 for minor actinides:**

^{241}Am(n,γ) desired modification (Thermal and Epithermal Range)	**$\Delta\sigma$ = +15% ± 3%**
^{241}Am → ^{242M}Am Branching Ratio (Epithermal Range)	**BR= 0.14 ± 0.01**
^{245}Cm	**JENDL3.3 evaluation**

The new evaluation of ^{241}Am by CEA [7] is in progress and will be available soon for implementation in JEFF3.1; this evaluation, which is an improvement of the Frohner work used in JEF2.2, will account both for the above integral trend and for the Slaughter differential measurements.

Concerning the LEU reactivity underprediction problem [8] and the ^{239}Pu build-up overestimation in JEFF3.0-based calculations, the new evaluation of ^{238}U, including resonance parameters by Derrien-Courcelle [3] and improved inelastic scattering, should strongly decrease the C/E discrepancy in future JEFF3.1 calculations.

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