Benchmark tests for **ENDF/B-VIII.0 beta1** using *Sodium-void reactivity worth of FCA-XXVII-1*

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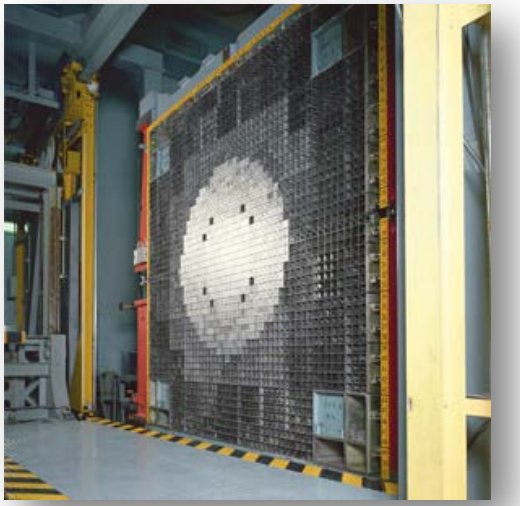
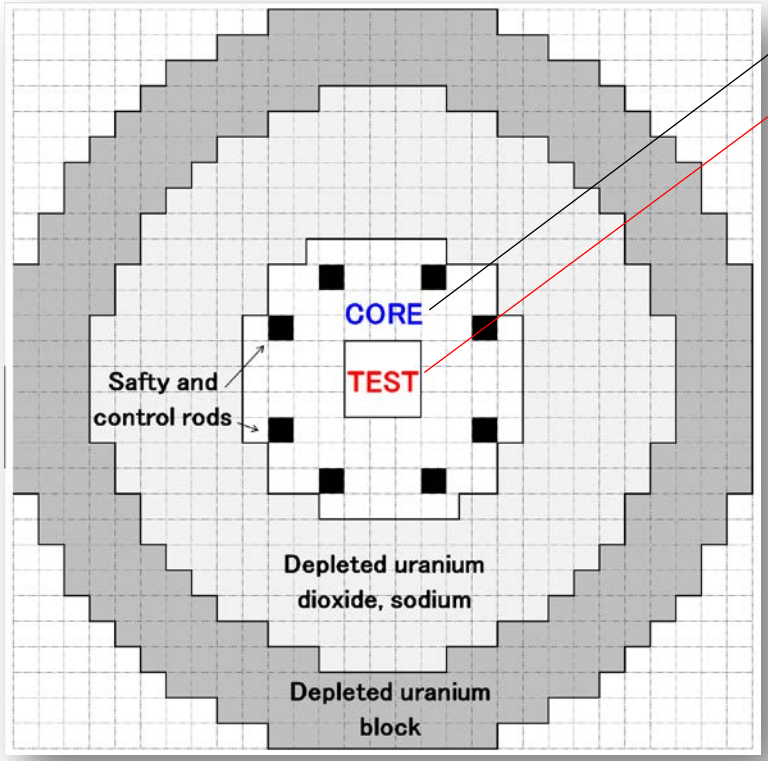


Fast **C**ritical **A**ssembly

Sodium-void reactivity worth (SVRW) of FCA XXVII-1

M. Fukushima, et al., Prog. Nucl. Sci. Tech. 2, 306-311 (2011).

XY cross sectional view of FCA XXVII-1

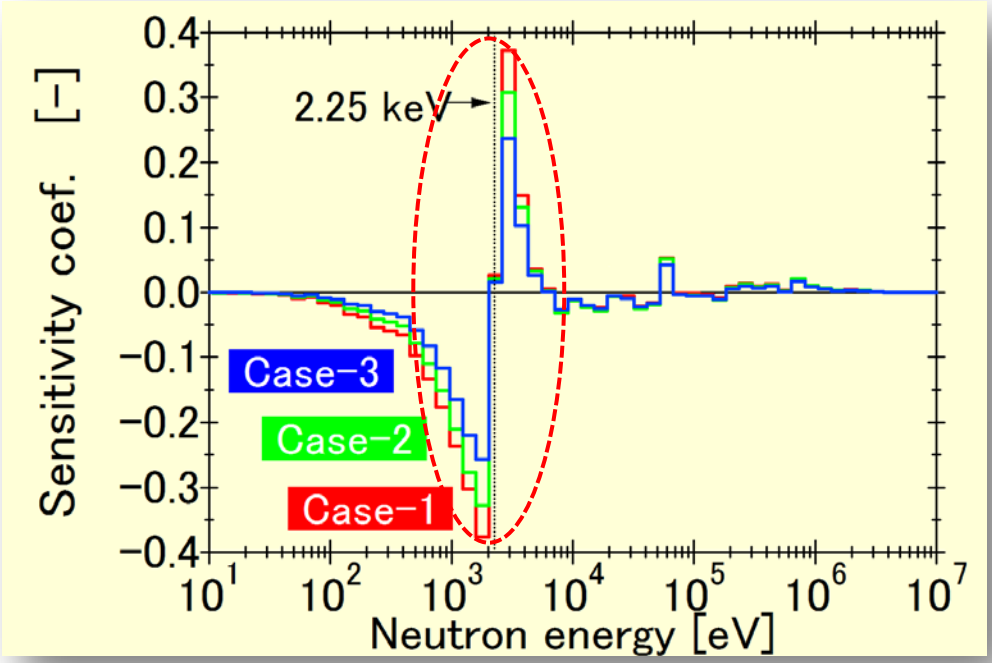


Core region: Enriched uranium + Graphite

Test region for void measurements:

Enriched uranium + Sodium

(Average enrichment of ^{235}U : 30%)



Height of Test region	Case-1	Case-2	Case-3
	10.16cm	20.32cm	30.48cm

SVRWs were measured by replacing sodium-filled SS cans with empty cans

Sensitive to ^{235}U capture cross section around keV region

owing to ^{23}Na resonance around 3 keV

Condition of benchmark tests and sensitivity analyses

Benchmark tests

Code: **Continuous-energy Monte Carlo code**, MVP

$$\rho = \left(k_{eff}^{void} - k_{eff}^{ref}\right) / \left(k_{eff}^{void} \cdot k_{eff}^{ref}\right)$$

200 million histories for each k_{eff} calculations

Sensitivity Analyses

Code : Generalized perturbation code SAGEP based on diffusion theory

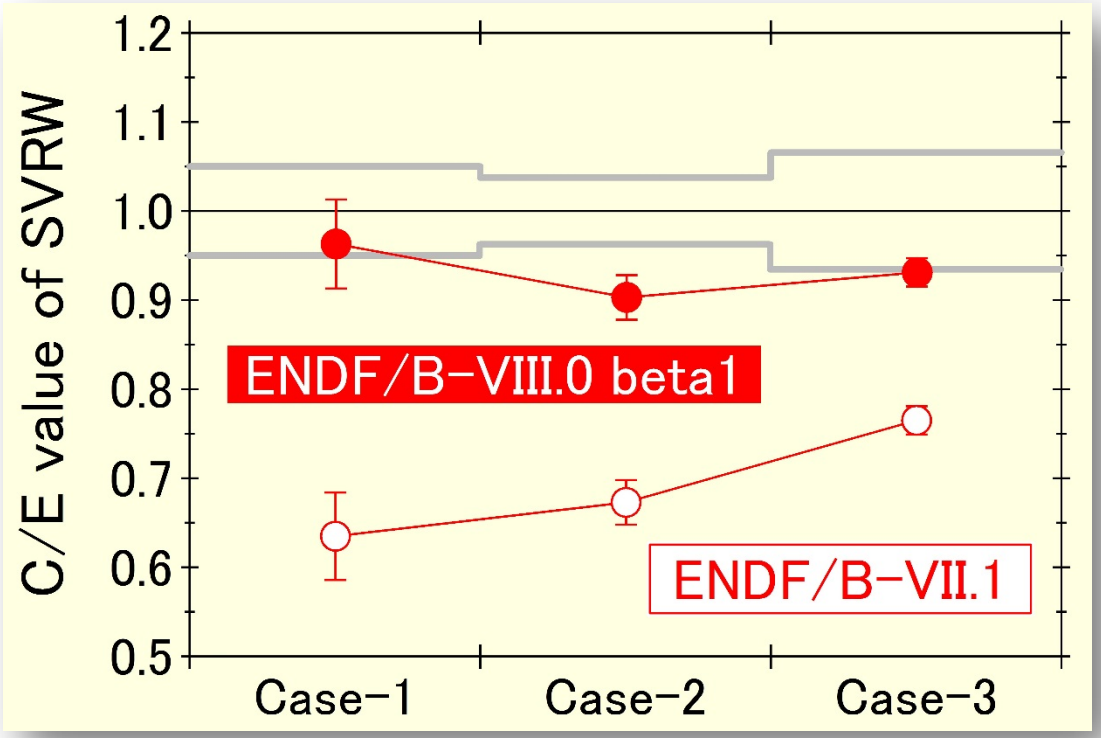
Sensitivity coefficients: $S_{X,G}^{B71} = \left(\frac{d\rho/\rho}{d\sigma_{X,G}^{B71}/\sigma_{X,G}^{B71}} \right)$

Here, X**(nuclide, reaction)**, G**(energy group)**

In replacement from ENDF/B−VII.1(B71) to -VIII beta (B8b1),
nuclide, reaction− and **energy−wise** changes were estimated by

$$\left(\frac{d\rho}{\rho}\right)_{X,G}^{B71 \to B8b1} = \underbrace{S_{X,G}^{B71}(R)}_{\text{sensitivity coefficients}} \cdot \underbrace{\left(\frac{\sigma_{X,G}^{B8b1} - \sigma_{X,G}^{B71}}{\sigma_{X,G}^{B71}} \right)}_{\text{relative discrepancy between B71 and B8b1}}$$

Benchmark results by MC calculations



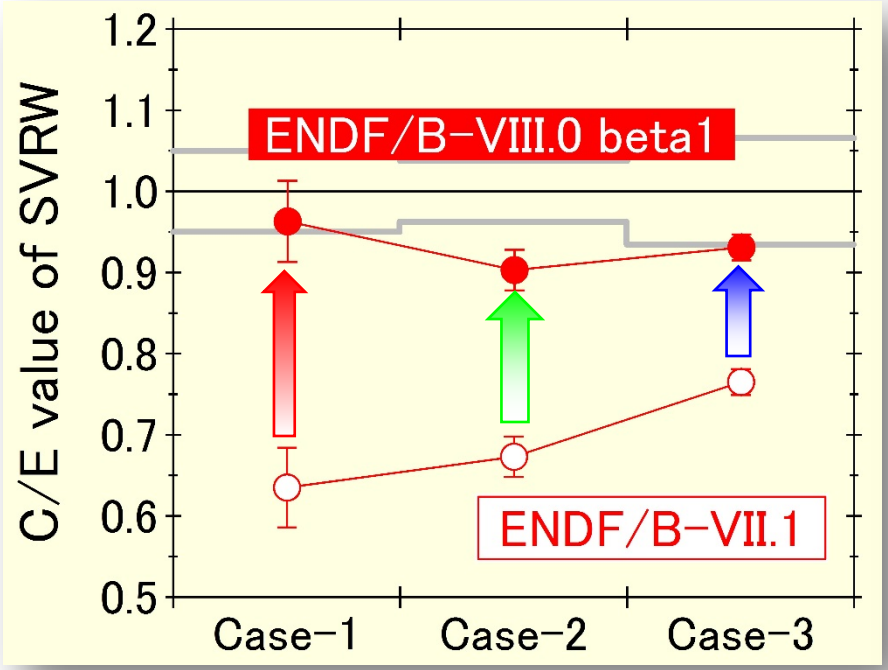
C/E ENDF/B- VIII.0 beta1	
Case-1	**0.963** ±0.049[*1] ±0.048[*2]
Case-2	**0.903** ±0.025[*1] ±0.034[*2]
Case-3	**0.931** ±0.016[*1] ±0.061[*2]

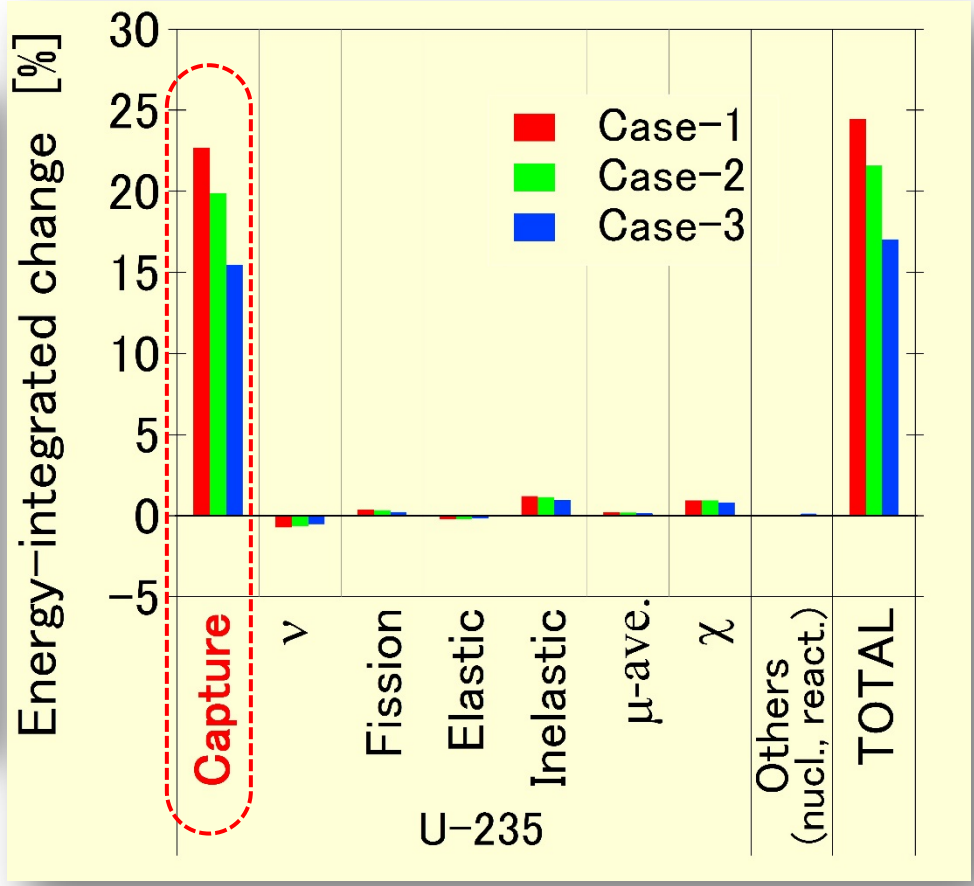
C/E ENDF/B-VII.1	
Case-1	**0.635** ±0.049[*1] ±0.032[*2]
Case-2	**0.673** ±0.025[*1] ±0.025[*2]
Case-3	**0.765** ±0.016[*1] ±0.050[*2]

[*1] Due to MC statistical errors.
[*2] Due to Experimental uncertainties.

- ENDF/B-VIII.0 beta1 obviously improves the C/E values by ENDF/B-VII.1 for sodium-void reactivity worth of FCA-XXVII-1

Sensitivity Analyses

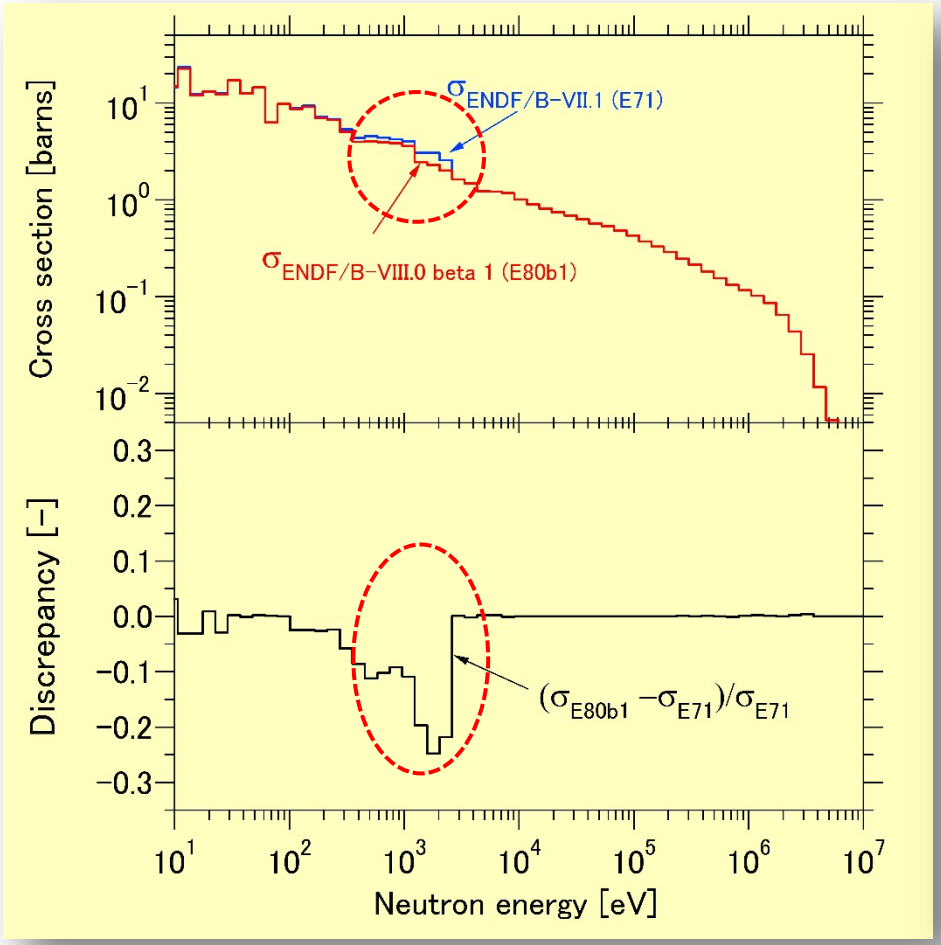


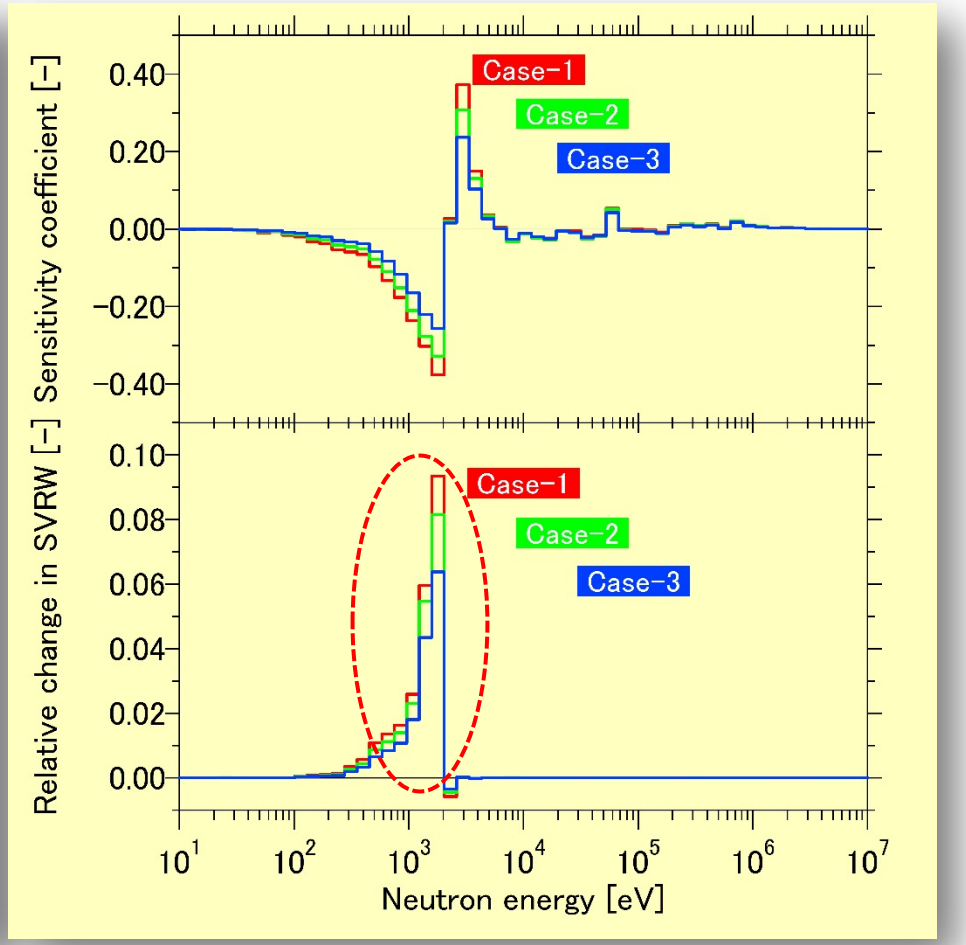


Replacement from B71 to B80b1 **increases** void reactivity worth

Positive changes are mainly due to discrepancy between **^{235}U capture cross sections**

Sensitivity Analyses





Improvements from B71 to B80b1 are mainly caused by discrepancy of **^{235}U capture around keV region**

Summary

- ✓ Adoption of ENDF/B-VIII.0 beta1 instead of ENDF/B-VII.1 leads obvious improvements of the C/E values for sodium void reactivity worth of FCA XXVII-1.

- ✓ The improvements were caused mainly by the discrepancy between ^{235}U capture cross sections around keV region.