UNIVERSIDAD POLITÉCNICA DE MADRID

POLITÉCNICA

INDUSTRIALES
ETSII | UPM

BENCHMARKING & VALIDATION JEFF-4T2.2 – A COMPARISON WITH OTHER EVALUATIONS

José A. Miras on behalf of "INGENIA NUCLEAR" Team (UPM) &

Oscar Cabellos (UPM)

23/05/2023

E-mail: oscar.cabellos@upm.es

CEIDEN
PLATAFORMA TECNOLÓGICA DE ENERGÍA NUCLEAR DE FISIÓN

CONTENT

❑Benchmark Phase-VII

- See **JEF/DOC-1844** (*O. Cabellos, "Testing JEFF-3.3T3 in the computational PHASE-VII Benchmark, 2017)*

❑Application in LWR – Depletion

- NNPP ALMARAZ – PWR Westinghouse 1000 MWe - Cycle 1

❑ PWR UO_2 discharge fuel compositions for decay calculations

- 21 FA, 4.5-wt% 235U initial enrichment
- 50 GWd/MTU burnup

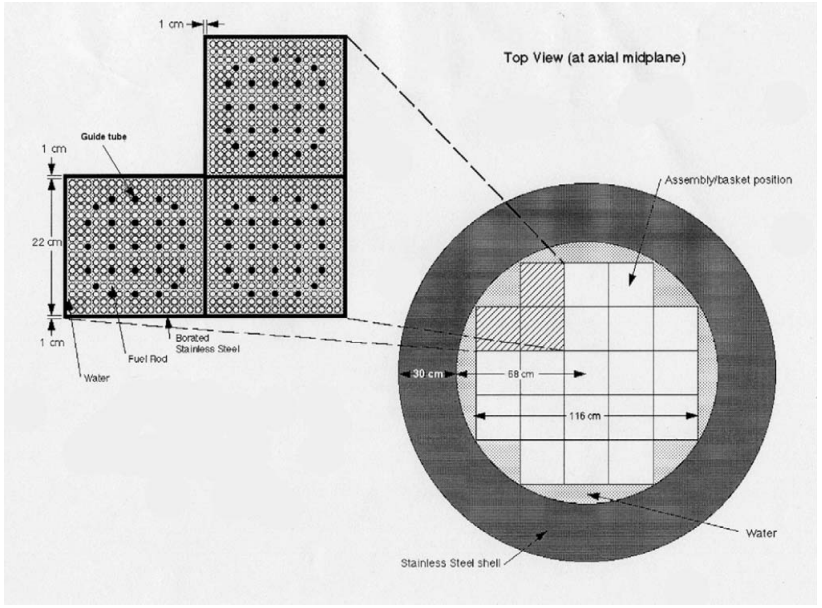


Figure. Cask model (top view)

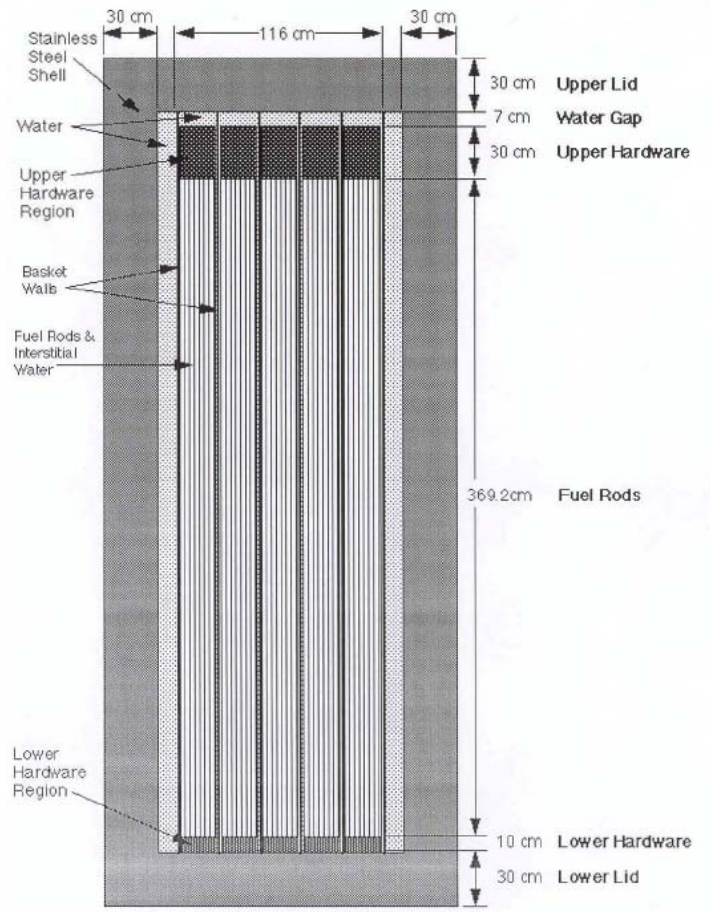
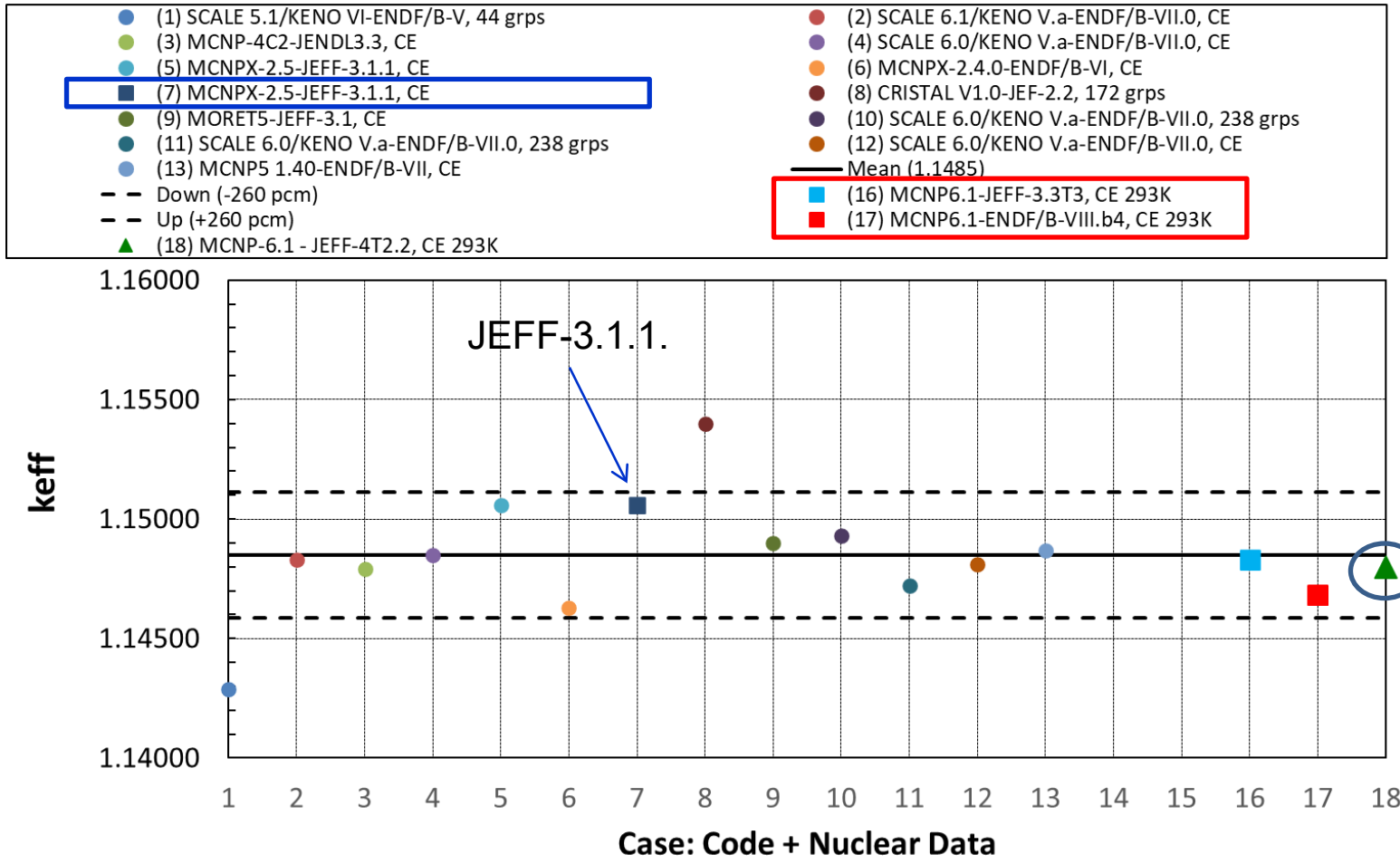


Figure. Cask model (side view)

Reference: *John C. Wagner and Georgeta Radulescu, Specification for Phase VII Benchmark UO2 Fuel: Study of spent fuel compositions for long-term disposal, NEA Expert Group on Burn-up Credit, November, 2008*

❑ Keff values – mean value and std.: CASE "*Keff Fresh Fuel*"

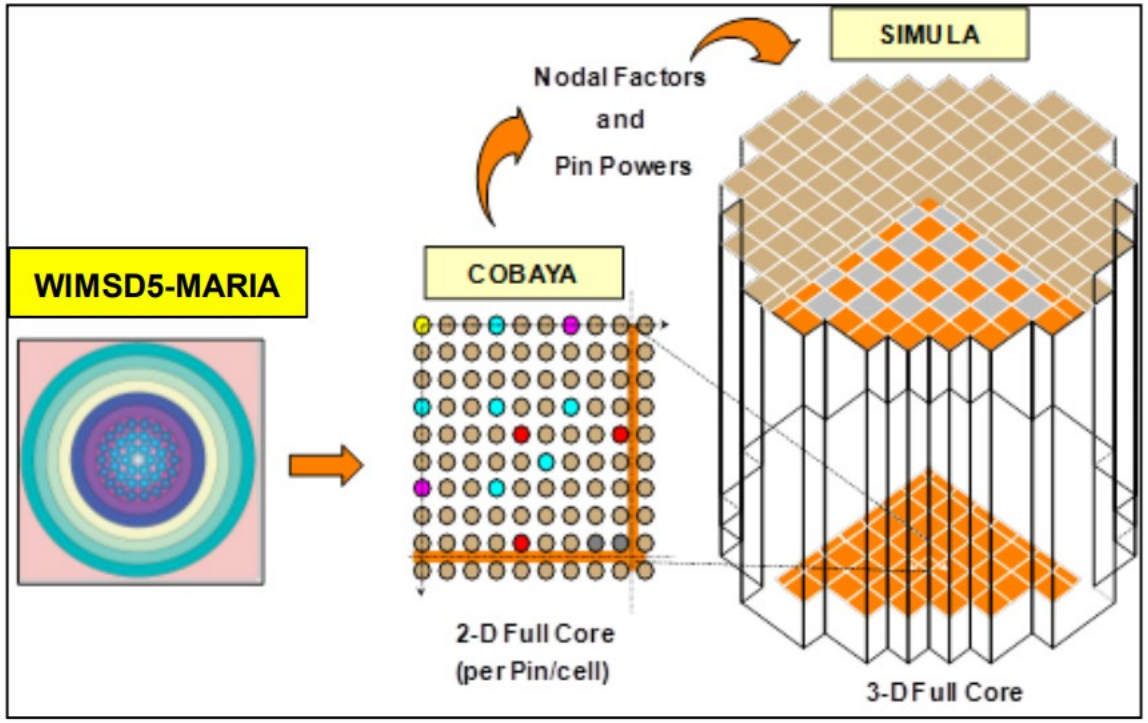


Calculations:

- ❑ MCNP-6.1
- ❑ JEFF-4T2.2 processed with NJOY2016.69 in ACE format at 20ºC

❑ Application in LWR: Lattice code – WIMSD5b and PWR Core analysis - SEANAP System

❑ Application in LWR – Depletion



- ❑ Lattice code: WIMSD5b
- ❑ Core calculation 2D/3D : SEANAP
- ❑ Processing ND libraries (JEFF-4T2.2 into WIMSD format using WIMS Library Update Project (https://www-nds.iaea.org/wimsd/)

SEANAP system has been developed and validated in **~90 cycles** of Spanish PWRs: Zorita, Almaraz I and II, Ascó I and II, and Vandellós II:

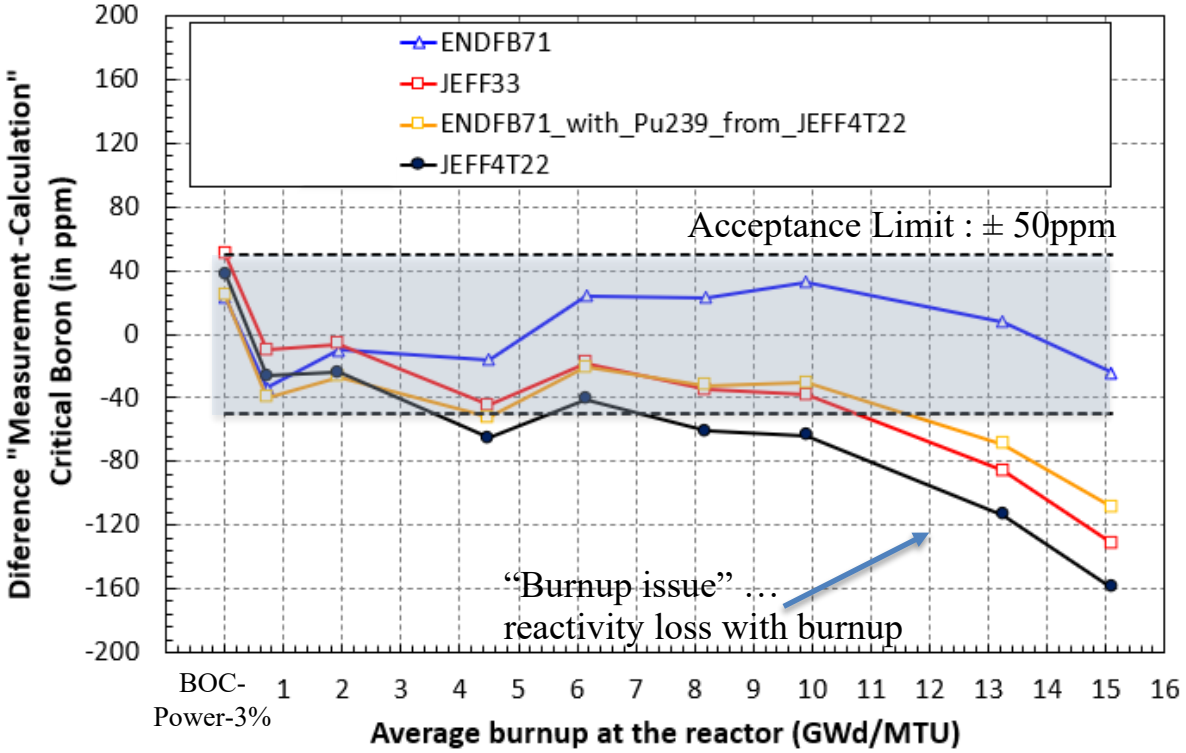
- HZP- Startup tests
- Core Design
- Loading pattern optimization

SEANAP has been implemented as an on-line simulator **~20 cycles** of three PWRs (Vandellós-II, Ascó-I and Ascó-II)

- Every 5 minutes, continuous operational surveillance: boron concentration, reaction rates at the excore detectors, A.O., fluid temperatures at the location of thermocouples, temperatures at hot legs…
- Planning of Optimal Maneuvers, Dynamic Core Analysis for safety and training for plant engineers and operators

❑ Modification in reactivity (Critical Boron letdown) versus Critical Boron Measurements

Experimental – measured "Critical Boron concentrations" can be found at:
Ref. IAEA-TEC-DOC 815 "In-Core Fuel Management Code Package Validation for PWRs", 1995
https://inis.iaea.org/collection/NCLCollectionStore/_Public/26/077/26077395.pdf



Processing Nuclear Data:

Case **ENDF/B-VII.1**

- ❑ See processed WIMSD library at:

  https://www-nds.iaea.org/wimsd/downloads2.htm

Case **JEFF-4T2.2 == INGENIA work!!**

- ❑ JEFF-4T2.2 – XS + Thermal Scattering Libraries (H in H_2O)
- ❑ JEFF-3.3 - Decay Data and Fission Yields

❑ Conclusions

❑ Benchmark Phase-VII

- Good agreement

❑ Application in LWR – Depletion

- SEANAP system is used to simulate PWR Almaraz I, cycle 1
- Reactivity issue along burnup still exists (comparison with ENDF/BVII.1)
  - Large impact of Pu239

CEIDEN
PLATAFORMA TECNOLÓGICA DE ENERGÍA NUCLEAR DE FISIÓN

POLITÉCNICA

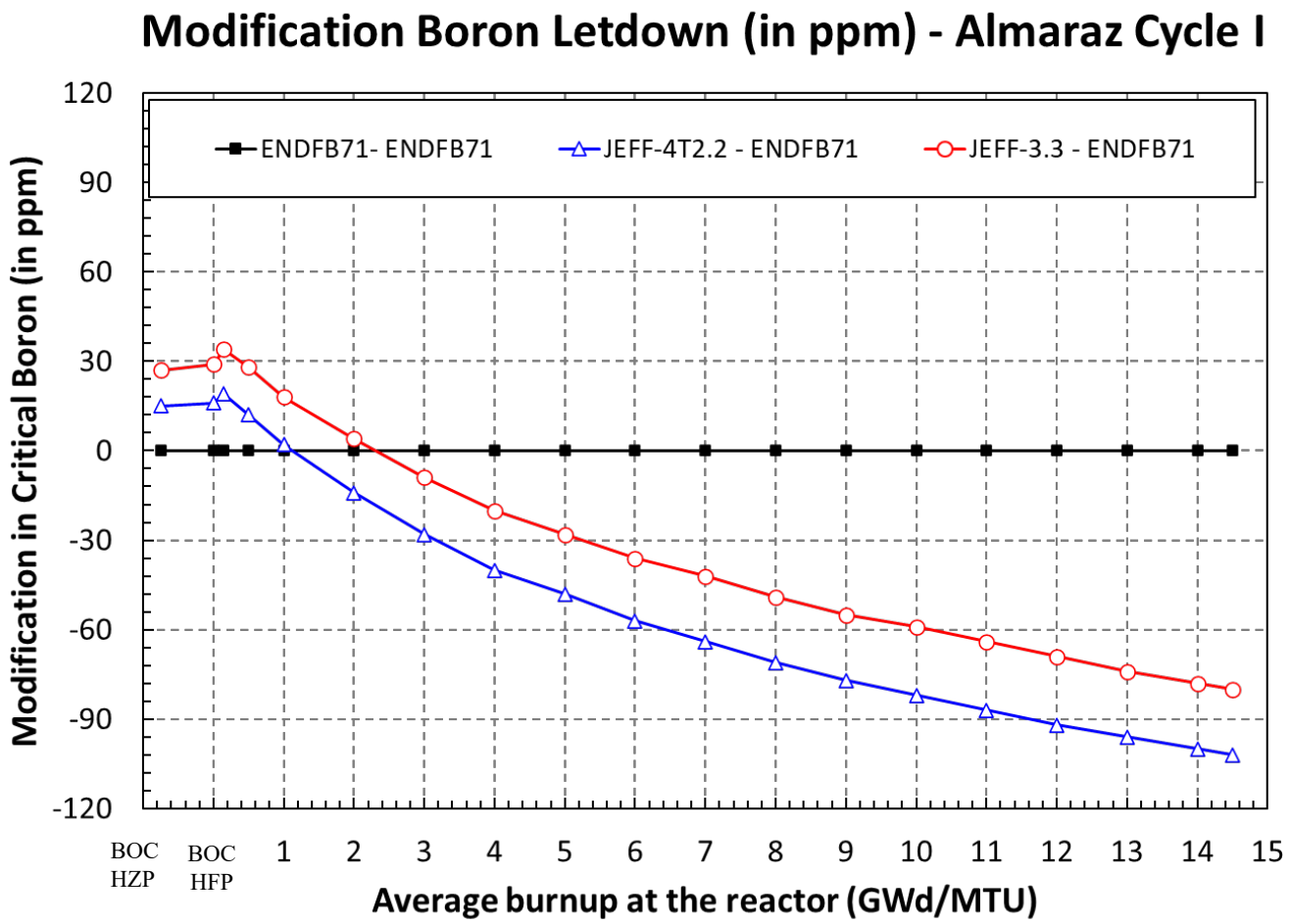
UNIVERSIDAD POLITÉCNICA DE MADRID

Thanks for your attention

❑ Application in LWR – Depletion

NNPP – PWR Almaraz I, cycle 1

❑ Modification in reactivity (Critical Boron letdown): ENDF/B-VII.1 as reference



Nuclear Data:

Case JEFF-4T2.2

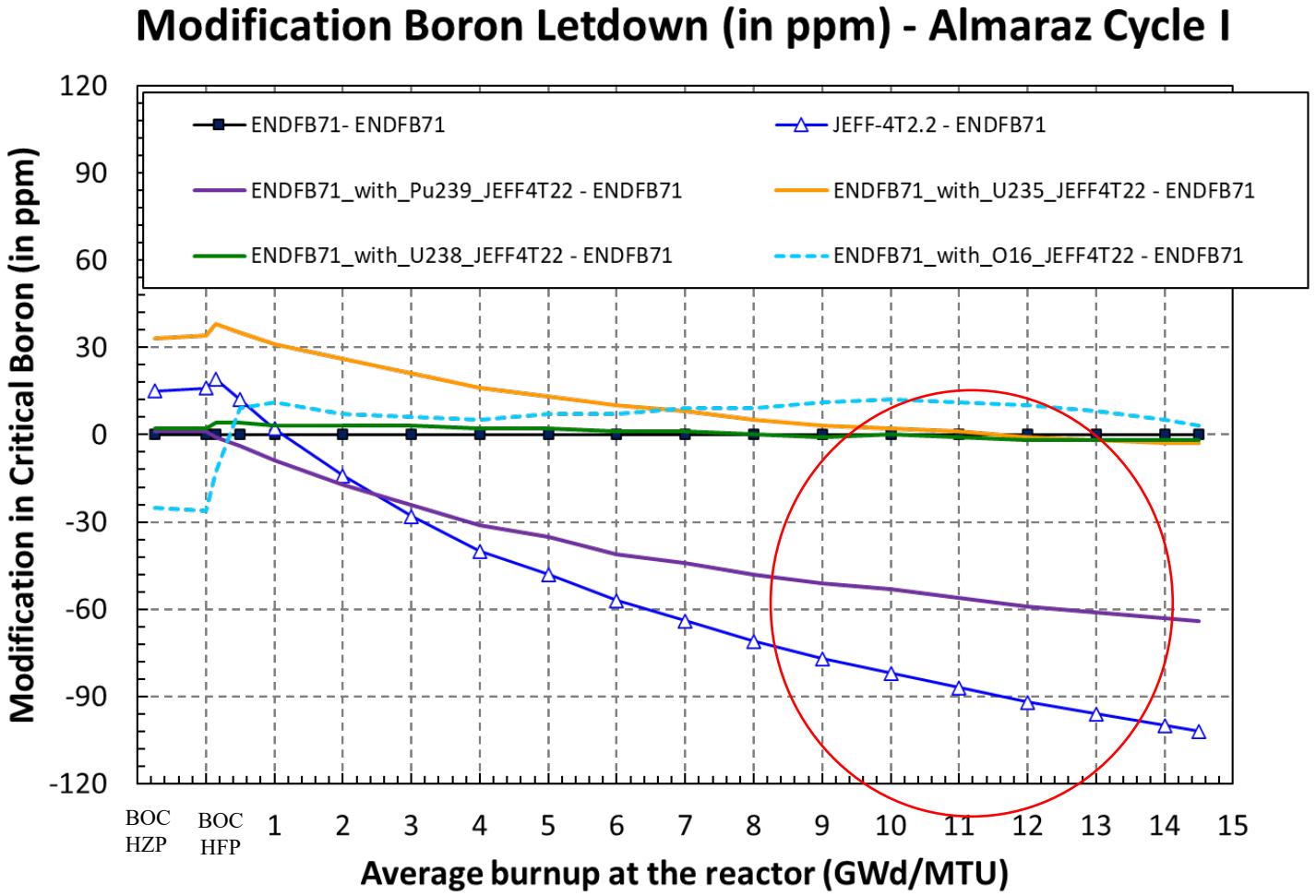
- ❑ JEFF-4T2.2 – XS + TSL
- ❑ JEFF-3.3 DD and FYs

- ❑ Loss of Reactivity with burnup
- ❑ Calculations with SEANAP system

❑ Application in LWR – Depletion

NNPP – PWR Almaraz I, cycle 1

❑ Modification in reactivity (Critical Boron letdown): ENDF/B-VII.1 as reference



Nuclear Data:

Case JEFF-4T2.2

- ❑ JEFF-4T2.2 – XS + TSL
- ❑ JEFF-3.3 DD and FYs

- ❑ **Contribution of different isotopes at high burnup:**
  - Low contribution 238U
  - Large impact of 239Pu
  - Large contribution of Fission Products