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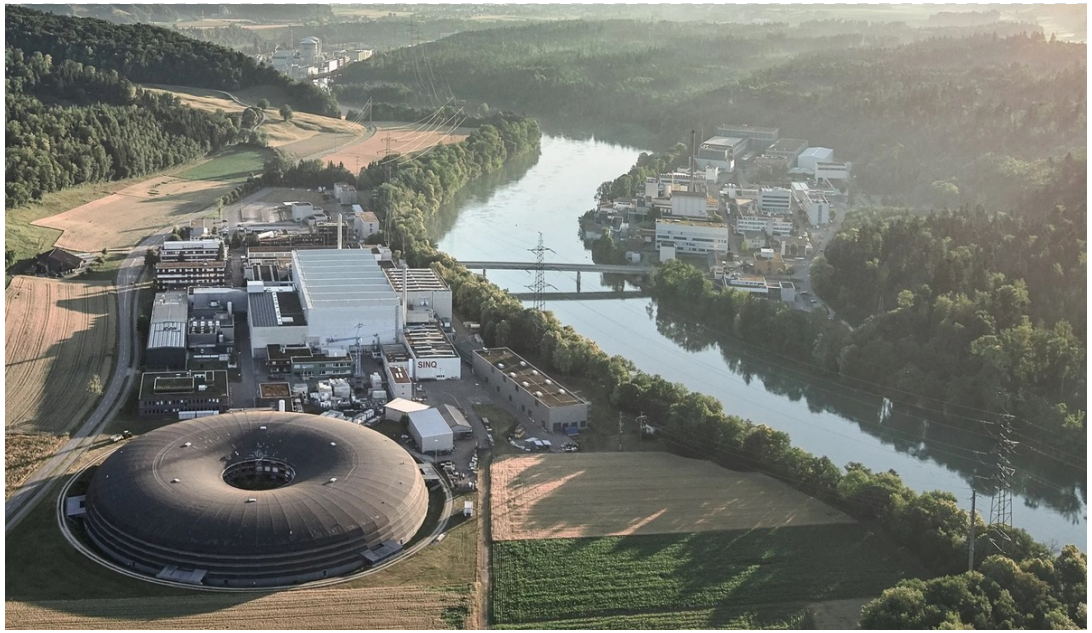

Reporting on the 1st meeting of SG16 on

"Computational Spent Nuclear Fuel decay heat: the PWR 0E2 case"

D. Rochman

WPNCS Meeting, September 27th, 2024,

OECD-NEA, Boulogne Billancourt, France

Report on the 1st SG16 meeting

- Feedback from SG12
  - On assessing our current knowledge regarding decay heat for current SNF
  - From January 2022 to December 2023
  - Gather actors from different horizons and exchange of knowledge
  - Find a consensus, presented in
    - Publication at the ICNC 2023 conference
    - Accepted review paper in EPJ/N

- Follow-up activity: this SG16, on “Computational Spent Nuclear Fuel decay heat: the PWR 0E2 case”
- Goals:
  - Defining a decay heat benchmark (done)
  - Perform required calculations (to be submitted 31/12/2024)
  - Analyze results (2025)
  - Report/publish results and discussions (2025)
  - Possibly extend the benchmark with new measurements & analysis (2025)

SG16 decay heat benchmark

- Specifications: sent by email on August 29

NEA
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NEA/NSC/WPNCS/WD(2024)1/REV1

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31 July 2024

NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE

Working Party on Nuclear Criticality Safety (WPNCS)

Decay heat computational comparison exercise: definition for a PWR UO2 assembly and pincell

Specifications for the exercise of WPNCS SG16

Revision of June 25th, 2024: in table 4, He gap density was corrected to 1.3e-3 g/cm3 (in lieu of 1.3e-4 g/cm3)

PAUL SCHERRER INSTITUT
PSI

Decay heat computational benchmark: definition for a PWR UO_2 assembly and pincell

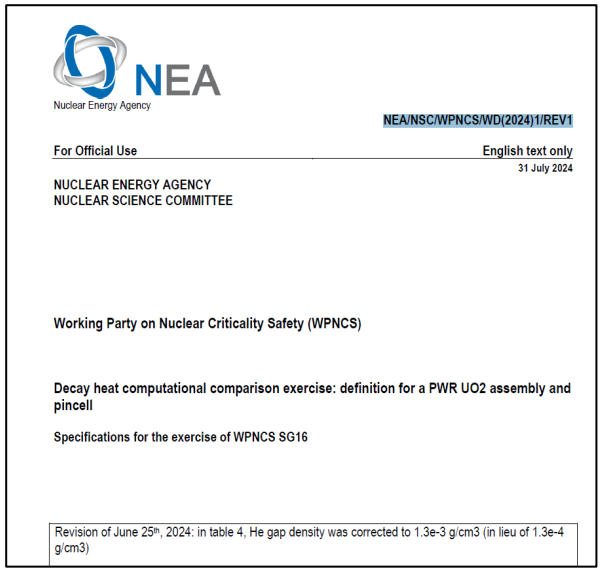
WPNCS SG16

D. Rochman

Reactor Physics and Thermal hydraulic Laboratory, PSI, Switzerland

SG16 decay heat benchmark

- Specifications: sent by email on August 29
- Benchmark description in the document
  - Pincell
  - Assembly
  - 6 measurements



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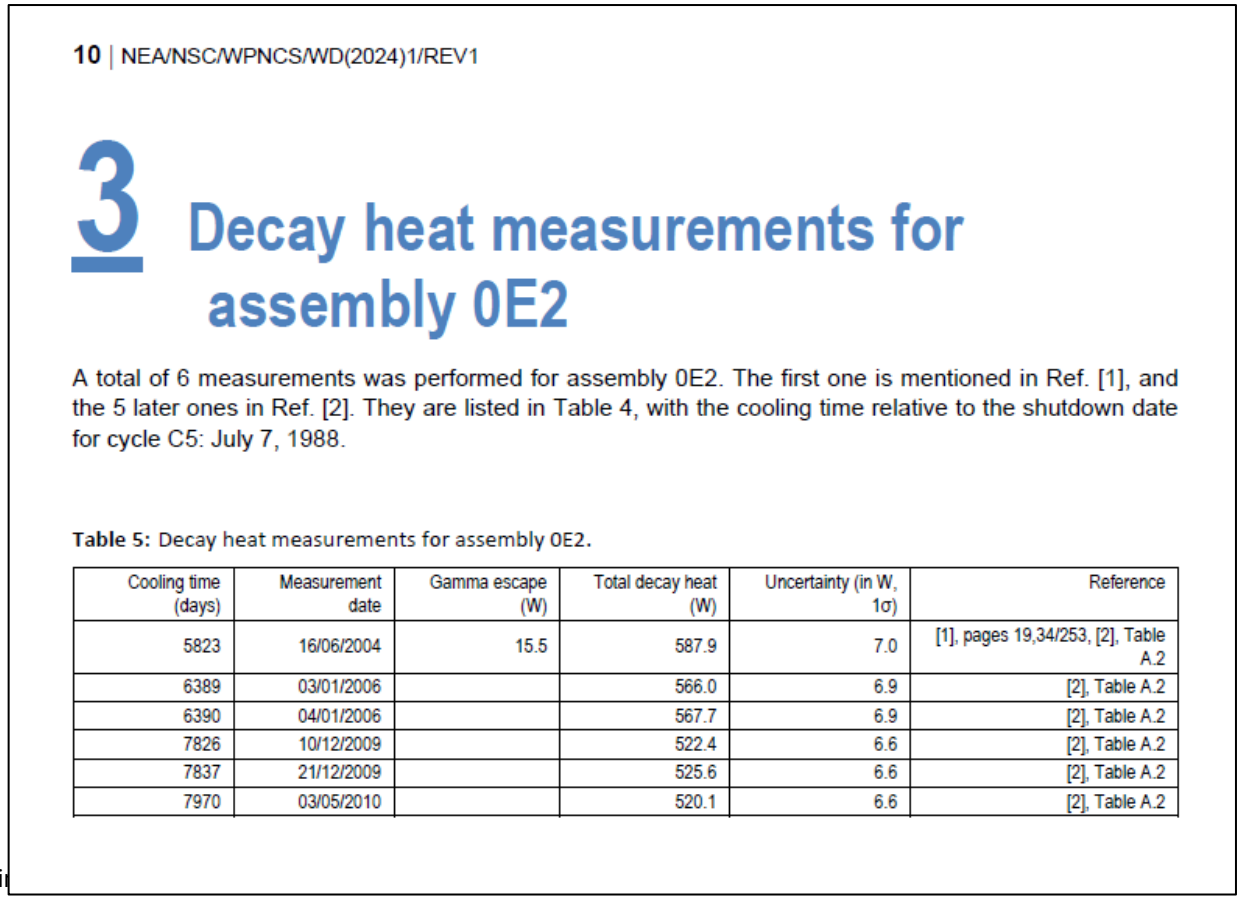


3 Decay heat measurements for assembly 0E2

A total of 6 measurements was performed for assembly 0E2. The first one is mentioned in Ref. [1], and the 5 later ones in Ref. [2]. They are listed in Table 4, with the cooling time relative to the shutdown date for cycle C5: July 7, 1988.

Table 5: Decay heat measurements for assembly 0E2.

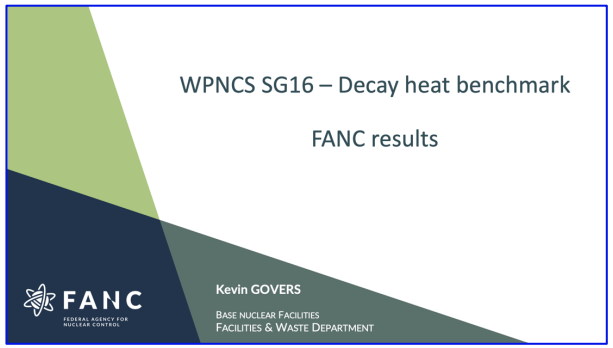
Cooling time (days)	Measurement date	Gamma escape (W)	Total decay heat (W)	Uncertainty (in W, 1σ)	Reference
5823	16/06/2004	15.5	587.9	7.0	[1], pages 19,34/253, [2], Table A.2
6389	03/01/2006		566.0	6.9	[2], Table A.2
6390	04/01/2006		567.7	6.9	[2], Table A.2
7826	10/12/2009		522.4	6.6	[2], Table A.2
7837	21/12/2009		525.6	6.6	[2], Table A.2
7970	03/05/2010		520.1	6.6	[2], Table A.2

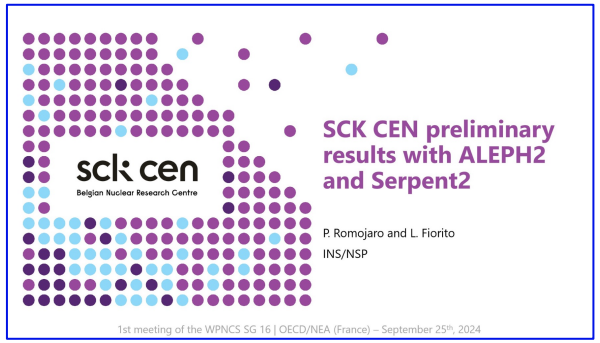
SG16 decay heat benchmark

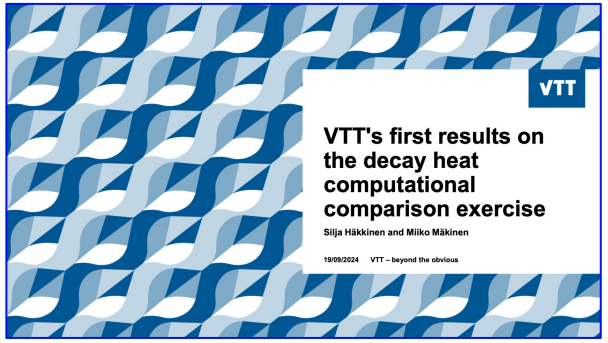
- Required output: fill an Excel table about
  - Calculated decay heat at the measured times
  - Decay heat contributors
  - Neutron and gamma emission at the measured times (possibly with 7 groups gamma spectrum)
  - Number densities (during irradiation and at measured times)
  - k_∞
  - Fission rates
  - Possibly input files after the submission of results
- Excel document distributed and available on the SG16 webpage

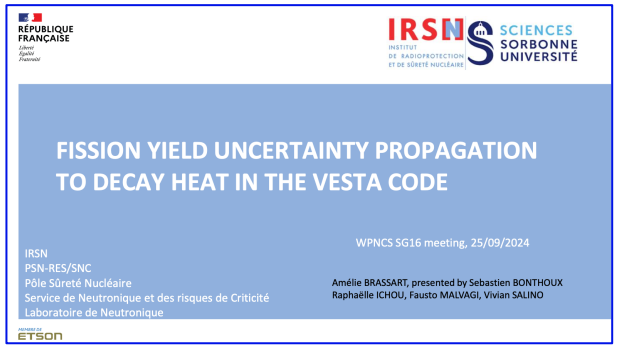
- At the date of the 1st meeting:
  - Results received from 5 institutes
  - Some institutes provided different scenarios (nuclear data, codes, options)
  - In total:
    - 15 calculations for the pincell and
    - 8 calculations for the assembly

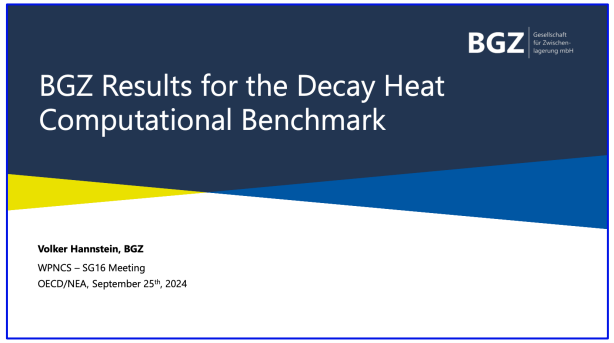
SG16 Presentations

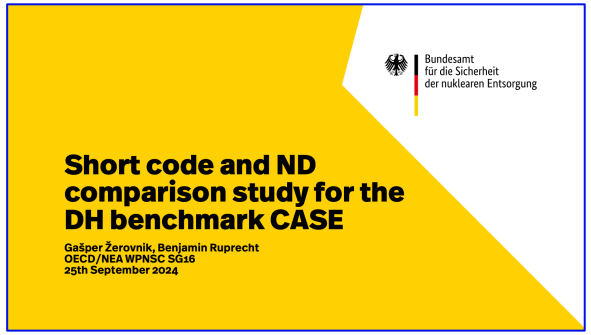


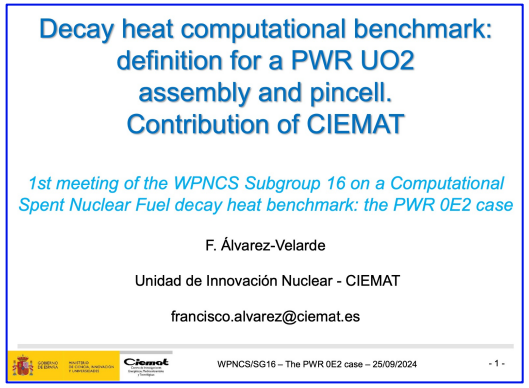


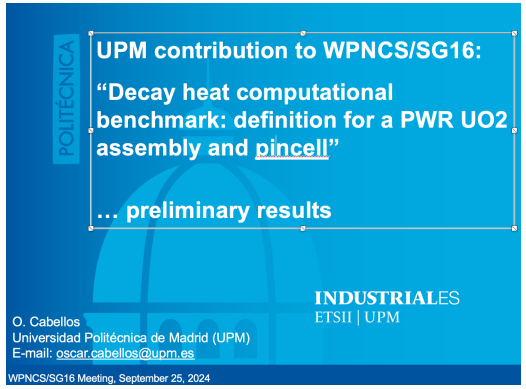


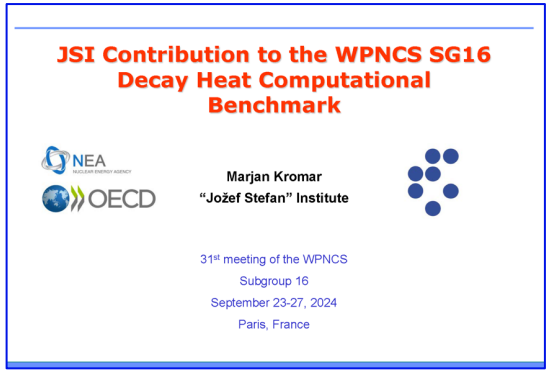


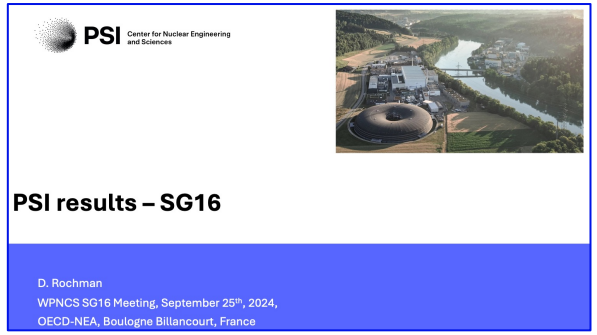












SG16 Presentations: main points

- All required quantities (preliminary) presented
  - Decay heat, number densities, kinf,
  - Different nuclear data libraries
  - Different codes
  - Different modelling assumptions

- Additional quantities
  - Sensitivities
  - Uncertainties (from fission yields)

- Main comments
  - Pincell model: overestimation of the decay heat
  - Necessity to analyse differences
  - Discussion on relevance of C/E=1

- Some preliminary results at EOL (Δ = 1 standard deviation)

	pincell	assembly
• Δk_∞ :	≈ 1800 pcm	≈ 2700 pcm
• $\Delta^{235}U$:	≈ 4 %	≈ 2 %
• $\Delta^{239}Pu$:	≈ 3 %	≈ 2 %
• Δneutron emission:	≈ 3 %	≈ 9 %
• Δgamma emission:	≈ 29 %	≈ 38 %

- Average pincell C/E decay heat: 1.023 ± 0.048
- Average assembly C/E decay heat: 0.982 ± 0.056

Many thanks

- Questions ?