PAUL SCHERRER INSTITUT

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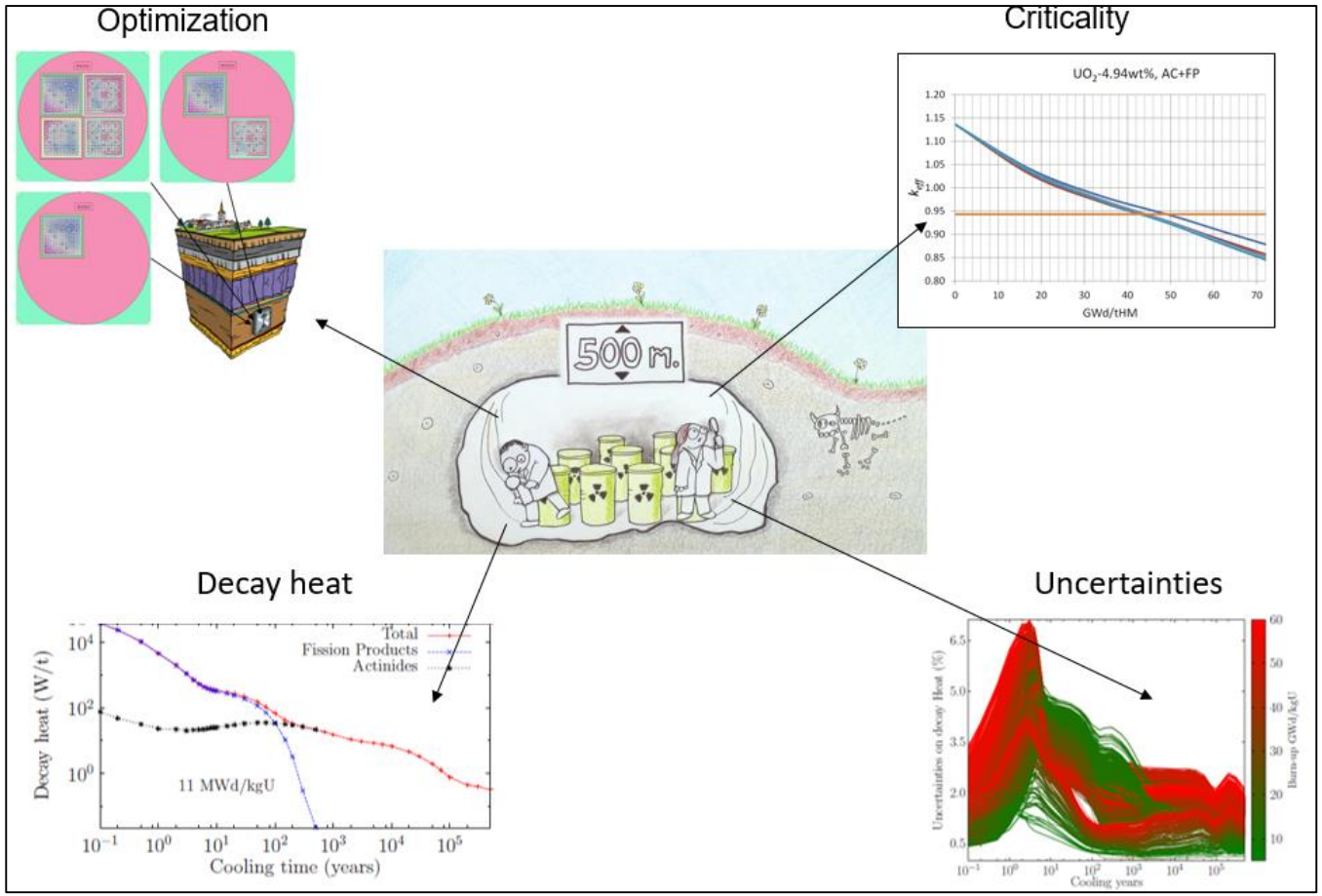
Update on the recent SFC work

IAEA SFC CM, September 12-13, online

Zertifiziertes Managementsystem
STARS
ISO 9001

Introduction

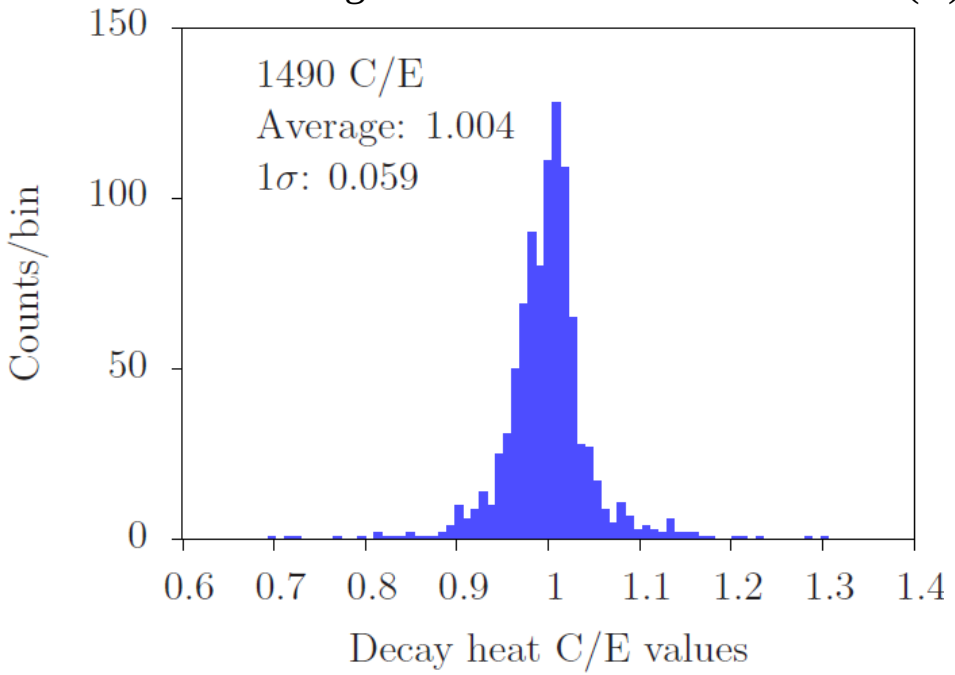
- Precise knowledge on SNF decay heat is required for
  - Core transients (short cooling time, a few seconds to minutes),
  - Safe and economical storage, transport and long-term repository (long cooling time, weeks to 1 billion of years)

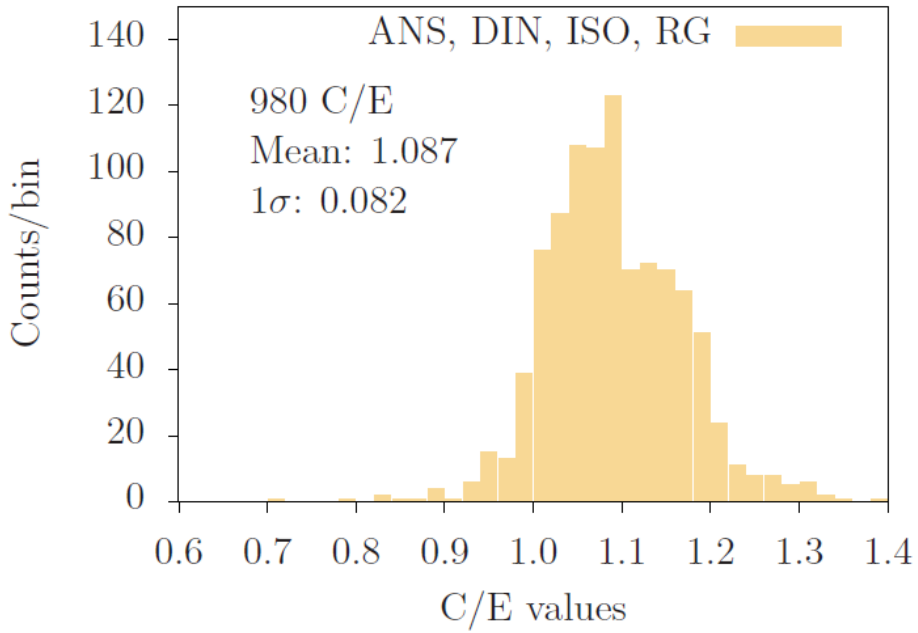


Current questions (partly addressed)

- How well can we characterize SNF (nuclides, decay heat)?
- What are the (industrial) needs ?
- Source of uncertainties (modelling, 2D, core simulator…)
- How much do we trust calculated burnup, core power…
- How blind are we ?
- New measurements, which ones ?

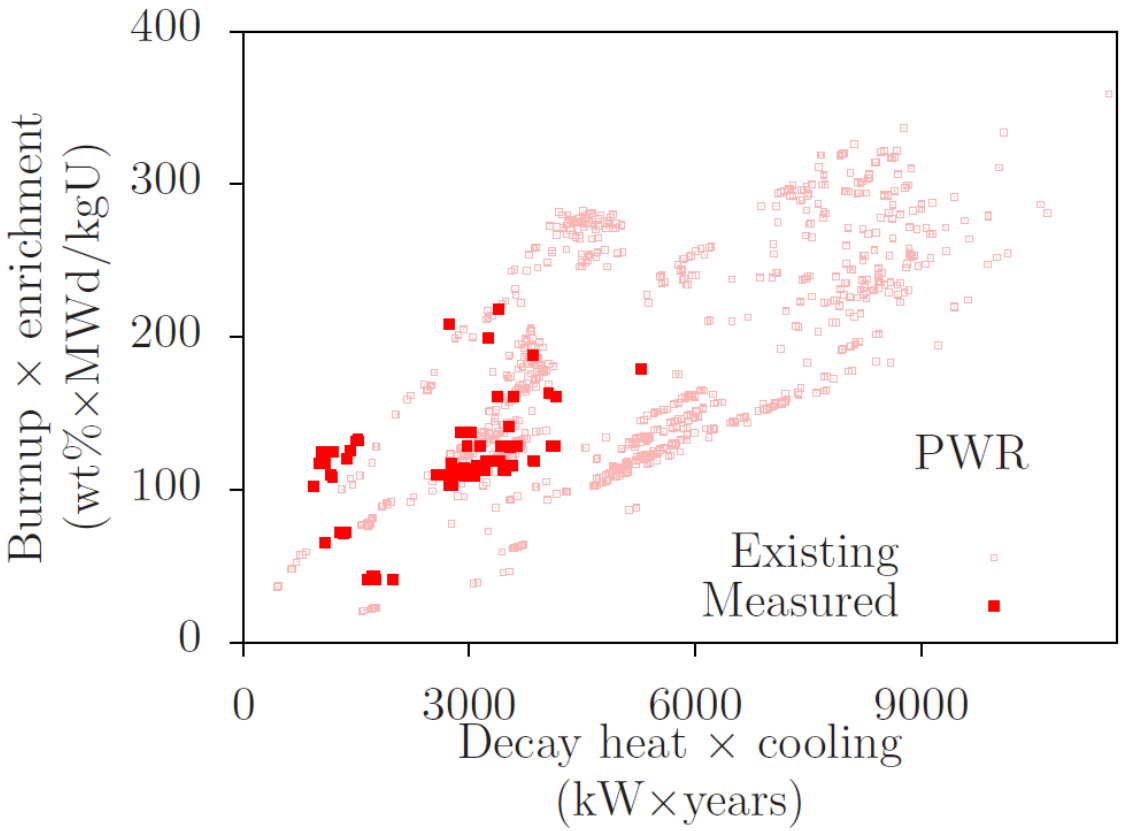
Histograms of the ratios of calculated (C) over experimental (E) decay heat values





Experimental needs

- Limited overlap between measured SNF decay heat and SNF currently in storage
- Current SNF:
  - high enrichment,
  - high burnup,
  - long cooling,
  - high decay heat



- No measurements for MOX, and for VVER or CANDU fuels

Experimental needs

- Currently only 1 calorimeter (Clab, Sweden), but plans for 2 new ones
  - France: Decay heat at the rod level, compact and “cheap” calorimeter, portable and/or easy to produce
  - Switzerland: Decay heat at the assembly level, full size calorimeter, fixed
- If new measurements are feasible, which SNF parameters ?
  - Burnup, initial enrichment, type, cooling ?
  - A dedicated study by Nagra will soon be available, indicating “where we learn the most”.

International efforts

- Current IAEA SFC CRP
- EU EURAD Work Package 8 on Spent Fuel Characterization
- NEA WPNCS SG12 on decay heat from Spent Nuclear Fuel
- NEA WPNCS SG13 on SNF loading curves for canisters
- Future:
  - NEA WPNCS SG14 on decay heat benchmark (2024 ?)
  - EU EURAD-2 Work Package 19 on criticality safety for Geological Repository (2024 ?)

Recommendations from SG12 1/2

- Current experimental uncertainties: between 1 and 5 %
- Current calculated uncertainties: between 2 and 10 %
  - Nuclear data
  - Operating conditions
  - Manufacturing tolerances
  - Burnup induced changes

- Need for new measurements (burnup, enrichment, cooling time, fuel type) and facilities

- Need for improved theoretical understanding and nuclear data
  - For different cooling periods
  - For different fuel types

- Recommendations are needed for the use of standards, calculation methods, code improvement

Recommendations from SG12 2/2

- Redundancy
  - Experimental (multi measurements of same SNF, and multi facility)
  - Simulation (double check, different codes)

- Comparisons of code implementation
  - Module
  - Solvers, inputs, assumed values

- Use of blind benchmarks
  - Based on experimental values
  - Or computational benchmark

- User effect due to
  - Interpretation of the same information
  - Ambiguity of definition
  - Different options
  - Mistakes

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Wir schaffen Wissen – heute für morgen