Lessons Learned from International Investigations of Burnup Credit Criticality

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Presentation Outline

- Describe OECD/NEA organization of Expert Groups
- Scope of the Expert Group on Burnup Credit
- Outline the Benchmark Problems
- Lessons Learned
  - Validation
  - PWR studies
  - BWR studies
  - MOX studies
- Atomic Energy Research (AER) VVER studies
- Future Activities

WPNCS: scope and objectives

International forum for scientific co-operation in nuclear criticality safety devoted to

- Exchange of information on on-going and projected national programs
- Co-ordination and performance of international technical studies
  - BUC (PWR, BWR, Waste disposal application)
  - Uncertainty analyses for CSA
  - Assay Data for Spent Nuclear Fuel
- Assessment of calculation tools through code inter-comparison exercises
  - Criticality excursions
  - Source convergence
- Development of experimental Data Bases (ICSBEP, SFCOMPO)
- Development of bibliographical resources

WP on Nuclear Criticality Safety

Chair: V Rouyer (France)

EG on Assay Data for SNF

Chair: I. Gauld (USA)

EG on Burnup Credit

Chair: M. Brady Raap (USA)

EG on Uncertainty Analyses for CSA

Chair: T. Ivanova (France)

EG on Criticality Excursions

Chair: Y. Miyoshi (Japan)

EG on Source Convergence Analysis

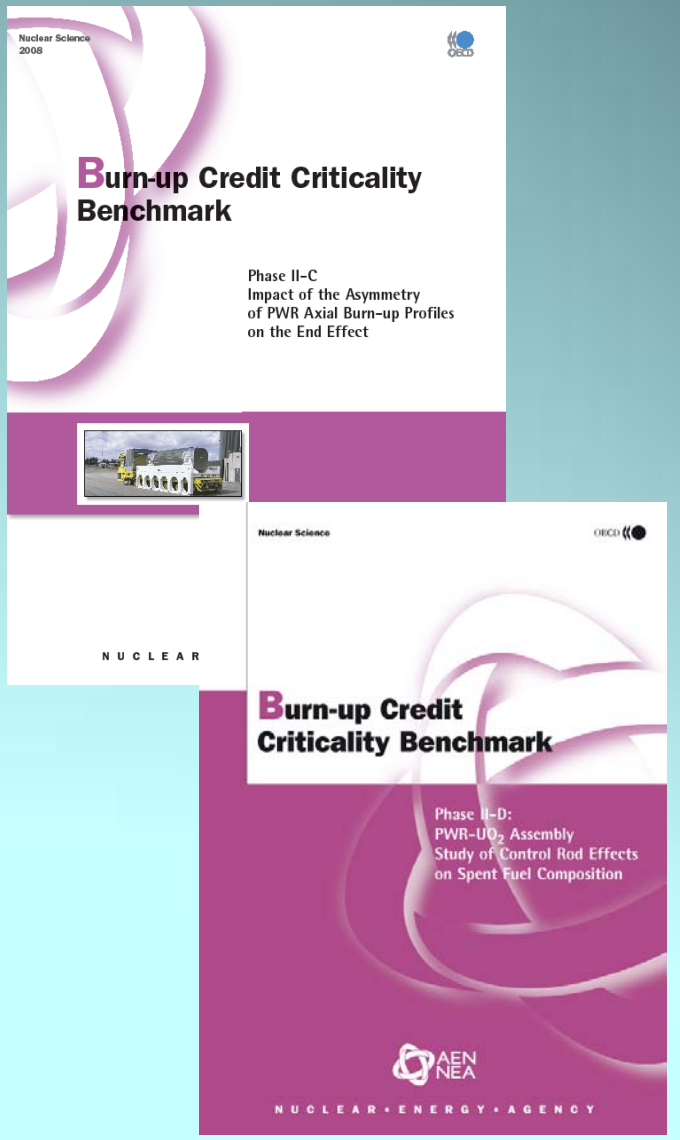
Chair: R. Blomquist (USA)

ICSBEP project

Chair: B. Briggs (USA)

EGBUC Activities

- ✓ Publication of BUC/Phase II-E report is in progress, preliminary results were discussed during last meeting. The publication is expected for early 2010.
- ✓ Benchmark exercise for the BUC EG to study the performance of the depletion calculation codes for long term geological disposal applications
- ✓ The BUC EG investigating the possibility to coordinate further work in the area of spent fuel reprocessing & repository safety



EGBUC Scope and Mission

This NEA expert group was set up to examine burn-up credit* as applied to criticality safety in the transportation, storage, and treatment of spent fuel for a wide range of fuel types, including UOX and MOX fuels for PWR, BWR, and VVER.

Primary Activities of the EGBUC

- carrying out international comparison exercises and benchmarks to assess the ability of code systems to predict the reactivity of spent nuclear fuel systems
- comparison with experimental data as available;
- investigating the physics and predictability of burn-up credit based on the specification and comparison of calculational benchmark problems;
- publishing the results for the benefit of criticality safety community, so that the work may be used to help establish suitable safety margins.

Ongoing Work

Status of the different benchmarks
Benchmark specifications
Expert group publications and reports
SFCOMPO: Spent Fuel Isotopic Composition Database
Burn-up credit bibliography
Structure of lessons learnt contribution
Guidance for BUC (reports in preparation)

Phase	Fuel	Description	Status
I-A	UOX PWR	Multiplication factor, spectra and reaction rates calculations for an infinite PWR fuel rod lattice with varying compositions (different enrichments, burnups, cooling-times, presence or absence of actinides -major and minor- and of fission products -major and minor-	Complete
I-B	UOX PWR	Depletion calculations for a simple infinite PWR pin-cell lattice.	Complete
II-A	UOX PWR	Multiplication factor calculations of an infinite array of PWR fuel with finite axial height. The aim being to study the effect of axial burn-up profile on criticality calculations of PWR fuel storage.	Complete
II-B	UOX PWr	Multiplication factor and spatial fission distribution calculations of a realistic PWR spent fuel transport cask including accidental situations. The aim being to further study the effect of axial burn-up profile on criticality calculations.	Complete

Phase	Fuel	Description	Status
II-C	UOX PWR	Multiplication factor and fission distribution calculations of a realistic PWR fuel transport cask. The aim being to study the sensitivity to the axial burnup shape.	Complete
II-D	UOX PWR	Multiplication factor and fission distribution calculations of a realistic PWR fuel transport cask. The aim being to study control rods effects on spent fuel composition.	Complete
II-E	UOX PWR	Study on the impact of changes in the isotopic inventory due to control rod insertions in PWR UO_2 fuel assemblies during irradiation on the end effect	In-progress First results
III-A	UOX BWR	Criticality calculations of an infinite array of BWR spent fuel assemblies with emphasis on axial burnup and void profiles.	Complete
III-B	UOX BWR	Depletion calculations of an array of BWR fuel.	Complete

Phase	Fuel	Description	Status
IV-A	MOX PWR	Reactivity Prediction Calculations for Infinite Arrays of PWR MOX Fuel Pin Cells	Complete
IV-B	MOX PWR	Inventory MOX Fuel Depletion Calculations	Complete
VI	UOX VVER	Burn-up profile in a VVER-440 assembly	In-progress Draft Report
VII	UOX PWR BWR	Study of spent fuel compositions for long-term disposal	In-progress First results

Publications from EGBUC

Burn-up Credit Criticality Benchmark Final Results of Phase 1A Infinite Array of PWR Pin-Cells
January 1994, Makoto Takano (JAERI)
JAERI-M-94-003, NEA/NSC/DOC(1993)22

OECD/NEA Burn-up Credit Calculational Criticality Benchmark Phase-IB Isotopic Prediction: Final Report
M.D. DeHart (ORNL), M.C. Brady (SNL), C.V. Parks (ORNL)
June 1996, ORNL-6901, NEA/NSC/DOC(1996)6

OECD/NEA Burn-up Credit Criticality Benchmark: Results of Phase IIA PWR Spent Fuel Rods Effect of Axial Burn-up Profile
M. Takano, H. Okuno, (JAERI) JAERI-Research 96-003
February 1996, NEA/NSC/DOC(1996)1

Burn-up Credit Criticality Benchmark Analysis of Phase II-B Results: Conceptual PWR Spent Fuel Transportation Cask
A. Nouri May 1998, IPSN/98-05, NEA/NSC/DOC(1998)1

Publications from EGBUC (cont'd)

Burnup Calculations of BWR Spent Fuel Assemblies in Storage and Transport H. Okuno, Y. Naito, K. Suyama
February 2002, JAERI-Research 2002-001, NEA/NSC/DOC(2002)2

Criticality Calculations of of BWR Spent Fuel Assemblies in Storage and Transport H Okuno, Y. Naito, Y. Ando
September 2000, JAERI-Research 2000-041, NEA/NSC/DOC(2000)12

OECD/NEA Burn-up Credit Criticality Benchmark Phase III-A Criticality Calculations of of BWR Spent Fuel Assemblies in Storage and Transport H. Okuno, Y. Naito, Y. Ando
September 2000, JAERI-Research 2000-041, NEA/NSC/DOC(2000)12

OECD/NEA Burn-up Credit Criticality Benchmark Phase III-B Burnup Calculations of BWR Spent Fuel Assemblies in Storage and Transport H. Okuno, Y. Naito, K. Suyama
February 2002, JAERI-Research 2002-001, NEA/NSC/DOC(2002)2

Publications from EGBUC (cont'd)

OECD/NEA Burn-up Credit Criticality Benchmark Phase IV-A Reactivity Prediction Calculations for Infinite Arrays of PWR MOX Fuel Pincells
G. O'Connor (DfT), R. Bowden (BNFL), P. Thorne (BNFL)
NEA/NSC/DOC(2003)3, May 2003.

OECD/NEA Burn-up Credit Criticality Benchmark Phase IV-B Results of Phase IV-B Analysis
G. O'Connor (BNFL), P. H. Liem (NAIS)
NEA/NSC/DOC(2003)4, May 2003.

The Isotopic Compositions Database System on Spent Fuels in Light Water Reactors (SFCOMPO),
Masayuki Kurosawa, Yoshitaka Naito, Hiroki Sakamoto, Toshiyuki Kaneko,
JAERI-Data/Code 96-036, February 1997.

Burnup Credit Bibliography, Dennis Mennerdahl (2005)

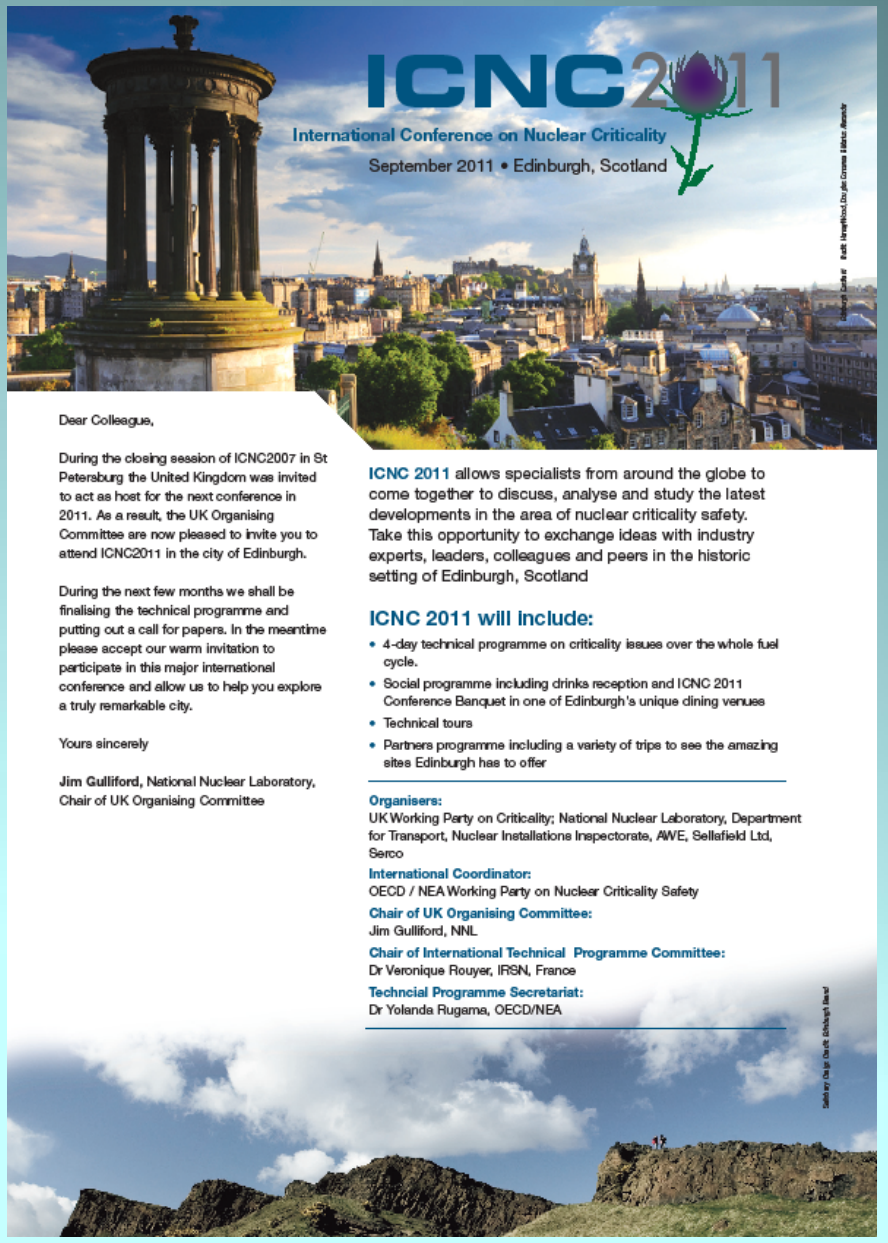
New activities for the EGBUC:

- ✓ Benchmark exercise for the BUC EG to study the performance of the depletion calculation codes for long term geological disposal applications

✓The EGs provide Technical Support to ISO activities

ICNC11, International Conference on Nuclear Criticality Safety
http://icnc2011.com/

- WPNCS acts as international coordinator and technical program committee
- 2007 in St Petersburg
- UK to host ICNC11
- Edinburgh will be venue
- Technical Programme in development
  - Will consider issues raised at Idaho workshop



https://secure.inl.gov/OECDNEAWS09/

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AEN NEA

NCSP

INL Idaho National Laboratory

Idaho State University

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

OECD

OECD-NEA Workshop on Future Criticality Safety Research Needs

21-22 September 2009 in Pocatello, Idaho

Workshop Information: View the Technical Session Schedule

The OECD-NEA workshop will help the international nuclear criticality safety community identify future criticality safety research needs so it will be better prepared to respond to those needs as future energy systems are developed.

ISU Rendezvous Complex – Pocatello, ID

The OECD-NEA Workshop will be held at the Idaho State University's Rendezvous Complex in Pocatello, ID. The complex promotes an enhanced collegial atmosphere in a facility where students and faculty can meet both in the classroom and in a social setting.

Registration and Special Events

The workshop will include two days of technical sessions, group dinner, and the opportunity to visit Yellowstone National Park the weekend before the workshop.
For more information visit registration or special events. Please note that the registration deadline for the Yellowstone