

## ***International Workshop on Advances in Applications of Burnup Credit for Spent Fuel Storage, Transport, Reprocessing, and Disposition***

***Córdoba, Spain  
27-30 October, 2009***

***Organized by the  
Nuclear Safety Council of Spain (CSN)***

***In cooperation with the  
International Atomic Energy Agency (IAEA)***

***Co-sponsored by  
ENUSA Industrias Avanzadas S.A.  
Empresa Nacional de Residuos Radiactivos S.A. (ENRESA)***

Website: [www.csn.es](http://www.csn.es) under the heading "BUC Workshop 2009"

Meeting information also available at: [www.iaea.org/cgi-bin/maeps.page.pl/search.htm](http://www.iaea.org/cgi-bin/maeps.page.pl/search.htm)

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### **1. BACKGROUND**

The most common assumption used in criticality safety analysis of spent nuclear fuel from power reactors is that the irradiated fuel has the same reactivity as the unburned fuel. This approach is usually known as the "fresh fuel assumption" and results in a significant conservatism in the calculated value of the system's reactivity. Modern calculation methods have made possible taking credit for the reactivity reduction associated with the fuel burnup process, hence reducing the analysis conservatism while maintaining an adequate criticality safety margin.

Spent fuel management is a common and costly activity for all operators of nuclear power plants, which involves different operational safety risks. An accepted possibility to achieve a reduction in fuel cycle costs while diminishing the risks associated to the different processes is to implement burnup credit in spent fuel management systems. In fact, in many countries, burnup credit is already applied to transport systems, wet and dry storage facilities, and components of reprocessing plants. For disposal of spent fuel and reprocessing of some advanced fuel designs, burnup credit is considered to be important for viable schemes.

In 1997, the IAEA initiated a task to monitor the implementation of burnup credit in spent fuel management systems, to provide a forum to exchange information, to discuss the matter and to gather and disseminate information on the status of national practices of burnup credit (BUC) implementation in the Member States. The IAEA started this active programme with an advisory meeting in 1997 (resulting in TECDOC-1013, 1998), followed by major meetings on BUC held in Vienna in 2000 (TECDOC-1241, 2001), Madrid in 2002 (TECDOC-1378, 2003), and London in

2005 (TECDOC-1547, 2007). Moreover, the Agency has contributed to the organization of BUC training courses held in different countries.

The Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OCDE/NEA) has also performed an extensive collection of activities since it created the Expert Group on Burnup Credit in 1991. This group was set up to examine BUC 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. The major assignments of the expert group include carrying out international comparison exercises and benchmarks to assess the ability of code systems to predict the reactivity of spent nuclear fuel systems, including 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; and publishing the results for the benefit of the criticality safety community, so that the work may be used to help establish suitable safety margins.

The CSN has since the beginning supported both the IAEA and NEA in their cooperative efforts to improve the knowledge of the physics underlying in BUC criticality safety analysis and to maintain adequate safety margins in its implementation. Given the time elapsed since the last major BUC meeting was held, the CSN, in cooperation with IAEA, is organizing an International Workshop on Advances in Applications of Burnup Credit for Spent Fuel Storage, Transport, Reprocessing and Disposition.

The annual meeting of the Expert Group on Burnup Credit of the OCDE/NEA will be held back to back with the international workshop.

## ***2. WORKSHOP OBJECTIVES***

The objective of the workshop is to identify the benefits that accrue from recent improvements of the burnup credit analysis methodologies; to discuss and analyze the implications of applying improved burnup credit methodologies, focusing on both the safety-related and operational aspects; and to foster the exchange of international experience in licensing and implementation of burnup credit applications.

## ***3. AUDIENCE***

The workshop is directed to a broad range of experts in several areas, including professionals from the different disciplines involved in the implementation of burnup credit techniques. It is aimed at both operators and governmental officials, including experts from regulatory bodies, industry and research institutions.

## ***4. PROGRAMME STRUCTURE***

The workshop will be structured so as to facilitate focused discussion of specific topics and issues. Senior experts will introduce the major issues during each topical

session. Three panel sessions will provide the opportunity for a more intensive exchange of views with the audience on important technology and safety issues.

## ***5. SCOPE OF THE SESSIONS.***<sup>1</sup>

### ***5.1. Topical sessions***

#### ***Session I. International and national reports***

- IAEA presentation
- OECD/NEA BUC activities
- Overview of the status of national programmes for BUC applications in Slovakia, China and India

#### ***Session II. Calculation methods***

##### II.A. New code developments

- Chair overview of the status and the main challenges in burnup credit depletion calculation
- Advances in depletion calculations
- Energy treatment
- 3-dimensional deterministic and Monte Carlo codes
- Advances in energy treatments, e.g. Resonance treatments in given energy mesh structures
- Advances in Monte Carlo criticality codes, e.g. Source convergence detection, diagnostics
- Automated tools for BUC calculations

##### II.B. Nuclear data

- Chair overview of the main improvements in nuclear data with respect to burnup credit nuclides
- New differential measurements
- New evaluations
- Covariance data
- New libraries

##### II.C. Sensitivity/Uncertainty analyses

- Chair overview of the objectives, key concepts, and methods
- Methodologies:
  - Standard perturbation
  - Generalized perturbation

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<sup>1</sup> Prospective participants are advised that this list is not intended to exclude relevant presentations on related topics.

- Methods to calculate sensitivity profiles
- Uncertainty calculations
- Statistical adjustment
- Similarity coefficients
- Integral experiment method
- Selection and design of representative experiments
- Methodologies of calculating the bias and the a posteriori uncertainty

#### II.D. Verification and validation

- Chair overview of the available data and methods
- Numerical benchmarks
- New experimental data:
  - Spent fuel isotopic compositions
  - Critical experiments and reactivity worth measurements
  - Recent evaluation of commercial reactor critical data
  - Performance of new libraries
  - Future programmes

#### ***Session III. Applications and implementation***

- Applications to storage, transport and reprocessing of different fuel types, e.g. PWR (including WWER), BWR, RBMK, PWR and BWR MOX, PHWR, AGR, HTR, research reactor fuel designs
- Overview of reactor operations impacting the spent fuel reactivity and the burnup distribution
- Identification and use of bounding burnup profiles
- BUC application to advanced reactor fuel cycles (e.g., GEN-4 fuel)
- Burnup credit applications to final disposal
- Operational implementation of burnup credit
- Chair overview of the issues related to burnup verification
- Objective, criteria and techniques of burnup verification
- Use of reactor records
- Out-of-reactor measurement techniques
- Specific aspects of burnup credit application to damaged fuel
- Regulatory issues and perspectives

#### ***5.2. Panel Discussions***

##### ***Panel I: Code developments and nuclear data:***

- What accuracy in the representation of the fuel system in the depletion calculations is required?
- What is the target accuracy for isotopic predictions?
- What is the target accuracy for  $k_{\text{eff}}$  prediction?
- Are the currently available tools fit for the foreseeable future requirements?

***Panel II: Sensitivity/uncertainty analysis, verification and validation:***

- What is the benefit of the today's more rigorous sensitivity and uncertainty analyses?
- Is there a rigorous way to define the representativity of experiments?
- How many experiments have to be analysed (e.g., post irradiation experiment data)?
- How can the calculation uncertainty be derived for applications where no suitable experimental validation is available?

***Panel III: Applications and implementation:***

- Under what circumstances are burnup measurements required?
- What is the overall reduction in risk due to performing burnup measurements?
- Are there realistic prospects of subcritical  $k_{\text{eff}}$  measurements?
- Why should the most conservative depletion conditions be assumed for all the fuel assemblies to be loaded in a spent fuel system?
- Have burnup profiles always to be normalized?

## ***6. WORKSHOP VENUE AND LOCATION***

The International Workshop will take place in the city of Córdoba, located in the southern part of Spain. The meeting will be held at the

***HOTEL HESPERIA CÓRDOBA***  
Avenida de Fray Albino 1  
14009 Córdoba  
Córdoba (España)

Detail information about Córdoba and about the Hesperia Hotel, as well as some additional travel information, can be found at [www.csn.es](http://www.csn.es).

## ***7. REGISTRATION AND PAPER SUBMISSION***

Persons wishing to participate in the workshop should complete the Registration Form enclosed and send it electronically to [BUC-2009@csn.es](mailto:BUC-2009@csn.es). The registration form can be downloaded from the web page [www.csn.es](http://www.csn.es). Registration requests received after September 15<sup>th</sup> 2009 will be accepted on a case-by-case basis depending on space availability at the workshop venue.

Registered participants wishing to present a paper at the Workshop should complete the Form for Submission of a Paper enclosed and send it electronically to [BUC-2009@csn.es](mailto:BUC-2009@csn.es) before May 15<sup>th</sup> 2009. The form can be downloaded from the web page [www.csn.es](http://www.csn.es). An abstract not exceeding 400 words should be included as an attachment to the email. The abstract should be prepared using MS-WORD. Times New Roman font 11 should be used for the text file, avoiding the use of local fonts.

Authors will be notified of the acceptance of their paper, including suggested changes or modifications, by June 30<sup>th</sup> 2009. The final version of the paper should be sent to [BUC-2009@csn.es](mailto:BUC-2009@csn.es) before September 15<sup>th</sup>, together with the completed Copyright Form. The slides to be used at the meeting should be sent to the same address before October 10<sup>th</sup>.

### ***8. EXPENDITURES AND GRANTS***

No registration fee will be charged to the participants.

As a general rule, the organization does not pay for participants' travel and living expenses. However, the International Atomic Energy Agency (IAEA) has limited funds available to help meet the cost of the attendance of selected specialists, mainly from developing countries with low economic resources. Selection preference will be given to applicants with an accepted contributed paper. Generally not more than one grant will be awarded to any one country.

To apply for a grant, please send the IAEA Grant Application Form (attached) through the competent national authority (Ministry of Foreign Affairs or national atomic energy authority) to reach the IAEA not later than April 1<sup>st</sup> 2009. The grants awarded will be in the form of a lump sum, usually covering part of the cost of attendance. Incomplete or late applications will not be considered.

### ***9. DISTRIBUTION OF DOCUMENTS AND PROCEEDINGS***

A preliminary conference programme will be sent to registered participants in July 2009, and will be made available at [www.csn.es](http://www.csn.es) at the same date. The final programme will be available upon registration at the workshop.

The proceedings will be published as soon as possible after the Conference.

### ***10. WORKING LANGUAGE***

The working language of the conference will be English.

### ***11. ACCOMMODATION***

A block of rooms has been reserved at the Hesperia Córdoba Hotel, where the meeting will be held. To secure your room, fill the Hotel Reservation Form enclosed and send it electronically to [srolan@viajesindigo.com](mailto:srolan@viajesindigo.com) before July 20<sup>th</sup> 2009. The form can be downloaded from the web page [www.csn.es](http://www.csn.es). Enquiries about other hotels or additional practical information, reservations, etc. should be directed to the same email address.

### ***12. VISA***

Participants who require a visa (Schengen visa) to enter Spain should submit the necessary application to the nearest diplomatic or consular representative of Spain as soon as possible. Please note that this process could take up to one month.

### **13. KEY DEADLINES**

- January 2009: Conference announcement.
- February: Opening of the electronic registration.  
The workshop announcement, the different formats for registration, submission of a paper and hotel reservation and practical information will be made available at [www.csn.es](http://www.csn.es) (lower right corner of the home page).
- May 15<sup>th</sup>: Electronic submission of abstracts by registered participants.  
Grant Application Form to be sent to the IAEA through the competent national authority of a Member State of the IAEA.
- June 30<sup>th</sup>: Notification of acceptance to authors.
- July: Workshop program drafted and communicated to registered participants, and published at [www.csn.es](http://www.csn.es).
- July 20<sup>th</sup>: Deadline for hotel reservation.
- September 15<sup>th</sup>: Deadline for submission of full papers and publication authorization (copyright form).Deadline for registration.
- October 10<sup>th</sup>: Deadline for submission of the slides to be used at the conference.

### **14. WORKSHOP COMMITTEES**

#### ***Organization Committee***

José M. Conde	CSN
Consuelo Alejano	CSN
Zvonko Lovasic	IAEA

#### ***Scientific Committee***

General Chairs:	Jens-Christian Neuber	AREVA
	José M. Conde	CSN