

# **Recent and Current Activities of the Working Group on Fuel Safety (NEA/CSNI)**

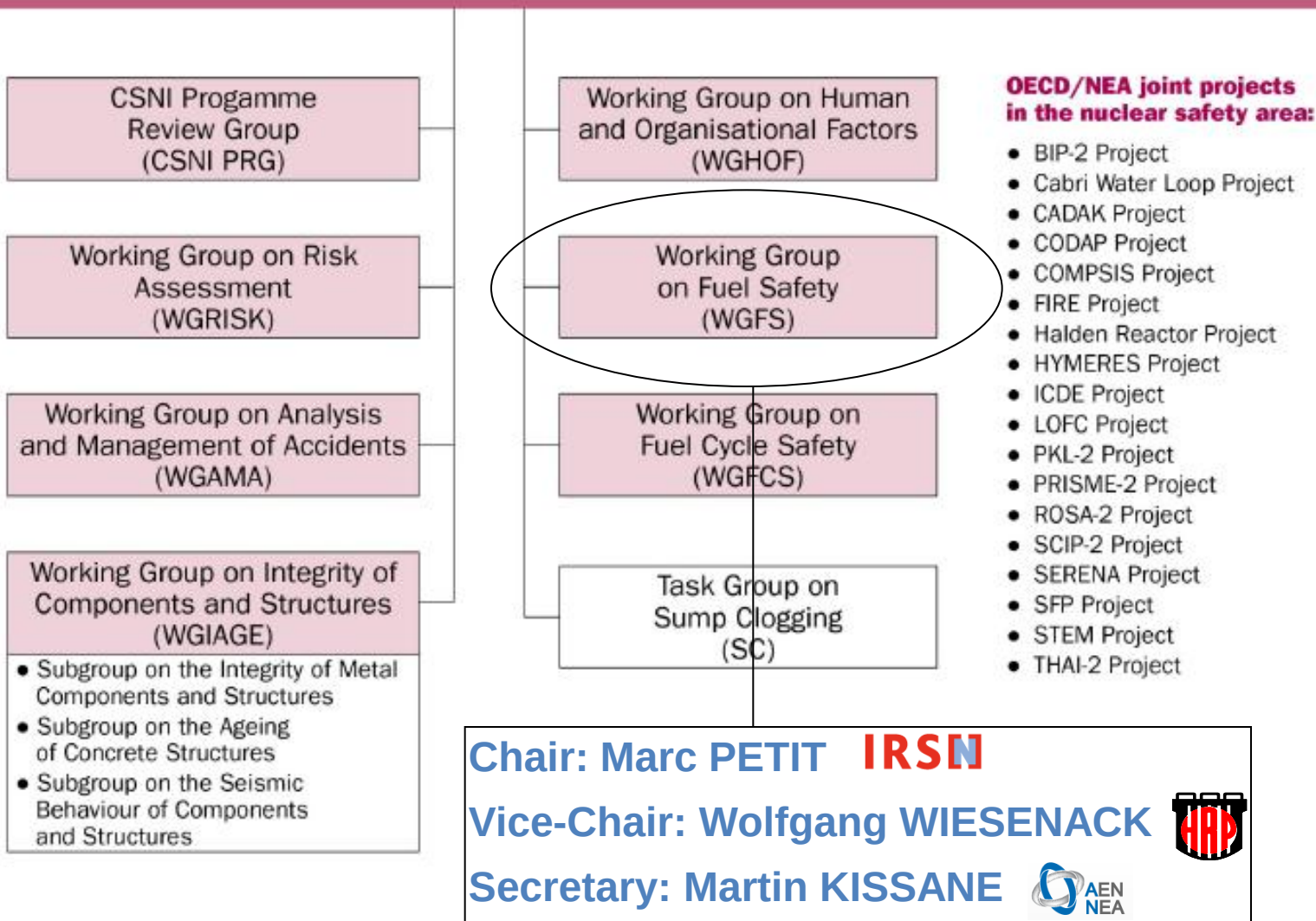
**Marc PETIT**  
**IRSN - France**

OECD/NEA/NSC/EGATFL meeting  
28 – 29 April, 2014  
NEA Headquarters, Issy-les-Moulineaux

## **This presentation will cover**

- ☐ The Working Group on Fuel Safety (WGFS)
- ☐ WGFS activities
- ☐ Conclusions

## Committee on the Safety of Nuclear Installations (CSNI)



## Excerpts from the mandate of the WGFS

- ▶ The main mission of the Working Group on Fuel Safety (WGFS) is to advance the current understanding and address safety issues related to fuel safety
  - ▶ Assess the technical basis for current safety criteria and their applicability to high burn-up (above 50 MWd/kg) and to new fuel designs and materials. ...
  - ▶ Determine needs and priorities for future research programmes in the area of fuel safety behaviour, with the aim of understanding and adequately modelling key phenomena and of quantifying safety margins.
  - ▶ Review from a safety point of view the adequacy of fuel codes and methodologies used for different core assessments as related to high burn-up fuel. ...
  - ▶ Provide a forum where safety-relevant fuel issues emerging from operating experience and research work can be addressed and resolved in an effective manner.

# Recent and current activities of the WGFS

- ▶ The most recent activities of the WGFS cover the following topics
  - ▶ Loss of Coolant Accidents (LOCA)
  - ▶ Reactivity Initiated Accidents (RIA)
  - ▶ Fuel Safety Criteria
  - ▶ Leaking fuel impacts and practices

Nuclear Safety

ISBN 978-92-64-99091-3

**Nuclear Fuel Behaviour in  
Loss-of-coolant Accident  
(LOCA) Conditions**

State-of-the-art Report

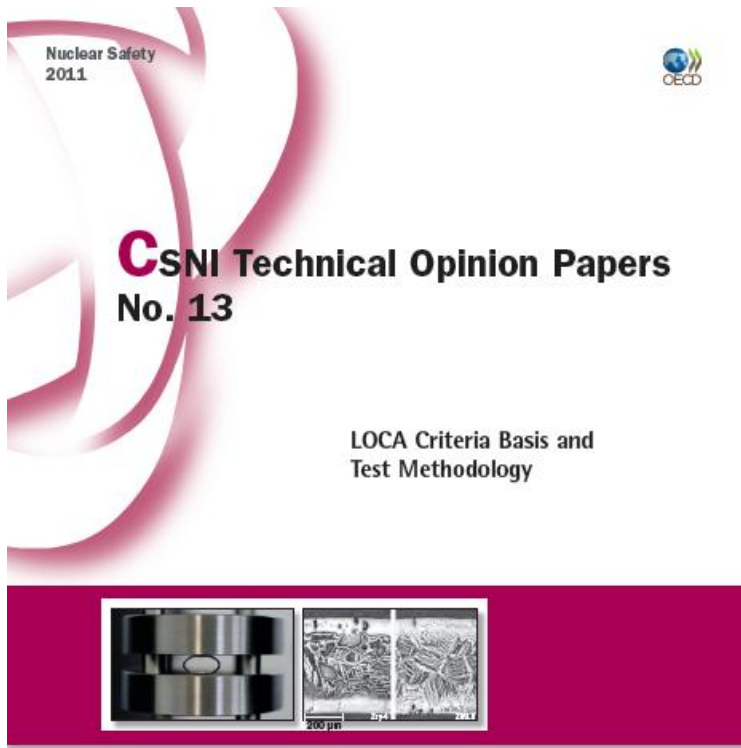
© OECD 2009  
NEA No. 6846

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

## LOCA State of the Art Report

- ▶ Everything you need to know about LOCA (and even more)
- ▶ NEA/CSNI/R(2009)15

## Other LOCA related documents



- ▶ LOCA Criteria Basis and Test Methodology

- ▶ NEA/CSNI/R(2011)7

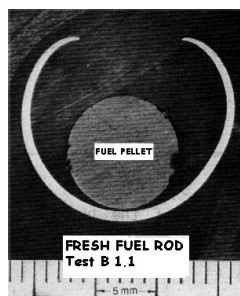
- ▶ Safety Significance of the Halden IFA-650 Test Results

- ▶ NEA/CSNI/R(2010)5

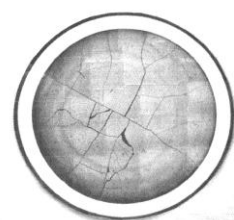
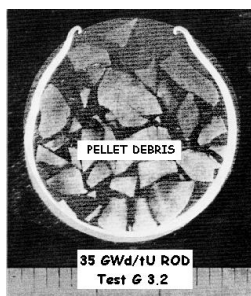
- ▶ The report discusses recent results on high burnup fuel showing fuel fragments dispersal out of the cladding under LOCA simulated conditions

## New LOCA activity

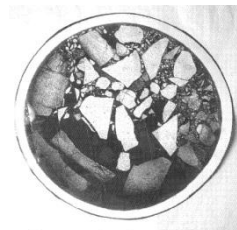
- ▶ Report on Fuel fragmentation, relocation and dispersal under LOCA conditions
- Fuel fragmentation and relocation under LOCA conditions has been consistently observed in different experiments



FR2; 35 GWJ/t



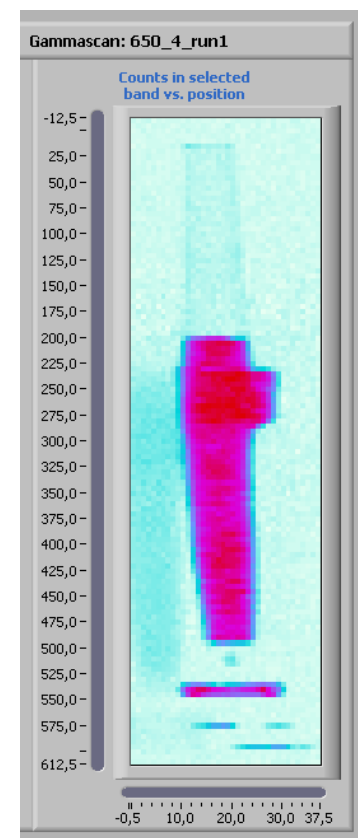
As-received Specimen:  
180 mm away from the LOCA sample



Post-test Specimen B:  
≈12 mm above the burst mid-plane  
Strain: 15% - 25%

ANL ; 55 GWJ/t

- Recent experiments in Halden as well as in Studsvik confirmed that the fuel may relocate in balloons but also showed that some amount of fuel may be dispersed out of the fuel rods at burst



Halden ; 90 GWJ/t



Nuclear Safety  
NEA/CSNI/R(2010)7  
November 2010  
[www.nea.fr](http://www.nea.fr)



## Nuclear Fuel Behaviour During Reactivity Initiated Accidents

Proceedings of a CSNI Workshop  
Paris, France  
9-11 September 2009



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RIA Workshop

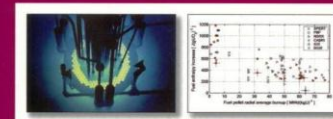
► NEA/CSNI/R(2010)7

Nuclear Safety  
2010



## Nuclear Fuel Behaviour under Reactivity-initiated Accident (RIA) Conditions

State-of-the-art Report

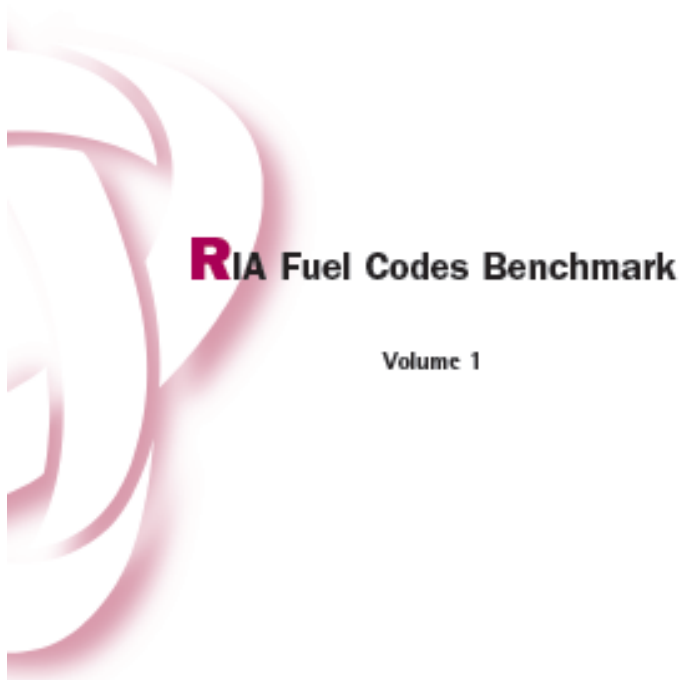


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RIA State of the Art

► NEA/CSNI/R(2010)1

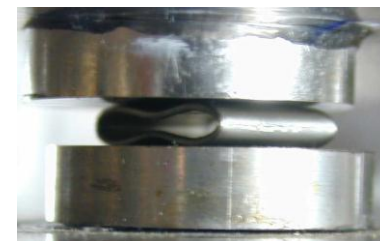
Nuclear Safety  
NEA/CSNI/R(2013)7  
November 2013  
www.oecd-nea.org



RIA Benchmark  
► NEA/CSNI/R(2013)7

## Executive summary

1. Background and introduction
  2. Cladding mechanical loading during **RIA**
  3. Description of existing methodologies
  4. Discussion of the different methodologies
  5. Recommendations regarding different methodologies
  6. Conclusions
- References

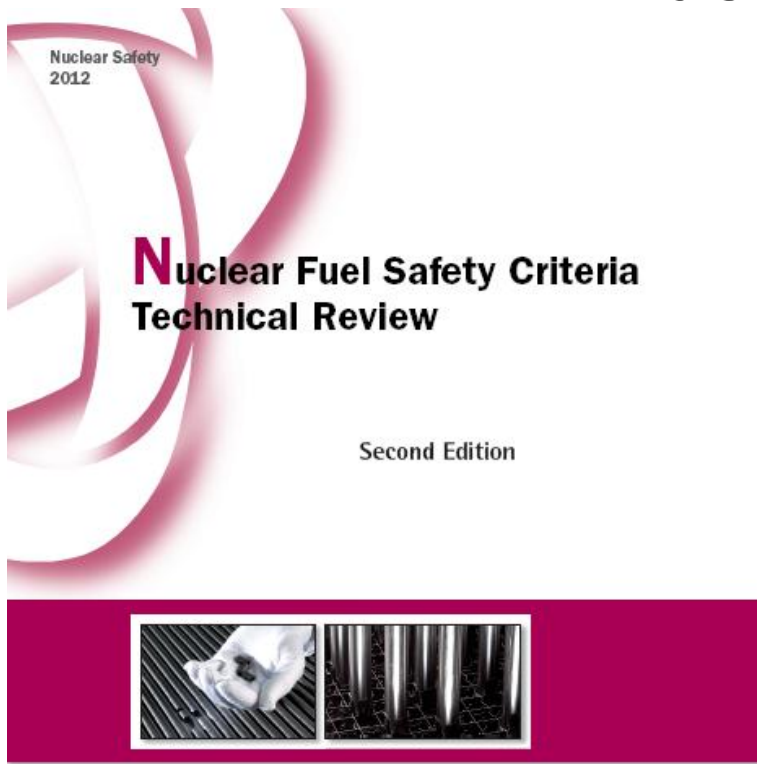


RIA Mechanical testing  
► Under final editing

## New RIA activity

- ▶ Second phase of the RIA benchmark
  - ▶ Make in-depth comparisons to substantiate the explanations for the discrepancies exhibit in Phase 1
  - ▶ Include sensitivity and uncertainty analyses to give a wider perspective on the result comparisons

## Fuel Safety Criteria



### ► Review of fuel safety criteria

#### ► NEA/CSNI/R(2012)3

► Although the criteria discussed in this report may not all be directly applicable to design different than the current ones for LWRs, this document is of interest because it compiles a list of phenomena to be addressed when assessing fuel safety

# Leaking fuel impact and practices (Final draft)

- ▶ Compares approaches in different countries
  1. Operation of NPP reactors with leaking fuel
  2. Identification of leaking fuel assemblies and fuel rods
  3. Consideration of leaking fuel in safety analyses on core behaviour during postulated accidents (LOCA, RIA and other transients)
  4. Storage of leaking fuel in the spent fuel pool (SFP)
  5. Activity release from leaking fuel during storage in the SFP
  6. Activity release from leaking fuel during manipulations in the SFP
  7. Transport and interim storage of leaking fuel assemblies
  8. Activity release from leaking fuel in interim storage facilities
  9. Hydrogen gas generation from leaking fuel in dry storage facilities and/or during transportation
  10. Reprocessing of leaking fuel rods
  11. Experimental investigations of leaking fuel

## Conclusions

- ▶ The WGFS is focused on safety aspects related to fuel, mostly for LWRs
- ▶ The WGFS is willing to interact more with other working groups of the NEA
- ▶ Innovative fuel concepts have been given more attention following the Fukushima accident
- ▶ Safety aspects have to be integrated early in the process of new fuel development because they induce important constraints
- ▶ The WGFS is open to discussion on its possible contribution to EGATFL tasks