

OECD/NEA Workshop on Accident Tolerant Fuels of LWRs

10-12 December 2012

NEA Headquarters

12 Boulevard des Iles, Issy-les-Moulineaux, France

Background

After the events at the Fukushima Nuclear Power Plant in Japan in March 2011, enhancing the accident tolerance of light water reactors (LWRs) became a topic of serious discussion. One outcome of those discussions has been to promote research into the development of advanced fuels and more robust reactor system technologies (e.g. instruments, auxiliary power sources) with improved performance, reliability and safety characteristics during normal operations and accident conditions. In this context, the OECD Nuclear Energy Agency (NEA) is organising an international workshop to share information and discuss technical and safety issues associated with the development of accident tolerant fuels for LWRs.

This workshop will be organised by the NEA Nuclear Science Committee (NSC), supported by the NEA Committee on Safety of Nuclear Installations (CSNI).

Objectives and Scope

The main objectives of the workshop are:

- Review lessons learned from the Fukushima accident and identify desired advanced fuel characteristics;
- Evaluate state-of-art of potential fuel/cladding candidates and related technical and regulatory issues;
- Discuss future programmes of work, international cooperation and the role of OECD/NEA.

The scope of the workshop is to create a forum for discussing the design and manufacturing of Accident Tolerant Fuels (ATF). The agenda includes a series of presentations by experts from various organisations, industry and regulatory bodies from the OECD/NEA member states as well as representatives of international bodies. The topics of the workshop will include technical and safety issues of developing accident tolerant fuel, such as:

- Lessons learned from the Fukushima accident
- Accident tolerant fuel design
 - Design requirements, potential options, R&D on new materials, modelling and simulation methods
- Issues and constraints
 - Reactor performance, reactor safety in normal/accident phase, DBA, auxiliary safety features, impact on fuel cycle including reprocessing, availability of testing facilities, economics, licensing and regulation issues, ranking of attributes, development/definition of metrics
- Future programmes of work

- Advanced modelling methods, international cooperation, role of international organisations, future works

The participants will also be given an opportunity of in-depth discussions through two breakout sessions covering:

- Safety and regulation issues;
- Scientific and engineering issues.

The main outcomes of those discussions will be carried forward to a final session which will aim to synthesise the information shared at the workshop and to discuss the key elements of future programmes of work.

Venue

The workshop will take place at **NEA Headquarters**. Local information about hotels and transport, as well as an area map, can be found on the Web page <http://www.oecd-nea.org/general/practical/>.

Due to the security policy of the OECD, you are kindly requested to report upon arrival to the Reception Desk on the ground floor with a photo ID. A badge will be issued that will allow you to enter the premises at all times during the meeting.

Registration and contacts

Registration was open until 9 November 2012 and is currently closed.

Information available on the NEA website:

<http://www.oecd-nea.org/science/wpfc/atf/atf2012/index.html>

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10 December 2012

9:00-9:40	NEA Welcome and introduction of the attendees	<i>(Th. DUJARDIN, NEA)</i>
9:40-9:55	Introduction and background	<i>(J. GULLIFORD, NEA)</i>
9:55-10:05	Objectives of the workshop	<i>(K. PASAMEHMETOGLU, INL, USA)</i>

Session 1: Lessons learned from the Fukushima accident

Chair: K. Pasamehmetoglu (INL, USA)

10:05-10:25	Current understanding of the sequence of events	<i>(J. GULLIFORD, NEA)</i>
10:25-10:45	Overview of fuel behaviour and core degradation, based on modelling analyses	<i>(S. MASSARA, NEA)</i>
10:45-11:00	Additional information (from recent workshops etc.)	<i>(K. PASAMEHMETOGLU, INL, USA)</i>
11:00-11:20	<i>Coffee break</i>	
11:20-11:40	Key regulatory and safety issues emerging, NEA activities	<i>(J. NAKOSKI, NEA)</i>
11:40-12:00	Recent and current activities of the OECD/NEA Working Group on Fuel Safety (NEA/CSNI)	<i>(M. PETIT, IRSN, France)</i>
12:00-12:10	Summary of the current status of the lessons learned from Fukushima	<i>(K. PASAMEHMETOGLU, INL, USA)</i>

Session 2: Accident tolerant fuel design

Chair: K. Pasamehmetoglu (INL, USA)

12:10-12:30	Overview of Accident Tolerant Fuel Development	<i>Frank GOLDNER (DoE, USA)</i>
12:30-14:00	<i>Buffet Lunch</i>	
14:00-14:20	Evaluation of potential alternative nuclear fuel cladding materials for LWRs applications with increased margins in LOCA and beyond LOCA conditions at CEA	<i>Marion LE FLEM, Aurore MICHAUX, Jean-Christophe BRACHET (CEA, France)</i>
14:20-14:40	Silicon carbide materials for LWR application: current status and issues	<i>Tatsuya HINOKI (Kyoto Univ., Japan)</i>
14:40-15:00	Development of advanced claddings for suppressing the hydrogen emission in the accident condition	<i>Jeong-Yong PARK (KAERI, Rep. of Korea)</i>
15:00-15:20	Accident tolerant control rod	<i>Hirokazu OHTA, Takashi SAWABE, Takanari OGATA (CRIEPI, Japan)</i>
15:20-15:40	Fully ceramic microencapsulated fuel design and irradiation testing	<i>Lance SNEAD (ORNL, USA)</i>
15:40-16:00	Development of LWR Fuels with enhanced accident tolerance	<i>James TULENKO, Ghatu SUBHASH (Univ. Florida, USA)</i>

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16:00-16:30	<i>Coffee break</i>
16:30-16:50	Enhanced accident tolerant fuel <i>John STRUMPELL (AREVA-NP, USA)</i>
16:50-17:10	Developments in silicon carbide cladding for nuclear applications <i>Christina BACK (General Atomic, USA)</i>
17:10-17:30	Suggestion of a novel failure tolerant fuel element <i>Manuel POUCHON (PSI, Switzerland)</i>
17:30-17:50	Engineered zircaloy cladding modifications for improved accident tolerance of LWR Fuel <i>Brent HEUSER (Univ. Illinois, USA)</i>
17:50-18:00	First Day Close-Out
18:00	Adjourn

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Session 3: Reactor operation, safety, fuel cycle constraints, economics & licensing

Chair: K. Pasamehmetoglu (INL, USA)

- 9:00-9:20 **Preliminary assessment of the impact of candidate accident tolerant fuels/cladding on the predicted reactor behavior at normal operating conditions and under DB (LOCA and RIA) and BDB (STSBO AND LTSBO) accident conditions**
Larry OTT (ORNL, USA)
- 9:20-9:40 **Fuel behaviour in severe accidents and potential ATF designs**
Bo CHENG (EPRI, USA)
- 9:40-10:00 **Safety of some fuel cladding materials, alternative to Zr alloys**
Georges HACHE, Bernard CLEMENT, Marc BARRACHIN (IRSN, France)
- 10:00-10:20 **Steam attack studies in SiC clad and advanced steel clad**
Kurt TERRANI, Lance SNEAD (ORNL, USA)
- 10:20-10:35 **Contributing to the design of accident tolerant fuels by applying the TRANSURANUS fuel performance code**
Paul VAN UFFELEN, A. SCHUBERT, V. DI MARCELLO, J. VAN DE LAAR (EC-JRC, EC)
- 10:35-10:50 **In-reactor testing capabilities at Halden relevant for ATF fuel**
Carlo VITANZA (OECD / Halden)
- 10.50-11:10 *Coffee break*
- 11:10-11:30 **Introducing a new type of fuel in EDF reactors: main issues**
Hing-Ip WONG, Marie MOATTI (EDF, France)
- 11:30-11:50 **Fuel licensing process for an industrial use**
Nicolas WAECKEL (EDF, France)
- 11.50-12:00 **Key items for discussion at break-out sessions** (NEA)
- 12:00-13:30 *Lunch break*
- 13:30 – 18:00 **Breakout discussions:**
- A. Safety issues**
- *Chair: Marc PETIT (IRSN, France)*
- *Rapporteur: Lars HALLSTADIUS (Westinghouse, Sweden) + NEA/CSNI Secretariat*
- B. Reactor performance, R&D and technology issues**
- *Chair: Larry OTT (ORNL, USA); Co-chair Mikhail VESHCHUNOV (IBRAE, Russian Fed.)*
- *Rapporteur: Nicolas WAECKEL (EDF, France) + NEA/NSC Secretariat*
- 18:00 *Adjourn*

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Session 4: Synthesis and future programmes

Chair: K. Pasamehmetoglu (INL, USA)

9:00-10:40	Report from breakout sessions and discussion:	
	A. Safety issues (30')	<i>(M. PETIT, IRSN)</i>
	B. Reactor performance, R&D and tech. issues (30')	<i>(L. OTT, ORNL)</i>
	Discussion (40')	
10:40-11:00	International collaboration for development of accident resistant LWR fuel <i>Andrew SOWDER (EPRI, USA)</i>	
11:00-11:20	<i>Coffee break</i>	
11:20-12:45	Synthesis of reports and elements for a roadmap	<i>(Chairs of the Workshop)</i>
	• Need for development of advanced modelling methods, experimental needs • Collaboration and future programmes of work • Role of international organisations	
12:45-13:00	Concluding remarks	<i>(NEA)</i>
13:00	Adjourn	