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**English text only**

**NUCLEAR ENERGY AGENCY  
COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS**

## **Working Group on Fuel Safety**

### **Summary Record of the 14th Working Group on Fuel Safety Plenary Meeting**

**OECD Conference Centre, Paris, France  
10-11 September 2013**

**JT03365101**

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**SUMMARY RECORD OF THE 14<sup>th</sup> WORKING GROUP ON FUEL SAFETY  
PLENARY MEETING**

OECD Conference Centre, Paris, France, 10 - 11 September 2013

The fourteenth (14<sup>th</sup>) meeting of Working Group on Fuel Safety (WGFS) took place on 10 and 11 September 2013 at the Nuclear Energy Agency Headquarters, Issy-les-Moulineaux, France. The following is a summary record of the meeting. All presentations and documents discussed in the meeting were uploaded into the WGFS member's area in the NEA web site: <http://www.oecd-nea.org/download/wgfs/index.html>.

**Opening:**

**1. Opening of the meeting and introductions of new participants**

The meeting was opened by *Mr. Marc Petit (IRSN)* as the WGFS chair, and then he welcomed Mr. Javier Reig, NEA Nuclear Safety Division (NSD) Head, to give a welcome address.

*Mr. Javier Reig* started with the report on the Fukushima Daiichi Nuclear Accident: OECD/NEA Nuclear Safety Response and Lessons Learnt, which was about to be published and which summarised the accident and NEA post-Fukushima activities. Then he mentioned the importance of new tasks for the group and encouraged the group interest in the Jules Horowitz International Programme and informed about upcoming personnel changes in NSD.

The round-table introduction of the WGFS members followed. The following regrets of absence were received by the NEA Secretariat: Patrick Raynaud (NRC) replaced by Richard Lee, Winfried Beck (AREVA) replaced by Martin Sperlich, Clive Ingram (ONR) replaced by John Jones, Christian Bernaudat (EDF) replaced by Farida Khattout, Michel Couture (CNSC) replaced by Ho Chun Suk and Olga Nechaeva (VNIINM).

There were a few WGFS members who left the group: John Voglewede (NRC), Dietmar Märtens (TÜV), and Ian Wilson (ONR), whose work was acknowledge by the WGFS chair and members.

New WGFS members nominated since the 13<sup>th</sup> plenary meeting were: Bharat Patel (EC), Juraj Rovny (SE, a.s., Slovakia), Clive Ingram (ONR, UK) replaced Ian Wilson, Anna Alvestav (SSM, Sweden), Gerold Spykman (TÜV) replaced Dietmar Märtens, Patrick Raynaud (NRC) replaced John Voglewede.

As visitors participating in the meeting: Seppo Tarkiainen (FORTUM), Christian Gonnier (CEA), Veronique Lhomme (IRSN), Andreas Verst (TÜV).

The list of participants is attached to these minutes (Appendix 1).

**2. Adoption of the Agenda [[NEA/SEN/SIN/FUEL/A\(2013\)1](#)]**

The Agenda was unanimously adopted, but the Chair noted that the order of some of the items may be changed over the course of the meeting. A simplified agenda is attached as Appendix 2.

### 3. Approval of Summary Record of the 13<sup>th</sup> Meeting of WGFS [[NEA/SEN/SIN/FUEL\(2013\)1](#)]

The summary record of the 13<sup>th</sup> WGFS meeting was approved without any additional comments.

#### NEA activities and recent meetings including a brief situation report with selected WGFS tasks:

#### 4. Report by NEA Secretariat

*The NEA Secretariat* informed about OECD/NEA membership, personnel changes at the NEA/Nuclear Safety Division, status of the WGFS actions of the last meeting, and how the publishing of the WGFS documents is going.

*The NEA Secretariat* reviewed the list of actions of the 13<sup>th</sup> meeting of the WGFS. All the actions were either completed or ready for discussion under different items of the agenda. The status of all Actions is shown in Appendix 3.

Concerning the *Action 13-1*, *Mr. Ho Chun SUK* (CNSC) provided an update on the CANDU Fuel Safety Criteria Technical Review – Status in Canada. *Mr. Suk* informed the meeting that it was planned to base the CSNI report on CANDU Fuel Safety Criteria on the report of the CANDU Owners' Group, which will conclude their effort in the area. The group agreed that a yearly update on this activity should be given by a CSNC representative at the WGFS plenary meetings. (*Action 14-1*)

#### 5. Report by the WGFS Chair

*Mr. Petit* as WGFS chair informed the meeting about the WGFS tasks time schedule and also the tasks current status. He underlined those that will be discussed under different Agenda items such as leaking fuel or new task proposals. Cooperation with other NEA bodies was mentioned as playing an important role in the group's activities, and examples such as the workshop on long-term interim storage facilities or the Status Report on Spent Fuel Pool (SFP) under loss of cooling accident conditions were brought to the participants' attention.

He recalled that the WGFS Integrated Plan has been kept alive by co-operation of the Chair and the Secretariat. Updates have been done regularly after CSNI meetings and posted on the WGFS members' area (<http://www.oecd-nea.org/download/wgfs/>).

*Mr. Petit* further informed about the CSNI meetings in December 2012 and June 2013. The WGFS chair reported only to the December 2012 CSNI meeting where he gave an overview of the group's activities. The Group submitted for approval the mechanical testing of fuel cladding for RIA applications in December 2012, which was approved by CSNI, and he reminded the members about still-missing permissions required by the NEA to publish copyrighted material. Additionally in June 2013, the report on RIA fuel rod codes benchmark was approved by the CSNI.

#### Detailed discussion of selected WGFS tasks:

#### 6. Task on Leaking fuel impacts and practices: status of the report, results of the preparatory meeting discussion

*Mr. Zoltan Hozer* (MTA EK), the task leader, recalled first the whole history of the initiation of the task, which was approved by CSNI in June 2012, and its main objective as to promote a better understanding of the handling of leaking fuel in power reactors. He appreciated the members' involvement in responding to the questionnaire. Contributions were provided by 15 countries with 26 sets of answers, and different reactor types were included, viz.: PWR, BWR, VVER, CANDU, PHWR.

Although the report has progressed very well and went through thorough review by members and also by all contributors, it was agreed that another half a year would be needed to finish the report, mainly to clarify the following issues by the end of 2013 (*Action 14-2*):

- EDF and AREVA representatives in the meeting agreed to find out the source of information given by Mr. Katsuichiro Kamimura that according to McGraw Hill in Nuclear Fuel (Vol. 34, No. 12, June 2009) more hydrogen gas in casks with leaking fuel was found than expected.
- Japanese representatives in the meeting were asked to elaborate the part of the report concerning regulation of leaking fuel.

Afterwards, an updated version will be ready for members' review by 28 February 2014, members will comment by 15 March 2014, and CSNI submittal must be ready by 15 April 2014. (*Action 14-3*)

Additionally, two topics were found as potential follow-ups once the task will be finished:

- a benchmark exercise, where the role of leakers in accident conditions would be evaluated.
- an information-exchange meeting on the techniques applied to handle leaking fuel assemblies in co-operation with IAEA.

What the benchmark exercise will be about should be specified in a White Paper which would define goals, scope and other objectives of the task by 28 February 2014. It will then be discussed further during the 2014 WGFS interim meeting. Once this is ready, it will be used for a survey of interest in the benchmark. (*Action 14-4*)

In connection with the second potential topic, Messieurs Zoltan Hozer, Marc Petit and the NEA secretariat were asked to contact the IAEA about the possibility of holding an information-exchange meeting on techniques applied to handling leaking fuel assemblies and rods, which would aim to find optimal solutions. (*Action 14-5*)

## **7. New proposed Task on RIA fuel rod codes benchmark follow up. New CAPS proposal review and discussion**

*Mr. Petit* started the presentation saying that the new task should be a follow-up of the RIA benchmark just finished with a report, which was approved by CSNI in June 2013, and should mostly focus on the report's main recommendations such as to compare the differences in modelling of the concerned phenomena, and on the assessment of the uncertainty of the results.

A CAPS was circulating for comments in advance of the meeting, and a new version was issued for the members' final review. As there were no further comments, the CAPS was endorsed by the Group. The members were asked to express their intention to participate in the task and the secretariat to finalise the CAPS such that it could be sent for the last check by 30 September, and then submitted for CSNI approval in December 2013. (*Action 14-6*)

## **8. Fuel fragmentation, fuel relocation and fuel dispersal during LOCA**

### **8.1 New proposed Task: CAPS review and discussion**

The WGFS interim meeting in 2013 decided to put forward a new task proposal on fuel fragmentation, fuel relocation and fuel dispersal during LOCA. Mr. Heinz-Günther Sonnenburg (GRS) agreed to draft a CAPS proposal. *Mr. Sonnenburg* reported that two versions of the CAPS were circulated

in the group for comments. He presented synopses of all comments received on the second version of the CAPS and went through the main questions to be resolved in the meeting.

After discussion of all main issues, it was decided that RIA would not be included in the task and that a State-of-the-art-report could be a final product. The group agreed that the CAPS will be redrafted and sent for review to the WGFS by 30 September 2013. Comments are due not later than 15 October, and the final version will be submitted for the CSNI approval in December 2013. (*Action 14-7*)

## **8.2 Presentation on how much fuel can be allowed to be released from the fuel rod without risking re-criticality**

*Mr. Andreas Verst (TÜV SÜD)* presented results of his study on the amount of nuclear fuel which can be allowed to be released from the fuel rod without risking re-criticality after LOCA. He started with presenting the computer code used in the study (SCALE) and went through the state of the core after LOCA and how its geometry is represented in a simplified model for calculations. He then commented the results obtained. He concluded his presentation by saying that the composition of free pellets together with intact fuel rods is unknown. For modelling of the composition, a hemisphere at the bottom of the reactor core is assumed with an optimally moderated hexagonal moderator-fuel pellet space lattice. In this calculation model, criticality is reached when about 1% of the pellets are set free.

In the following discussion, the meeting's participants stated that calculations with smaller particles would go to lower numbers, as there will be less moderator, but this was not calculated in detail. Finishing this item, *Mr. Petit* acknowledged *Mr. Verst's* effort and willingness to inform the group about this study.

## **9. Task on safety of long-term interim storage facilities: status of the workshop preparation.**

*Ms. Veronique Lhomme (IRSN)* of the Working Group on Fuel Cycle Safety (WGFCs) informed the meeting about the international workshop on Safety of long-term interim storage facilities, which was held in cooperation with WGFS and other NEA and international bodies in Munich in May 2013. The workshop was very well attended with more than 90 participants, who were given 29 technical presentations on topics such as national approaches for long-term interim storages facilities, safety requirements, regulatory framework & implementation issues, technical issues & operational experience, and needs for R&D.

*Ms. Lhomme* concluded that the range of 50 to 100 years of interim storage, and even longer, is being discussed. This has entailed a lot of unknown issues, for example the way of storage or data gaps for long-term behaviour of fuel rods and fuel cladding in particular for high burn-up and MOX fuels. Additional data for validation of computer codes for analysing fuel rod performance under storage conditions should be provided.

The participants then raised question mainly about the need for code validation, if the codes being in question were specified, and what kind of data would be required. *Ms. Lhomme* recommended reading all workshop documents including a summary, which was prepared and will be sent also to the WGFS members for review.

## **10. Task on Spent Fuel Pool (SFP) under loss of cooling accident conditions: status report preparation.**

*Mr. Petit* reported about the status of the task on the Status Report on Spent Fuel Pool (SFP) under loss of cooling accident conditions on behalf of Nicolas Trégourès (IRSN), the leader of the task. The task is a common WGFS-WGAMA activity with participation of a good number of WGFS members. The objective of the activity is to produce a Status Report which will present the SPF possible accident

scenarios, the accident phenomenology, assess the current experimental and analytical knowledge, discuss the mitigation strategies, and contribute to the post-Fukushima Daiichi accident decision-making process.

A kick-off meeting was held which agreed on the contents of the report and the chapters' main contributors. The report was drafted but still a lot of effort will be needed to make it well balanced and ready to go forward for CSNI approval in December 2014. The second task group meeting was planned for October 2013.

#### **11. Task on Sump clogging: Downstream effect findings, web portal**

On the group's request, *Mr. Seppo Tarkiainen (Fortum)* presented the final report on Updated Knowledge Base for Long Term Core Cooling Reliability, which was the final product of the work of the CSNI task group on Sump Clogging, which was created with WGFS contribution. *Mr. Tarkiainen* focused his presentation on Downstream Effects part of the task. He started with basic characteristics of the downstream effects and continued through different examples of flow schemes inside the PWR pressure-vessel fuel spacers blockages. Concluding, he underlined that the downstream effects issue was identified in recent years as an important subject because relatively small amounts of debris captured by the fuel assemblies can have a drastic impact on thermal hydraulics in the core in post-LOCA conditions.

There were a few questions concerning possible future directions of the topic, and the item was closed by Mr. Petit's appreciation of Mr. Tarkiainen's effort and willingness to inform the group about the task's results.

#### **12. Future activities: further discussion of the query about potential topics results**

*Mr. Petit* recalled that the WGFS plenary 2012 meeting discussed widely potential future activities and that based on this discussion Mr. Wolfgang Wiesenack (IFE) prepared a list of topics of interest. The list was sent to the members for rating of their priorities. The results of this rating process were presented at the WGFS 2013 interim meeting, and the group took forward three topics. Related proposals were reviewed under items 7 and 8 of this meeting. After the interim meeting, an additional list of activities was distributed for additional rating, but there was not a lot of response. The total list of topics with their ranking is given in the Appendix 4.

A discussion afterward brought a few more proposals, but it was decided that for the time being the list as well as the new proposals raised in the meeting would be put on standby, and the group will discuss it again in one year's time, as for now the group should mainly focus on appropriate preparation of the new tasks mentioned above.

### **NEA Projects**

#### **13. Jules Horowitz International Programme: new objectives, scope, time schedule, financing**

*Mr. Christian Gonnier (CEA)* gave this presentation on behalf of Mr. Gilles Bignan. First *Mr. Gonnier* recalled scientific consensus achieved at an expert meeting in 2010 that favoured focusing the research programme on two topics dealing with the LOCA:

- metallurgical analysis of post-LOCA cladding.
- source-term analysis using a LOCA test of HBU and MOX fuels.

The proposal discussed during the previous meetings was based on these topics, and a 3-year project duration was proposed, but it was found difficult to balance the budget of the project. This is why the project technical programme proposal was modified and adapted in order to include the needs which could

arise from the latest results and latest information in the nuclear activities, still remaining in field of the LOCA studies. Today's proposal has three parts:

- experimentation dedicated to fuel micro-structure evolution (possible fuel fragmentation) and FP releases in a LOCA transient.
- metallurgical cladding characterization (sample subjected to a LOCA transient).
- joint analytical work for the definition of study needs and potential JHR LOCA test programme addressing safety issues.

He elaborated each topic in more details and concluded that this so-called JHIP phase 1 has to be seen as a scientific phase to have early feedback and guide preparing future experiments in the Jules Horowitz Reactor. Now the project kick-off meeting is targeted for mid-2014 and the project is planned for the period 2015–18.

The WGFS members appreciated this third in a row information about the project preparation progress and expressed that more information would be needed concerning the third topic in the proposal as this is totally new.

#### **14. Studsvik Cladding Integrity Project (SCIP) 2 overview and SCIP 3 proposal: achievements and new plans**

*Mr. Francesco Corleoni (Studsvik)* presented an overview of the Studsvik Cladding Integrity Project (SCIP), where 13 countries are participating. The project started in 2004. Since 2009, another five-year extension of the project has been going on. While SCIP I (2004–09) was focused on cladding integrity at high burn-up, SCIP II is focused on pellet properties at high burn-up. *Mr. Corleoni* described in detail the four SCIP II tasks and some of their results, and added some examples of examination techniques to measure pellet chemical properties or to perform parametric studies of the PCI behaviour.

Then *Ms. Pia Tejlund (Studsvik)* gave a technical presentation on advanced microscopy and achievements within SCIP II.

The item was finished by *Mr. Corleoni* informing the meeting about the preparation of the third phase of the SCIP project. The so-called SCIP III (fuel performance in transients) has been planned for the period 2014–19. It should be oriented towards LOCA and high temperature behaviour, PCMI and PCI, and modelling. The programme's review by the member countries should be finished in October 2013, the contracts should be signed in March 2014, and the project's kick-off meeting is planned in June 2014 in conjunction with the final SCIP II meeting.

Questions were asked mainly about more technical details of the programme. It was underlined that close co-operation with Halden would be appreciated in the area of ballooned fuel behaviour. The WGFS members were encouraged to ask the SCIP project directly for more details in a timely manner, if they are also SCIP project members.

#### **Information exchange:**

#### **15. Accident tolerant fuel designs: Workshop December 2012 follow up**

*Mr. Simone Massara (NEA)* informed the meeting about the workshop on Accident Tolerant Fuel which was organised by the Nuclear Science Committee (NSC) with the support of the Committee on the Safety of Nuclear Installations (CSNI), and where some WGFS members actively participated. After providing the workshop's background, objectives, programme and attendance, main findings and

conclusions, he focused on future steps. An important role should be played by a meeting with key players to be organized in October 2013 by the NEA. The main goal of this meeting is to define a programme and road map of the activity, define the role of the NEA and also identify all interested organisations which would intend to participate. *Mr. Massara* concluded his presentation inviting WGFS members to further co-operation on this task. *Mr. Petit* confirmed WGFS permanent interest and participation.

#### **16. Overview of EGRFP activities**

*Mr. Akifumi Yamaji (NEA)* gave an update on Expert Group on Reactor Fuel Performance (EGRFP) under NSC Working Party on Scientific Issues of Reactor Systems (WPRS); an overview of the International Fuel Performance Experiment (IFPE) Database was included together with information that the EGRFP was preparing an update of the Review of Nuclear Fuel Experimental Data from 1995. *Mr. Yamaji* concluded the presentation by mentioning many links with other groups' activities including WGFS.

*Mr. Petit* underlined that the contacts with EGRFP and also other NSC groups will certainly continue, and exchange of information such as given today would be a regular part of it. *Mr. Yamaji* was asked to include some extract of useful elements of the IFPE database in the next presentation, which could be of WGFS use for benchmark tasks. (*Action 14-8*)

#### **17. Significant Events**

Nothing reported. AREVA and EDF representatives were asked to report on 14-foot assemblies bowing in the next meeting. (*Action 14-9*)

#### **18. HRP, CIP, SFP, and national news**

*Mr. Wolfgang Wiesenack (IFE)* briefed the meeting on the news from the Halden Reactor Project (HRP). There was a summer school held as usual in August. The theme was principles of fuel behaviour modelling and practical applications. The summer school was very well attended with 40 participants from outside the Halden Reactor Project, and lectures were given by some WGFS members as well. Shortly after the school a workshop on data uncertainties in experiments and modelling was organised by Halden staff, where experienced participants discussed their needs to know the uncertainties of key data for fuel modelling code applications and discuss their influence on calculated results.

*Mr. Marc Petit* brought to the members' attention the main highlights of the CABRI Water Loop International Programme (CIP) between September 2012 and September 2013. The CABRI reactor core refuelling was completed, and the commissioning tests were under way. Mostly all requested seismic reinforcement was carried out. The first test with water loop, the so called CIPQ test, should be performed in late 2015. The CIP Technical Advisory meeting was organised back to back with the WGFS meeting.

*Mr. Richard Lee (NRC)* gave an update of the SFP project status. He mainly focused on the scope of phase I and phase II testing and results, and phase II results were presented for the first time in the WGFS meeting. The tests were associated with pre-test and post-test code-to-data comparison to assure code adequacy. He mentioned a concluding seminar open to SFP member countries to be held in October 2013.

After the presentation, a question was asked about the status of the potential follow-up of the project as evaluated a year ago; *Mr. Lee* responded that further discussion and some calculations of the potential follow up are carried out inside the NRC and no decision was made yet.



A round table country information exchange was carried out afterwards. Contributions submitted in writing (Finland and Slovak Republic) were distributed with the meeting documents.

## General Issues:

### 19. WGFS mandate review

The WGFS mandate was distributed for comments in advance of the meeting. There were no comments received before or during the meeting. The mandate was endorsed with the same wording as was valid for the previous three-year period.

## Wrap-up and future planning:

### 20. Summary of WGFS future activities and next meetings

- *Action 14-1:* The group agreed that a yearly update on the CANDU Fuel Safety Criteria Technical Review should be given by a CSNC representative in the WGFS plenary meetings.
- *Action 14-2:* The group agreed that another half a year would be needed to finish the report on leaking fuel impacts and practices, and mainly to clarify the following issues by the end of 2013:
  - EDF and AREVA representatives in the meeting agreed to find out the source of information given by Mr. Katsuichiro Kamimura (JNES) that according to McGraw Hill in Nuclear Fuel (Vol. 34, No. 12, June 2009) more hydrogen gas in casks with leaking fuel was found than expected,
  - Japanese representatives in the meeting were asked to elaborate the part of the report concerning regulation of leaking fuel.
- *Action 14-3:* An updated version of the report on Leaking fuel impacts and practices will be ready for members' review by 28 February 2014, members will comment by 15 March 2014, and submittal for CSNI approval must be ready by 15 April 2014.
- *Action 14-4:* A benchmark exercise, where the role of leaking rods in accident conditions would be evaluated, should be specified in a White Paper which would define the goals, scope and other objectives of the task by 28 February 2014 and then be discussed further during the 2014 WGFS interim meeting. Once this is ready, it will be used for a survey of interest in the benchmark.
- *Action 14-5:* Messieurs Zoltan Hozer, Marc Petit and the NEA secretariat were asked to contact the IAEA about the possibility of holding an information-exchange meeting on techniques applied to handle leaking fuel assemblies and rods which would aim to find optimal solutions.
- *Action 14-6:* The CAPS on RIA fuel rod codes benchmark was endorsed by the Group. The members were asked to express their intention to participate in the task and the Secretariat to finalise the CAPS which should be sent for a final check by 30 September and then submitted for CSNI approval in December 2013.
- *Action 14-7:* The group agreed that the CAPS on fuel fragmentation, fuel relocation and fuel dispersal during LOCA will be redrafted and sent for review to the WGFS by 30 September 2013 with comments due by 15 October, and the final version be submitted for CSNI approval in December 2013.
- *Action 14-8:* The NEA secretariat was asked to include in the agenda of the next WGFS plenary meeting information about EGRFP activities, and remind Mr. Yamaji to include in the next presentation some extract of useful elements of the IFPE database which could be of WGFS use for benchmark tasks.

- Action 14-9: AREVA and EDF representatives were asked to report on 14-foot assemblies bowing in the next meeting under agenda item Significant Events.

The next WGFS meeting will be held from 29 September to 2 October 2014 in conjunction with the CABRI TAG meeting. More information will be distributed in due course. There is an intention to continue organising a WGFS interim meeting also in 2014, but no final decision about a date and a place was taken.

## **21. Closure of the Meeting**

The *Chair* thanked the WGFS members for their active participation. The group members and the Secretariat expressed strong appreciation to Mr. Petit for his chairing of the meeting. With this the meeting was closed.

**APPENDIX 1  
LIST OF PARTICIPANTS**

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## APPENDIX 2

### AGENDA

#### Opening:

1. Opening of the meeting. Introductions of new participants.
2. Adoption of the Agenda [[NEA/SEN/SIN/FUEL/A\(2013\)1](#)].
3. Approval of Summary Record of the 13<sup>th</sup> Plenary Meeting of WGFS [[NEA/SEN/SIN/FUEL\(2013\)1](#)].

#### NEA activities and recent meetings including a brief situation report with selected WGFS tasks:

4. Report by NEA Secretariat.
5. Report by the WGFS Chair.

#### Detailed discussion about selected WGFS tasks:

6. Task on Leaking fuel impacts and practices: status of the report, results of the preparatory meeting discussion.
7. New proposed Task on RIA fuel rod codes benchmark follow up. New CAPS proposal review and discussion.
8. Fuel fragmentation, fuel relocation and fuel dispersal during LOCA.
  - 8.1. New proposed Task: CAPS review and discussion.
  - 8.2. Presentation on How much fuel can be allowed to be released from the fuel rod without risking re-criticality.
9. Task on Safety of long term interim storage facilities: the workshop results and WGFS steps further.
10. Task on Spent Fuel Pool (SFP) under loss of cooling accident conditions: Status report preparation.
11. Task on Sump clogging: Downstream effect findings, web portal.
12. Future activities: further discussion of the query about potential topics results.

#### NEA Projects

13. Jules Horowitz International Programme: new objectives, scope, time schedule, financing.
14. Studsvik Cladding Integrity Project (SCIP) 2 overview and SCIP 3 proposal: achievements and new plans.

#### Information exchange:

15. Accident tolerant fuel designs: Workshop December 2012 follow up.
16. Overview of EGRFP activities.
17. Significant Events - discussion about selected events, tests and analysis techniques.
18. HRP, CIP, SFP, IAEA and national news.

#### General Issues

19. WGFS mandate review.

**Wrap-up and future planning:**

20. Summary of WGFS future activities and next meetings.
21. Closure of the Meeting.

### APPENDIX 3 WGFS13 ACTIONS

Action 13-1: The NEA secretariat will contact CNSC representative in the WGFS, and will figure out the status of the Technical Review Plan for the CANDU Fuel Safety Criteria review by CSNC and also their participation in the leaking fuel task.

*Status:* The CNSC was contacted in January 2013. Information about Safety criteria task status was provided that the CANDU Owner Group (COG) Inc had approved a project (COG-WP # 20326) whose output, at the time of completion, would be used as input to an eventual NEA document on CANDU fuel safety criteria. A meeting between the CNSC and members of the COG to discuss the overall project, including the NEA project, took part in July 2013. CNSC representative gave an update in the meeting and a new **Action 14-1** was accepted.

Canadian industry responded to the Leaking fuel questionnaire and merged Canadian response was received in early July 2013, and they were included in the report version 1 in August 2013. **Carried out.**

Action 13-2: The group agreed to postpone completing the report on RIA fuel code benchmark to Spring 2013, with the goal to submit it for CSNI approval in June 2013. The following steps to fulfil this goal were accepted:

- a) Proposed inputs should be provided by the participants by 15 November 2012.
- b) A complete draft of the final report will be issued by the end of January 2013.
- c) The draft will be reviewed by participants and WGFS members in February and March 2013.
- d) Final document to be submitted to PRG in April 2013.

*Status:* The report distributed for members' review in April 2013, and then submitted to PRG for endorsement. PRG asked to include in the report as follows:

- Explanation for a large scatter of cladding temperatures;
- Reasoning for large differences in enthalpy at failure;
- A more detailed discussion of the “temperature effect”, as this was one of the main objectives of the task.

Based on a teleconference with a PRG representative, and a discussion in the WGFS interim meeting the report was revised. New version was endorsed by the PRG and later approved by CSNI. **Carried out.**

Action 13-3: The RIA fuel code benchmark report will be published in two volumes, where the second one will contain all detail calculation results. Volume II should be ready by the end of June 2013.

*Status:* Volume II prepared by IRSN. CDs or/and webpage link to the published report will be prepared. **On going.**

Action 13-4: The group reviewed the report on Mechanical testing of fuel cladding for RIA applications and confirmed that, when additional comments and contributions are accommodated that:

- a) A new draft will be issued by end of September 2012, containing the executive summary;
- b) Members' comments should be provided by 15 October 2012; and
- c) Report to be submitted to PRG by 22 October 2012.

*Status:* The report was completed, approved by CSNI in December 2012. **Carried out.**

Action 13-5: Most of the WGFS member countries confirmed their willingness to contribute to the task on Leaking fuel impacts and practices, and agreed to response to the questionnaire by the end of November 2012. An evaluation of collected data should be presented in WGFS 2013 Interim meeting; and a report on the results of the task should be ready for discussion in the WGFS plenary meeting in September 2013.

*Status: The responses were collected by the end of January 2013. A draft of the report was distributed to the WGFS members for comments by 15 June 2013. The comments have been expected by 15 August 2013. Canadian contribution was received in early July. First draft reviewed, second version was distributed in advance to the WGFS meeting to be discussed there. **Carried out.***

Action 13-6: The members were asked to indicate by email to the NEA secretariat their intention to participate in the task on State-of-the-art report (SOAR) on Spent Fuel Pool (SFP) and assembly handling accident phenomenology and mitigation strategies by 15 October 2013.

*Status: The nomination was finished after the CSNI approval in December, when CSNI changed the SOAR on status report. Their representatives were nominated. **Carried out.***

Action 13-7: The Group agreed to merge similar or overlapping potential future tasks proposed in the plenary meeting and to relate them to the Group's mandate and CSNI expectations regarding the Group's products. The list of proposals will then be distributed for further comments and proposals from which to agree on new activities. The further steps were agreed as follows:

- a) A questionnaire based on discussed topics will be prepared by Wolfgang Wiesenack in cooperation with Marc Petit and NEA secretariat by the end of September 2012;
- b) WGFS members will provide their preferences by the end of 2012;
- c) A topic ranking will be ready for the interim meeting preliminary discussion, when how to proceed with selected proposals to WGFS 2013 plenary meeting will be outlined.

*Status: The preferences were received from 18 countries/organisations. The responses were summarised in a table, which were discussed in the interim meeting. The top three topics were as follows: **Assessment of Fuel fragmentation and relocation during the LOCA, Fuel dispersal, and (High burnup) Fuel rod behaviour during long term storage and transportation.** The meeting decided to merge the first two in one and start to prepare a CAPS for this. Additional proposals were distributed for rating and results of both runs were merged and will be discussed in the WGFS meeting in September 2013. **Carried out.***

Action 13-8: The chair of the group together with the NEA secretariat were tasked to find appropriate date to organise WGFS 2013 Interim meeting.

*Status: The meeting was held on 17 May 2013, when big portion of the group participated through a MegaMeeting webcast. **Carried out.***

### WGFS 2013 Interim Actions

**Action II3-1:** WGFS interim meeting agreed that the report on RIA fuel code benchmark should be sent for the CSNI approval in June 2013, when before it should be updated as requested by the PRG, and sent again for review in parallel to the Group and the PRG.

*Status: Carried out.*

**Action II3-2:** A CAPS on RIA fuel rod benchmark Phase II will be prepared by IRSN for WGFS review well in advance to the plenary meeting in September 2013 (first draft by 15 July 2013).

*Status: First draft of the CAPS was distributed 2 August 2013. Comments from review and preliminary interest in the task received. An updated version will be ready for discussion in the WGFS meeting. Carried out.*

**Action II3-3:** A complete draft of the report on Leaking fuel impacts and practices will be sent to the WGFS members and also to all contributors outside the group for review by the middle of June 2013.

*Status: Carried out.*

**Action II3-4:** A CAPS on new task on Fuel fragmentation, fuel relocation and fuel dispersion will be prepared by Mr. Sonnenburg (GRS), and will be circulated in the group for comments well in advance to the WGFS plenary meeting (first draft by 30 June 2013).

*Status: Carried out.*

**Action II3-5:** Additional proposals for the group's activities made during the survey of future tasks will be sent for ranking to the members. The results will be then merged with original set besides top four topics. This complete ranking will be discussed in the WGFS plenary meeting in September 2013.

*Status: Additional proposal sent for rating. Complete list will be prepared for the WGFS meeting. Carried out.*

**Action II3-6:** The countries responses to the Slovak request merged in one document will be sent for the last check to authors, and then as a response they will be sent to Slovakia, with a copy to the WGFS members, including Slovak questions, by mid June 2013.

*Status: Carried out.*

**Action II3-7:** IRSN will prepare an abstract of the presentation about RIA fuel code benchmark exercise at the IAEA Technical Meeting on Modelling of Water-Cooled Fuel Including Design Basis and Severe Accidents held in China in late October 2013. The abstract should be circulated for WGFS comments by the end of July 2013.

*Status: It will be distributed later.*

## APPENDIX 4

**WGFS Future activities ranking - 2013**

<b>PROPOSAL</b>	<b>SUM</b>	<b>RANKING</b>
9. Assessment of Fuel fragmentation and relocation during the LOCA.	50	<b>1</b>
3. (High burnup) Fuel rod behaviour during long term storage and transportation	43	<b>2</b>
8. Fuel dispersal	43	<b>2</b>
10. RIA fuel rod benchmark Phase II	42	<b>4</b>
2. The kinetics of Zr-based cladding oxidation at high and intermediate temperature, in relation to degradation of the mechanical properties (particularly, fuel rod behaviour under SFP accident).	38	<b>5</b>
11. Assessment of post-DNB heat transfer and potential fuel failure	38	<b>5</b>
6. Fuel with high burn-up (>60MWd/kgHM)	37	<b>7</b>
1. Accident-tolerant fuel design (e.g. mechanical and thermo-physical properties of SiC cladding).	31	<b>8</b>
4. Fuel pellet conductivity degradation (accidents and design)	31	<b>8</b>
7. MOX	27	<b>10</b>
5. BWR channel bow	25	<b>11</b>
18. (AP7) LOCA fuel rod benchmark Phase III	19	<b>12</b>
12. (AP1) Fuel thermal and mechanical response/damage during DBA ( LB LOCA or worst RIA) in a power reactor core or a fuel assembly	18	<b>13</b>
14. (AP3) Assessment of fuel heat up behaviour under boil-off conditions in SFP accident	16	<b>14</b>
13. (AP2) Source term of fuel rods failed by DnB at various BU	16	<b>14</b>
17. (AP6) Data uncertainties in experiments and modelling	13	<b>16</b>
15. (AP4) Fuel with high burn-up (>60MWd/kgHM) (Material properties of high uranium density fuel)	11	<b>17</b>
16. (AP5) Proposal title: Fuel performance and safety in Small-Modular Reactor(SMR)	9	<b>18</b>