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CO-OPERATION AND DEVELOPMENT**

NUCLEAR ENERGY AGENCY

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OECD-NEA SFP Project

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DRAFT

**Summary Record of the
First Meeting of the Programme Review Group
of the OECD SFP Project**

NEA Headquarters, 12, boulevard des Iles, Issy-les-Moulineaux

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1. Opening

1. Mr. Reig, head of the NEA Nuclear Safety division, opened the meeting and welcomed the participants to the NEA. He highlighted the important activity supported by the NEA around the Joint Projects which currently consist of 12 experimental projects plus 5 database projects. He reminded that those projects are aiming at gathering countries with common needs in safety research together with a country operating a unique facility so resources can be put in common and results can be shared in minimising costs for all participants. He concluded in reminding that this new project was led by the USNRC, which has been very active in NEA safety research in the past in leading several joint projects - the last one being the MCCI project – and wished success to the SFP project which attracted 13 countries.

2. Welcome address and introductory remarks

2. Mr. Vitanza, on behalf of the NEA secretariat, welcomed also the participants to the NEA. He mentioned that the Mr. Trambauer, the Chair of the Expert meeting held last year for this project, was not in condition for attending this meeting and he asked GRS to convey to him the warm wishes of prompt recovery on behalf of the participants. The list of participants is given in Appendix 2.
3. Mr. Zigh, on behalf of the USNRC, welcomed the participants and thanked the countries for having joined this new OECD Project. He briefly summarised the history of fuel assembly fire studies which started some years ago with a national programme with BWR fuel. Since the results were not directly transposable to PWR fuel assemblies and that many countries were interested they decided to start a new programme with PWR fuel within the framework of the OECD Joint Projects. He concluded his introduction in mentioning that the SFP Programme Manager was not yet decided and that he would serve as Project liaison officer in the meantime.

3. Election of the PRG Chair

4. Mr. Vitanza recalled that, According to Article 3 d) of the Project Agreement, the Programme Review Group (PRG) shall elect each year a Chairperson and a Vice-Chairperson from amongst its members and he asked for proposals for nominations. He suggested the name of Mr. Techy who had already skilfully chaired other NEA project and the proposal was supported by all other countries. Mr. Techy accepted to be candidate and he was then elected Chairman of the Programme Review Group.

4. Role of the Programme Review Group (PRG)

5. Mr. Techy chaired the meeting and first invited participants to briefly introduce themselves since this was a new Project. In addition Mr. Vitanza indicated that he had received apologies for not being able to attend the meeting from Sweden and United Kingdom and that he was also representing Norway.

6. Mr. Vitanza reminded that the role of the Programme Review Group (PRG) was described in Article 3 of the agreement and that mainly PRG shall:
 - advise the Management Board concerning the annual programme of work and budget;
 - provide technical advice and recommendations to the USNRC acting as Operating Agent concerning the carrying out of the programme of work; and
 - review the technical reports of the Project, assess the results of experiments performed and provide guidance for future work.
7. He also mentioned that there were provisions in the Agreement for a vice-chair; since no nomination was suggested it was agreed that the position will be considered again at the next meeting, possibly in connection with the coordination of analytical activities.

5. Adoption of the Agenda

8. The PRG Chair asked about comment to the tentative Agenda proposed by the Secretariat by e-mail on 30 May 2009 and as revised on 21 June 2009. Mr. Vitanza mentioned that under Item 7 the Programme of Work should cover the years 2009 and 2010 since the next meeting will be in 2010. It was also suggested to discuss the prospects on analytical activities under Item 10. With these comment the Agenda was approved and is given in Appendix 1.

6. Report by the Operating Agent

6.1 Boiling Water Reactor (BWR) tests Information

9. Mr. Lindgren presented the results of Spent Fuel Pool Heat-up and Propagation Phenomena Experiments. The objective of these experiments was mainly to validate severe accident codes for whole pool LOCA analyses using phased experimental approach and examine nature of Zircaloy fires in prototypic assemblies. Among separate effects such as hydraulics to determine form loss and laminar friction coefficients, thermal hydraulics to determine input conditions for partial length experiments and thermal radiation to determine radiation coupling in a 1×4 arrangement were tested. Two integral effects test were carried out then. A prototype of the GE 9x9 BWR full length Zircaloy assembly was used for axial ignition test and Zircaloy short stack for radial propagation test with hot center assembly “surrounded” with four un-powered ones.
10. Mr. Lindgren summarized the results of the BWR testing as follows:
 - Separate effects tests allowed different physical phenomena to be studied independently and provide Hydraulic characterization of prototypic assembly, which is vital.
 - Full-scale assembly ignition test confirmed importance of the breakaway phenomena and showed interesting dynamics on burn-front movement, which was usually downward to follow oxygen and fresh Zr and late phase ignition above the initial ignition location.
 - 1×4 ignition test confirmed delayed ignition in un-powered assemblies but strong radial heat transfer to un-powered peripheral assemblies.
11. Following discussion brought questions as:
 - how MELCOR calculations were set up for the BWR cases, in particular how the nodalisation was done;

- what is the status of the MELCOR code, such as the users, users group, future developments etc;
- if a sample of MELCOR input deck can be provided to members.

As these questions were not responded during the discussion the Operating Agent should provide particular information in the due time given by recommendation 1.4, 1.5 and 1.6 of part 11 of this Summary record.

6.2 *Pressurized Water Reactor (PWR) Hydraulic Analysis*

12. Mr. Lindgren informed about the results of the hydraulic test to determine form loss and laminar friction coefficients for PWR assembly. The tests were carried out with Westinghouse 17×17 RFA PWR, which contains more form losses than BWR assembly. As results were found significant dependence in viscous loss coefficient and little dependence in form loss coefficient. The nature of flow near spaces as function of Re and flow split between bundle and annular regions as function of Re were determined.

6.3 *PWR Plan for SFP Experiments*

13. Proposed thermal-hydraulic and ignition phenomena characterization of prototypic pressurized water reactor assemblies were presented by Mr. Lindgren. The main objective of the project is to provide prototypic thermal hydraulic and zirc-fire data for accident code validation under air flow conditions associated with:
 - Spent fuel pool complete LOCA;
 - Late phase core melt progression;
 - Complete loss of water during refuelling; and
 - Dry cask storage (thermal Hydraulic data).
14. The geometry of PWR assemblies is so differ from BWR ones that the interpretation of BWR results for PWR is not real. During the two phase project single heated full length assembly and five full length assemblies in 1×4 cell will be tested by pre-ignition and ignition. The 1×4 cell will be arranged with one center heated and four peripheral unheated assemblies. The two peripheral assemblies will consists of pressurized rods that should allowed study effect of ballooning on ignition. Pre-ignition tests will be analogous to BWR tests. Ignition tests than could be influenced by lack of channel box of PWR assembly that may alter axial propagation in single assembly test and ballooning will induce flow in peripheral assemblies.
15. As the main objective of project is to provide prototypic data for code validation, there will be three component numerical effort:
 - Experimental design;
 - Pre-test predictions; and
 - Post-test analysis.Data available to all project participants will be test plans, spreadsheet data files and modeling database.

7. Programme of work and budget for 2009 and 2010

16. Mr. Zigh informed that the Programme of work for 2009 (cost 1 300 000 US\$) will include:
 - Phase 1 - Axial heating and burn propagation.
 - Preparation of facilities, design of experiments including safety assessments, acquisition of parts

- Set up of the single PWR full length assembly, heated rods and instrumentation, pre-ignition characterisation, test execution with two different storage cell dimensions, post-test examinations and analyses
 - Test documentation, project management, reporting to Project steering bodies and to Signatories, final report preparation
 - Phase 2 - Radial heating and burn propagation.
 - Preparation of facilities, design of experiments including safety assessments, acquisition of parts
17. Further Mr. Zigh added that The Programme of work for 2010 (cost 1 700 000 US\$) will include:
- Phase 1 - Axial heating and burn propagation.
 - Set up of the single PWR full length assembly, heated rods and instrumentation, pre-ignition characterisation, test execution with two different storage cell dimensions, post-test examinations and analyses
 - Test documentation, project management, reporting to Project steering bodies and to Signatories, final report preparation
 - Phase 2 - Radial heating and burn propagation.
 - Preparation of facilities, design of experiments including safety assessments, acquisition of parts
 - Set up the five-assembly (PWR) arrangement, heated rods and instrumentation, pre-ignition characterisation, ballooning rod design and testing, test execution, post-test examinations, test analyses
 - Test documentation, project management, reporting to Project steering bodies and to Signatories, final report preparation
18. The PRG took note of this planning and recommended MB to approve the SFP Programme of Work for the year 2009 and 2010.

8. Organisation of project reporting to participants

19. Mr. Zigh presented the technical documentation foreseen in the project, which will consist in:
- Technical information about the test facility;
 - Test design specification for each phase to be submitted for comment to the PRG;
 - First test results presented in Excel spreadsheets with an introduction to data (quick-look report);
 - A final test report supplied for each phase, providing additional information on background, objectives, boundary conditions, test results;
20. Regarding the result of the BWR tests, he indicated that the final report would be distributed before the end of August 2009 and that the Excel Data sheet would be distributed before the end of October 2009.

9. Other matters: analytical activities

21. The PRG Chair recalled that the analytical support activity performed in the frame of previous OECD projects had proven to be very useful and that he was expecting that such an analytical activity could be organised in the frame of this new project. He then

asked participants about the foreseen activities regarding pre or post test computations related to the SFP programme. The preliminary indications from the participants were as follows:

- Hungary, Japan, Korea, Switzerland and USA plan to perform CFD calculations
- Czech Rep., France, Germany, Hungary, Italy, Japan, Korea, Spain, Switzerland and USA plan to perform calculations with lumped parameter codes (MELCOR, ICARE, ATHLET-CD).

22. After this review the Chair noted that there was quite a lot of analytical activity planned but it was too early to discuss about workshops or benchmarks; this topic will be revisited in future meetings.

10. Next Meeting

23. SNL offered to host the next PRG meeting so members can visit the SFP facility and the PRG welcomed this proposal. It was suggested that the 2nd PRG meeting will be hosted by SNL in Sandia two and half days on the week 19-23 April 2010. The 3rd meeting is planned for autumn 2010.

11. Summary of actions and recommendations to the MB

24. Mr. Techy summarised the PRG actions and recommendation and after the discussion the PRG agreed on their formulation as follows:

- 1.1. Mr. Zsolt Techy was elected Chairperson of the SFP PRG.
- 1.2. The SFP Programme Manager will be nominated by the USNRC in a few week time.
- 1.3. The overall programme as outlined by the Operating Agent is in accordance with the Agreement and with members' expectations.
- 1.4. The USNRC will provide basic information regarding how MELCOR calculations were set up for the BWR cases, in particular how the nodalisation was done – before end of September 2009.
- 1.5. The USNRC will provide general information regarding the status of the MELCOR code, such as the users, users group, future developments etc.- before end of September 2009.
- 1.6. Many members are users of MELCOR. The USNRC will check if a sample of MELCOR input deck can be provided to members – before end of September 2009.
- 1.7. The deliverables will primarily consist of:
 - **Test Plan**, to be communicated before the start of the test, in time for receiving feedback from members. The Test Plan contains the type and location of thermocouples and of other instrumentation, such as pressure and flow meters; design features of the fuel assembly or assemblies, including geometry and materials; storage cell geometry and composition; test power level(s); MELCOR pre-analyses if any; in such case, the MELCOR input deck could be provided.

- **Quick-Look Report**, to be communicated to members about one month after the test execution, explaining how the test was carried out, possible differences with respect to the Test Plan and significant findings.
- **Test Report**, to be communicated 6 months after the test completion, containing the detailed set up and outcome of the test, the test analysis and all relevant data files. The members will be given the opportunity to comment and review the Test Report.
- The PRG recommends that a **Project Final Report** including result analysis be prepared by a writing group, with the contribution from Project members, focusing on the use of the data for actual cases, including possible test limitations.

1.8. The 2009 Programme of Work (POW) consists of:

- Design work and acquisition of parts for the entire programme;
- Test Plan for Phase-1, before end of October 2009, comments by PRG one month later.

The overall cost for the 2009 POW is 1.3 million US\$, as in the Agreement. In addition, the USNRC will provide:

- Delivery of the BWR Final Report, before end of August 2009;
- Delivery of the BWR data files, including assembly geometry data, possibly also MELCOR input deck, before end of October 2009.

1.9. The 2010 POW consists of:

- Phase 1 testing and Quick Look report in 2nd quarter of 2010, Test Report at end of 2010;
- Test Plan for Phase 2 and possibly some ballooning tests at end of 2010.

1.10. Regarding analytical activities, it was clarified that the following members are interested in CFD calculations: Hungary, Japan, Korea, Switzerland and USA. For Lumped Parameter codes the following members were interested: Czech Rep., France, Germany, Hungary, Italy, Japan, Korea, Spain, Switzerland, USA.

1.11. The OA will explore possibilities for providing additional information needed for CFD calculations.

1.12. Members expressed the view that analyses should not evolve towards code benchmarking and believed that the focus should be on post test analyses. The BWR tests should be considered as first step in this analytical activity. The NEA will in due time before the next meeting remind members to contribute with BWR result analyses (both CFD and lumped parameter codes), to be presented at the next PRG meeting.

12. Close of the meeting

25. Mr. Techy thanked the OA for the information provided by the project and thanked the participants for their effective input to the PRG discussions. Finally he expressed his wish of a successful project and closed the first PRG meeting.

**Agenda of the First Meeting of the Programme Review Group
of the OECD SFP Project**

1. Opening
2. Welcome address and introductory remarks
3. Election of the PRG chairman
4. Role of the Programme Review Group
5. Adoption of the meeting Agenda
6. Report by the Operating Agent
 - 6.1. Boiling Water Reactor (BWR) tests Information
 - 6.2. Pressurized Water Reactor (PWR) Hydraulic Analysis
 - 6.3. PWR Plan for SFP Experiments
7. Programme of work and budget for 2009 and 2010
8. Organisation of project reporting to participants
9. Other matters
10. Next meeting
11. Summary of actions and recommendations to the MB

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