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

Working Group on Risk Assessment (WGRISK)

**SUMMARY RECORD OF THE SEVENTEENTH (17th) MEETING OF THE
WORKING GROUP ON RISK ASSESSMENT (WGRISK)**

Held on 16-18 March 2016 at the OECD Headquarters, Paris, France

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17TH MEETING OF THE WORKING GROUP ON RISK ASSESSMENT

**OECD CONFERENCE CENTRE,
PARIS, FRANCE
16-18TH MARCH 2016**

1. Opening of the Meeting

The Chair Ms. Röwekamp welcomed the members to the meeting and noted that there had been the following changes in membership:

- Mr. Gheorghe will be retiring. Ms. Akl is joining as the representative from Canada.
- Mr. Fujimoto from Japan is leaving and is replaced by Mr. Hamaguchi.

Mr. White provided some words of welcome on behalf of Mr. Nieh, the head of the Nuclear Safety Technology and Regulation Division. He noted that it was a time of change and renewal for the NEA and the former Nuclear Safety Division. Mr. Reig had recently retired from the NEA, and his division had been divided into the Nuclear Safety Technology and Regulation Division, under Mr. Nieh, and a new division on Human Aspects of Nuclear Safety, under Ms. Hah. Mr. White also reported that Mr. Blundell had completed his term with the NEA and had returned to the UK, and that he (Mr. White) had been asked to provide Secretariat support to WGRISK going forward. Mr. White expressed the view that the WGRISK programme of work is important to the CSNI as it touches on the work of many of the other working groups, and said he was looking forward to working with WGRISK on its various activities.

2. Adoption of the Agenda [NEA/SEN/SIN/WGRISK/A(2015)1]

Ms. Röwekamp observed that the agenda is very busy and suggested that in particular, the technical discussion on Thursday afternoon should start a bit earlier than originally scheduled to allow time for discussion. It was also noted that since the agenda had been circulated, there had been some further clarification of the presentations to be made under agenda item 15. With these observations, the agenda was approved.

3. Approval of the 16th WGRISK Meeting Summary Record [NEA/SEN/SIN/WGRISK (2015)1]

There had been feedback prior to the meeting that Spain's contribution to the roundtable had been missed. The Summary Record was approved with the following addition noted:

Spain

The Spanish Regulatory Body (CSN) had developed a Supervision System for NPP based on risk insights, and the PSA group in CSN is involved in the activities related to this work (Prioritizing inspection items, inspection findings, categorization, etc.). PSA models have been developed for the Utilities that are updated periodically. In order to be sure about the update quality, CSN carries out biennial inspections to supervise the updating process for a PSA. The CSN representative showed a table with the scope of Spanish PSA, in general:

- Level 1 and Level 2 for internal events at power, low power and shutdown,
- Level 1 and Level 2 for fire PSA at power and for internal flooding,
- Spent fuel pool PSA has also been developed.

4. The Use and Development of PSA in NEA Member Countries

Belgium

Mr. Mitaille explained recent developments on Fire and Flood PSA in Belgium. An assessment of internal flooding for Belgium plants is continuing to show flooding is a minor contributor to CDF, and is highlighting where some improvements can be made. Using Fire PSA, the utility has performed an assessment for all plants but Doel 1-2, and has developed some recommendations to improve detection, suppression and protection for fire events. Lastly, they are making improvements to PSA methodologies, and are updating PSA models to take into account operating experience.

Canada

Ms. Akl outlined developments within Canada and described some of the updates to regulatory standards and guides related to PSA/PRA. One of the highlighted changes is that the scope of PSA has been extended to include all sources of radioactivity, including spent fuel pools, multi-unit impacts, and combinations of external hazards. Ms. Akl noted that more guidance is required for alternative methods that can be used for external events PSA. She also noted that one of the major challenges for the CNSC is defining quantitative health objectives, and an immediate focus in this area is expectations for full-site PSAs. Ms. Akl described some of the CNSCs research projects and international initiatives.

Chinese Taipei

Mr. Chao noted developments in the area of Seismic PSA and spent fuel pool risk assessment. Seismic PSA updates were required by 2016 for existing plants and before first fuel load for new plants. Reconsideration of fault characteristics has led to an increase in seismic hazard, which is dominant in the risk profile for Chinese Taipei NPPs.

Czech Republic

Mr. Patrik noted that a new specific Regulatory body Decree continues to be developed for the Czech Republic, and PSA is now required as an integral part of the safety report and periodic safety reviews. A primary focus in PSA has been on making improvements to address findings related to post-Fukushima measures, particularly with respect to external events. An important PSA application has been as a risk monitor tool to focus efforts on addressing and avoiding high risk areas during plant maintenance activities. Going forward there is still a need for further work in the area of external events, and work on combined hazards.

Finland

Mr. Sandberg summarized some general developments in Finland. He noted that the PSA for Loviisa 1&2 have been developed and used to support Fukushima modifications, including updated hazard curves, improved seawater protection and back-up cooling. Amongst other developments in the area of research, they are looking at using PSA to support security arrangements such as the identification of vital areas.

France

Mr. Corenwinder provided an overview of the developments in PSA and the PSAs available for each reactor type in France. The main use of PSAs for operating plants is to support periodic safety reviews. For EPR, PSA is being used to support activities like design verification and identification of risk reduction categories. PSA is also being used to support the design of the ASTRID sodium-cooled fast reactor. A variety of improvements are being made to PSAs to extend the scope to include further hazards, to improve models (e.g. HRA, CCF, I&C) and to incorporate maintenance data and operating experience to reflect aging.

Germany

Ms. Röwekamp provided a list of documents that have been published by GRS on PSA R&D, noting that while the reports are in German, there are extended abstracts in English. She also highlighted some work on site-specific PSA for external hazards. This work follows a systematic approach with a standardized methodology for screening site-specific hazards, and the approach has been tested for Seismic and Fire PSA. Ms. Röwekamp noted that the FIRE Database Project has been particularly useful in supporting development of Fire PSAs. Looking forward, research is being performed on Site Level PSA, systematic consideration of combinations of hazards, dynamic PSA, improving human reliability analysis, and enhancing a diagnosis and prognosis tool based on a Bayesian Belief Network.

Hungary

Mr. Bareith reported that preparatory work is underway for two new reactors at the Paks site. He noted that the Level 1 and 2 PSAs for the existing 4 Paks reactors were quite broad in terms of covering a wide range of plant states and internal and external events. He described some developments in the areas of low-power and shutdown PSA, and external-events PSA. In the future, efforts will continue to make further uses of the plant specific risk monitor for NPP Paks, and an update to the component reliability database is planned. For the new plants, site investigations of seismicity are being performed using new methods such as response to small explosions.

India

Mr. Varde noted that there was a national risk working group within India, for which he serves as a link to WGRISK. He outlined developments in the area of R&D to support PSA improvements, and developments in PSAs for various reactor designs and to account for wider ranges of events. Level 1 PSA is now mandatory, and Level 2 PSA is recommended, under India's regulatory framework. There is focussed effort in India on reliability and PSA education.

Italy

Mr. Burgazzi reported on developments to address advanced reactors and post-Fukushima lessons learnt. Two topics of current interest are analysing the risk of external events to reactors and the assessment of the reliability of passive safety systems. ENEA will present a paper on the latter at ICONE 24. He noted that ENEA has joined the NEA SAREF group that is following up on safety research opportunities post-Fukushima, and is contributing to the ASAMPA_E project. Finally, Mr. Burgazzi highlighted developments being led by the Polytechnic of Milan in aspects of PSA such as computational methods for fault detection, and methods for Integrated Deterministic and PSA (IDPSA).

Japan

Mr. Hamaguchi reported on use and development activities for PRA in Japan. NRA has established guidance for periodic safety assessments of continuous improvement that include the requirement for PRA covering various internal and external events. NRA is developing models for countermeasures against severe accidents to include in PRA. They are also developing improvements for fire and flood models. Mr. Hamaguchi also noted that the industry is developing a state-of-practise PRA for Ikata unit 3.

Korea

Mr. Ahn provided an update on PSA developments within regulatory, research and utility organizations. From a regulatory perspective, the nuclear safety act has been amended to strengthen the legal framework for severe accident management, and it is expected that there will be specific requirements for PSA in the legal framework. In the research area, a project is underway to develop risk evaluation methodologies for extreme external events, an integrated risk assessment approach for multi-unit sites, technologies for site-level accident management and emergency preparedness, and technologies for risk-informed applications and digital environments. On the utility side, they are revising PSAs to address developments following

Fukushima, and are embarking on a research project to develop a state-of-the-art approach for Level 2 and 3 PSA.

Mexico

Mr. Lopez reported that CNSNS is updating PSA models for regulatory applications (Level 1 and 2 for internal events, full power, and the most important POS in shutdown) to incorporate the latest available plant specific data such as equipment failures and transient event occurrences. They are also inspecting the status of Utility PSA models and assessing the risk significance of several Licensee Event Reports using the SDP methodology and a Level 1 model. CNSNS continues to devote some efforts to develop models (deterministic and probabilistic) for dynamic and integral safety assessment.

Netherlands

Mr. Brinkman described the changes that have been made to the regulatory framework in the Netherlands. He highlighted some of the updates in guidance for Level 1 and 2, including harmonization between nuclear and non-nuclear Level 3. He described development for the PSAs for the Petten research reactor and the research reactor at Delft University of Technology.

Poland

Mr. Staron reported that Poland is continuing the programme for building a nuclear power plant, with a current focus on siting, including consideration of external events. Regulatory staff are participating in a variety of international activities to gain an appreciation of current approaches and practises.

Romania

Ms. Nitoi highlighted that the regulatory framework has been revised to update the requirements for the safety analysis report (aligns now with the USNRC content) which will require more detail on PSA. She outlined some of the activities of the Pitesti research institute in the area of PSA. She noted that the Institute for Nuclear Research (INR) is involved in implementation of the National Strategy for Safety and Security in Nuclear (issued by CNCAN in 2014). The Strategy is aimed at improving nuclear safety, and in particular improving the national capacities and competencies in nuclear safety research. The PSA team at INR has ongoing activities related to ASAMP_{SA}_E, the JRC Petten project on PSA that incorporates aging, and the FALCON initiative to support the Advanced Lead Fast Reactor European Demonstrator (ALFRED).

Slovak Republic

Mr. Kovacs described developments around 3 issues for PSA in Slovakia: 1) implementation of severe accident management (SAM) systems and SAMG for both plants (J. Bohunice and Mochovce), 2) re-evaluation of external events, and 3) reduction of shutdown risk for both plants.

Slovenia

Mr. Vojnovic summarized new developments in Slovenia. He noted the improvements in CDF for Krsko NPP that have come from PSA of various types of events. Most recently, dikes have been upgraded to reduce the risk of external flooding. He also described post-Fukushima modifications to include passive autocatalytic recombiners and primary containment filtered venting. Lastly, Mr. Vojnovic provided some results from low-power and shutdown PSA, and listed some planned future improvements.

Spain

Ms. Vazquez reported that there are no major new developments in Spain. She highlighted the use of PSA in various regulatory inspection and oversight activities such as gaining risk insights, prioritizing inspections, etc. Currently, utility models are used, with inspections to ensure quality. CSN is working to develop PSA models that are independent from the utilities.

Sweden

Mr. Hellström outlined the activities of SSM in the areas of PSA. They are reviewing a number of submissions from utilities, and have been working with the utilities on keeping PSAs up-to-date on a 3-year cycle (living PSA). Mr. Hellström described the process underway on review of four new major documents. SSM has ongoing projects in areas such as Level 3 PSA, HRA, and digital systems.

Switzerland

Mr. Schoen reported that a new probabilistic seismic hazard analysis for all Swiss NPPs was submitted at the end of 2013. Based on the regulatory review, a new seismic hazard will be defined for all Swiss NPPs in the course of this year. The regulatory guideline ENSI-A06 (Probabilistic Safety Analysis (PSA): Applications) was revised in 2015. The revision addresses mainly formal issues and some details on the probabilistic event analysis.

United States

Mr. Coyne summarized PRA use and development within the US NRC. In the area of reactor oversight, precursors are categorized and trended as an indicator of industry performance. In general, there is no adverse precursor trend, but one of the monitored precursor sub-groups, loss-of-offsite-power (LOOP) events, indicates an increasing trend over the past 10 years. This observation underscores the importance of the ongoing loss of offsite power task being done under CAPS WGRISK (2013)1. Mr. Coyne went on to describe a number of risk-informed activities, and progress in the areas of Level 3 PRA, fire research, and human reliability analysis. He provided a list of relevant recent publications.

5. Reports on Activities in the Area of PSA by other International Organisations

5.1 IAEA presentation

Mr. Amri highlighted that the IAEA has issued its report on the Fukushima Daiichi Accident, which completes the IAEA's Nuclear Safety Action Plan (<http://www-pub.iaea.org/books/IAEABooks/10962/The-Fukushima-Daiichi-Accident>). Follow-up activities are included in the regular IAEA programme. A major focus area that was identified was Human and Organizational Factors / Safety Culture.

In the area of safety standards, there have been revisions post-Fukushima, of GSR Part 4 on safety assessment for facilities and SSR-2/1 on safety of nuclear power plants: design. This had led to revision, or planned revision, of a large number of safety guides, as listed by Mr. Amri. There is also a TECDOC to clarify the latest revision of SSR-2/1. There are several risk assessment-related TECDOCs at different stages of preparation:

- PSA Quality Assurance,
- Integrated Risk Informed Decision Making,
- Safety Goals for Nuclear Installations,
- Considerations for Supplementary Safety Analysis on Nuclear Power Plants in the light of the Fukushima Daiichi NPP Accident.

Turning to other areas, Mr. Amri noted that there is a report being prepared to provide guidance on application of PSA to Research Reactors. Within the International Seismic Safety Centre, there is work on multi-unit PSA, with an upcoming meeting planned for April 25-29, 2016. Mr. Amri noted that the person in charge of multi-unit PSA was prepared to contribute to the WGRISK task on multi-unit PSA, and will pass on the information.

5.2 European ASAMPSA_E Project (Advanced Safety Assessment: Extended PSA)

Mr. Raimond explained the background on the project on extended PSA. The project is nearing completion, with all reports to be sent for review in May 2016, and then issued by the end of 2016. An end-user's workshop is planned for September 12 to 14, 2016. Mr. Raimond provided a list of the documents that will be delivered under the project.

Ms. Röwekamp noted that WGRISK Bureau members had discussed the possibility of participating in the September workshop as a WGRISK activity, and noted it would be a very challenging schedule. The Bureau suggested that it would be better to have an activity that follows the ASAMPSA_E final report, possibly with a workshop that can identify follow-up actions.

5.4 MDEP EPR Subgroup for PSA

Ms. Lanore summarized the activities of EPR Subgroup on PSA. They have compared the PSAs from Finland, France, USA and the UK for specific events. The main findings are that the results are overall similar, but in the details there are differences. They met with AREVA and noted that there are design differences in the 4 versions of EPR, and also there are differences in the level of detail for the PSAs. The level of detail will of course evolve as the design work advances. There will be a detailed report restricted to MDEP participants and a publicly available report issued shortly.

6. Report by the Secretariat

Mr. White provided the Secretariat report, covering the following areas:

- NEA developments: The changes to the NEA Secretariat had been described under the opening remarks, Agenda item 1.
- WGRISK actions: The review of outstanding actions showed they were all closed.
- CSNI items: Mr. White highlighted that the CSNI had approved the WGRISK report on the Fire PSA Workshop and the three new WGRISK CAPS proposed in to the June CSNI. He also summarized the reports and CAPS approved for other CSNI working groups and joint projects, and highlighted that the CSNI had approved the formation of a working group on electrical power systems, WGELEC (their first meeting will be March 24-25, 2016).
- The Chairs of WGRISK, WGEV, and WGIAGE have been tasked by CSNI to review their working group mandates to ensure there are no gaps or overlaps (this is discussed in more detail under item 14.3).
- CNRA items: The CNRA (with input from CSNI, CRPPH and NLC) approved the report *Five Years after the Fukushima Daiichi Accident*, which was published in March 2016 (<https://www.oecd-nea.org/nsd/pubs/2016/7284-five-years-fukushima.pdf>). The CNRA also approved 2 green booklets on Safety Culture of the Regulatory Body, and on Implementation of Defence in Depth at Nuclear Power Plants.

7. Status report on PSA insights relating to the loss of electrical sources [Task 2013(1)]

Ms. Lanore provided an overview of the progress on the task. Since the last meeting, 14 member countries have provided responses to complementary questions, and the draft final report has been completed and circulated to the WGRISK members. The main insights are that loss of electrical sources is an important initiating event, and a number of safety improvements have been identified. WGRISK members agreed that the report could be submitted to the PRG once Ms. Lanore had incorporated the feedback received

from the working group. Ms. Röwekamp expressed the appreciation of WGRISK for the excellent work of Ms. Lanore and the task group.

8. HRA in External Events PSA [Task 2015(1)]

Mr. Dang provided an update on the task. He noted that there was good participation from both WGRISK and WGHOFF on the core group and full task group. An informal survey has been completed to identify the external events to address in the questionnaire, a questionnaire that has been drafted. Pending the finalization of the questionnaire and example response, it will be circulated to the working group in April, with responses to come in June. WGRISK members were asked to forward the survey to relevant experts within their countries. There will be a meeting of the extended task group in September to review the preliminary findings – tentatively planned for September 21&22, 2016 at the NEA in Boulogne Billancourt.

Action WGRISK-17-1: Mr. Dang to provide Mr. White with slides to update WGHOFF on the progress of the task on HRA in External Events PSA.

Action WGRISK-17-2: Mr. Dang to confirm dates for the September 2016 meeting with members of the task group for HRA in External Events PSA.

9. Status report on Site Level PSA (Including multi-unit PSA) Developments [Task 2015(2)]

Y. Akl, Canada, summarized the status of the task in a presentation. This task is being performed in two Phases – Phase 1 lead by CNSC (Canada) and Phase 2 will be a workshop (lead by Germany (GRS)). As part of Phase 1, an initial survey has been completed to determine the 3 focus areas for the task and to determine the follow-on activities. The focus areas are risk aggregation, multi-source interactions and dependencies, and safety goals. Some challenges have been identified for each of these focus areas. The task group members were identified and the work on the 3 focus areas will continue as per the schedule. Electric Power Research Institute (EPRI) expressed interest in opportunities to participate with the task group on their activities. India also expressed interest in being involved in this task. UK felt that they could potentially participate in some of the focus area topics. WGRISK members commended Canada for the well organised task and noted that the Phase 1 task is progressing well.

10. Status report on Status of Practice for Level 3 Probabilistic Safety Assessment [Task 2015(3)]

Mr. Coyne outlined progress on establishing the task. The approach is to survey member and observer countries, identify common challenges and notable practises, and document the results. Mr. Coyne noted that the activity touched on the work of many other groups within the NEA and the broader nuclear community, e.g. IAEA. The task will communicate and coordinate with these other groups. Mr. Coyne reviewed the structure of the survey that is being developed and the schedule of activities. The task survey will be distributed to the WGRISK membership and other interested parties later this spring and an expanded core group task meeting is being planned for later in the fall of 2016. This task is on track to be completed in June 2017.

11. Status report on Use and Development of Probabilistic Safety Assessment in Member and Non-member Countries [Task 2015(4)]

Ms. Lanore reported on the activities to update the 2012 Report with an emphasis on new developments and results in PSA. The core group has prepared a revised structure to the report to reduce repetition, to show post-Fukushima insights separately under each topic, and to include a chapter on international activities. WGRISK members agreed on the structure of the report and were encouraged to provide their country input according to the new structure and to volunteer to contribute to the writing of the summary

report. Mr. Varde noted that India would like to participate in the core group and was willing to write one of the chapters.

Action WGRISK-17-3: Ms. Lanore to circulate the structure of the update for the report on use and development of PSA via the secretariat to solicit input from WGRISK.

Action WGRISK-17-4: WGRISK members to provide their input for the update of the report on use and development of PSA according to the new structure.

12. & 13. WGRISK participation to international conferences, workshops, etc.

WGRISK members reported on the results of the following technical meetings over the past year:

- PSAEA – 18th Technical Meeting on Experiences with Risk-based Precursor Analysis, October 28-30, 2015, Brussels:
 - Mr. Mitailé provided feedback from the meeting, noting there were 9 presentations on precursor analysis, 1 on PSA Level 1-2, and 1 on the European Clearinghouse project. He summarized 3 of the presentations on precursor analysis. A major discussion point was that while 10^{-6} is accepted as a threshold for Level 1, it was less clear what to use for Level 2. For example the LERF (typically $10^{-7}/a$) is used in some analyses but not generally accepted. One of the main observations from the meeting was that many of the events were related to the loss of electrical sources, showing the impact of electrical supply on PSA results. Mr. Mitailé discussed steps that may be taken to adjust the focus and frequency of the meeting to address waning interest. Mr. Mitailé will send information on the next meeting, and a report from the 2015 meeting, for the Secretariat to circulate to WGRISK members.
- PSA 2015, Sun Valley, Idaho (USA), 26-20 April, 2015:
 - Mr. Coyne provided an update on the meeting, noting good representation across risk disciplines. All presentations are available on the PSA 2015 website, the papers are available through the ANS. Mr. Coyne provided the link to the PSA 2015 website to the NEA Secretariat to post on the WGRISK members area (<http://www.psa2015.org/FinalPresentations.aspx>).
- ARMS-ICRESH15, Lulea, Sweden, June 1-4, 2015:
 - Mr. Varde summarized the conference, noting the objective was to provide a platform to discuss reliability and safety. Three technical tutorials were provided on the first day of the meeting, and then over the next 3 days there were 10 invited talks and more than 80 papers. Fifty-three of the papers were selected for publication in a book “Current Trends in Reliability, Availability, Maintainability and Safety – An Industry Perspective”.
- ESREL 2015, Zürich, Switzerland, September 7-10, 2015:
 - Mr. Dang reported that it has been a very successful conference – one of the largest ESRELS in the history of the conference, with good participation from the nuclear industry and members of WGRISK.

The following upcoming meetings were brought to the attention of WGRISK members:

- 11th International Conference of the Croatian Nuclear Society, 5-8 June 2016, Zadar:
 - WGRISK members to follow-up as they wish.

- ICONE24 – end of June 2016, Charlotte, NC (USA):
 - Ms. Röwekamp reported that the WGRISK Bureau had decided that there would not be an overview presentation. Mr. Burgazzi will be attending and presenting a paper on passive system reliability, and can provide feedback.
- ESREL 2016, 26-29 September 2016, Scotland:
 - Again, the Bureau had decided not to have an overview presentation from WGRISK. The CNSC may be presenting a paper, and could provide feedback if they attend.
- PSAM13 – 2-7 October 2016 in Seoul:
 - An abstract for a presentation on the ongoing activities of WGRISK has been submitted, and a number of representatives from member countries will attend and/or present papers.
- PSAEA 2016, not yet determined:
 - Information to come (Mr. Mitailé).
- PSA 2017, September 24-28, 2017 in Pittsburgh:
 - A presentation from WGRISK on loss of electrical sources is planned.
- ESREL 2017, end of June 2017, Slovenia.
- PSAM Topical on HRA and Quantitative Human Factors, June 7-9, 2017, Munich.
- Nordic PSA, 2017, Sweden.

14. Cooperation with other NEA Working Groups, Task Groups or Expert Groups

14.1 Outcome of discussion on “Using probabilistic and deterministic methods when making regulatory decisions” at 34th CNRA meeting

Ms. Röwekamp summarized the discussion that had been organized for the 2015 December CNRA meeting. The presentations used by the three speakers, Mr. Apostolakis, Mr. Jamet, and Ms. Röwekamp are posted on the WGRISK website. Items raised where possible further work may be beneficial included training, and methods to improve communications between PSA specialists and regulators. The CNRA Bureau had a follow-up discussion and decided that no further action would be taken at this time.

14.2 Interactions with Database Projects

The discussion on Interactions with Database Projects deferred to item 17.1.

14.3 Interactions with WGEV – feedback from Secretariat and discussion

Mr. White reported that there was an action on the chairs of WGEV, WGIAGE and WGRISK to discuss the mandates for their respective working groups to ensure there are no overlaps or potential gaps and report back to the CSNI in June 2016. The WGRISK Bureau had discussed the request at their meeting and has provided the chair with feedback that can be provided to the WGIAGE and WGEV chairs. Essentially, it was felt that it needed to be clear that WGEV and WGIAGE worked on characterizing the risks of external and seismic hazards, whereas WGRISK worked on the consequences of those hazards.

14.4 CAPS received from other working groups for input from WGRISK

Three CAPS had been received from other working groups for input from WGRISK. The Bureau discussed these CAPS and recommended that the Chair provide the following feedback;

- WGAMA CAPS on passive safety systems: WGRISK Bureau thought that the CAPS looked interesting, but noted that the CAPS appears to be focussed on deterministic assessment of thermal hydraulics, and at this point, it does not appear necessary to include assessment from a risk perspective. As a result, there was no need for WGRISK to participate in the CAPS. It was further suggested that statements on PSA and reliability be removed, and WGRISK be removed from the CAPS identifier.
- WGEV CAPS on science-based screening criteria: WGRISK Bureau members expressed concern that the CAPS appears to include consequence assessment for external hazards, which would be more appropriately part of the WGRISK mandate. Specifically, they noted that the scope is unclear, and should be focussed on hazard characterisation. Also, the working methods are unclear and the schedule needs to be updated. Bureau members will prepare a comment with suggestions for and requests for clarification to the CAPS to be sent to WGEV.
- WGIAGE CAPS on a 2-day course on accident management of Seismic Events: WGIAGE would like to have from WGRISK a lecture on Seismic PSA as a tool for providing useful input to accident management activities. WGRISK Bureau members agreed to circulate the request for a lecture on seismic PSA after the CAPS is approved. Bureau members noted that it might be better to refer to post-seismic response as opposed to accident management. It was also suggested that WGRISK should not be formally listed in the CAPS as the group's involvement would not be clear until the request for a lecture is made. A proposal for improving the CAPS has been prepared and will be submitted to WGIAGE by the Secretariat.

15. WGRISK Discussion 2016 – PSA Experience in modelling digital I&C

This topical discussion was led by Mr. Coyne and Mr. Porthin. Mr. Coyne introduced the session, noting the previous WGRISK activities had been to produce a report on Digital I&C Risk (<http://www.oecd-nea.org/nsd/docs/2009/csni-r2009-18.pdf>), which led to a task to develop a failure modes taxonomy (<http://www.oecd-nea.org/nsd/docs/2014/csni-r2014-16.pdf>). Mr. Coyne highlighted the recommendations arising from this earlier work and suggested that the members consider these open issues when planning further tasks in this area. He also noted the NEA Database Project that had collected information on digital system failures, COMPSIS, which ran from 2005 to 2011. Mr. Coyne highlighted the objectives of the session to share information, identify gaps and help shape future WGRISK activities.

The following are short summaries of the presentations, which can be found on the WGRISK website.

15.1 Modelling Digital I&C – Experience from Nordic research projects

Mr. Porthin described the experience gained from Nordic projects on reliability analysis of digital systems and on modelling of digital I&C. He described lessons learned from an example PSA model and implications for defence in depth. Mr. Porthin then outlined work that they have completed on assessing software reliability. Fatal failures can be estimated from operational history. Non-fatal failures can be estimated using engineering judgment, factoring in complexity and a V&V assessment. Mr. Porthin noted that international consensus and cooperation is required. Following Mr. Porthin's presentation, there was a lively discussion on methods for assessing software failures.

15.2 Slovakian Experience in modelling reliability of digital I&C

Mr. Sopira described RELKO's work on reliability of digital I&C, software failures, and common cause failures (CCF). Based on their work, hardware common cause failures are not a dominant contributor to system unavailability. Mr. Sopira also noted the challenges with software reliability, and suggested that failures should be minimized through extensive, standardized V&V and testing. He also suggested that reliability analysis has shown that well-designed safety I&C can be very reliable from the point of view of consequential failures. Mr. Sopira fielded a number of questions to clarify his presentation and views.

15.3 Digitalized NPP Risk Assessment Research Status in Korea

Mr. Kang summarized the experience in Korea. He described the challenges with determining software reliability, fault detection reliability with real systems, and network communication risk.

15.4 Risk-Informed Statistical Testing for Digital I&C Systems

Mr. Coyne described an application of a statistical testing methodology to a thermal hydraulics control system, using simulated input data and an actual control system to test the software.

15.5 Achieved and Planned Advances of Digital I&C Modelling in Flamanville EPR PSA

Mr. Quatrain described the Compact Failure Model that has been developed by EdF, and used to enable cooperation between designers and PSA analysts and between EdF and the Safety Authority and its TSO.

15.6 Modelling Digital I&C in PSA – German Experience

Mr. Piljugin described some of the challenges with modelling digital I&C based on German experience, and a model that they have developed for a generic digital I&C safety system.

15.7 Brief overview on ICDE data collection rules for I&C components

Mr. Piljugin summarized recommendations for addressing digital I&C needs within the ICDE Database. He also described ideas for a taxonomy of diversity attributes for digital I&C.

15.8 Summary of the Session

Following the presentations Mr. Coyne observed that there was some very good information on approaches to assessing reliability and modelling digital I&C for PSA. He suggested that discussions on potential future activities be held as part of agenda item 17.3.

16. WGRISK Planning

Ms. Röwekamp reviewed the status of the integrated plan. She noted that the proceedings of the workshop on Fire PRA have now been published and there is a follow-on task proposed to update the Technical Opinion Paper (TOP) on Fire PSA. The task on loss of electrical sources is a bit delayed but now going to the PRG and CSNI for approval. Lastly, the good progress on the four ongoing tasks had been reported under agenda items 8 to 11. WGRISK accepted the integrated plan, as presented.

17. WGRISK New Activities

17.1 Proposed CAPS “Joint Workshop on Use of OECD/NEA Data Project Operating Experience Data for Probabilistic Risk Assessment”

Mr. Coyne described the proposed task for a joint workshop with the Database Projects on use of their data for PRA. This is a follow-on to the previous task that culminated in a report on how to improve the use of data project outputs to support PRA. He noted that the Database Projects appreciated the input on how to improve their data collection, and that a follow-on workshop would continue to provide such advice from a PRA perspective, and would help member countries realize the value of participating in the database projects. The US and Germany have offered to lead, but would welcome interest of other participants. Mr. Coyne noted that the task is structured to respect the rights of participants of the Database Projects to ownership of their data, as the workshop would only involve publicly available derived or summarized information.

A WGRISK participant suggested that the title be modified to reflect that it is only open or available data that is the subject of the workshop, and the paragraph on confidentiality be moved up to the objective, to ensure that the rights of the Database Project participants are clearly respected.

The next step would be to incorporate the feedback that has been received and circulate the draft CAPS to the Database Projects for their input and participation, prior to finalization. Once the database projects have provided their feedback, the CAPS would be discussed at the WGRISK Bureau meeting in September 2016, and then be circulated for WGRISK final review and approval prior to going to the PRG and CSNI in December 2016. WGRISK members agreed with the path forward for the CAPS.

Action WGRISK-17-5: Mr. Coyne to finalize the CAPS on a workshop with Database Projects, and send to Mr. White for circulation to the Database Projects.

17.2 Proposed CAPS “Update of CSNI Technical Opinion Paper (TOP) No. 1: Fire Probabilistic Safety Assessment for Nuclear Power Plants”

Ms. Röwekamp noted that significant progress has been made on Fire PSA since TOP 1 on Fire PSA had been issued, and the purpose of this CAPS is to update the TOP accordingly. Germany, Sweden and the USA have agreed to take part, and participation of other WGRISK members was welcomed. Mr. Sursock noted that EPRI would be willing to help with the update. Mr. Amri noted that the IAEA would also be interested in participating. Also Ms. Akl said the CNSC would be willing to take part in the review. Mr. Porthin for VTT and Ms. Lanore for IRSN expressed their interest in reviewing the TOP draft.

WGRISK agreed that the CAPS should be submitted for approval by PRG and CSNI at their next meetings.

Action WGRISK-17-6: Mr. White to post the TOPs 1&2 on Fire and Seismic PSA on the WGRISK members website: <https://www.oecd-nea.org/nsd/reports/nea3948-fire-seismic.pdf>.

17.3 Discussion on a possible activity on Digital I&C

Mr. Coyne noted that there were some common themes from the presentations under agenda item 15. First, there are different approaches as to how detailed you model the system. Second, common cause failure is an area that needs further consideration. Mr. Dang observed that while there had been a lot of progress on assessing digital I&C, there is still a high degree of variation in approach, and therefore some form of benchmark might be useful. For example, it might be beneficial to develop a sample problem or sample system that could be used to investigate and assess the methods and approaches. Mr. Porthin and Mr. Kang

agreed that a sample problem would be useful, and both offered to contribute to the task. Ms. Röwekamp and Mr. Coyne noted that Germany and the USA would also be willing to contribute. Mr. Kang further offered to create a first draft of a CAPS in collaboration with Mr. Porthin. Mr. Hellström suggested some coordination with the MDEP cross-cutting group on Digital I&C would be valuable.

17.4 Other ideas

Ms. Röwekamp noted that following the completion of ASAMPSA_E later in 2016, it would be valuable to identify follow-on activities. She also noted that TOP 2 on seismic PRA (same document as the TOP on fire) could also benefit from updating, and this should be considered as a follow-on task. There could also be a task on spent fuel pool PSA.

18. WGRISK Working Methods

Ms. Röwekamp noted that the current working methods (surveys, workshops, etc.) are serving the group very well. She noted that it is important to remember to get input from groups working in similar areas, within and outside the NEA. Mr. Dang reminded members that if they have questions, they can approach the Bureau members. He also noted that there was an effort underway to provide a set of standard Q&As. It was noted that the distribution list for the WGRISK needed updating.

Action WGRISK-17-7: Mr. White to circulate the WGRISK members list for updating, particularly to note the primary members.

19. Next Meetings

- Next Bureau Meeting will be 19th-20th September 2016, NEA Headquarters.
- Next Annual meeting: OECD Conference centre CC5, 8th-10th March 2017.
- March 2017 Bureau meeting OECD Marshall Building MB2122, 6th-7th March 2017.

20. Other Matters

20.1 Technical issue discussion for 2017

The WGRISK Bureau discussed potential topics for the technical issue at the next meeting, and thought that PSA related to weather-induced hazards would be timely and interesting. Mr. Varde suggested that PSA for non-reactor facilities which might include, large scale industrial & R&D irradiators, isotope fabrication, fuel fabrication and reprocessing facilities, etc., may also be interesting. It was noted that it may be difficult to discuss the details of fuel processing facilities, but you could discuss methodologies or initiating events. There was a workshop in Canada on risk in fuel cycle facilities held around 2010, and there were safety studies presented, but little information on PRA.

Mr. Hollo offered to make a presentation on severe weather PRA. Mr. Kovacs offered to make a presentation covering their experience particularly with combinations of events. Mr. Schoen also offered a presentation on hazard estimation. Mr. Ahn noted that KAERI may be able to make a presentation on high winds and flooding PSA. Mr. Dang suggested that WGEV should be invited to make a presentation on their work on hazard characterization. With these offers, there is a good basis for the technical discussion in 2017, and the Bureau will follow-up.

Action WGRISK-17-8: Mr. White to ask WGFCs if they have any activities or interest in a discussion on fuel processing facilities PSA.

20.2 Succession Planning

Ms. Röwekamp reported that the terms for the Chair and Vice-chairs are complete, and thanked the group for their support for the past 3 years.

Mr. Dang noted Ms. Röwekamp had been a very effective chair and helped the group attain a high level of quality and productivity. He nominated Ms. Röwekamp for a second term, and this was seconded by Mr. Coyne. Ms. Röwekamp was accepted for a second term as Chair for WGRISK.

Mr. Coyne nominated Ms. Lanore, seconded by Mr. Hellström, for another term as Vice Chair, noting her strong contributions and vision for the group. Mr. Hollo also strongly her nomination and she was accepted for another term as Vice Chair.

Mr. Coyne nominated Mr. Bareith as Vice Chair, seconded by Ms. Lanore, noting his strong contributions to PSA and the working group and Bureau. Ms. Röwekamp supported his nomination, and he was elected as a Vice Chair.

Ms. Röwekamp thanked Mr. Coyne for his service as Vice Chair, and strong support for the WGRISK programme of work. She noted that he would continue to serve as a member of the WGRISK Bureau, and therefore continue to contribute to the group. Ms. Röwekamp noted that Mr. Patrick, Mr. Hellström, and Mr. Dang would continue their excellent support to WGRISK through membership on the Bureau. Lastly, Ms. Akl was welcomed as a potential future member for Bureau. Ms. Röwekamp encouraged WGRISK members to feel welcome to express their interest in joining the Bureau.

21. Closure of the Meeting

Ms. Röwekamp thanked everyone for their strong interest and contributions to the discussions, and wished everyone a safe trip home.

APPENDIX 1

ABBREVIATED AGENDA

1. **Opening of Meeting**
2. **Adoption of the Agenda [NEA/SEN/SIN/WGRISK/A(2016)2]**
3. **Approval of the 16th WGRISK Meeting Summary Record [NEA/SEN/SIN/WGRISK (2015)1]**

Exchange of Information

4. **The Use and Developments of PSA in NEA Member Countries**
5. **Reports on Activities in the Area of PSA by Other International Organisations (IAEA, CEC, WANO, VVER RG, WENRA, etc.)**
 - 5.1 IAEA presentation
 - 5.2 Presentation of the ASAMPSA_E Project
6. **Report by Secretariat**

WGRISK Programme of Work

7. **Status report on the PSA insights relating to the loss of electrical sources [Task 2013(1)]**
8. **HRA in External Events PSA [Task 2015(1)]**
9. **Status report on Site Level PSA (Including Multi-unit PSA) Developments [Task 2015 (2)]**
10. **Status report on Status of Practice for Level3 Probabilistic Safety Assessment [Task 2015(3)]**
11. **Status Report on Use and Development of Probabilistic Safety Assessment in Member and Non-member Countries [Task 2015 (4)]**

Other International PSA Activities

12. **WGRISK participation to international conferences, workshops, etc.**
13. **Other International Meetings/Activities Relevant to WGRISK**

14. Cooperation with other NEA Working Groups, Task Groups or Expert Groups

- 14.1 Outcome of discussion on “Using probabilistic and deterministic methods when making regulatory decisions” at 34th CNRA meeting (Chair)
- 14.2 Interactions with Database Projects (see also 17.1)
- 14.3 Interactions with WGEV – feedback from Secretariat and discussion
- 14.4 Further Activities - Secretariat

WGRISK Technical Discussion

15. WGRISK Discussion 2016 – PSA experience in modelling digital I&C

- 15.1 Nordic experience from the MODIG project (M. Porthin, VTT, Finland)
- 15.2 Slovakian experience in modelling digital I&C (V. Sopira, RELCO; Slovak Republic)
- 15.3 Digitalized NPP risk assessment research status in Korea (H.G. Kang, KAIST, Korea)
- 15.4 Risk-informed Statistical Testing for Digital I&C Systems (K. Coyne, NRC, USA)
- 15.5 Achieved and planned advances of Digital I&C modelling in Flamanville EPR PSA (R. Quatrain, EdF, France)
- 15.6 Modelling digital I&C in PSA – German experience (E. Piljugin, GRS, Germany)
- 15.7 Brief overview on ICDE data collection rules for I&C components (E. Piljugin, GRS, Germany)

WGRISK Programme of Work

16. WGRISK Planning

17. WGRISK New Activities

Closing Session

18. WGRISK Working Methods

19. Dates of Next Meetings

- 19.1 Annual Meeting
- 19.2 Task Group Meetings

20. Other Matters

- 20.1 Technical Issue Discussion for 2017 possibly “PSA for harsh weather conditions”
- 20.2 Election of Chair for 2016 to 2019
- 20.3 Election of Vice-Chairs for 2016-2019
- 20.4 Bureau Composition

21. Closure of Meeting.

APPENDIX 2

ACTIONS FROM 17TH WGRISK MEETING

Action WGRISK-17-1: Mr. Dang to provide Mr. White with slides to update WGHOE on the progress of the task on HRA in External Events PSA.

Action WGRISK-17-2: Mr. Dang to confirm dates for the September 2016 meeting with members of the task group for HRA in External Events PSA.

Action WGRISK-17-3: Ms. Lanore to circulate the structure of the update for the report on use and development of PSA via the secretariat to solicit input from WGRISK.

Action WGRISK-17-4: WGRISK members to provide their feedback on the structure of the update for the report on use and development of PSA.

Action WGRISK-17-5: Mr. Coyne to finalize the CAPS on a workshop with database projects, and send to Mr. White for circulation to the database projects.

Action WGRISK-17-6: Mr. White to post the TOPs 1&2 on Fire and Seismic PSA on the WGRISK members website: <https://www.oecd-nea.org/nsd/reports/nea3948-fire-seismic.pdf> .

Action WGRISK-17-7: Mr. White to circulate the WGRISK members list for updating, particularly to note the primary members.

Action WGRISK-17-8: Mr. White to ask WGFCF if they have any activities or interest in a discussion on fuel processing facilities PSA.

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