

OECD WGRISK – Recently Ongoing and Potential Future International Risk-Related Activities

Marina Roewekamp

**Kwang-II Ahn, Yolande Akl, Attila Bareith,
Vinh Dang, Jeanne-Marie Lanore, Markus Porthin,
Gerhard Schoen, Sung Min Shin**

**PSAM 14,
Los Angeles, CA, USA, September 17-21, 2018**

Background: OECD Nuclear Energy Agency (NEA) - 1

- NEA is an intergovernmental agency under the framework of the Organisation for Economic Co-operation and Development (OECD), with headquarters in Paris, France
- NEA facilitates cooperation among countries with advanced nuclear technology infrastructure to achieve excellence in nuclear safety, technology, science, related environmental and economic matters, and law
- NEA consists of **33 countries** accounting for ~ 84 % of the world's installed nuclear capability



Background: OECD Nuclear Energy Agency (NEA) - 2

- NEA has eight standing committees – two of which directly relate to nuclear power plant safety:
 - **CNRA** - Committee on Nuclear Regulatory Activities
 - **CSNI** - Committee on the Safety of Nuclear Installations

- CNRA and CSNI have jointly identified five main challenges and focus areas:
 - Adequate nuclear skills and infrastructure
 - Effectiveness and efficiency of safety activities
 - Safe operation of current nuclear installations
 - Safety in new nuclear installations and in advanced reactor designs
 - Human aspects of nuclear safety



Introduction - WGRISK

- Main objective of the CSNI Working Group on Risk Assessment (WGRISK) is to advance the understanding and utilization of probabilistic safety assessment (PSA = PRA) in improving the safety of nuclear installations in member countries
- PSA is a necessary and useful complement to traditional deterministic safety analysis
- WGRISK carries out various activities
 - to exchange risk related information between experts in member countries and
 - to advance the use of these tools for improving safety
- WGRISK reports can be found at:
<https://www.oecd-nea.org/nsd/docs/indexcsni.html>

Introduction – WGRISK Tasks

- Task 2015(1): HRA in External Events PSA
- Task 2015(2): Status of Site Level-PSA (Including Multi-Unit PSA) Developments
- Task 2015(4): Use and Development of Probabilistic Safety Assessment in Member and Non-Member Countries
- Task 2016(1): Update of CSNI Technical Opinion Paper (TOP) No. 1: Fire Probabilistic Safety Assessment for Nuclear Power Plants
- Task 2017(1): Workshop for Database Joint Projects
- Task 2017(2): Digital I&C PSA (DIGMAP)
- Task 2017(3): Update of CSNI Technical Opinion Paper (TOP) No. 2: Seismic Probabilistic Safety Assessment for Nuclear Power Plants

Task 2015(1): HRA in External Events PSA - 1

■ Objectives

- Survey on Human Reliability Analysis (HRA) methods and their applications in existing PSAs for external events, or being considered for such PSA

■ Scope

- Focus on seismic, external flooding, and severe weather initiators
- Draw experience and parallels for other hazards, if available

■ Survey responses

- 11 institutions from 9 member countries
 - ❖ 8 responses for HRA in **seismically initiated scenarios**
 - ❖ 9 responses : **severe weather scenarios**
 - ❖ 3 responses : **flooding induced scenarios**
- Focus: breadth of modelling approaches and their rationales

Task 2015(1): HRA in External Events PSA - 2

- **Observations based on survey responses**
 - Actions appearing in both EEPsA and other scenarios: challenge to establish consensus for adjustments ... and even if needed
 - Actions outside control room: portable equipment such as pumps, but also preparation of plant, including deployment of barriers
 - Challenging to trains and/or observe in anticipated conditions
- **Next Steps**
 - Examine assumptions and models in light of available operating experience to prioritize modeling issues
 - Submission of Task Report after WGRISK approval in March 2019 to CSNI for endorsement in June 2019 and publication

Task 2015(2): Status of Site-Level PSA Developments - 1

■ Objectives

- Survey on exchanging information, how multiple reactor and multiple radioactive source issues are addressed in risk analyses in member countries, identifying their challenges and ongoing research activities for Site Level PSA

■ Two Task phases

- Phase 1: Surveys on member countries' practices and research activities on Site Level PSA for 3 focus areas
 - ❖ Focus Area 1: Risk aggregation
 - ❖ Focus Area 2: Multi-source interactions or dependencies
 - ❖ Focus Area 3: Site-based risk metrics and safety goals
- Phase 2: International workshop on “Site-Level PSA Developments (Including Multi-Unit Issues)”, in July 2018 expanding different technical challenges identified in Phase 1

Task 2015(2): Status of Site-Level PSA Developments - 2

■ Results of Phase 1

- Responses in total by 18 member countries
- Focus Area 1: **Risk Aggregation**
 - ❖ Increasing interest in assessing and understanding total aggregated risk from internal and external hazards involving all major radiological sources at a nuclear installation at different plant operating states
 - ❖ Aggregation methods vary from simple addition of single hazards risks to the development of a master fault tree integrating contributions from different hazard groups
 - ❖ Lack of multi-unit, site-based acceptance criteria

Task 2015(2): Status of Site-Level PSA Developments - 3

■ Results of Phase 1 (contd.)

- Focus Area 2: **Multi-Source Interactions and Dependencies**
 - ❖ For most countries the four types of dependencies identified in IAEA SSG-3 are sufficient to be modeled within Site-Level PSA
 - ❖ Other countries have developed new classification schemes
 - ❖ Common challenges identified as important for Multi-Unit HRA:
 - Extreme conditions
 - Prioritization/limitation of resources
 - Stress level
- Focus Area 3: **Site-Based Risk Metrics and Safety Goals**
 - ❖ Safety goals are used as indicators
 - ❖ No different Level 1 and Level 2 PSA safety goals for sites and individual units

Task 2015(2): Status of Site-Level PSA Developments - 4

■ Findings from Phase 2

- Safety goals and regulatory framework
 - ❖ Differences regarding definition and application of safety goals in member states
 - ❖ In general, no site-based safety goals
 - ❖ Significance of Level 3 PSA
- Risk aggregation
 - ❖ Technical concerns regarding different degrees of realism across the analyses of different risk contributors
 - ❖ Some risk metrics not applicable to all sources at a site
 - ❖ Need for more detailed aggregation schemes
 - ❖ Risk aggregation by extension of Single-Unit PSA or through an integrated model

Task 2015(2): Status of Site-Level PSA Developments - 5

- **Findings from Phase 2 (contd.)**
 - Risk aggregation (contd.)
 - ❖ Some countries introduce Multi-Unit PSA considerations in a gradual approach
 - ❖ Site and regional risk
 - Dependencies
 - ❖ Dependencies due to limited resources
 - ❖ Dependencies associated with cascading effects

Task 2015(2): Status of Site-Level PSA Developments - 6

- **Findings from Phase 2 (contd.)**
 - Technical challenges
 - ❖ CCF for large component groups
 - ❖ HRA
 - ❖ Systematic hazards consideration
 - ❖ Cascading failures
 - ❖ Modeling issues
 - **Other insights**
 - ❖ High pressure to work on Site-Level PSA in some countries
 - ❖ Multi-Unit PSA is technically feasible
 - ❖ Multi-Site events (regional events)
 - ❖ OPEX provides useful lessons

Task 2015(2): Status of Site Level PSA Developments - 7

■ Next Steps

- Draft Task Report by end-2018
 - ❖ Summarizing Phase 1 and Phase 2 results in a common report structure
 - ❖ Including as attachments Phase 1 survey responses and Phase 2 Workshop contributions
 - ❖ Providing some conclusions by Task group and recommendations to WGRISK and CSNI/CNRA
- Submission of Task Report after WGRISK approval in March 2019 to CSNI for endorsement in June 2019 and publication

Task 2017(1): Use of OECD/NEA Database Project Operating Experience Data for PSA - 1

- **Scope**
 - Conduct a joint workshop of WGRISK with NEA joint Database Projects
 - ❖ ICDE (International Common Cause Failure Data Exchange)
 - ❖ FIRE (Fire Incidents Record Exchange)
 - ❖ CODAP (Component Operational Experience, Degradation, and Ageing Programme)
 - Follow-up activity of former task reported in NEA/CSNI/R(2014)2, *“Use of OECD/NEA Data Project Products in Probabilistic Safety Assessment”*

Task 2017(1): Use of OECD/NEA Database Project Operating Experience Data for PSA - 2

■ Objectives

- Identify, update, characterize, and share current uses of Database Project products and data in support of PSA for nuclear power plants
- In collaboration with the Database Projects, identify and characterize new operating experience data needs for Probabilistic Safety Assessment
- Demonstrate the value of the Database Project products to PSA and continue to strengthen the coordination between Database Project activities and end users

■ Task status

- Workshop was conducted in late April 2018 with nearly 20 participants from WGRISK, ICDE, FIRE and CODAP
- All 8 presentations will be included in the Task Report

Task 2017(1): Use of OECD/NEA Database Project Operating Experience Data for PSA - 3

- **Findings / discussion issues of the workshop**
 - Can the NEA Databases be used to support RIDM, and what may improve their usefulness for RIDM
 - Is there additional information that could be collected to improve the use of the NEA Databases for PSA
 - Other applications for the NEA Databases to support risk assessments
 - Are there new data needs to support PSA/PRA
- **Next Steps**
 - Draft Task Report
 - Submission of Task Report after WGRISK approval in March 2019 to CSNI for endorsement in June 2019 and publication

Task 2017(2): Digital I&C PSA (DIGMAP) - 1

■ Objectives

- Compare the PSA models developed concerning methods used, level of detail, quantification issues, consideration of specific digital features
- Identify possible modeling methods and issues for further development

■ Scope

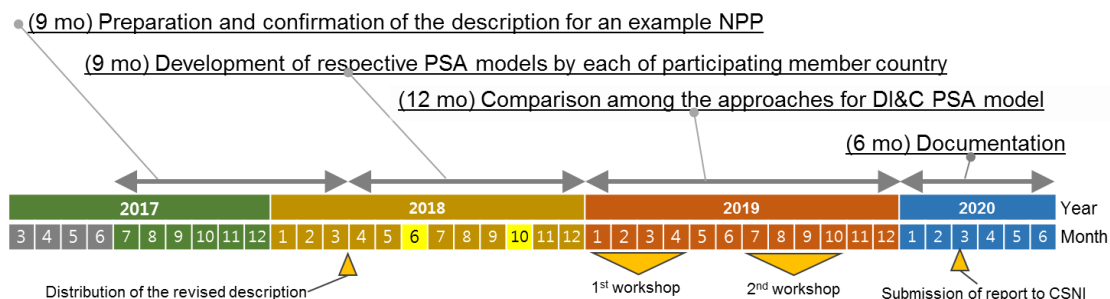
- Each participant needs to develop a model and its description based on a system layout of an example NPP equipped with digital features
- Collection of modeling approaches and their descriptions
- Workshops for (1) sharing the models and setting a comparison framework, and (2) discussion on comparison

Task 2017(2): Digital I&C PSA (DIGMAP) - 2

Task status

- Nine participating countries (KOR and SWI as lead, FIN, CZE, FRA, GER, NED, UK (core group), CAN (observer))
- Reference plant description developed based on the DIGREL PSA model of a simplified fictive BWR provided by Finland
- Plant description concerning digital I&C finished in spring 2018
- Each participant to develop a corresponding DI&C PSA model by December 2018

Next steps



- CSNI endorsement in June 2020

Los Angeles, CA, USA PSAM 14
September 17-21, 2018

Task 2015(4): Use and Development of Probabilistic Safety Assessment in Member and Non-member Countries - 1

■ Scope and Objectives

- Regular update every 5 years
- Present status of PSA developments and applications in WGRISK member countries and some non-member countries through IAEA (22 countries involved)
- Specific focus on lessons learned from post-Fukushima investigations and their effects on PSA

■ Insights so far

- Use and development of PSA continues to grow internationally, e.g., regarding scope of PSA studies, number of risk-informed applications, and volume of ongoing PSA R&D
- New applications often need new developments which lead to further new applications
- International cooperation is also a driver for PSA extension

Task 2015(4): Use and Development of Probabilistic Safety Assessment in Member and Non-member Countries - 2

■ Insights so far (contd.)

- Development of new and advanced designs has led to a more rapid development in certain topical areas, e.g., definition of a more formal framework concerning PSA and its scope required, more precise safety goals, consideration of external hazards.
- Several important ongoing PSA activities are related to the Fukushima Dai-ichi reactor accidents with increasing interest:
 - ❖ Some of these activities (e.g., whole site PSA) involve unresolved issues recognized before March 2011 but not yet subject of major projects
 - ❖ Other activities (e.g., External Hazards PSA, Spent Fuel Pool PSA) were already being addressed by development efforts, however were revised and improved (e.g. Seismic PSA)

Task 2015(4): Use and Development of Probabilistic Safety Assessment in Member and Non-member Countries - 3

■ Next steps

- Draft Task Report available
- Submission of Task Report after WGRISK approval in fall 2018 to CSNI for endorsement in December 2018 and publication

Task 2016(1): Update of CSNI Technical Opinion Paper (TOP) No. 1: Fire Probabilistic Safety Assessment for NPPs - 1

■ Objectives

- Provide a clear technical opinion of risk analysts and experts from NEA member countries on the current state-of-the-art in fire probabilistic safety assessment (Fire PSA) for the design and operation of nuclear power plants for the entire operational plant life cycle

■ Scope

- Provide a state-of-the-art update of the OECD/NEA/CSNI TOP No. 1: Fire Probabilistic Safety Assessment for NPPs published in the early 2000s

Task 2016(1): Update of CSNI Technical Opinion Paper (TOP) No. 1: Fire Probabilistic Safety Assessment for NPPs - 2

■ Status and insights of the task

- Updated TOP contains viewpoints and perspectives resulting from work of the corresponding task members
- It is also based on results of an international WGRISK Workshop on Fire PRA
- Technical opinions also consider the operating experience regarding fires in NPPs, in particular from those fire events collected and analyzed within the OECD FIRE Database Project.
- Moreover, results from the fire related experimental NEA Projects PRISME and HEAF have been considered

Task 2016(1): Update of CSNI Technical Opinion Paper (TOP) No. 1: Fire Probabilistic Safety Assessment for NPPs - 3

■ Status and insights of the task (contd.)

- TOP clearly demonstrates that fire continues to be an important risk contributor for nuclear installations in member countries
- Fire PSA methods, models, tools, and data continue to improve and the practice of Fire PSA continues to mature
- Fire PSA is a valuable tool providing useful results and insights in support of risk-informed decision making
- It is important to note that knowledge of the uncertainties and potential biases in Fire PSA results can and should be addressed.

■ Next steps

- Draft Task Report for comments
- Submission of Task Report after WGRISK approval in fall 2018 to CSNI for endorsement in December 2018 and publication

Task 2017(3): Update of CSNI Technical Opinion Paper (TOP) No. 2: Seismic Probabilistic Safety Assessment for NPPs - 1

▪ Objectives

- Provide a clear technical opinion of risk analysts and experts from NEA member countries on the current state-of-the-art in seismic probabilistic safety assessment (Seismic PSA) for the design and operation of nuclear power plants for the entire operational plant life cycle

▪ Scope

- Provide a state-of-the-art update of the OECD/NEA/CSNI TOP No. 2: Seismic Probabilistic Safety Assessment for NPPs published in the early 2000s

Task 2017(3): Update of CSNI Technical Opinion Paper (TOP) No. 2: Seismic Probabilistic Safety Assessment for NPPs - 2

■ Status and insights of the task

- TOP provides a technical opinion of risk analysts and experts on current state-of-the-art in seismic probabilistic safety assessment
- Main elements of the TOP: probabilistic seismic hazard analysis, fragility analysis, development and quantification of the SPSA model
- Important applications of a SPSA are also discussed
- SPSA provides a broad scope of insights relating to plant safety
- Including SPSA in a risk assessment results in a more complete risk picture, and thus enables more meaningful PSA applications

■ Next steps

- Draft Task Report for comments by WGRISK, WGEV and WGIAGE
- Submission of Task Report after WGRISK approval in March 2019 to CSNI for endorsement in June 2019 and publication

PSAM 14

Los Angeles, CA, USA

September 17-21, 2018

27

Conclusions

- WGRISK provides timely, high-quality work products addressing broad range of risk assessment and management needs identified by CSNI and the working group members
- It serves as an important resource for risk-related knowledge management activities as well as an internationally recognized, authoritative source on risk-related matters
- WGRISK reports are generally available to the public on the OECD NEA website (<http://www.oecd-nea.org/nsd/docs/indexcsni.html>)

Outlook

- Topics of high interest for future Technical Discussions:
 - Use and application of operating experience in PSA (including precursor events)
 - Modeling portable equipment in PSA
 - PSA model uncertainties
 - Dynamic PSA
 - PSA data updates
 - PSA for SMR

Thank you for your attention!