

WGRISK (2019)2

Project/Activity Title	Probabilistic Safety Analysis (PSA) for Combinations of External Hazards – an Overview of the Current State of the Art
Objective	The objective of the task is to provide an overview of the current state of the art for risk analysis of combinations of external hazards and to review the methods applied for these analyses in order to present a basis for advances in the area.
Scope	A survey will be performed which is intended to recognize and briefly characterise the methods and approaches used in the WGRISK member states to include combinations of external hazards in the scope of PSA. The scope will include methodologies for identification, interpretation, selection and screening of hazard combinations, probabilistic hazard assessment, plant response and fragility analysis, development of event sequence models including the role of plant personnel, and risk quantification along with the treatment of uncertainties. As internal events and hazards that are consequential to external hazards or combinations of external hazards are typically considered in plant response and fragility analysis and in the associated accident sequence modelling, this aspect will be addressed accordingly in the survey. Natural as well as man-made external hazards will be in the scope of the activity, considering accidents induced by hazard combinations in full power as well as in low power and shutdown states. Moreover, to what extent and how the combinations of external hazards with internal hazards or other plant transients independent of the external hazards are treated in plant PSA will be addressed in the survey too.
Justification	<p>The definition of the design basis for nuclear power plants (NPPs) has often been based on considering single external hazards explicitly. Accordingly, the analysis and evaluation of plant protection against design basis loads, the assessment of safety margins for design basis and beyond design basis events, and the probabilistic safety assessment have been focused on single external hazards applicable to a given site and facility. In the aftermath of the Fukushima Dai-ichi accidents, national nuclear safety regulations pay more attention to the requirements related to safety demonstration of NPPs by considering an exhaustive list of site-specific hazards relevant to specific plant designs including, in particular, combined external hazards. These requirements, international recommendations (e.g., from IAEA and WENRA) and lessons learnt from the Fukushima Dai-ichi NPP accidents point out the importance of systematically identifying and assessing those combinations of external hazards that may endanger NPPs so that the impact of these hazards on the plant safety can be properly understood and evaluated.</p> <p>Consequently, substantial efforts are devoted in several WGRISK member states to analysing and evaluating plant protection against design basis loads and beyond as induced by combinations of external</p>

	<p>hazards and to developing PSA models for such hazard combinations. However, there appears to be a lack of international consensus, and no widely agreed and accepted methods are available for risk assessment in this area. The lessons to be learnt from the proposed survey aim on identifying state of the art approaches and on determining challenges and analysis areas that need to be further dealt with in order to develop PSA studies with a more systematic and rigorous treatment of combined external hazards.</p>
Expected results and Deliverables	<p>The evaluation of the survey will provide an overview of the current state of the art for risk analysis of combinations of external hazards including methods applied for these analyses as well as recommendations for follow-up activities (if necessary).</p> <p>The deliverable of the activity will be a Task Report summarizing the survey results and the conclusions drawn from the evaluation of the survey.</p>
Users	<p>Expected users:</p> <ul style="list-style-type: none"> - Regulatory organizations - Safety analysts in utilities - Specialists and responsible managers in utilities employing and supervising the use of risk-oriented decision making - Technical support organisations (TSOs) - Risk analysis practitioners and consultants from nuclear industry supporting nuclear safety authorities and licensees
Relation to other projects	<p>The proposed activity is related to the WGRISK Task (2006)¹ (NEA Report NEA/CSNI/R(2009)⁴), where a survey on PSA of external events other than earthquake was performed. The combinations of external hazards were addressed in the survey report to some limited extent. Significant improvements have been made in this area since then that should be reviewed and evaluated. Moreover, the earlier WGRISK task did not specifically address methodological issues in detail. Accordingly, the proposed task is an extension of the previous task in this direction.</p> <p>Other recent WGRISK tasks such as Task (2012)¹, NEA Report NEA/CSNI/R(2014)⁹ related to the WGRISK Workshop on “Probabilistic Safety Assessment (PSA) of Natural External Hazards Including Earthquakes”, Task (2012)², and Task (2015)² on the “Status of Site-Level (Including Multi-Unit) PSA Developments”, NEA/CSNI/R(2019)^x (under publication) highlighted that the impacts of combinations of external hazards are an important area of concern in risk studies. Accordingly, the proposed task is also a follow-up to these earlier tasks.</p> <p>The new activity is planned to be performed in close coordination and interfacing with the Task of WGEV on “Integrated Hazard Impacts”.</p>
Safety significance/ priority (see priority criteria in	<p>The activity corresponds to all the CSNI criteria used for</p>

Operating Plan and Guidelines)	determination of priorities of research activities: Criterion 1: Relevance to CSNI challenges and technical goals – High Criterion 2: Better accomplished through international co-operation under the NEA – High Criterion 3: Likely to bring conclusive results and significant added value to nuclear safety in a reasonable time frame – Medium Criterion 4: Capacity to maintain and preserve strategic safety competence – High
Technical Goal(s) covered	The following CSNI Main Challenges (and associated Technical Goals) are addressed by the proposed project: 2. Effectiveness and efficiency of activities related to safety <ul style="list-style-type: none"> • to ensure that work activity proposals address safety-significant issues including the lessons learnt from accidents and incidents that should result in deliverables that are clear, accurate, timely and useful for furthering safety activities; • to build and harmonize international approaches to safety issues through the use of multi-national collaborative efforts and cost and resource sharing. 3. Safe operation of current nuclear installations <ul style="list-style-type: none"> • to develop approaches and methods to quantify safety margins; • to further review and assess the development of PSA methods, to promote further PSA applications in the operation of nuclear installations and to review risk-informed approaches. 4. Safety in new nuclear installations and in advanced reactor designs <ul style="list-style-type: none"> • to review current analytical tools as well as risk assessment approaches regarding their applicability to safety assessments of new and advanced designs and further develop and validate them where needed.
Knowledge Management and Transfer covered	Available methodologies, good practices sharing and gaps/challenges will be covered by the task and documented in a CSNI report to facilitate knowledge transfer.
Milestones (deliverables vs. time)	The following task schedule is proposed: <ul style="list-style-type: none"> • Kick-off task group meeting – February 2020 (prior to annual WGRISK meeting) • Preparation and distribution of survey – May 2020 • Collection of survey responses – September 2020 • Evaluation of survey responses and distribution of clarifying questions as necessary – December 2020 • Responses to clarifying questions as necessary – February 2021 • Task group meeting on development of task report – March 2021 (prior to annual WGRISK meeting) • Preparation of draft task report – July 2021 • WGRISK and WGEV comments on draft report – September

	<p>2021</p> <ul style="list-style-type: none"> • Task Group meeting – October 2021 (in conjunction with WGRISK Bureau meeting) • Preparation of a final draft report and distribution to WGRISK and WGEV members for review – January 2022 • Feedback from WGRISK and WGEV on review of final draft – March 2022 • WGRISK/WGEV meeting: discussion and acceptance of the proposed report with specification of final modifications in a task group meeting, if needed – March 2022 • Finalization of task report– June 2022 • Approval by WGRISK – September 2022 • Endorsement by CSNI – December 2022 2022
Lead organisation(s) and coordination	NUBIKI (Hungary), GRS (Germany), UJV (Czech Republic), RELKO (Slovakia)
Participants (individuals and organisations)	TBD
Resources	<p>Task leaders: approx. 3-4 months of work required, including phone and/or video conferences (developing the survey questionnaire and the synthesis report)</p> <p>Core group: approx. 1-2 months of work required, including phone and/or video conferences (developing/reviewing the questionnaire and the synthesis report)</p> <p>Other countries: approx. 2 weeks of work required (filling out the questionnaire and reviewing the report)</p>
Requested action from PRG/CSNI	Endorsement by PRG and CSNI is requested.
PRG Recommendation	
CSNI Disposition	Being requested at the December 2019 CSNI meeting.