



NUCLEAR SAFETY RESEARCH INSTITUTE

Understanding of the overall risk profile: multiunit context and risk aggregation topics Panel discussion

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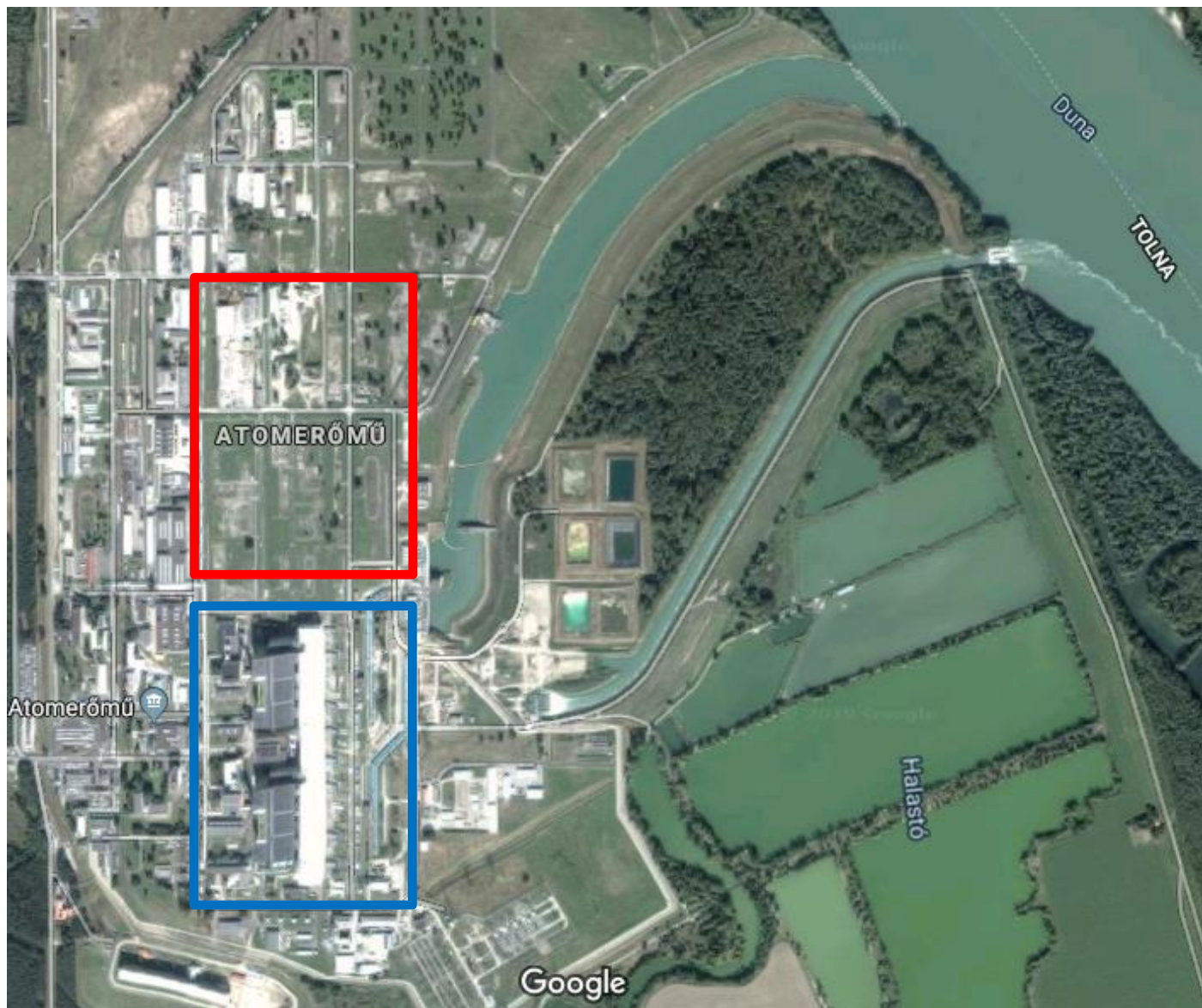
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Question 1: experience in PSA for a multi-unit site and/or risk-informed decision making

- Paks NPP: four VVER-440/213 units in twin-units arrangement plus an interim dry storage facility for spent fuel
- Preparation for two additional units of 1200 MWe each is ongoing
- Site level risk assessment for the four existing reactors is underway
 - All sources
 - All hazards
 - All operating modes (operational states)
- Ultimate goal is level 2 site risk assessment, although current efforts aim at developing and quantifying multi-unit and multi-source level 1 PSA model(s)
- Four existing reactor units plus two new builds will make the risk picture/profile even more complex
 - Construction phase of new builds
 - Parallel operation of old and new NPP units
 - Successive decommissioning of old units
 - Need for additional interim spent fuel storage space/facility





Question 2: major benefits and/or challenges in the area of risk assessment in multiunit context

- (Expected) benefits
 - Better understand the overall risk profile? Important and useful... but mostly from the point of view of health effects, i.e. level 3 PSA
 - Develop an improved, risk(PSA)-informed understanding of plant vulnerabilities to events that can challenge multiple plant units or/and sources of release simultaneously
 - Better evaluate the effectiveness of plant design solutions and safety upgrades (supported by considerations to risk primarily on the basis of single-unit and single-source assessments)
- Major challenges?
 - Taking an unpaved road – challenging but exciting
 - Modeling/quantifying responses of multiple facilities to an initial disturbance or multiple disturbances in a credible and still manageable way
 - HRA – including modelling the roles and interactions of multiple actors, shared decision processes, emergency response team decisions, conditions of actions

Question 3: experiences/major difficulties in the aggregation of various risk contributors

- Experience
 - Risk aggregation for various (numerous) plant operational states and hazards
 - Combined use of fully integrated and less integrated PSA models and analysis tools/software
 - Aggregated point estimates and uncertainty distributions with considerations to differences in the scope and detail of addressing uncertainties
 - Aggregation of importance and sensitivity measures
 - Qualitative description of the effects of heterogeneity between different PSA model parts / quantified risk contributors to help the better use of risk information in decision making
- (Some) challenges
 - Properly substantiated considerations to the effects of heterogeneity in risk aggregation
 - Development of fully integrated risk models as a basis for risk aggregation using a common, appropriate quantification tool
 - Aggregation that is suitable for describing site risk (covering multiple and often markedly different risk sources) in general

Analysis area			Unit 1	Unit 2	Unit 3	Unit 4	Multi-unit
Reactor	Full power	Internal events	Completed	Completed	Completed	Completed	Ongoing
		Internal fire	Completed	Completed	Completed	Completed	Ongoing
		Internal flooding	Completed	Completed	Completed	Completed	Ongoing
		Seismic events	Ongoing	Ongoing	Completed	Ongoing	Ongoing
		Extreme weather	Ongoing	Ongoing	Partially completed	Ongoing	Ongoing
		Riverine events	Ongoing	Ongoing	Completed	Ongoing	Ongoing
	Low power and shutdown	Internal events	Completed	Completed	Completed	Completed	Ongoing
		Internal fire	Completed	Completed	Completed	Completed	Ongoing
		Internal flooding	Completed	Completed	Completed	Completed	Ongoing
		Seismic events	Ongoing	Ongoing	Completed	Ongoing	Ongoing
		Extreme weather	Ongoing	Ongoing	Partially completed	Ongoing	Ongoing
		Riverine events	Ongoing	Ongoing	Completed	Ongoing	Ongoing
Spent fuel pool	All modes	Internal events	Completed	Completed	Completed	Completed	Ongoing
		Internal fire	Completed	Completed	Completed	Completed	Ongoing
		Internal flooding	Completed	Completed	Completed	Completed	Ongoing
		Seismic events	Ongoing	Ongoing	Completed	Ongoing	Ongoing
		Extreme weather	Planned	Planned	Partially completed	Planned	Planned
		Riverine events	Planned	Planned	Planned	Planned	Planned

Legend

- Completed
- Partially completed
- Ongoing
- Planned

Question 4: most important steps to be taken to achieve substantial progress

- Reconsideration of probabilistic safety targets/ goals – with appreciation of and considerations to uncertainties
- Making advancement in single-source, single-unit PSA to reduce heterogeneity and fill-in existing gaps in our capabilities to model and quantify certain phenomena/sequences to the extent practicable
- Synthesis of results and findings from international (e.g. OECD NEA CSNI/WGRISK, IAEA , etc.) and associated national efforts to help identify viable, preferably consensus-based, approaches/methods
- Development of common platforms (computerized tools) useful for developing and quantifying integrated PSA models including single-source and multi-source PSA models and risk aggregation

**Thank you for your
attention!**
