

Tutorial on Fundamentals of External Hazard Probabilistic Risk Assessment and Its Use in Risk- informed And Performance-based (RIPB) Applications

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International Panel: Andrei Blahoianu

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Dedication

This tutorial is dedicated to the memory of Dr. Robert P. Kennedy. Dr. Kennedy was the primary developer and motivator of the concepts, methods, and applications of the subjects discussed in this tutorial. His leadership was crucial in advancing the use of risk-informed and performance-based approaches in the nuclear industry. He was a great mentor to all of us who have been involved in developing this tutorial.

Objectives

- The prime objective of this tutorial is to familiarize participants who are inexperienced with PRA (probabilistic risk assessment) in general and with external hazard PRA in particular, with an emphasis on seismic PRA (SPRA) as a well-established and practiced methodology, and its applications to risk-informed decisions including the regulatory framework now under active development for the new advanced reactor designs.
- A second objective of this tutorial in the venue of SMiRT-25 is to motivate newcomers to become practitioners in this important area.

Motivation

- PRAs and risk results and other insights that they provide are already being incorporated along with the traditional deterministic framework to understand safety, and to improve safety and performance. Our knowledge of natural hazards is continually improving which requires frequent evaluation of how new knowledge affects plant safety. The PRA methods and results provide a very efficient mechanism to address this concern.
- The next phase of the nuclear power industry is the development of advanced reactors. Both the industry and NRC are moving toward a more risk-informed regulatory framework for designing and regulating these reactors.
- The industry and regulators in the past have suffered from the lack of availability of knowledgeable and expert resources in some areas of PRA technologies. This lack of resources may become more acute as we move toward implementation of a more risk-informed regulatory framework for the new generation of power plants.

Scope of this Tutorial

- To describe basic concepts of a SPRA and RIPB decision framework, how their uses complement deterministic processes, and why it is necessary to consider both approaches
- To describe the three fundamental building blocks of a SPRA (and EEPRA): hazard assessment; fragility assessment; and plant response analysis
- To provide examples of results and insights obtained from past SPRAs and their applications to address regulatory and operational considerations
- To describe what lies ahead and what are the challenges associated with the RIPB regulatory framework for advanced reactors and relationship to seismic design and regulation
- Share international experience and activities related to RIPB framework

Tutorial Outline

Topic	Speaker	Time
Introduction and Key-note Lecture	Robert Budnitz	45 min
SPRA Methodology		
Hazard	Nilesh Chokshi	35 min
Plant Response / Systems Analysis	Robert Budnitz	45 min
Fragility	Greg Hardy	65 min
Applications of SPRAs for Regulatory & Industry Perspectives		
Regulatory Perspective	Mehdi Reisi Fard	30 min
Industry Applications	John Richards	30 min
RIPB for Advanced Reactors		
RIPB Framework	Amir Afzali and Jason Redd	30 min
Seismic Analysis and Design	Nilesh Chokshi	15 min
Closing	Nilesh Chokshi	10 min
International Panel on Use of SPRA & RIPB Framework Moderator: Andrei Blahoianu (Canada)	Nilesh Chokshi (USA) Amir Afzali (USA) Tsuyoshi Takada (Japan) Toshiaki Sakai (Japan) Emmanuel Viallet (France)	60 min