



Summary of Session 1

IEM on

**“Strengthening R&D Effectiveness in the Light of
the Accident at the Fukushima Daiichi NPP”**

IAEA Headquarters, Vienna, Austria

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JP Sursock

Electric Power Research Institute

Session 1: Measures to Protect NPPs Against External and Internal Events - Presentations

- **Liisa Heikenheimo (TVO):** Actions to protect NPP against external and internal events and R&D activities in Finland
- **Jon Ake (USNRC):** Current and Future Application of Seismic Research Activities at the NRC in Response to the Accident at the Fukushima Daiichi Nuclear Power Plant
- **Laurence Rigollet (IRSN):** Electrical failure during NPP cable fires
- **Toshihiro Matsuo (TEPCO):** Safety Measures taken at Kashiwazaki Kariwa NPS based on the Fukushima Daiichi Accident
- **Marina Roewekamp (GRS):** Recent Research on Hazards PSA
- **Stuart Lewis (EPRI):** EPRI Risk & Safety Management Program Research Priorities
- **Luciano Burgazzi (ENEA):** Implementation of External Event Modeling in Advanced PSA Studies

Key Points from Presentations

- Seven Presentations:
 - 4 papers primarily focused on Implementation of post-Fukushima investigations to improve plant safety (TVO, USNRC, TEPCO, GRS,)
 - 3 Papers focused on investigating existing R&D gaps (IRSN, EPRI, ENEA)
- 1 Poster Paper: Armenian Nuclear Power Plant (ANPP) – External Hazards Analysis

Key Points from Presentations: Applications to Plant Safety

- **TVO: Safety Authority in Finland (STUK) updated several guides based lessons learned from Fukushima accident, e.g.**
 - B1: Safety design of a nuclear power plant
 - A7: Probabilistic risk assessment and risk management of a nuclear power plant
 - C5: Emergency preparedness arrangements of a nuclear power plant and)
- **USNRC: NTF 2.1 required updating seismic hazard evaluation at US plants**
 - Use recent geological data to establish seismic hazard curves
 - Some plants will require Seismic PRA (outcome 2)
 - Substantial energy content in high frequency spectra (outcome 3)
 - Characterisation and treatment of uncertainties, fragilities
 - Multi dimensional effects for certain sites
 - Seismic wave propagation models and soil structure interactions



Key Points from Presentations: Applications to Plant Safety

- **TEPCO: Evaluating Safety level at Kashiwazaki Kariwa NPP : Study has identified several weaknesses in safety and recommended improvements:**
 - Reinforcement of defense in depth
 - Adoption of phased approach (Filtered Containment Venting System, Power Supply equipment, etc)
 - Design requirements for Primary containment vessel
- **GRS: Developed a standardized approach for performing a comprehensive site-specific hazards PSA (all modes)**
 - Introduce use of Hazard equipment lists and Hazard dependencies lists
 - These lists are used either for screening purposes or for altering PRA (Level 1) fault trees taking dependencies into account.
 - Systematic consideration of all internal and external hazards and their potential combinations (and screening methodology)
 - Use of international operating experience database to determine/validate combined consequences of hazards
 - Next phase is to apply methodology to level 2 PRAs



Key Points from Discussion: Investigating R&D Gaps

- **IRSN: Investigating combined impact of smoke (soot) and thermal stress on performance of electrical/electronic equipment during Fire events**
 - Developed standardized protocol for testing and analyzing data
 - Identified conditions where both T and soot Concentration degrade performance
 - Successful Application to analogue converter
 - Further testing of equipment to follow
- **EPRI: Investigating extreme phenomena and developing risk techniques to better account for SSC failures and human errors linked to these phenomena**
 - Improvements in seismic fragility analysis/ assessment
 - Methods and guidance for risk assessment of external flooding
 - Advances in human reliability analysis
 - Advanced PRA software platform



Key Points from Discussion: Investigating R&D Gaps

- **ENEA: Investigating the impact of correlations among hazard risks;**
 - Underestimating Risk associated to the correlation of hazards
 - Several instances of dependencies among hazards
 - Improving techniques for taking hazard correlations into account
- **Poster Paper: “Implementation of external hazards analyzer at ANPP” (Oleg Grigoryan)**
 - Based on The FSA method and FAST-EE software developed by the IAEA
 - Purpose of analysis is to assess impact of external events on plant safety
 - Focus in particular on combinations of external events (seismic and flooding)
 - Model can be used for “what if” analysis (stress tests)



Session 1: Key Issues and Areas identified for Further R&D

- Uncertainties associated with Initiating events from external hazards, multiple (dependent) events
- Uncertainties of seismic and Fire events models (e.g. fragilities, smoke) and consequences
- Methods and guidance for risk assessment of external flooding
- Modelling of cliff edge effects
- Accident mitigation: deterministic and probabilistic assessment of long lasting accidents, Alternate heat removal mechanisms,
- Hydrogen concerns and modeling release of fission products
- Safety of the entire fuel life cycle focusing on the storage of spent fuel
- Entire site response: Characterization and treatment of uncertainties
- Advances in human reliability analysis for external events
- Advanced PRA analytical tools & software platforms



...Thank you for your attention!

