NARSIS

New Approach to Reactor Safety ImprovementS

OBJECTIVES

Based on the latest theoretical progresses and outcomes of recent European projects (e.g. FP7 SYNER-G, FP7 MATRIX, FP7 ASAMPSA_E), the NARSIS project aims at proposing elements of improvement to be integrated in the current Probabilistic Safety Assessment (PSA) procedures:

- A better characterisation of natural external hazards in a multi-hazard perspective (occurrence of concomitant external events, either simultaneous-yet-independent hazards or cascading events) .
- A better evaluation of the physical and operating fragility of NPPs' SSC under single or multiple external aggressions, accounting for interdependencies and temporal effects (ageing, fatigue).
- A better risk integration combined with uncertainty characterisation and quantification, proposing approaches to allow efficient risks comparison and to account for all the possible risk interactions and cascade effects (both low-frequency / high consequences events and combined events).

The foreseen improvements and related supporting tools will be tested on a simplified virtual PWR as well as on a real one, to assess applicability for normal and severe accident management purposes.

DESCRIPTION OF WORK

The NARSIS project is organised in five S&T Work Packages (WP 1-5) and two WPs for coordination and dissemination activities. Regarding S&T activities, WP1 will adapt some methodological developments existing in science dealing with risk and safety to safety demands of NPPs exposed to external natural hazards (earthquakes, flooding, extreme weather and lightning). WP2 will develop and/or improve existing (deterministic/stochastic) models, to assess the impact of complex multiple external aggressions on the physical and functional integrity of main critical NPP system components, aiming at reducing the uncertainties in the estimation of their responses. WP3 proposes two axes of development: one is to build a non-parametric dynamic Bayesian Belief Networks (BBN) approach for a NPP to account for cause and consequence of Technical, Social/organisational and Human aspects. The second one is based on an Extended Best Estimate plus Uncertainty (Extended BEPU) approach, combining probabilistic and deterministic analyses. WP4 will compare the different approaches (purely deterministic, purely probabilistic and combined deterministic-probabilistic) for safety analysis by applying them on a simplified theoretical PWR representative of the European fleet. The pros and cons of each approach will be explored. Finally, the results from the analysis in WP4 will be used in WP5 to support the definition of severe accident management guidelines (SAMGs) as well as flexible coping strategies (FLEX) and extensive damage mitigation guidelines (EDMG), in real operational situations. A supporting tool will be developed, relying on the PSA techniques and these guidelines.

MAIN RESULTS / HIGHLIGHTS

- Development of an integrated multi-hazard framework for nuclear safety assessment accounting for single, cascade and combined events at different time scales; recommendations for regulators (use of the framework).
- Methodologies to account for cumulative effects, ageing mechanisms and interactions in the fragility and functionality assessment of SSCs (model reduction strategy for probabilistic analyses)
- Hazard integration and risk analysis for NPPs through a Bayesian approach
- Reactor safety analysis results useful for Severe Accident analysis (deterministic and probabilistic approaches)
- Supporting SAMG DM tool for demonstration purposes

DURATION

1 September 2017 – 31 August 2021
4 years

CONTACTS

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PARTNERS

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