NARSIS

New Approach to Reactor Safety ImprovementS

This project has received funding from the Euratom research and training programme 2014-2018 under Grant Agreement No. 755439.

Final Workshop

Progress in Probabilistic Safety Assessment for nuclear installations

February 16th & 17th, 2022 - Online

General Project Overview

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General information

- **One connection link is sent for each session**
- ⇒ **4 links are needed to attend the whole event (3 on day#1, 1 on day#2)**
- **Each session will be recorded**
- ⇒ **A replay will be available after the workshop via a link sent only to participants registered to this session**

During presentations/discussions

- **The Chat will be available for general interactions between the organizing team and audience** (connection issues, minor schedule changes, …)
- **The "Questions" page is dedicated to questions related to the presentations:** use it at any time, we will try to answer.
- **Turn your camera on when speaking,** keep it off otherwise.
- **Mute your microphones when not speaking**

General Project Overview

- **Start:** Sept. 1st, 2017

COVID-19 + 6 months

- **End:** Feb. 28th, 2022

- **Consortium:**
  18 partners

General Project Overview
Main objectives

- **Identifying gaps** between practice and needs **in existing PSA methodologies for external events and multi-hazard analyses**
- **Improving parts of these methodologies,**

  based on & complementing other European projects:

ASAMPSA_E
SEVENTH FRAMEWORK PROGRAMME
Advanced Safety Assessment Level 2 PSA

INFRARISK
Novel indicators for identifying critical INFRAstructure at RISK from Natural Hazards

SEVENTH FRAMEWORK PROGRAMME MATRIX
New Multi-Hazard and Multi-Risk Assessment Methods for Europe

- **Hazards & related secondary effects / combinations considered:**
  - Earthquake & secondary effects (excluding tsunamis),
  - Riverine and coastal flooding (e.g. storm surge)
  - Extreme meteorological hazards (high winds, rainfall, heat waves, ice, hail)
  - Tsunamis
  - Volcanoes (tephra)

General Project Overview
Methodology & expected results

- **Methodology adopted for the scientific improvements:**
  - **Full reviews** of existing methodologies
  - **Verification & testing** of the applicability and effectiveness of the proposed developments w.r.t. the safety assessment process

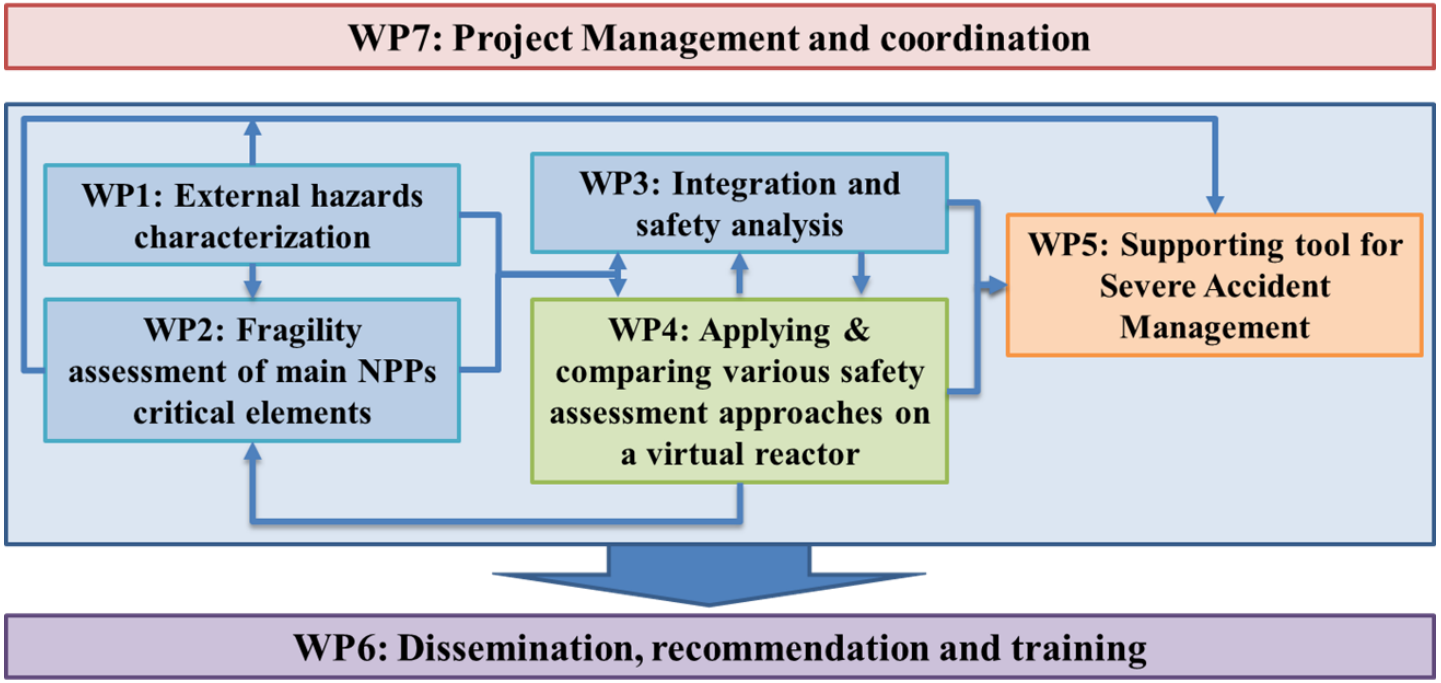
    ⟹ Using generic & real simplified NPP test cases located on real decommissioned sites

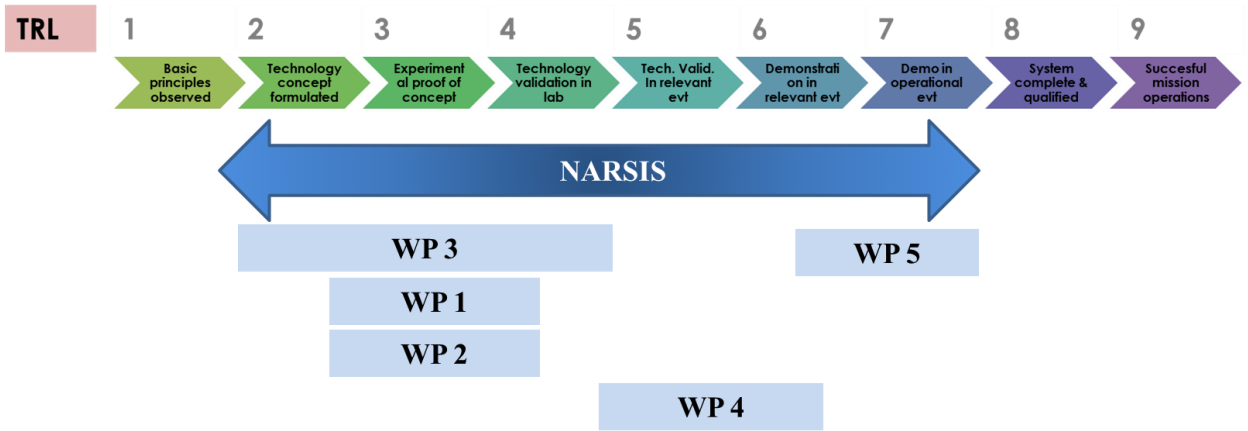
- **Main scientific achievements:**
  - **Multi-hazard assessment framework & scenarios** →**Topic#1**
  - **Fragility evaluation of the main critical SSCs** →**Topic#2**

    ⟹ Conjunct effects (ageing, SSI, …) and interdependencies under single or multiple external aggressions.
  - **Multi-risk integration & uncertainty reduction** →**Topic#3**
  - **Comparing & applying various approaches for PSA** →**Topic#4**

    ⟹ Metamodelling & model reduction strategies, E-BEPU, …
  - **Support-decision tool for Severe Accident Management** →**Topic#5**

General Project Overview
Organization





General Project Overview
Dissemination & communication

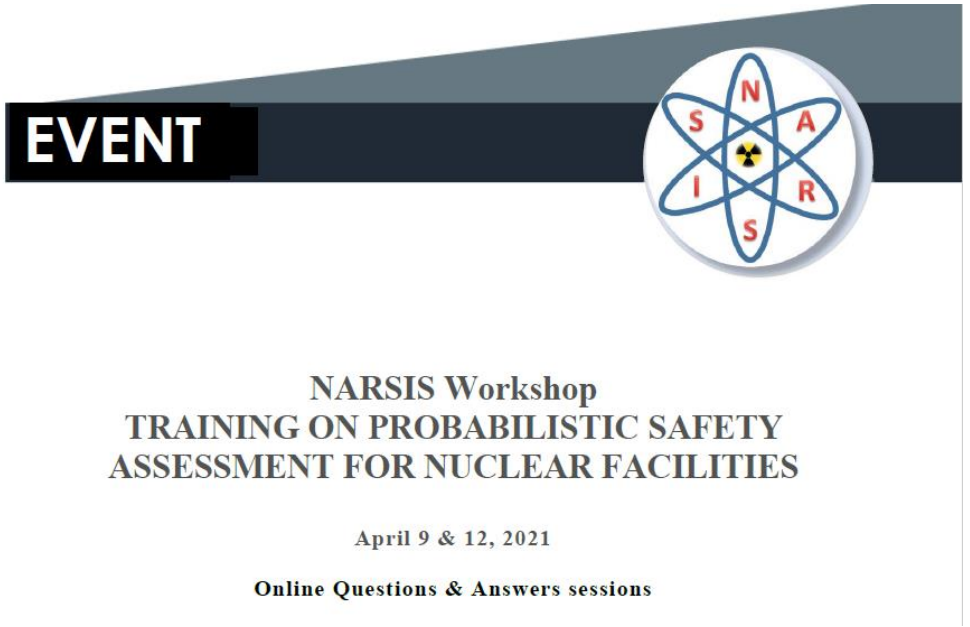
- **59 Deliverables & 34 Milestones**
  - **Scientific reports: 47**
  - **Other materials:**
    - 2 software tools
      - Open-access Multi-Hazard Explorer →Topic#1
      - Decision-Support prototype (SAMG demonstration) →Topic#5
    - Project leaflet & website (www.narsis.eu)
    - 2 training workshopsEducation & training materials (master students)
    - Newsletters
    - EGU session NH10.1 organized in May 2020 on *Multi-hazards: Innovative approaches for disaster risk reduction, climate change adaptation and critical infrastructure management*
- **International interactions on the topics addressed by NARSIS:**
  - On-going international initiatives (e.g., SNETP/NUGENIA)
  - Dedicated International Advisory Board (IAB) to have a feedback on the project results and give recommendations

1st Workshop *Warsaw*

- **63 participants (PhD, postdocs, researchers, engineers)**
- **20 students with mobility funding**
- **Proceedings**

2nd Workshop *Online*

- **55 participants (PhD, postdocs, researchers, engineers)**
- **Videos, tutorials and training materials (notebooks), …**



Programme Day #1 - morning

Session #1 - Topics #1 & 2

February 16th, 2022			
8.45-12.45	**Session#1 - Multi-hazards & Fragility Assessment**		
8.45-9.00	*Welcome & General introduction*	*E. Foerster (Pl. NARSIS)*	*CEA*
9.00-10.15	**Topic#1: Multi-Hazard Assessment for nuclear facilities**	**NARSIS main speakers**	**Organization(s)**
9.00-9.30	*The NARSIS Multi-Hazard Framework*	*J. Daniell (Pl. WP1)*	*Karlsruhe Institute of Technology*
9.30-10.15	*Highlights on Probabilistic Hazard Assessment progress for Natural Hazards:*		
	- Tsunamis	*A. Gailler[1], Luca Arpaia[2]*	*[1]CEA, [2]BRGM*
	- Extreme weather & Flooding	*L. Pheulpin[1], J. Daniell[2]*	*[1]IRSN, [2]KIT*
	- Extreme earthquake hazard assessment	*J. Daniell*	*KIT*
10.15-10.30	*Coffee break*		
10.30-11.15	*Expanding PSA* horizons - IAEA perspective (invited talk)*	*S. Poghosyan*	*IAEA*
11.15-12.45	**Topic#2: Fragility Assessment for nuclear SSC***	**NARSIS main speakers**	**Organization(s)**
11.15-11.45	*The vector-valued fragility assessment for combined hazards*	*P. Gehl (Pl. WP2)*	*BRGM*
11.45-12.45	*Highlights on some impacts of including various effects in the fragility assessment:*		
	- Soil-Structure Interactions (earthquakes)	*A. Pavithran[1], R. Fares[2]*	*[1]Framatome, [2]CEA*
	- Cumulative effects: fatigue & earthquakes	*PE. Charbonnel*	*CEA*
	- Human & organizational aspects in fragility assessment	*P. Van Gelder*	*Technical Univ. of Delft*
	-Ageing effects	*S. Paci, R. Lo Frano*	*University of Pisa*
12.45-13.45	*Lunch Break*		

PSA: Probabilistic Safety Assessment; SSC: Systems, Structures & Components*

Programme Day #1 - afternoon

Sessions #2 & 3 - Topics #3 & 4

February 16th, 2022			
13.45-16.30	**Session#2 - Risks & Uncertainties**		
13.45-14.30	*Surrogate models for uncertainty quantification and structural reliability (invited talk)*	*M. Maliki*	*ETH Zürich*
14.30-15.45	**Topic#3: Multi-Risk integration for PSA of NPP***	**NARSIS main speakers**	**Organization(s)**
14.30-15.15	*The Bayesian Networks (BN) integration*	*P.Vardon (Pl. WP3)*	*TU Delft*
15.15-15.45	*Highlights on BN integration components:*		
	- Comparison of BN with other PSA approaches	*VKD.Mohan*	*TU Delft*
	- Constraining uncertainties: components' modelling & expert-based information	*J. Rohmer*	*BRGM*
15.45-16.30	*State-of-the-Art for Multi-Unit and Multi-hazards PSA in the U.S. (invited talk)*	*D. Henneke*	*GE-Hitachi Nuclear Energy*
16.30-16.45	*Coffee Break*		
16.45-18.30	**Session#3 - Nuclear Safety applications**		
16.45-18.30	**Topic#4: Applying & comparing various approaches for PSA**	**NARSIS main speakers**	**Organization(s)**
16.45-17.15	*Global S&T synthesis and key outcomes from NARSIS*	*G. Rastiello (Pl. WP4)*	*CEA*
17.15-18.30	*Highlights for nuclear safety analyses:*		
	- Metamodeling techniques for seismic & tsunami PSA	*I. Zentner[1], C. Feau[2], J. Rohmer[3]*	*[1]EDF, [2]CEA, [3]BRGM*
	- PSA methods related to combined earthquake & flooding hazards	*A. Kaszko[1], VKD.Mohan[2]*	*[1]NCBJ, [2]TU Delft*
	- Applying the E-BEPU methodology*	*P. Mazgaj[1], P. Darnowski[1], M. Dusic[2]*	*[1]Warsaw Univ. of Technology, [2]Nuccon*
	- Sensitivity&Uncertainty Analyses with uncertainty quantification for Severe Accident	*A. Prošek*	*Jožef Stefan Institute*

PSA: Probabilistic Safety Assessment; NPP: Nuclear Power Plant; E-BEPU: Extended Best Estimate Plus Uncertainty

Programme Day #2 - morning

Session #4 - Topics #5 & 6

February 17th, 2022			
9.00-12.45	**Session#4 - Severe Accident**		
9.00-9.45	*Probabilities in regulatory hazard studies for the chemical industry in France (invited talk)*	*F. Masse*	*INERIS*
9.45-10.45	**Topic#5: Severe Accident Management**	**NARSIS main speakers**	**Organization(s)**
9.45-10.00	*Global S&T synthesis and key outcomes from NARSIS*	*L. Štrubelj (Pl. WP5)*	*GEN energja*
10.00-10.30	*Severa: A New Decision-Support Tool*	*M. Bohanec*	*Jožef Stefan Institute*
10.30 – 10.45	*Coffee break*		
10.45-12.45	**Topic#6: Possible impacts and wider perspectives**		
10.45-11.15	*Multi-hazard PSA in the nuclear field: recommendations & perspectives*	*NARSIS team*	
11.15-12.15	*Use & perspectives for probabilistic assessment and uncertainty quantification in various high-risk industries (round table)*	*Invited experts*	
12.15-12.45	*General discussions and closing of the workshop*	*All*	