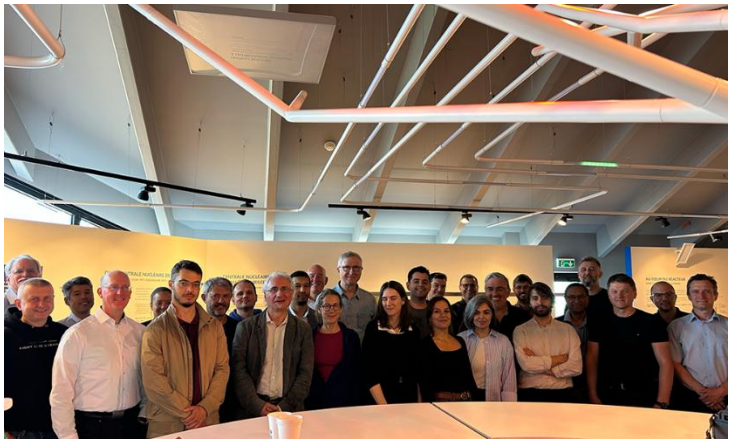
METIS Project Concludes, Delivers Significant Advancements in Nuclear Seismic Safety

After almost five years (fifty-seven months) of dedicated research and collaboration, the Methodologies and Tools Innovation for Seismic Risk Assessment (METIS) project, launched under the Horizon 2020 programme, has successfully concluded at the end of May 2025. This significant European initiative has delivered crucial advancements in ensuring the seismic safety and integrity of nuclear facilities, a paramount priority in a world increasingly reliant on nuclear energy.

"The METIS project has significantly increased the state-of-the-art for conducting a Seismic Probabilistic Seismic Assessment (seismic PSA) and has made the technology easily accessible to others by creating open-source tools." – Nilesh Chokshi, VERIZON, retired from US Nuclear Regulatory Commission (NRC).



© METIS

The project held its final events on 21-23 May, celebrating the significant work and progress that has been made over the last 5 years.

The METIS Final Symposium was packed with insightful presentations that delved into the project's goals, outcomes, and crucial lessons learned. Attendees gained a deeper understanding of seismic hazard assessment, ground motion for engineering, and risk analysis in the context of nuclear installations. Highlights included a reflective look "Back to the Future," showcasing the progress made throughout the METIS project and its case study, effectively paving the way for future research.

As the cornerstone of the project, the METIS case study implements the different steps of a seismic PSA for a Nuclear Power Plant (seismic hazard, site response, fragility analysis, and risk assessment), leveraging real data at all stages from the hybrid test site[1].

[1] . The open datasets produced for the METIS case-study and available on OpenMETIS at Zenodo (https://zenodo.org/communities/openmetis).

The Final Symposium heard presentations on the METIS project's achievements. This included the implementation of new approaches in OpenQuake hazard software (conditional spectra, declustering, aftershocks, vector hazard), successfully applying and evaluating the conditional spectra approach for nuclear safety analysis, and developing a comprehensive strategy for conducting site response and propagating uncertainty.

Furthermore, the project compared and validated different approaches for numerical computation of fragility curves and compared them to conventional approaches. A significant achievement was the creation of a new open-source PSA tools and the consideration of aftershocks in seismic PSA. All project progress and achievements can be found in the 35 technical deliverables published on the METIS website.

METIS builds on opensource tools for the whole analysis chain (OpenQuake, code_aster, salome_meca, OpenSees, SCRAM).

METIS Final Symposium had the pleasure of hosting invited speakers from Japan and the USA, Masato Nakajima and John Richards, to look beyond Euratom, sharing their visions on improving and maintaining seismic PSA. The event also welcomed Zeynep Gulerce who shared visions from the International Atomic Energy Agency and Manuel Pellissetti who presented on the seismic fragility and risk analysis in the context of the new reactor design (EPR).

A stepping stone in the nuclear industry

By improving the tools and methodologies used in seismic safety assessments of nuclear power plants, METIS has provided a valuable starting point for other research teams to test new methodologies and integrate them using the METIS framework. These datasets will also serve as a benchmark for future research projects focusing on specific steps of seismic PSA. Beyond its technical contributions, METIS aimed to actively foster and inspire the next generation of researchers and engineers. The project and its consortium partners organised impactful seasonal and training schools across Slovenia, Germany, Greece, Italy, and France. These initiatives were designed to facilitate and deliver comprehensive education and practical training for emerging researchers, underscoring the importance of knowledge sharing in advancing collective expertise.

"The METIS project was a great step forwards for the nuclear community towards integration of seismic risk assessment procedures in a transparent and open-source based environment. The international participation and partners contributed strongly with know-how and best practices, which will support the recent and ambitious developments in the nuclear industry." - Philippe Renault, CEO, SDA Engineering.

The METIS project has laid a robust foundation for enhanced nuclear seismic safety assessments in Europe and beyond, contributing to set new standards and providing valuable insights and resources for the global nuclear safety community.

Useful Links:

- METIS Project video
- METIS website
- OpenMETIS Gitlab
- METIS on Zenodo

Contact:

- Irmela Zentner, irmela.zenter@edf.fr
- Ella Morgan, ella.morgan@lgi.earth

About METIS

Launched in September 2020, the Methodologies and Tools Innovation for Seismic Risk Assessment (METIS) project is a 57 month (after an extension) long Horizon 2020 project funded under the Euratom research and training programme that brings together 15 partners from 9 different countries. The METIS project set out to contribute to European consensus on improved best practices for seismic safety assessment, focusing on the three core facets of seismic risk: hazard, fragility, and consequence.