

# Addressing concerns about radiological protection and safety in a context of emerging nuclear technologies

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**Abstract** – With the increasing energy demands of artificial intelligence (AI), advanced and small modular reactors (AMRs/SMRs) are emerging as new nuclear technologies. While raising safety and environmental concerns, SMR designs focus on enhanced intrinsic and passive safety features. Deployment of nuclear facilities is governed by rigorous national and international regulations, including non-proliferation safeguards. In addition to technical safety demonstrations, transparent communication and public engagement are essential for achieving societal acceptance. Initiatives such as the CATAPULT project from the PIANOFORTE Partnership of the European Union are systematically studying how to adapt Environmental Impact Assessment (EIA) and Emergency Preparedness and Response (EP&R) frameworks to these technologies, taking into account both technical and societal factors.

**Keywords:** small modular reactor / radiation protection / nuclear safety / CATAPULT

In the framework of increasing energy requirements of Artificial Intelligence (AI) and the development of innovative nuclear technologies, especially Advanced and Small Modular Reactors (AMRs and SMRs), concerns have been raised in recent scientific and public discussions (Andrade, 2026). Indeed, any nuclear facility must be considered with regard to safety, environmental assessments, and societal acceptance.

It is important to recognize that SMRs design philosophy is focused on enhanced intrinsic safety characteristics and robust engineered safety systems. These includes passive safety mechanisms (Hussein, 2020), such as coolant natural circulation and gravity-driven injection water, that work without external power, and the development of accident-tolerant fuels (ATFs) (Tulkki *et al.*, 2025). These features aim to strengthen radiological protection by improving core damage resistance and mitigating fission product release under normal and hypothetical accident conditions.

In addition, the decentralization model for power generation does not inherently imply a weakening of the radiological risks control: SMRs deployment, as for any other nuclear power facility, remains subject to rigorous national regulations and international safeguards that oversee nuclear material transport and non-proliferation (NEA/OECD, 2021).

Having this in mind, after the technical demonstration of the safety performance of the designs, transparent communication and public engagement are a key aspect to provide sustaining confidence in radiation protection. In Europe, these

issues are being systematically studied. As an example, the CATAPULT project, within the EU-funded PIANOFORTE partnership, is devoted to investigate how Environmental Impact Assessment (EIA) and Emergency Preparedness and Response (EP&R) frameworks can be adapted to AMR and SMR technologies, while considering their societal and ethical aspects (CATAPULT, 2025).

In conclusion, while AI-driven increasing energy needs is renewing the interest in nuclear technologies, the radiological protection community (*e.g.*, via CATAPULT) is proactively addressing these challenges to ensure that safety and societal concerns remains central to future nuclear energy developments.

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### Conflicts of interest

The authors declare that they have no conflict of interest.

### Data Availability

The research data associated with this article are included within the article.

### Ethics approval

Ethical approval was not required.

### Informed consent

This article does not contain any studies involving human subjects.

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