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Choosing the key topics for regulatory oriented nuclear safety research

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NUCLEAR SAFETY RESEARCH AND STAKEHOLDERS

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- Nuclear safety (including existing reactors) requires continuing support from research, in order to avoid risk of complacency: cost is an issue
- Research should cover issues related to all types of nuclear installations envisaged to be used in next years, existing, evolutionary, innovative, including aspects of fuel cycle and waste
- Research should provide facts to reverse unfavourable public and political attitudes to nuclear energy in some states
- There are many stakeholders involved in nuclear safety research (political representatives; public; regulators; utilities, manufacturers, vendors; research organizations and NGOs), regulatory bodies being one of them
- Commitment needed of all stakeholders on strategic R&D areas in accordance with the needs, available resources and options for time horizon of several decades
- Coordination and communication between all stakeholders from technical and socio-political sides is needed on needs and priorities, pooling of resources and combined funding
- There is no reason to make strict separation between regulatory and other kinds of research
- In spite of globalisation, it is needed to maintain research infrastructure in all countries to comply with national responsibility for nuclear safety

SPECIFICS AND EXPECTATIONS FROM REGULATORY ORIENTED RESEARCH

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- The regulators have exceptional role as stakeholders influencing policies, and establishing and supervising compliance with the legislation
- Strengthening of regulatory bodies is a high priority task needed to ensure efficient supervision over nuclear safety and to implement any kind of legislation.
- The regulatory bodies need specific tools and methods for safety assessment to enhance their competencies and capabilities to interpret scientific facts.
- Areas of special regulatory interests include development of scientifically based regulations and guides, quantification of margins to safety criteria, environmental issues, radioactive waste management, spent fuel storage and disposal, etc.
- **Countries have obligations to build nuclear infrastructure, including research**
- **Regulators have unique possibility to enforce implementation of advanced methods into practices in operating organizations, maintain the retention of critical knowledge**
- Publicly funded research for regulatory support is an important factor for regulatory independence as essential component for the public trust

INCENTIVES FOR THE NUCLEAR SAFETY RESEARCH TOPICS

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Requirements of the current national legislation, IAEA safety standards, WENRA RLs and safety objectives, EU directives	**Improvements of quality of safety demonstration for existing and newly built NPP (based on numerous reviews of SARs)**
Reduction and quantification of the largest uncertainties in safety analyses	**Responses to challenges resulting from the new technologies and multiple nuclear applications**

SUSTAINABLE NUCLEAR ENERGY TECHNOLOGY PLATFORM

Comprehensive overview of research topics is regularly updated by the SNETP (newest in 2021)

The document summarizes coordinated EU view, R&D and innovation challenges and priorities for nuclear fission technologies in the following areas:

- Innovation and performance of the existing NPPs, in-service inspection, qualification and nondestructive examination, design and demonstration of the next generation of fission reactors and SMRs
- Enabling conditions like safety of NPPs, development of fuel, assessment of the fuel cycle, management of spent-fuel, dismantling and decommissioning, strengthening social and environmental engagement, and the economic aspects.
- Cross-cutting technologies, like digitalization, modelling and simulation, and materials
- Non-technological cross-cutting aspects such as research infrastructure, harmonisation and education, training and knowledge management

Source: SNETP Strategic Research and Innovation Agenda 2021 www.snetp.eu

SNETP – EXAMPLES OF R&D TOPICS FOR SAFETY OF NPPS

- Assessment and mitigation of external hazards especially those beyond design basis
- Identification and quantification of uncertainties within the assessment methods
- Improving the methods dealing with source identification and cumulative hazards
- Development of methods extending the scope of PSA for inherent safety features;
- Focus on long-term and multi-unit loss of safety functions
- Development and validation of advanced tools for DSA and PSA
- Safety and reliability assessment of passive safety systems and inherent safety features
- Reliability evaluation of digital I&C and its integration into PSA
- The ability to cool in- and ex-vessel corium/debris
- Mitigation of gas explosion risk in containment
- Source term assessment and mitigation
- Accidents in spent-fuel pools

EXAMPLES OF SPECIFIC DIRECTIONS FOR ENHANCEMENTS IN THE AREA OF SAFETY ASSESSMENT

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- Integration of neutronic, thermal-hydraulic, structural and radiological safety analysis by means of code coupling or code integration;
- Reducing uncertainties and harmonization of approaches for determination of the source term and prediction of radiological consequences of reactor accidents;
- Improving practicability and broader use of methods for quantification of uncertainties in DSA, with future extension of the methods also to severe accidents;
- Further development of safety analyses by means of microsimulation codes (such as CFD codes) and their acceptance in licensing;
- Development of methods and guidance documents for systematic safety analysis of different types of innovative designs;
- Broader international consensus on demonstration of practical elimination of early or large radioactive releases for both evolutionary and innovative reactor designs;
- Harmonization of approaches for analysis of internal and external hazards including links between the hazards and plant states;
- Closer integration of deterministic and probabilistic safety analysis approaches