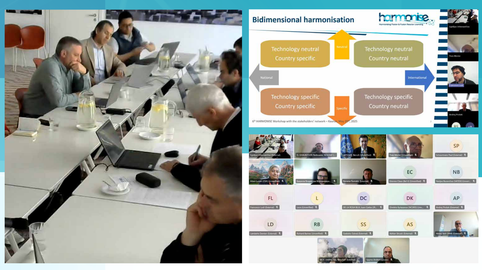
3rd

harmonise
Harmonising Fission & Fusion Reactor Licensing

Newsletter
May 2025

HARMONISE is close to completion after three years of activities during which the partners addressed issues related to (a) the preliminary safety assessments and licensing needs of innovative fission and fusion installations; (b) risk-informed, performance-based (RIPB) approaches in licensing reviews and regulatory decision-making; (c) harmonisation and standardisation on component assessments, methodologies, codes and standards.

Work package 1 activities evolved along the line of stakeholder updating for a potential path towards harmonisation for effective licensing and safe / reliable operation of innovative fission and fusion power plants. To this end, the **fourth workshop** with the stakeholder network of the HARMONISE project took place in-person during the TSO Café of the IAEA "International Conference on Enhancing Nuclear Safety and Security Through Technical and Scientific Support Organizations (TSOs): Challenges and Opportunities in a Rapidly Changing World" in Vienna, Austria on 3 and 4 December 2024. The **fifth workshop** with the stakeholder network took place on 18 March 2025 as an online event where the project activities were outlined along with ideas from aviation regulations. The **sixth workshop** of the project was organised as a hybrid event in Kaunas, Lithuania on 20 May 2025. During the meeting, the project objectives and achievements were presented and discussed. In addition, presentations were given regarding input from aviation regulations, the IAEA Nuclear Harmonization and Standardization Initiative and the OECD-NEA activities related to SMR safety assessment and regulation.



Sixth workshop with the HARMONISE stakeholder network

KAUNAS, LITHUANIA

Work package 2 actions investigated the extent of the innovations contained in the novel designs proposed in the European panorama and their impact on the current safety framework. A bidimensional harmonisation was pursued considering two main directions: a harmonisation towards technology neutrality and a harmonisation towards country neutrality. An in-depth study of the current safety framework was performed to better understand the licensing gaps in relation to the specificities of innovative technologies. The reference safety framework was analysed, for the in-depth study, at international and national levels while ALFRED and DEMO were selected for the applicability review. In line with the aim of developing recommendations for future licensing processes applicable to future reactors, five topics have been examined i.e., regulatory framework; site, end use and modularity; safety architecture; safety claims; safety approach, each topic having specific findings. Each topic and finding listed in the matrix of compliance with the existing regulatory framework (considering both international and national levels) highlights the commonalities that might represent the bases for a harmonised licensing process to be based upon. Specific issues in applying the existing licensing frameworks to advanced fission and fusion technologies were analysed and the challenges in applying the current regulations to innovative technologies were identified. For each of these challenges, potential solutions for addressing the identified gaps were recommended. These recommendations will be aimed at representing the building blocks for a harmonised approach to the licensing of advanced fission and fusion systems.

Work package 3 activities provided a description of the current use of RIPB requirements in regulatory frameworks for licensing and lifelong oversight of nuclear facilities. The notion of safety architecture integrates in its new interpretation all the provisions that participate in achieving the fundamental safety functions at nuclear installations. Defence in Depth (DiD), graded approach and "risk domain" are the foundations of the suggested approach for an innovative RIPB. The RIPB proposal aims to achieve the following objectives: (a) to select and evaluate licensing-based events and to identify all the provisions implemented within the safety architecture; (b) to establish / suggest, in compliance with the graded approach, an adequate Safety Classification approach for these provisions; (c) to establish the risk-informed and performance-based evaluation of DiD adequacy. It is proposed on the one hand to build the safety architecture with a top-down approach that defines this architecture from the needs and, on the other hand, to evaluate the architecture in question by building the probabilistic studies directly on the structure of the DiD thus defined.

Work package 4 actions aimed to identify the needs to support innovative reactor projects in terms of codes and standards and digital technology with, as a final result, a map of the scope already covered by codes and for unmet needs recommendations to treat them. It started with a survey among the HARMONISE stakeholders to identify innovative technology needs covering the potential use of digital technologies in the nuclear sector, in general, and the digital twin application, in particular. The needs can be split into two main categories: i) new designs with more challenging operational conditions and with much less, or no feedback, experience; ii) the need to incorporate new materials, manufacturing methods and digital technologies. The needs identified in answers received to a questionnaire sent to standards development organisations and other industrial sectors allowed highlighting the needs already covered in the existing codes and standards while identifying also those in need of development in the fields of materials and digital technology. As a conclusion, for all investigated digital technologies, there is a lack of specific regulatory guidance on how to meet expectations for the safety demonstration. In addition, codes and standards appear as basis for regulation needed and achieving common regulatory positions on these issues needs to be a high priority. The project's activities to look at other industrial sectors could be developed further in other projects, particularly for digital technologies. The answers provided by the aeronautics sector are very interesting, but require further discussion to identify good practices and, above all, to define the adaptations needed to transfer them to the nuclear sector. Regarding materials dedicated to mechanical components, a technology readiness level notion has been established to quantify the qualification level. Depending on the technology maturity level, specific recommendations and developing plans are proposed in the final roadmap.

Dissemination and communication activities are among the project priorities and selected findings on **code and standard needs** were presented at the **International Conference Nuclear Energy for New Europe** held in Portorož, Slovenia on 9 through 12 September 2024 and published in the conference proceedings. In addition, HARMONISE was presented at events that included the **International Workshop on SMR Safety for a Sustainable Short-term Deployment**, the **IAEA "International Conference on Enhancing Nuclear Safety and Security Through Technical and Scientific Support Organizations (TSOs): Challenges and Opportunities in a Rapidly Changing World"**, the **IAEA "Technical Meeting on Demonstration of Defence in Depth Implementation Using Probabilistic and Deterministic Approaches for Nuclear Power Plants"** as well as to the **State Nuclear Regulatory Inspectorate of Ukraine.** Moreover, project activities were published on the **Scientific and Technical Journal "Nuclear and Radiation Safety"** and the **Journal of Nuclear Research and Development.** An up-to-date summary of the HARMONISE dissemination and communication activities appears on the **HARMONISE website.**

17-18 OCTOBER 2024
FONTENAY-AUX-ROSES, FRANCE

INTERNATIONAL WORKSHOP ON SMR SAFETY FOR A SUSTAINABLE SHORT-TERM DEPLOYMENT

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