ORIENT- NM

Organisation of the European Research Community on Nuclear Materials

A Coordination and Support Action in Preparation of a Co-Funded European Partnership on Nuclear Materials

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Public summary of the 1st ORIENT-NM Workshop with stakeholders on a possible future European partnership on nuclear materials

Author(s) name and affiliation	Lorenzo Malerba	CIEMAT
	María Luisa Fernández Vanoni	EERA
	Marjorie Bertolus / Angelika Bohnstedt	CEA / KIT

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List of abbreviations

DG	Directorate General
EERA	European Energy Research Alliance
ESNII	European Sustainable Nuclear Industrial Initiative
ETIP	European Technology and Innovation Platform
R&D	Research and Development
SMR	Small Modular Reactor
SNETP	Sustainable Nuclear Energy Technology Platform
SRA	Strategic Research Agenda
TSO	Technical Support Organisation

Public summary

The first ORIENT-NM Workshop on a possible future European partnership on nuclear materials was held on 22-23 November 2021, in an online format, hosted by the European Energy Research Alliance (EERA) in Brussels. Approximately, 80 participants attended it.

The event gathered official representatives from the European Commission and twelve countries, namely Belgium, Bulgaria, Czech Republic, Estonia, France, Germany, Hungary, Italy, Lithuania, Malta, Portugal and Romania. Moreover, high-level stakeholders from agencies, research centres and universities also participated, coming from Belgium, Bulgaria, Croatia, Czech Republic, Finland, France, Germany, Italy, the Netherlands, Poland, Romania, Sweden, Slovakia, Spain and Ukraine. In total, 20 countries were represented. The attendance list was completed by a few industrialists (EDF, Ansaldo Nucleare, Westinghouse) and one organisation that provides technical support to the regulator (Bel-V), i.e., a TSO.

The introductory speeches were given by the head of the Euratom unit of the European Commission - DG Research & Innovation, Elena Righi Steele; the chair of the ESNII[1] pillar of the SNETP[2], Roberto Adinolfi (Ansaldo Nucleare); and the Secretary General of EERA, Adel El Gammal. All three supported the idea of a European partnership on nuclear materials and provided helpful advice on setting it up. Elena Righi Steele insisted on the importance of proposing unifying goals that should find all Member States in agreement, both those keen on joining the partnership and those with less strategic interest in it. Roberto Adinolfi clearly described the path to be followed concerning materials to serve both current and future nuclear energy needs. Adel El Gammal stressed the need to take a pragmatic and holistic approach to face the challenge of counteracting climate change, highlighting the role that nuclear energy has in this endeavour.

Interactive virtual tools were used throughout the workshop to collect input from the participants. The outcome of the live polls can be summarised as follows:

- Materials are widely understood to play an essential role in the continued and safe use or development of nuclear energy.
- With this premise, a European partnership on nuclear materials is mainly expected to avoid duplication and fragmentation in nuclear materials R&D by coordinating both Euratom and national relevant activities under the same umbrella.
- A European partnership is also expected to provide continuity to R&D lines, avoiding that specific key subjects experience gaps of several years before a new project related to them is launched.
- The co-funded type of European partnership is preferred.

[1] European Sustainable Nuclear Industrial Initiative
[2] Sustainable Nuclear Energy Technology Platform, the nuclear energy European Technology and Innovation Platform (ETIP).

- The participants considered that the nuclear energy national programmes, as presented at the workshop, were correctly summarised and can be used as starting point to define the nuclear materials strategic research agenda.
- The live polls suggested that the partnership should devote significant attention to materials issues for enhanced safety of current and innovative nuclear power plants, including Small Modular Reactors (SMRs). It should enable improved sustainability, cost reductions and efficiency increase. It should also accelerate the development of advanced or new materials solutions, including manufacturing processes and their qualification for use in harsh environments.
    - In the case of **current reactors**, moderate materials improvement and increased knowledge on materials behaviour in operation are considered equally important. Safe and cost-effective long-term operation (LTO) of the most critical components is perceived as the main target: this includes remediation for irreplaceable parts, replacement or repair of aged parts using advanced manufacturing techniques and, in the case of fuel, reaching higher burnups safely. Experimentally validated models should support component lifetime assessment by linking microstructural evolution with macroscopic property changes and making ample use of advanced and combined microstructure characterisation techniques. These models should blend multiscale and multiphysics approaches with the use of modern data-driven techniques, based on the use of artificial intelligence, feeding engineering models directly. Importantly, automatised non-destructive monitoring in operation, e.g., using in-vessel sensors for monitoring of witness samples, with reliable interpretation of the signals, should be supported, as well as the creation of component digital twins.
    - Concerning **future reactors**, there is a clear perception of the need of significantly improving the performance of materials for the expected operating conditions, especially in terms of resistance to irradiation, high temperature and corrosion, considering coatings as well for the latter. Research on minor actinides bearing fuels should be pursued. The qualification process of both existing and improved materials solutions in operational conditions should be accelerated, without forgetting synergistic effects (e.g., radiation and corrosion), thereby updating codes and standards timely. Standards for testing in operating environments on which experience is still limited need to be developed to reduce data spreading. Advanced materials solutions should be affordable and take into account from their conception: (1) the needs of industrial production upscaling and joining, thus the supply chain; (2) the possibility of being monitored using automatised non-destructive examination techniques, also in challenging environments such as liquid metals used as coolants, with similar requirements as in current reactors; (3) long-term issues such as decommissioning; and (4) circularity aspects in general. Their development and qualification should be driven by needs and based on precise requirements, rather than targeting generic long-term use. Digital techniques such as artificial intelligence and robotics should help accelerate their development. Ion irradiation and suitable fast screening tests with the support of advanced models, as in the case of current reactors, are also perceived as enablers of this acceleration.

- Web-based, efficient and user-friendly materials data management, ensuring interoperability and completeness in terms of, e.g., sufficient metadata, is considered essential for application to both current and future reactors. Data compilation according to agreed formats and standards should be increasingly built-in in test equipment.

- Although focused on nuclear fission materials, the partnership should also benefit non-nuclear energy technologies where materials operate under extreme conditions, e.g. by identifying projects to be funded jointly by Euratom and the unit in charge of the interested non-nuclear technology. The partnership should also interact with the fusion community, by organising joint actions in which a structured dialogue for cross-fertilisation should be established between the two communities.

The participants to the first ORIENT-NM Workshop identified the potential difficulty of finding matching funds to those provided by the European Commission as one of the main challenges for the approval and implementation of the partnership. This may ensue from limited availability of (additional) public funds, as nuclear materials may not correspond to a top priority of the involved Member States. Another reason is the unlikeliness of industries to financially support a co-funded European partnership, given that it is an instrument in which they are often involved with a marginal role. In this sense, legal mechanisms to ensure the involvement of industries as active partners and targetted end-users need to be identified. Other stakeholders should also be considered as possible partners, if legally and practically feasible, while regulators should ideally be represented in the advisory board of the partnership.

Moreover, the participants considered that a potential partnership in nuclear materials could face fewer challenges if the co-funding of the participating countries via in-kind work and investments were to be formally accepted. In addition, they expressed a reasonable convergence towards the acceptability of a 50/50 participation between the European Commission and the participating countries. The interest and readiness to have coordinated use of nuclear materials infrastructures seem to be high. This task, as well as the task related with education and training, might be taken over and pursued, for the nuclear materials part, from the projects that will emerge as answers to the calls NRT-01-12 and NRT-01-13 in the 2021-2022 Euratom work-programme.

As a conclusion of this first broad feedback exercise with the project's stakeholders, the ORIENT-NM community considers that the input gathered during the workshop is relevant and can be effectively used to define the single vision that will guide the elaboration of a consistent European SRA on nuclear materials. The Vision Paper will be released to the stakeholders for comments between January and February 2022, while the first draft of the Strategic Research Agenda will be produced ahead of the 2nd ORIENT-NM workshop, which is planned for May 2022.

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