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Materials' Innovations for a Safe and Sustainable nuclear in Europe -MatISSE-

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Title
ADVANCED MATERIALS FOR MORE SUSTAINABLE ENERGY

The MatISSE project contributes to the wider European Strategic Energy Technology Plan (SET-Plan), with which the European Union aims to foster clean, efficient and low-carbon energy technologies. MatISSE aims to build an integrated European research programme on materials innovation for a safe and sustainable nuclear power industry. The selected scientific and technical work is directed towards progress in the fields of conventional materials, advanced materials and the capability to forecast their behaviour during operation for fuel elements and structural components.

Enhancing sustainability

The MatISSE consortium involves 27 European partners and Korean participant. Almost all the European research organisations working in the area of nuclear energy are participating, as well as three industrial partners and nine universities.

Advanced fission systems seek to demonstrate enhanced sustainability and economics while keeping high safety standards. These enhancements are critically related to breakthroughs in the area of materials and their performance during operation. Indeed, many components have to withstand severe conditions including high temperature and mechanical loading, prolonged operation under irradiation, and corrosive environments. The viability and potential for innovation of many advanced reactor concepts will crucially depend on the demonstration that the innovation path in materials for fuel elements and structural components can cope with the proposed operating conditions in the long term. In addition, the development of robust and predictive evaluation methods in support of the materials qualification programme is an essential task to support these objectives.

Coordination and research

European R&D organizations with a variety of expertise, competences and testing facilities have contributed to efforts to develop sustainable energy technologies including nuclear energy options. Under the auspices of the European Energy Research Alliance (EERA) initiative, a Joint Programme on Nuclear Materials (JPNM) with the objective of creating synergies between key organisations in this field has been set-up. This objective will be achieved through the coordination of national initiatives with European Commission funded programmes and, possibly, other private-public or transnational collaborations. The MatISSE project has been developed squarely in the frame of JPNM.

The first work package includes all coordination and support actions which accompany the evolution of the EERA JPNM towards a common strategic approach by defining an integrated research programme by integrating EU-funded and national R&D programmes. Four work packages are dedicated to technical work which are considered as priorities within the sub-programmes of the JPNM. These are modelling of irradiation-induced hardening and creep in ferritic/martensitic alloys; research activities on advanced materials for innovative nuclear reactors, specifically ceramic composites for Gas-cooled Fast Reactors (GFRs) and Lead-cooled Fast Reactors (LFRs); oxide dispersion strengthened (ODS) alloys for LFR and Sodium-cooled Fast Reactor (SFR) cladding; and shorter-term R&D on cladding and structural

materials for the European Sustainable Nuclear Industrial Initiative (ESNII) systems, namely austenitic steels and ferritic/martensitic steels, including activities on the fuel cladding interaction.

Two further work packages address education, knowledge-sharing and exploitation of the findings, and general management activities, including scientific and consortium management.

Materials research

One of MatISSE's main objectives is to effectively support the evolution of the JPNM towards an integrated research programme which should involve the Member States, the European Commission and the main European research stakeholders. In this context the expected results are a strategy to structure JPNM, the definition of a medium and long-term research strategy, as well as a road-map and an access scheme to large research infrastructures, the preparation of governance, financial and management structures, and a scheme for education and training, networking, dissemination and communication activities.

Moreover, MatISSE will comprise targeted R&D activities in thematic areas considered as priorities by the JPNM partners. Here expected results include progress towards an accurate assessment of the effects of irradiation-induced hardening and creep mechanism on the performance in operation of ferritic/martensitic alloys; assessment of the potentialities of ceramic composites as advanced fuel cladding for GFR and novel structural materials for LFR; elaboration of the pre-design of ODS steels for use as cladding for fast neutron reactors; and enlargement of the database of commercially available materials that can be used for fast neutron reactor prototypes and demonstrators, selection of functional coatings and modified surface layers and classification of phenomena such as fuel-cladding interaction and environment assisted degradation of steels in liquid lead alloys.

Implementing advanced systems

MatISSE aims to establish key priorities in the area of advanced nuclear materials, identifying funding opportunities and harmonizing this important scientific and technical domain at the European level by maximizing complementarities and synergies with the major actors in the field.

The mix of research and development on both conventional and advanced materials will benefit advanced nuclear systems in general. In the short-to-medium term the ESNII prototype reactors will be built with off-the-shelf materials and the first core will be fuelled with conventional fuel-elements. In a long-term, research and development is planned to develop innovative materials that will push forward the sustainability and safety goals for fast reactors. These advanced materials will be tested and qualified in the ESNII facilities, then implemented as advanced technologies within ESNII systems and beyond ESNII first-of-a-kind reactors.

Workshops and data

Several workshops and or training schools and one open plenary meeting will be organized. Public deliverables of interest for other projects will be identified and in particular, may be relevant for the international data banks on nuclear materials developed by the International Atomic Energy Agency and Nuclear Energy Agency.

Information

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