

Nuclear Energy Agency

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NUCLEAR ENERGY AGENCY

NUCLEAR SCIENCE COMMITTEE

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| This mandate is submitted for approval under the written procedure.  |

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**Mandate of the EXPERT GROUP ON FUEL MATERIALS (EGFM)**

**Members:** All NEA member countries

**Full Participant:**  European Commission

 *Under the NEA Statute*

**Observer(s):** International Atomic Energy Agency (IAEA)

(International Organisations) *(By agreement)*

**Date of creation:** 1 October 2022

**Start of the current mandate:** 1 October 2022

**End of mandate**: 30 September 2024

**Document Reference:**

* The Proposal for Restructuring of the NSC Working Party on Multi-scale Modelling of Fuels and Structural Materials for Nuclear Systems (WPMM), 17 September 2020, [[NEA/NSC/WPMM/DOC(2020)2](https://one.oecd.org/document/NEA/NSC/WPMM/DOC%282020%292/en/pdf)]
* Mandate of the Working Party on Materials Science Issues in Nuclear Fuels and Structural Materials (WPFM) [[NEA/SEN/NSC(2021)2](https://one.oecd.org/document/NEA/SEN/NSC%282021%292/en/pdf)]
* Summary Record of the 2nd meeting of the Working Party on Materials Science Issues in Nuclear Fuels and Structural Materials (WPFM) on May 2022 [*forthcoming*]

**Background**

At the invitation of the NEA Steering Committee to all NEA standing technical committees, the Nuclear Science Committee (NSC) launched a prioritisation exercise in 2020. As part of this process, the NSC mandate was revised and NSC activities were prioritised and restructured in order to improve efficiency and maintain the high standard of NSC deliverables, while addressing activities according to the priorities indicated by the member countries. As a result of the prioritisation effort, NSC activities were reformed under the guidance of the NSC Bureau. This has resulted in the consolidation of additional fuel and structural materials activities into the Working Party on Materials Science Issues in Nuclear Fuels and Structural Materials (WPFM). Under the WPFM, two new bodies will cover materials science aspects, one related to nuclear fuel (Expert Group on Fuel Materials or “EGFM”), and one related to structural materials (Expert Group on Structural Materials or “EGSM”).

**Scope**

Under the guidance of the NSC and under the mandate of the WPFM, the work of EGFM will cover materials science aspects of nuclear fuel. As such, it will advance multi-scale modelling and simulation together with experimental activities. The EGFM will address all fuel types, both fuel materials currently deployed in the nuclear fleet and envisaged for future fission reactors, as well as advanced fuels, such as oxide, metallic, nitride, carbide, silicide, composite fuels, and relevant cladding issues, etc.

**Objectives**

The EGFM will:

* Assess multi-scale modelling and simulation of fuel materials for nuclear systems;
* Promote the implementation of advanced computational techniques for scale bridging and model integration from physics-based computation to data-driven modelling;
* Perform verification and validation of simulations and model predictions through uncertainty analysis, evaluation of approximations, benchmarking of fuel materials behaviour simulation tools, and comparison with analytical solutions as well as experimental data;
* Conduct joint and comparative studies to improve the understanding and modelling of the behaviour of fuel materials;
* Enhance the implementation and exploitation of systematic fuel materials experimental characterisation through the establishment of protocols of execution, data collection and data analysis;
* Conduct joint and comparative studies to support the development, selection and characterisation of innovative fuel materials with enhanced performance;
* Engage with experimental campaigns, such as those performed within the NEA Framework for Irradiation Experiments (FIDES), to optimise the link between irradiation experimental data generated and the needs of the modelling and simulation community;
* Assess the status and future needs with regard to modelling and experimental data for the qualification of fuels;
* Catalogue and support existing fuel materials databases and promote the fuel modelling needs in the databases’ development;
* Promote activities which aim to develop best practices for data formatting and preservation;
* Disseminate and discuss the results of the task force in conferences or open literature; and
* Support the creation of task forces to address specific issues in the technical field covered by EGFM.

**Working methods**

The EGFM is a forum for discussion and information exchange. By promoting joint activities at the international level, it fosters collaboration among experts involved in the experimental and computational studies by doing the following:

* Creating opportunities for exchange of information between material scientists, materials manufacturers, designers (of reactor core, fuel cycle infrastructure, etc.) and utilities on fuels-relevant topics through the organisation of meetings (workshops, conferences, webinars); and
* Establishing task forces involving leading technical experts to address issues in nuclear fuels including links between modelling and experiments.

The EGFM will report its progress at the annual meeting of the WPFM.

**Membership**

The EGFM is both a forum for international exchanges between experts and a task-oriented expert group that is composed of a diverse range of specialists in the field of fuels. The expert group consists of specialists in multi-scale modelling and simulation of nuclear fuel as well as specialists in experiments at multiple scales that relate to nuclear fuel.

**Interactions**

The EGFM will liaise closely with other NSC subsidiary bodies in order to ensure coordination of their respective programmes of work and provide advice and support, where required, and undertake common activities, where appropriate. Information exchanges and collaborations will be established with the following working parties and expert groups:

* The Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS) and its Expert Group on Reactor Systems MUlti-Physics (EGMUP) and Expert Group on Reactor Fuel Performance (EGRFP), including the Database for International Fuel Performance Experiments (DATIF); and
* The Working Party on Scientific Issues of Advanced Fuel Cycles (WPFC) and its Expert Group on Innovative Fuel Elements (EGIFE).
* The Working Group on Fuel Safety (WGFS) of the Committee on the Safety of Nuclear Installations (CSNI).

For information exchange and mutual support through sharing of expertise and advice, the EGFM will liaise with materials science-related NEA joint undertakings such as the Thermodynamics of Advanced Fuels – International Database (TAF-ID), the Thermodynamic Characterisation of Fuel Debris and Fission Products Based on Scenario Analysis of Severe Accident Progression at Fukushima-Daiichi Nuclear Power Station (TCOFF), and the Accident Tolerant Fuel cladding bundle testing at QUENCH facility in KIT, Germany (QUENCH-ATF).

The EGFM will exchange information with FIDES and support its activities (especially with respect to modelling and simulation of fuel material behaviour under irradiation) when relevant and in compliance with their data dissemination policy. The efforts will involve providing advice on the prioritisation of the data needs for the parameterisation and validation of nuclear materials modelling and simulation tools, and expertise on the analysis and interpretation of post irradiation experiments.

The EGFM will work closely with the NEA Data Bank on database and knowledge preservation activities.

The EGFM will collaborate with industry representatives, as relevant, and international organisations such as the International Atomic Energy Agency (IAEA), the European Commission (EC) and the Generation IV International Forum (GIF).

**Deliverables**

The EGFM will publish reports and journal articles stemming from EGFM activities. The EGFM will cover the following topic areas:

* + State-of-the-art assessment of specific area to be considered as priority areas of research;
	+ Experimental and numerical protocols and standards, and the sharing of available experimental installations and simulation frameworks; and
	+ Development of common databases.

Specifically, the EGFM will:

* Produce a report on fuel micromechanical behaviour and its impact on fuel multi-physics modelling at the macroscopic scale (for publication);
* Produce Report(s) on protocols, standards and best practices in characterisation of nuclear materials (cross cutting fuel / structural materials);
* Create data model specification for the storage and preservation of thermodynamic properties of fuel materials;
* Develop a report(s) on needs for irradiation in material test reactors (MTRs) in the FIDES framework, linked to simulation validation and comprehension of bottleneck issues in fuel behaviour (mechanical, thermal or fission gas behaviour, etc.); and
* Develop a report on a survey of existing initiatives to implement Machine-Learning based simulation techniques for nuclear fuels: what methods, how to solve inherent difficulties linked to actinide-containing materials (and further areas such as availability of training databases, etc.).