



IAEA

International Atomic Energy Agency

Atoms for Peace and Development

Technical Meeting on Structural Materials for Heavy Liquid Metal Cooled Fast Reactors

**IAEA Headquarters
Vienna, Austria**

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Information Sheet

Introduction

The compatibility of structural materials, such as steels with lead and lead-bismuth eutectic (LBE), poses a critical challenge in the development of heavy liquid metal (HLM) cooled fast reactors. Factors such as very high temperature, high fast neutron flux, high irradiation exposure and corrosiveness provide a severe environment for the materials in these advanced reactor systems. The compatibility of liquid coolant with structural materials is critical for the development of innovative nuclear energy systems. The proper selection and development of structural materials for advanced reactor concepts is pivotal. The safety, feasibility and optimization of innovative nuclear systems depend on the capability of the selected materials to withstand the expected operating conditions.

Various phenomena affect the properties and behaviour of steels during exposure to HLMS, including the dissolution of some steel alloy elements, liquid metal embrittlement, non-passivating oxidation etc. Corrosion/degradation of standard steels has two major effects on the operation of lead/LBE cooled fast reactors (LFRs): the loss of material owing to corrosion affects the integrity of structures and

components, and the release of corrosion products in the coolant could result in a build-up in the coldest parts of the system, leading to a risk of plugging of the coolant circulation.

One of the main goals of the scientific community focused on LFRs is to explore and identify mitigation strategies that can reduce the degradation of materials in operation in order to ensure the safety and efficiency of the nuclear system. The mitigation measures should be based on a deep understanding of the physical phenomena and processes causing changes in the materials' properties. The major mitigation measures include HLM environmental control (e.g. low temperature, active control of oxygen concentration or employment of corrosion inhibitors), the adoption of surface engineering solutions (such as protective coatings), the development of innovative materials capable of withstanding harsh HLM environments etc.

Operation under controlled oxygen concentration and at low temperatures (below 450–480°C) has proven to be efficient against corrosion issues. However, experiments performed at higher temperatures have shown that oxygen control is less effective, and strong corrosion attack (depending on the steel type and experimental conditions) can occur as the temperature increases.

The development and use of coatings on standard steels seems to be the most viable solution in the short term having as advantage the use of materials with known properties and qualified for neutron irradiation.

The development of innovative materials (corrosion resistant to HLM) is a promising option to fight degradation phenomena in the long term; for example, alumina-forming austenitic (AFA) steels have shown very good performance in HLM environments compared to standard steels or high-entropy alloys, as they have some unique compositions, microstructures and engineering properties. However, efforts are required to develop modelling tools able to simulate and analyse the long-term behaviour of materials in the HLM harsh environment when exposed to corrosive environments and/or irradiation, by adopting a physics-based approach validated by experiments.

In addition, fast-evolving HLM technologies require the establishment of a standard procedure to perform corrosion and mechanical tests, as well as to assess the performance of manufactured materials in various shapes, as a next step. The assessment of mechanical properties in liquid metal and of steels and coatings under irradiation is also a high priority; these properties should be measured in the relevant ranges of temperature, neutron fluence, stresses and HLM flow velocity for the different components.

Taking recent developments into consideration, and in order to identify gaps and needs, the Technical Working Group on Fast Reactors (TWG-FR) recommended a Technical Meeting on this topic. This event addresses Member States' expressed need for information exchange on projects and programmes in the field, as well as for the identification of priorities based on the analysis of technology gaps to be covered through research and development (R&D) activities to be carried out at the international level under the IAEA's aegis.

Purpose

The purpose of the event is to review a wide range of issues related to the economic and industrial optimization of liquid metal cooled fast reactor (LMFR) designs. The participants will share the latest information on innovative LMFR designs and discuss improvements that could help decrease the cost of constructing and operating advanced LMFRs.

Objectives

The main objectives of the event are to:

- Promote and facilitate the exchange of information on structural materials for HLM cooled reactors at the national and international levels;
- Present and discuss the current status of R&D in this field;
- Discuss and identify R&D needs and gaps to assess the future requirements in the field, which should eventually lead to efforts being concentrated in the key lacking areas;
- Enable the integration of research on materials in Member States (e.g. development of materials for operating in corrosive/severe environments, study of physics and chemistry of the process, design of dedicated experimental facilities and development of computational tools for material characterizations etc.) to support the development of new technologies that have a higher level of technological readiness;
- Provide recommendations to the IAEA for future joint efforts and coordinated research activities (if required) in the field; and
- Prepare a reference document summarizing the work presented by the participants, including the findings of the study in the standard IAEA publications format.

Topics

The event will consist of five sessions, and all contributions, presentations and discussions will be categorized based on the following topics:

- HLM Compatibility with Structural Materials: Phenomena, modelling and operational experience;
- Corrosion Mitigation Measures: Coating and surface engineering, and environmental conditioning, etc.;
- Development of Structural Materials Resistant to HLM Corrosion;
- HLM Structural Materials and Coatings under Irradiation: Testing and characterization, and impact of neutron-induced radiation damage, etc.; and
- Qualification Programmes of Structural Materials for HLM Fast Reactors.

Expected Outputs

The expected outputs are:

- Information exchange between interested Member States on the topics of the event;
- Recommendations to the IAEA on future joint efforts and coordinated research activities in this area;
- A report on the event, which will serve as a reference for preparing the future IAEA publication *Structural Materials for Heavy Liquid Metal Cooled Fast Reactors*.

Participation and Registration

All persons wishing to participate in the event have to be designated by an IAEA Member State or should be members of organizations that have been invited to attend.

In order to be designated by an IAEA Member State, participants are requested to send the **Participation Form (Form A)** to their competent national authority (e.g. Ministry of Foreign Affairs, Permanent Mission to the IAEA or National Atomic Energy Authority) for onward transmission to the IAEA by 1 May 2019. Participants who are members of an organization invited to attend are requested to send the **Participation Form (Form A)** through their organization to the IAEA by above deadline.

Selected participants will be informed in due course on the procedures to be followed with regard to administrative and financial matters.

Please note that the IAEA is in a transition phase to manage the entire registration process for all regular programme events electronically through the new InTouch+ (<https://intouchplus.iaea.org>) facility, which is the improved and expanded successor to the InTouch platform that has been used in recent years for the IAEA's technical cooperation events. Through InTouch+, prospective participants will be able to apply for events and submit all required documents online. National authorities will be able to use InTouch+ to review and approve these applications. Interested parties that would like to use this new facility should write to: InTouchPlus.Contact-Point@iaea.org.

Abstracts, Papers and Presentations

The IAEA encourages participants to give presentations on the work of their respective institutions that falls under the topics listed above.

Participants who wish to give presentations are requested to submit an abstract of their work on the topics listed above. The abstract should contain title, contributing author(s) names and affiliation, must be written in English, and provide sufficient information on the contents of the proposed paper for evaluation. The abstract will be reviewed as part of the selection process for presentations. The abstract should be in Microsoft Word format and should not exceed 500 words. It should be sent electronically to the fast reactor technology development team of the IAEA (email: LFR.Materials@iaea.org), not later than **15 May 2019**. Authors will be notified of the acceptance of their proposed presentations by **30 June 2019**.

The authors will then be requested to prepare and submit the full papers (about ten pages) for peer review by **1 September 2019**. The revised papers will be included in the concluding IAEA publication *Structural Materials for Heavy Liquid Metal Cooled Fast Reactors*, which will be published as either as an IAEA Nuclear Energy Series publication or an IAEA Technical Document.

In addition, participants have to submit the abstract together with the **Participation Form (Form A)** and the attached **Form for Submission of a Paper (Form B)** to their competent national authority (e.g. Ministry of Foreign Affairs, Permanent Mission to the IAEA or National Atomic Energy Authority) or their organization for onward transmission to the IAEA not later than **15 May 2019**.

Expenditures and Grants

No registration fee is charged to participants.

The IAEA is generally not in a position to bear the travel and other costs of participants in the event. The IAEA has, however, limited funds at its disposal to help meet the cost of attendance of certain participants. Upon specific request, such assistance may be offered to normally one participant per country, provided that, in the IAEA's view, the participant will make an important contribution to the event.

The application for financial support should be made using the **Grant Application Form (Form C)**, which has to be stamped, signed and submitted by the competent national authority to the IAEA together with the **Participation Form (Form A)** by **15 May 2019**.

Key Deadlines and Dates

Action	Date
Submission of the Participation Form (Form A) Submission of the Form for Submission of a Paper (Form B) Submission of the Grant Application Form (Form C), if applicable	15 May 2019
Abstract submission deadline	15 May 2019
Notification of acceptance of abstract by the IAEA	30 June 2019
Full paper submission deadline Start of peer review	1 September 2019
Technical Meeting in VIC, Vienna, AUSTRIA	15–17 October 2019
Final deadline for revised papers	December 2019

Target Audience

The meeting is open to all Member States involved or interested in the research, development and/or deployment of HLM reactors, including government organizations (policymakers, analysts, regulators and R&D agencies) and industry stakeholders (vendors, engineering companies, plant operators and technology developers).

Working Language

The working language of this meeting will be English with no interpretation provided. All communications, abstracts and papers must be submitted in English.

Visas

Participants who require a visa to enter Austria should submit the necessary application to the nearest diplomatic or consular representative of Austria at least four weeks before they travel to Austria. Since Austria is a Schengen State, persons requiring a visa will have to apply for a Schengen visa. In States where Austria has no diplomatic mission, visas can be obtained from the consular authority of a Schengen Partner State representing Austria in the country in question.

Venue

The event will be held at the Vienna International Centre (VIC), where the IAEA's Headquarters are located. Participants must make their own travel and accommodation arrangements.

General information on the VIC and other practical details, such as a list of hotels offering a reduced rate for IAEA participants, are listed on the following IAEA web page:
<http://www-pub.iaea.org/iaeaevents/GeneralInfo/Guide/VIC>.

Participants are advised to arrive at Checkpoint 1/Gate 1 of the VIC one hour before the start of the event on the first day in order to allow for timely registration. Participants will need to present an official photo identification document in order to be admitted to the VIC premises.

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Subsequent correspondence on scientific matters should be sent to the Scientific Secretaries and correspondence on other matters related to the event to the Administrative Secretary.