Organisation for Economic Co-operation and Development

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Fourth Workshop of the OECD/NEA Lead-cooled Fast Reactor Benchmark (LFR-4)

1-2 July 2025
Department of Engineering of the University of Cambridge, Trumpington Street, CB2 1PZ, Cambridge, United Kingdom

The workshop will be held in Cambridge, UK, as part of the Benchmarks Workshops of the Working Party on Scientific Issues and Uncertainty of Reactor Systems (WPRS). The WPRS Benchmarks Workshops event with three parallel tracks combines benchmarking efforts in common areas such as neutronics, thermal-hydraulics, and multi-physics modelling and uncertainty analysis.

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Fourth Workshop of the OECD/NEA Lead-cooled Fast Reactor Benchmark (LFR-4)

Sponsorship

The fourth workshop of the OECD/NEA Lead-cooled Fast Reactor Benchmark (LFR) will be held on 1-2 July 2025 in Cambridge, UK, as part of the Benchmarks Workshops Event of the Working Party on Scientific Issues and Uncertainty of Reactor Systems (WPRS). This event with three parallel tracks combines benchmarking efforts in common areas such as neutronics, thermal-hydraulics, and multi-physics modelling and uncertainty analysis. The full schedule for the incoming WPRS Workshops, SINUS-3 school and CTF-11 Meeting and Training is given on the public meeting web page: https://www.oecd-nea.org/jcms/pl_98752/wprs-benchmarks-workshops-2025

Executive Summary

Lead-cooled Fast Reactors (LFR) are rather new concepts, which are gathering increasing international attention. However, apart from the reactors operated for the propulsion of military submarines in the former Soviet Union, no operational experience exists to support their design, verification, and licensing. Also, there are a few organizations that have the experimental infrastructure to investigate specific aspects in support of the LFR technology.
A series of thematic benchmarks is sought to overcome the limited experience on the scientific aspects of an LFR core, leveraging, thanks to the international context provided by the NEA framework, the presence of organizations with experience on the LFR:

1. The first in the series focuses on the neutronics of an LFR while
2. The second one focuses on thermal-hydraulics of an LFR.

To facilitate the gaining of experience on LFRs, a «staged approach» is devised, with progressively increasing levels of complexity and detail. In a first stage – the current one – introductory benchmark studies are proposed, to start familiarizing with the key phenomena and grasping sensibility on the order of magnitude; and to establish a common understanding and share background.
Subsequent stages will then allow deepening into the phenomena, issues, and challenges specific to an LFR (e.g., by addressing sensitivity and uncertainties); involving other competences by extending to other aspects or dealing with their mutual correlation (i.e., shifting to multi-physics).
The Advanced LFR European Demonstrator (ALFRED) is assumed as the reference system for the LFR benchmark. ALFRED is highly representative of international projects, so to increase the relevance of the benchmark exercise, and secure availability of design information and data, to allow the complete and coherent modeling of the core representative of LFRs in the Small Modular Reactors (SMRs) segment, such as to reflect the widespread interest in SMRs.
For the LFR neutronics benchmark (Stage I), three phases are devised on three levels – elementary cell (Phase I-1), assembly/supercell (Phase I-2), and whole core (Phase I-3), tackling both reference parameters and related nuclear data uncertainties. Specifications have been prepared and distributed among potential participants.
For the LFR Thermal-Hydraulics (T/H) benchmark (Stage II), introductory exercises are proposed focusing on the fuel assembly thermal-hydraulics of an LFR core. The phases are devised on three scales - turbulence scale (Phase II-1) with code-to-data comparisons; bundle scale (Phase II-2) with code-to-code comparisons; and bundle/system scale (Phase II-3) with code-to-data comparisons. The progressive nature of the benchmark will allow participants to familiarize and validate the purely dynamic turbulence

modelling of the grid spacers effects, especially of CFD codes, for a full scale bundle; apply the gained knowledge when moving to lead coolant in the simulation of the ALFRED fuel assembly; and test built modelling experience via comparison with representative steady state experimental data so to arrive at an integral code to experiment validation. Draft specifications have been prepared and distributed among potential participants
The information about the OECD/NEA LFR benchmark is provided at:
https://www.oecd-nea.org/jcms/pl_66836/lead-cooled-fast-reactor-benchmark-lfr

Scope and Technical Content of the Meeting

The topics to be addressed at the meeting include:

- Review and discussion of specifications of LFR Benchmark Phases I and II,
- Presentations on preliminary results of LFR Benchmark Phases I and II,
- Discussion of templates for submitting participants' results for different phases,
- Feedback and concerns of benchmark participants,
- Presentations on other related activities such as model developments, efficiency improvements, verification and validation efforts, and applications, and
- Defining a work plan and schedule for LFR activities.

The proposed meeting program is attached as Annex 1.

Organization of the Meeting

The meeting is organized around the discussion of the LFR neutronics and T/H benchmark specifications, preliminary results, participants' concerns, and benchmark-related activities. The participants are requested to present their expertise and experience in benchmark-related modeling, verification and validation, uncertainty quantification, and applications.

Participation in the Meeting

Meeting participation is not restricted. Benchmark participation is restricted to individuals from OECD/NEA member country institutions who agree to the benchmark non-disclosure agreement (NDA). Participants are asked to sign and send the corresponding NDA form to wprs@oecd-nea.org.
Benchmark LFR conditions to release form can be found at:
https://www.oecd-nea.org/upload/docs/application/pdf/2024-10/lfr-conditions_for_release_v5.pdf

Organization and Program Committee of the Meeting

An Organization and Program Committee has been nominated to make the necessary arrangements for the LFR-4 benchmark and to draw up the final program, etc.
The members of the Program Committee are:

Giacomo Grasso – Co-*Chair of Neutronics Stage*
ENEA, Italy

Francesco Lodi – *Co-Chair of Thermal-Hydraulics Stage*
ENEA, Italy

NEA Technical Secretariat: **Oliver Buss**
OECD/Nuclear Energy Agency, France

Proposed Program of the Meeting

The proposed program was drawn up by the Program Committee and is enclosed as Annex 1.

Language of the Benchmark Workshop

The official language of the workshop is English.

Proceedings of the Meeting

The program committee and the session Chairs will prepare a summary report on the main results of the meeting. Presentations will be available free of charge to the benchmark participants to download from participants' restricted area of the benchmark website after the workshop.

Contacts and Registrations

Link to the registration page for the WPRS-related workshops and meetings and the overall program: https://www.oecd-nea.org/jcms/pl_98752/wprs-benchmarks-workshops-2025

Workshop Location

The meeting place/venue for the meetings/workshops during the week of 30 June to 4 July 2025 is the Department of Engineering of the University of Cambridge:

Trumpington Street, CB2 1PZ, Cambridge, United Kingdom.

Annex 1:

Fourth Meeting of the OECD/NEA Lead-cooled Fast Reactor Benchmark (LFR-4)

Host Organization
Department of Engineering of the University of Cambridge, in collaboration with the Cambridge Nuclear Energy Centre, University of Cambridge, United Kingdom

1 July 2025 Track 2 (Afternoon) – LFR Thermal-Hydraulics Stage
2 July 2025 Track 2 (Morning) – LFR Neutronics Stage

PROPOSED PROGRAM

L01-05: LFR Thermal-hydraulics

L01. Introduction and opening remarks
L02. Overview of benchmark status
  L02.01 Presentation of the specifications and participants results' submission
  L02.02 Discussion and feedbacks
L03. Phase 1 - Participants' presentations on their modelling and results of the LFR benchmark
  L03.X Participants' presentations on their modelling and results of the LFR benchmark
L04. Action items and review of schedule of benchmark activities - next workshop and plans
L05. Conclusions and closing remarks.

L06-10: LFR Neutronics

L06. Introduction and opening remarks
L07. Overview of benchmark activities since last workshop
  L07.01 Discussion of specifications
L08. Presentations of related activities and reference analyses
  L08.X Participants' presentations on their modelling and results of the LFR benchmark
L09. Action items and schedule of benchmark activities - next workshop and plans
L10. Conclusions and closing remarks.