IAEA Activities and Events on Fast Reactor Technology

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Nuclear Power Techology Development Section
Division of Nuclear Power
Department of Nuclear Energy
International Atomic Energy Agency

IAEA Technical Meeting on
*Proliferation Resistant Features of
Fast Reactors and Advanced Fuel Cycles*
18 – 21 August 2025, IAEA, Vienna

https://www.iaea.org/topics/fast-reactors

IAEA Activities and Events on Fast Reactor Technology

- Coordinated Research Projects
- Technical Meetings
- Education and Training
- IAEA Publications on Fast Reactor Technology
- FR26: International Conference on Fast Reactors and Related Fuel Cycles
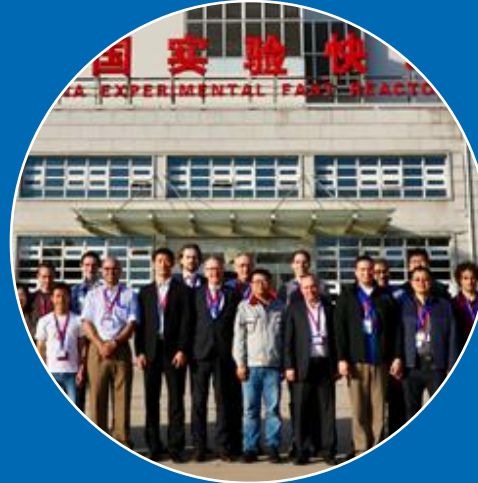- 2025 - 2026 Calendar
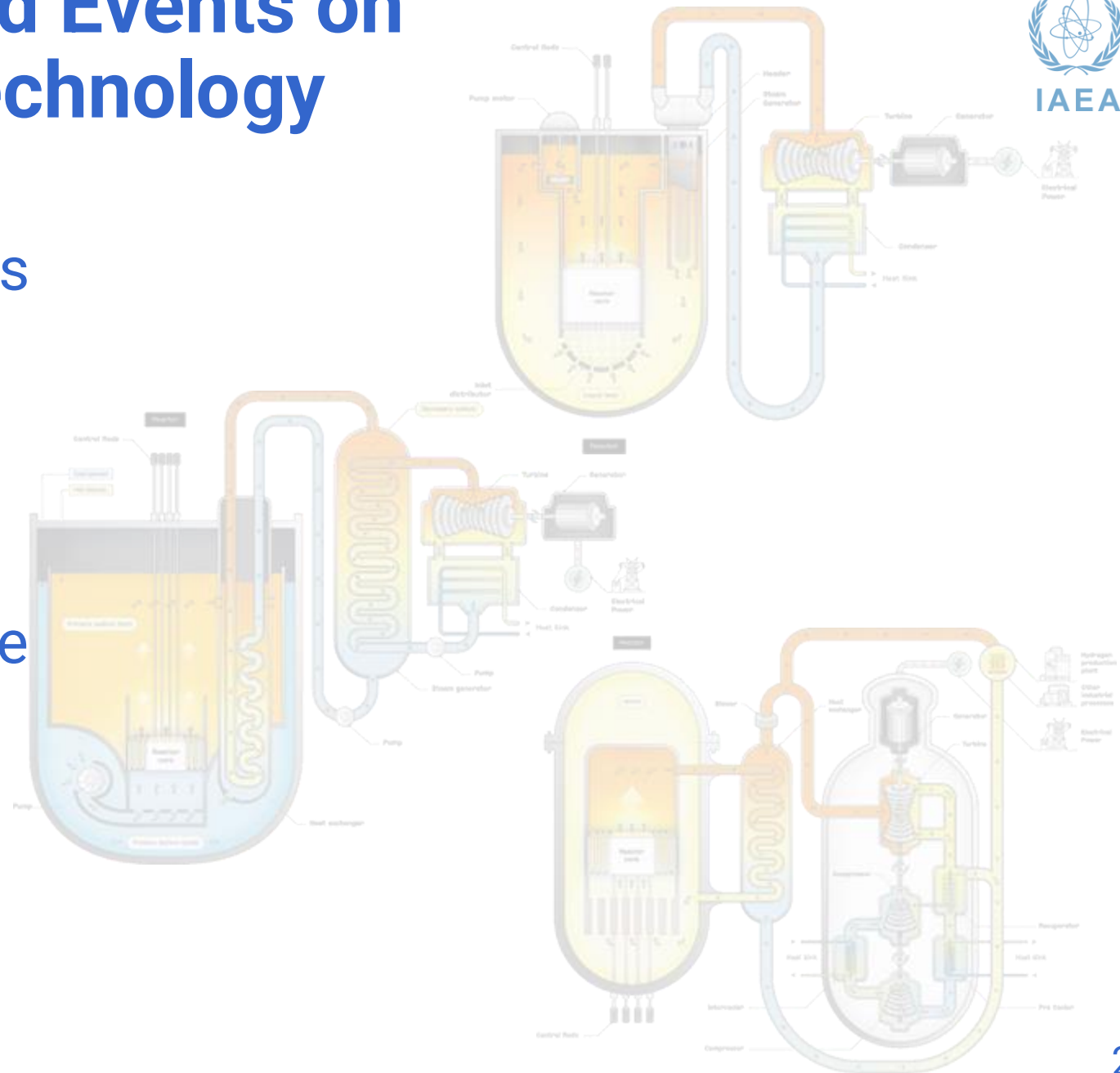
Main IAEA Activities on Innovative Reactor Technology
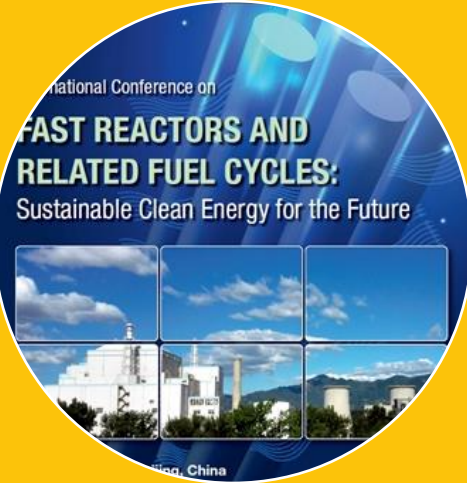
Knowledge Sharing

Publications

Conferences

TMs

Technology Development

Coordinated Research Projects (CRPs)

Capacity Building

Training Courses

Workshops

Webinars

e-Learning

TECDOCs

IAEA Technical Working Group on Fast Reactors

TWG-FR

Members of the IAEA Technical Working Group on Fast Reactors

Members

Argentina	**Belgium**
China	**Czech Republic**
France	**Germany**
India	**Italy**
Japan	Kazakhstan
Korea, republic of	**Mexico**
Netherlands	**Romania**
Russian Federation	**Sweden**
Switzerland	**UK**
Ukraine	**USA**

- Provide advice and guidance
- Forum for information exchange and knowledge sharing
- Link between IAEA activities and national communities
- Provide advice in planning and implementing of CRPs
- Develop and review selected documents
- Contribute to status report, technical meetings, topical conferences
- Identify important topics for SAGNE
- Encourage participation of young professionals in IAEA activities

Observers

European Commission/JRC   *OECD/NEA*

Generation-IV International

Forum (GIF)

20 MSs as members; 3 IOs as observers

58th TWG-FR Meeting: **23-26 June 2025**

FR Technology: Main Events and Activities in 2025

IAEA

CRPs on Fast Reactors Technology

On-going CRPs

Neutronics Benchmark of **CEFR** Start-Up Tests

Natural Circulation in LBE Sub/Assembly: **NACIE** Tests

Benchmarking **S-ALEGRO** Tests (LOCA)

New Proposals

Total Instantaneous Blockage of SFR Fuel

Simulation of **CLEAR-S** Loss-of-Flow Experiment

Benchmark Analysis of **STELLA-2** LOHS/LOF Tests

PLANDTL: Decay Heat Removal Thermal Hydraulics Tests
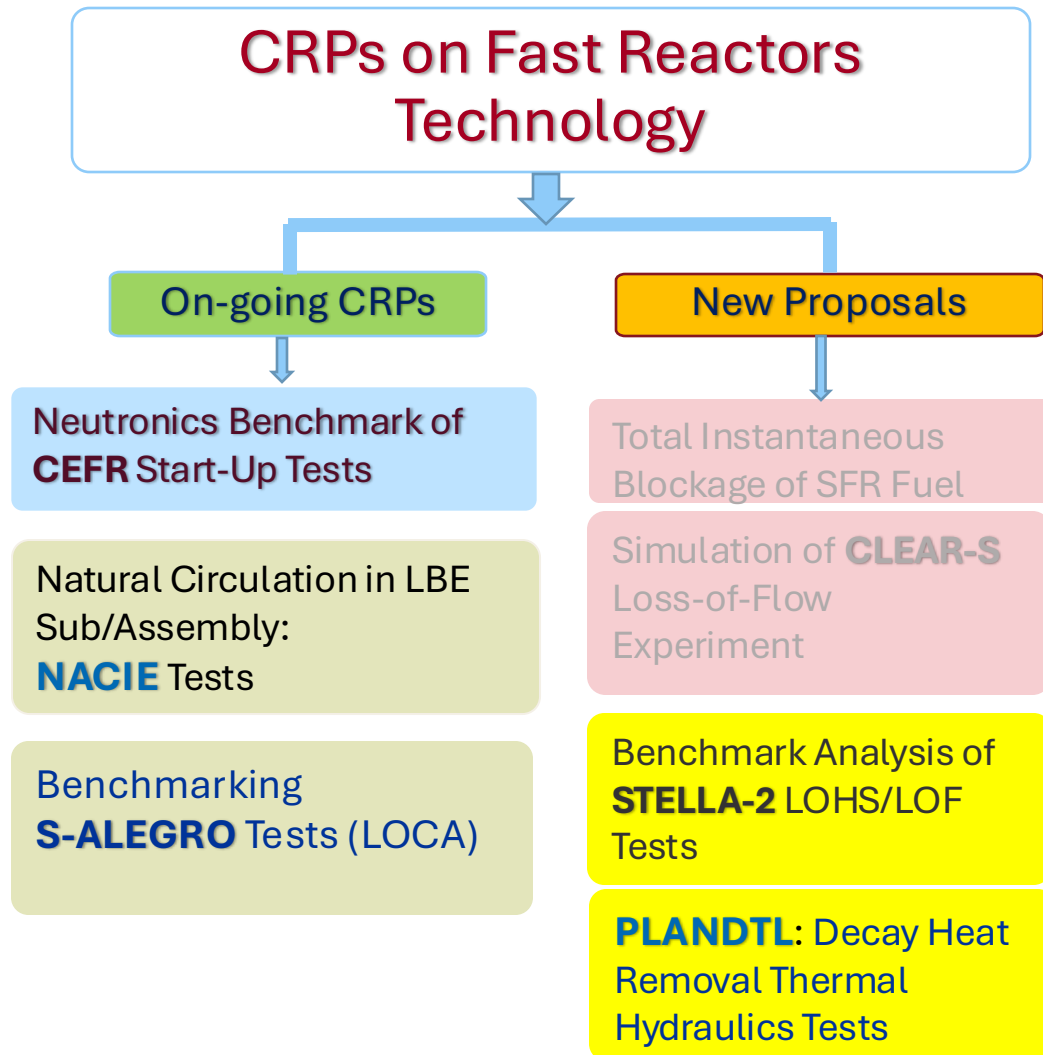
IAEA Technical Meeting on Proliferation Resistance of Fast Reactors and Associated Fuel Cycles

18 – 22 August 2025

https://conferences.iaea.org/e/PRFR

- *Evaluation of Proliferation Resistance (PR) of Fast Reactors and Associated Fuel Cycles: Methodologies, Definitions, Assessment and Metrics*
- *Reactor Design Features for Enhancing Proliferation Resistance*
- *Proliferation Resistance Considerations for Fast Reactor Fuel Cycles*
- *Safeguardability of Fast Reactors and Associated Fuel Cycles*

IAEA Technical Meeting on Advances and Innovations in Fast Reactor Design and Technology

29 September – 2 October 2025

https://conferences.iaea.org/e/FR-2025

- *Fast Reactors in National and International Nuclear Energy Programmes*
- *Review and comparison of fast reactor designs and technology*
- *Advanced fast reactor and core designs, including SMRs*
- *Innovative systems and components*
- *Advanced Fuels and Materials*
- *Experimental facilities and databases*

Joint ICTP-IAEA Workshops

Physics and Technology of Innovative Nuclear Energy Systems

- *In 2016, 2018, 2022 and 2024, in ICPT Trieste, Italy; Next in 2026?*
- *Contributed by NPTDS, INPRO, GIF and external experts*


Open-Source Nuclear Codes for Reactor Analysis (2023: IAEA ONCORE)

- *OpenFOAM and its derivatives for CFD simulation of multi-physics and multi-scale problems*
- *GenFOAM for core thermal hydraulics, neutron transport and structural mechanics modelling*
- *OpenMC Monte-Carlo neutron transport*
- *ARMI Advanced Reactor Modelling Interface*

2nd ONCORE Workshop: 22-26 September 2025:

- apply https://indico.ictp.it/event/10868

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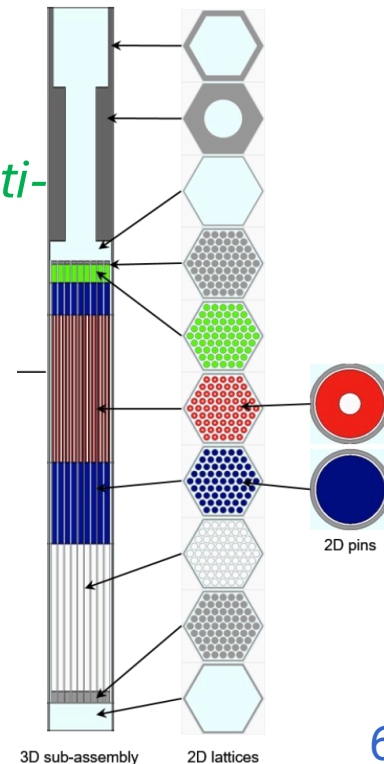
Joint ICTP–IAEA Workshop on Computational Tools for Simulation of Fast Reactors

The focus is on the following topics:

- **General overview**, theoretical background, benefits and challenges of the open-source approach in simulation of nuclear reactors

- **OpenMC** Monte-Carlo Neutron Transport Code: Applied to both fission reactors and fusion systems

- **OpenFOAM** and its Derivatives for Computational Fluid Dynamics (CFD) simulations of nuclear reactor thermal hydraulics and coupled neutronics, including GenFOAM

- **MOOSE** Parallel Finite Element Framework: Employed for multi-physics and multi-scale simulations, and

- **ARMI** (Advanced Reactor Modelling Interface): Providing an interface for advanced reactor modelling

22 - 26 Sep 2025, ICTP Trieste, Italy

apply https://indico.ictp.it/event/10868

Nuclear Reactor Simulators for Education and Training

Pressurized Water Reactor (PWR) Simulators

- Advanced PWR: Two-Loop Large PWR (Korean-OPR 1000)
- Russian-type PWR (VVER-1000)
- Advanced Passive PWR (AP-600)
- Integral Pressurized Water Reactor (SMR)

Boiling Water Reactor (BWRs) Simulators

- Conventional Boiling Water Reactor with Active Safety Systems (BWR)
- Advanced BWR with Passive Safety Systems (ESBWR)

Pressurized Heavy Water Reactor (PHWR)

- Conventional Pressurized Heavy Water Reactor (PHWR)
- Advanced PHWR (ACR-700)

Part-Task Simulator

- Micro-Physics Nuclear Reactor Simulator

Under Development

- High Temperature Gas Cooled Reactor (HTGR)
- Sodium Cooled Fast Reactor (SFR)

- Used for educational purposes and aid in the understanding of reactor plant fundamentals of a NPP, operational characteristics and various approaches to reactor designs.

- The IAEA sponsors training courses and workshops on a regular basis, and would also be willing to support additional training events on this topic at the request of Member States.

SFR Educational Simulator

- Pool type sodium cooled fast reactor simulator for education and training
- **Ready for Distribution to Member States**
- **Exercise Manual available**
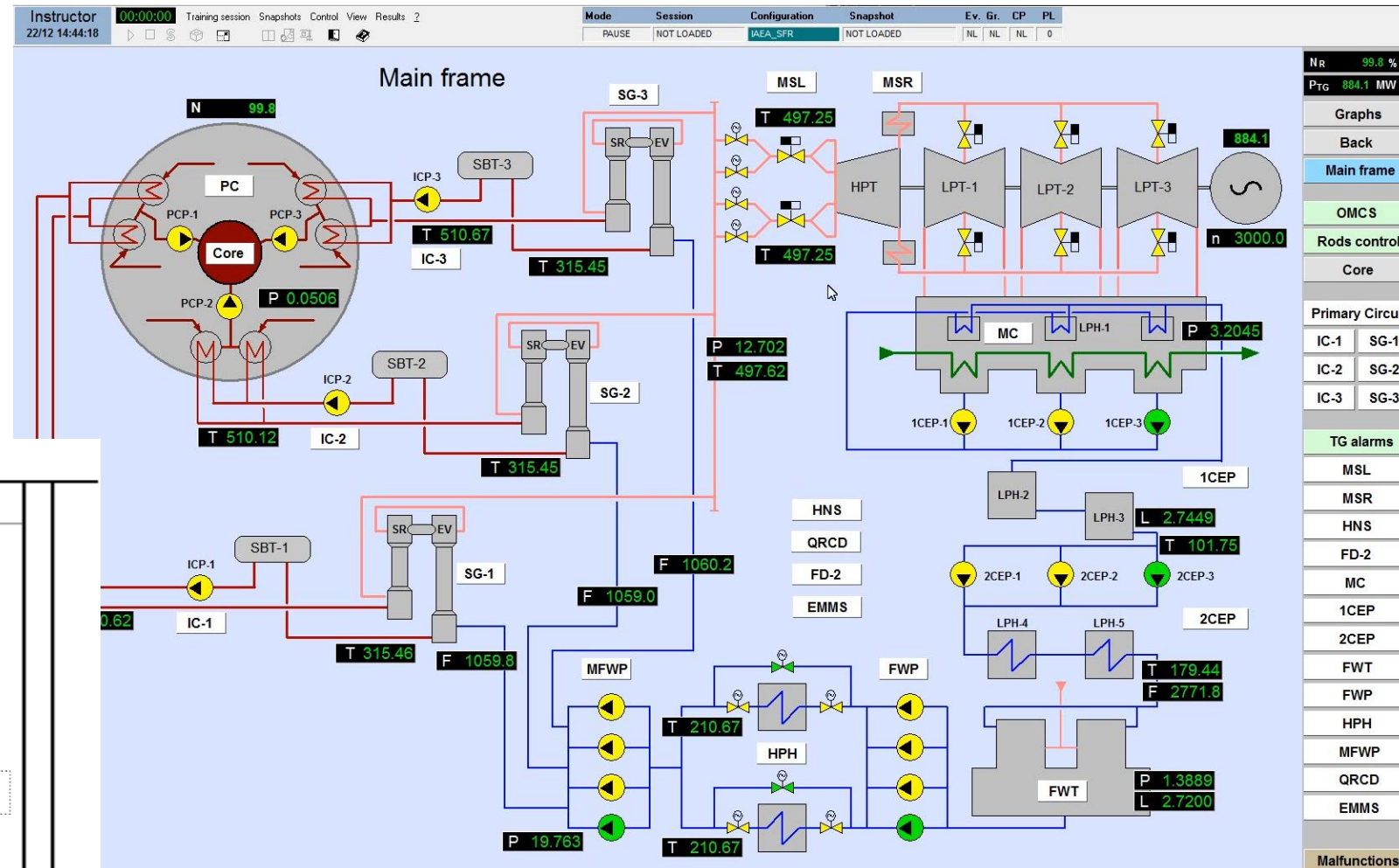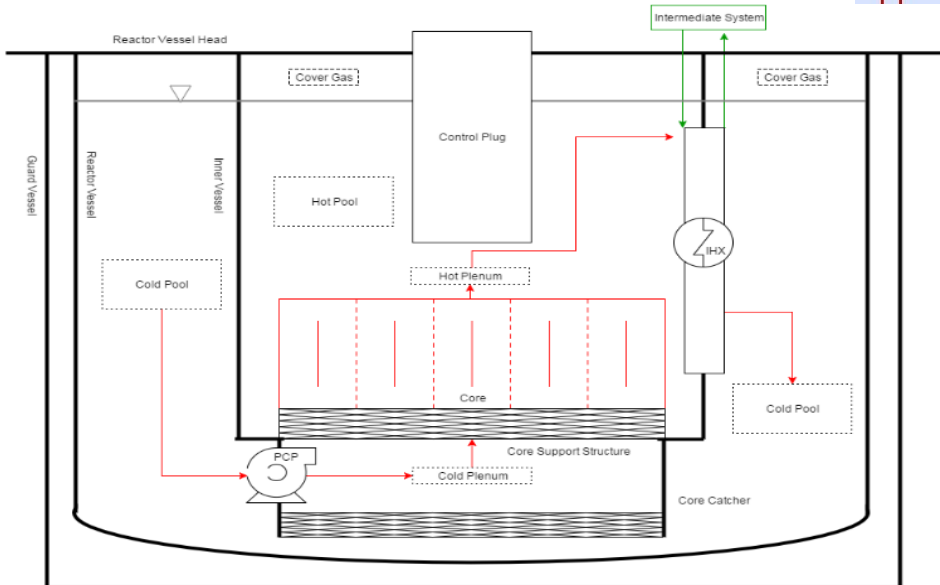
Available! Contact fr@iaea.org

Joint IAEA-GIF Webinar on Advanced Nuclear Technologies for Maritime Applications

- Current Status: latest developments and innovations for maritime use
- Potential Applications:
  - floating power plants
  - nuclear-propelled ships/icebreakers
  - non-electric applications

14 May 2025 at 14:30 (CET)

- Benefits and Challenges

- Speakers and Panellists from
  - JSC "Afrikantov OKBM" (RF)
  - Flibe Energy, USA
  - Seaborg Technologies, Denmark
  - IAEA

- Moderators:
  - Patricia Paviet (GIF)
  - Vladimir Kriventsev (IAEA)

Recordings and presentations available: https://conferences.iaea.org/e/2025-IAEA-GIF-Maritime

NACIE CRP: Benchmark of Transition from Forced to Natural Circulation Experiment with Heavy Liquid Metal Loop

- The Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) proposed this CRP to TWG-FR 2020, launched in 2022. ENEA operates NACIE-UP)facility:

  - Rectangular LBE flow loop

  - Containing a wire spaced 19 pin fuel pin simulator

  - Operating up to 250 kW for qualification and instrumentation testing.

Italian National Agency for New Technologies, Energy and Sustainable Economic Development

1st RCM: NACIE CRP
12-15 July 2022
Brasimone, IT
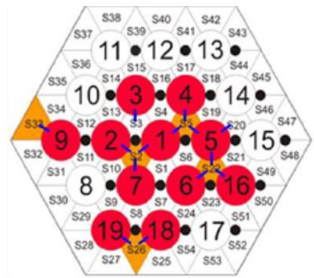
- **Objective**: Validation of computational fluid dynamics (CFD), subchannel, and system analysis codes for heavy liquid metal systems.

- First CRP dedicated to TH of lead and LBE technology.

New CRP: S-Allegro Facility

DHR HEX
12 m HEIGHT

PRIMARY HEX

SECONDARY CIRCULATOR
0.45 kg/s, 6.5 MPa

SECONDARY HEX
He / water

DHR CIRCULATOR
0.04 kg/s

PRIMARY CIRCULATOR
0.5 kg/s, 7 MPa

REACTOR PRESSURE VESSEL
1 MW ELECTRICAL HEATING
Up to 850 °C
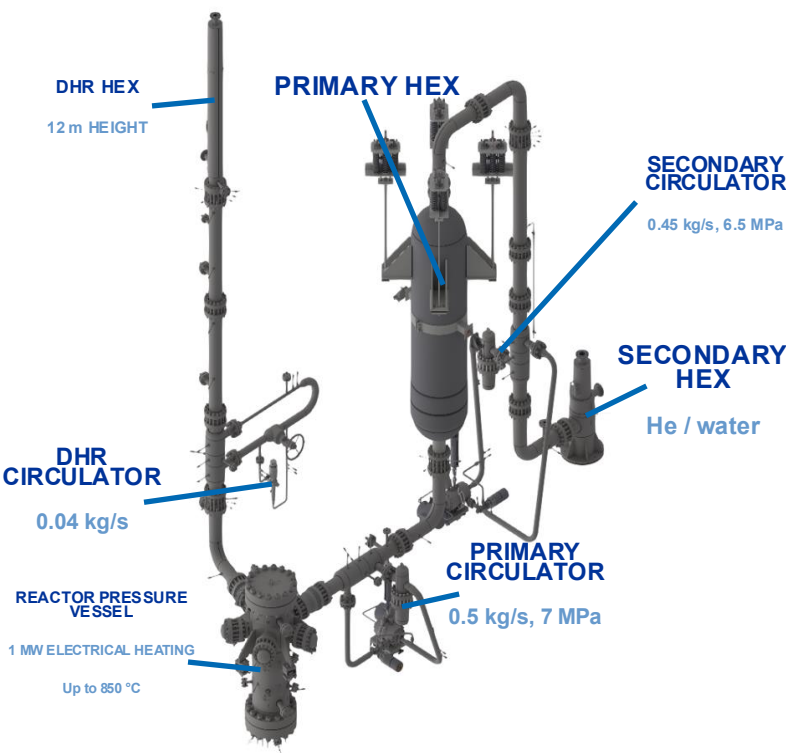
CRP: Benchmark Exercise: Simulation of Thermal Hydraulic Transients

1st Research Coordinated Meeting
3 – 5 March 2025, Vienna

Primary circuit	
Working fluid	Helium
Max. temperature	850°C
Max. pressure	7 MPa
Max. mass-flow rate	0.5 kg/s
DHR loop height	12 m
Reactor vessel	
Max. heating power	1.05 MW
Height	2.99 m
External diameter	0.62 m
N of heating assemblies	7
Secondary circuit	
Working fluid	Helium
Maximum temperature	820°C
Maximum pressure	6.5 MPa
Maximum mass-flow rate	0.45 kg/s
Tertiary circuit	
Working fluid	Water
Nominal temperature	Ambient
Maximum pressure	0.6 MPa
Maximum mass-flow rate	100 m3/h
Heat exchangers	
Primary HX nominal power	1.05 MW
Primary HX dimensions	D=1.4 m, H=5 m
Secondary HX nom. power	1.05 MW
Secondary HX dimensions	D=0.4 m, H=1.4 m
DHR HX nominal power	47 kW
DHR HX dimensions	D=0.25 m, H=3 m

LMFNS: Catalogue of Experimental Facilities in Support of Liquid Metal Cooled Fast Neutron Reactors

IAEA Nuclear Energy Series
No. NP-T-1.15

Basic Principles
Objectives
Guides
Technical Reports

Experimental Facilities in Support of Liquid Metal Cooled Fast Neutron Systems

IAEA
International Atomic Energy Agency

Example:
- 6B, IPPE, Russia
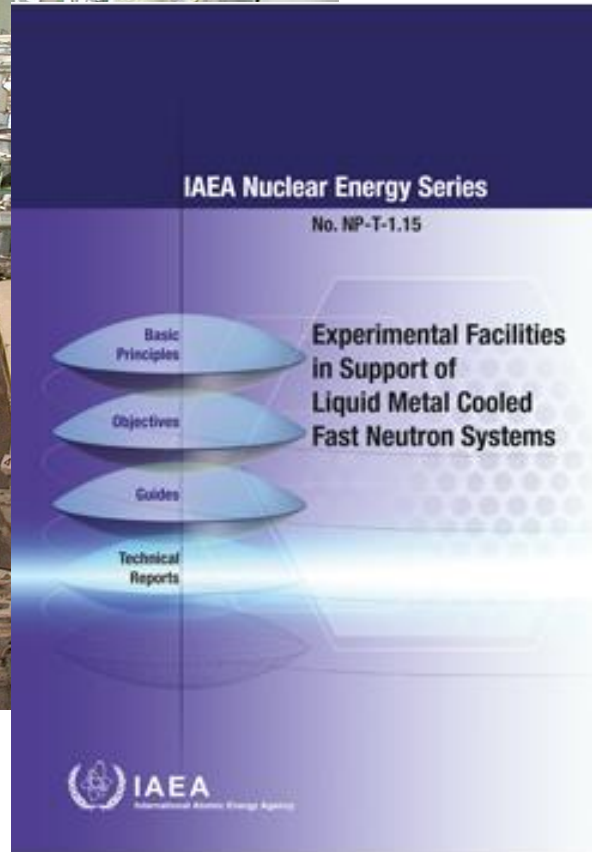
- Inputs received from 14 countries and EU

- 153 facilities reviewed and accepted:

- Na-based facilities: 79
  Pb-based facilities: 74

- online since 2016

- main upgrade in 2019

- last updated in 2024 (+2 from UK)

- Will be included in **NEXSHARE**

**Freely Available at iaea.org:
Search for "IAEA LMFNS"**

Publications on Fast Reactor Technology

Title	Status	
Sodium Coolant Handbook: Thermal Hydraulic Correlations	*Published*	2024
TECDOC: Benchmark Analysis of FFTF Loss-of-Flow Without Scram Test	*Final editing*	2025
TCS: Fundamentals of Neutronics Simulations of a Fast Reactor Based on IAEA's Benchmark of CEFR Start-Up Tests	*In publishing; waiting for main CEFR TECDOC*	2024/25
TECDOC: Neutronics Benchmark of CEFR Start-Up Tests	*Under internal Review*	2025
TRS: Development and Application of Open-Source Modelling and Simulation Tools for Nuclear Reactor Analysis	*In Printing; Preprint is available*	2024
TRS: State-of-the-art Review of Thermal Hydraulics of Fast Reactors	*In Publishing*	2025
Proceedings of FR22 Conference	*In Printing*	2025

Advanced Reactors Information System (ARIS)

IAEA

Designs in ARIS	Design Organizations	Countries
127	> 75	~25

Web accessible database and a tool for Member States at various stages of nuclear power development, offering standardized, impartial data on reactor designs, including evolutionary and innovative concepts, to support informed reactor technology assessments

Small Modular Reactors

Liquid Metal Cooled Fast Reactors

Water Cooled (Land based)

Advanced Reactors

Gas Cooled Reactors

Molten Salt Reactors

Microreactors
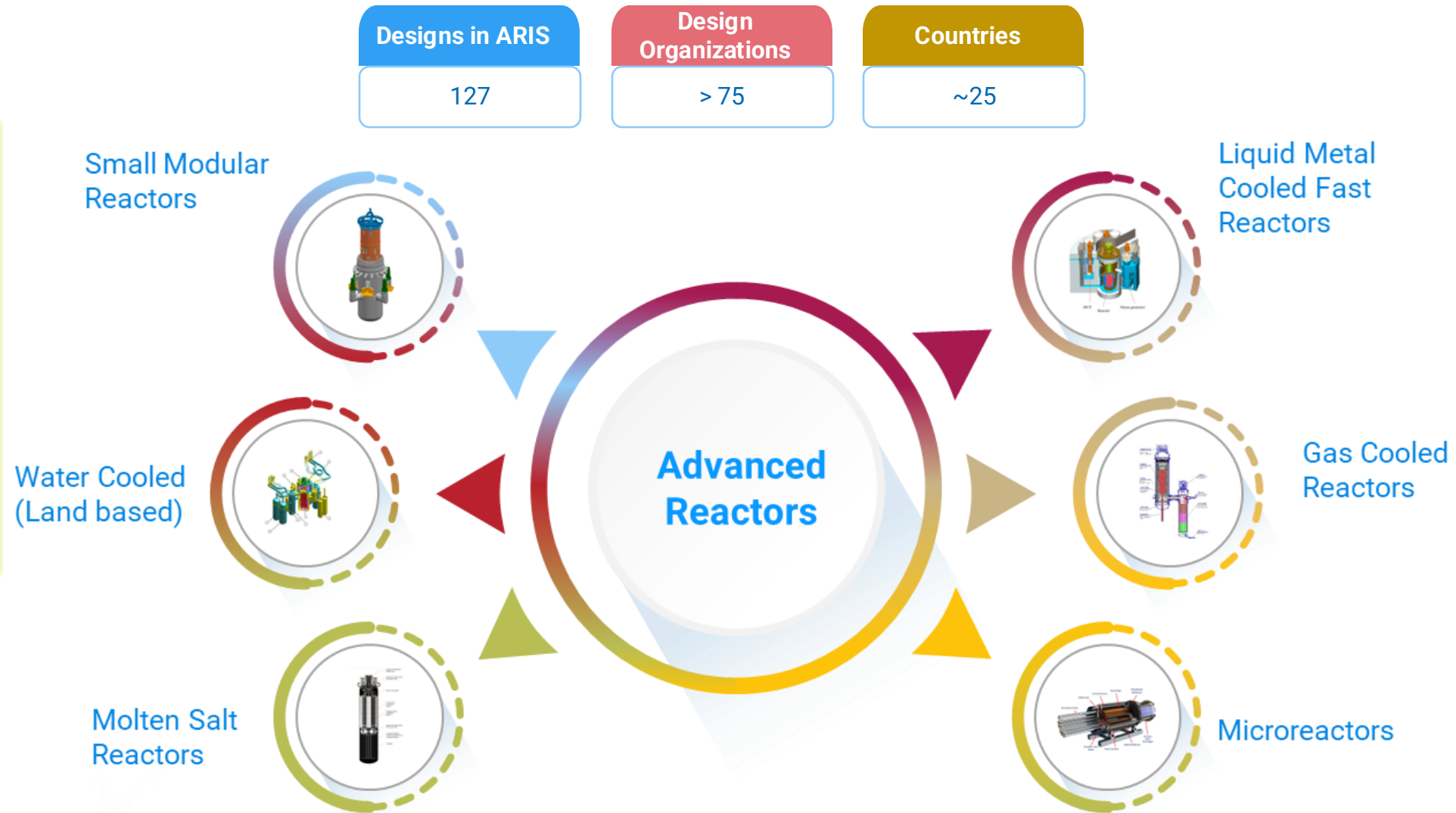
Access online: Advanced Reactor Information System | Aris

The Open-source Nuclear Codes for Reactor Analysis (ONCORE) initiative is an IAEA-facilitated international collaboration framework for the development and application of open-source multi-physics simulation tools to support research, education and training for the analysis of advanced nuclear power reactors. Institutions and individuals participating in ONCORE can collaborate in, and benefit from, the development of open-source software in the field of nuclear science and technology.

An international network of research and academic institutions is creating a common platform in the area of *advanced reactor experiments and high-fidelity multi-physics nuclear simulation techniques for open-source code development and validation*. The work focuses on three major areas: modelling and simulations, experimental reactor physics and education and training.

Access to
Members' Area

Related Stories
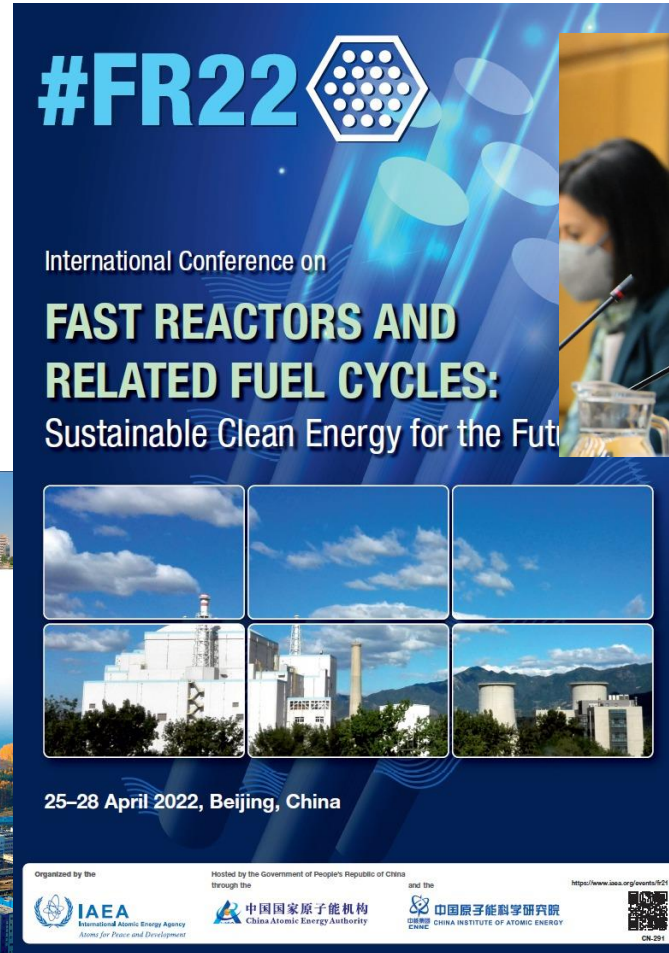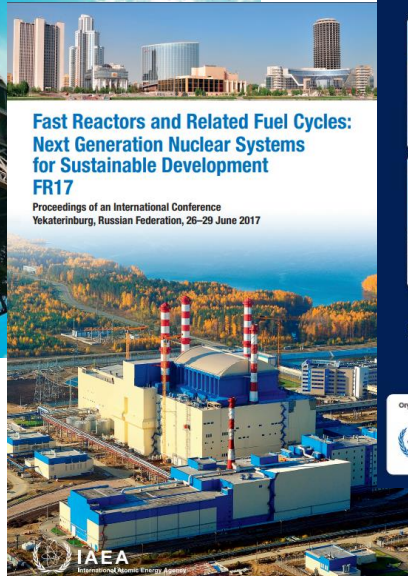
IAEA Designates Swiss Ecole Polytechnique Federale de Lausanne as Collaborating Centre

https://www.iaea.org/topics/nuclear-power-reactors/open-source-nuclear-code-for-reactor-analysis-oncore

https://nucleus.iaea.org/sites/oncore

IAEA Conferences on Fast Reactors and Related Fuel Cycles

Prof. Bhaduri,
General Chair

FR26 in Beijing
- Hosted by CIAE
- 18 - 21 May 2026

FR26: Preparation Timeline

| Date	Venue	Event
2025		
24 June	Vienna	*Joint Meeting of FR26 IAC and TWG-FR*
1 August		*Announcement/Call for papers*
15 October		*Deadline for abstract submission*
24-26 November	Vienna	*1st Meeting of PC*
15 December		*Abstract acceptance letters to authors*
2026		*Final conference programme*
15 February		*Deadline for submission of full papers*
1 April	Vienna	*2nd Meeting of PC*
30 April		*Paper acceptance letters to authors*
15 May		*Submission of revised papers*
18 – 21 May	Beijing	*Conference in Beijing*
1 July		*Final Papers (?) and Summaries from Track Leaders*

Activities and Events on Fast Reactor Technology

FR26: IAEA Conference on Fast Reactors and Related Fuel Cycles
hosted by *China Institute of Atomic Energy (CIAE)* in **Beijing, 18-21 May 2026**

Date	IAEA Events on Fast Reactors in 2025	Location
24 - 26 Jun 2025	58th Meeting of TWG-FR	Vienna
26 - 27 Jun 2025	Joint IAEA-GIF Interface Meeting	Vienna
30 Jun – 4 Jul 2025	Workshop on Fuel Performance Assessment and Behaviour for Liquid Metal Cooled Fast Reactors	Vienna
30 Jun – 4 Jul 2025	IAEA-GIF Joint Workshop on the safety of non-WCR	Vienna
18 - 22 Aug 2025	TM on Proliferation Resistant Features of Fast Reactors and Advanced Fuel Cycles	Vienna
29 Sep - 2 Oct 2025	TM on Advances and Innovations in Fast Reactor Design and Technology	Vienna
22 - 26 Sep 2025	Joint ICTP–IAEA Workshop on Computational Tools for Simulation of Fast Reactors	Italy
20 - 24 Oct 2025	4th RCM of NACIE CRP (Transition from Forced to Natural Circulation)	Vienna
3 – 7 Nov 2025	IAEA TC Workshop on Modelling and Simulation in Development of Advanced Gen-IV SMRs	Moscow

Atoms for Peace and Development…
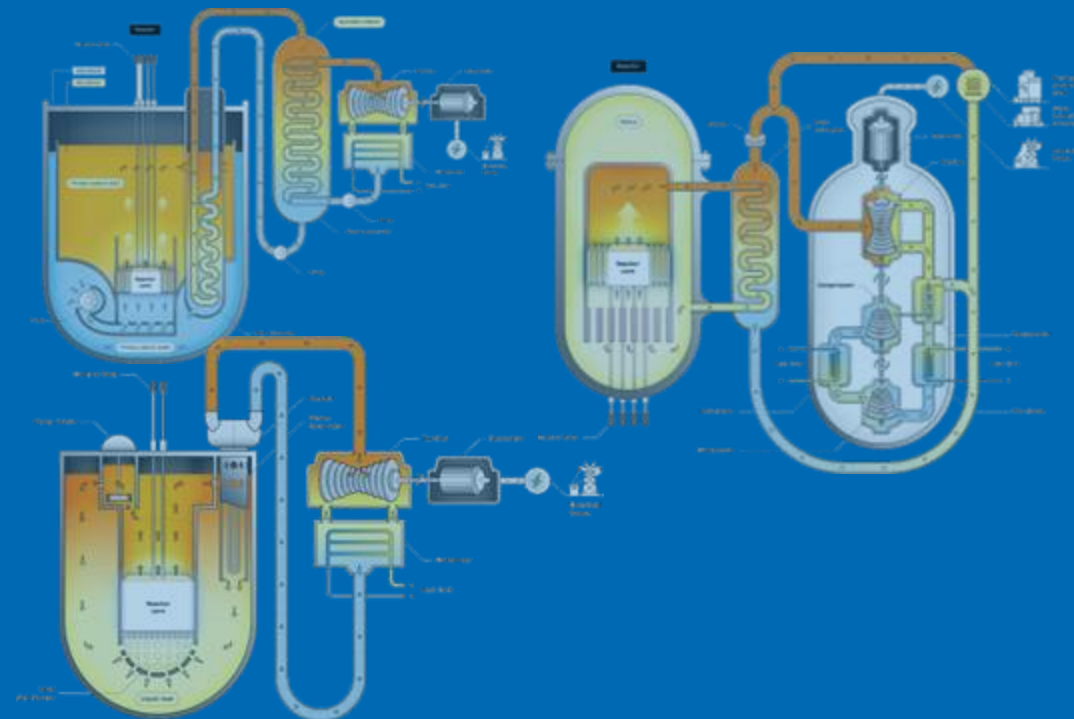
Thank You!

email: FR@IAEA.ORG

Joint ICTP-IAEA Educational Events
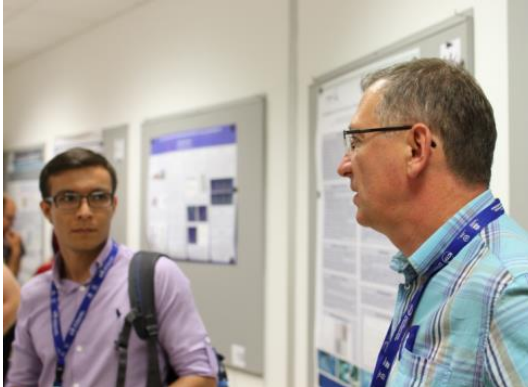
- Workshops on **Physics and Technology of Innovative Nuclear Energy Systems**
  - In 2016, 2018, 2022, 2024 in Trieste, Italy
  - Contributed by NPTDS, INPRO, GIF, and other external experts
  - Next: 2026

- School on Use of **Artificial Intelligence and Machine Learning in Advancing Nuclear Engineering and Technology**
  - 10-15 March 2025

- Workshops on **Open-Source Nuclear Codes for Reactor Analysis**
  - In Aug 2023, and
  - 22-26 September 2025

- Joint ICTP-IAEA **Fusion Energy School**
  - May 2025

IAEA Webinar Series on Multiphysics Modelling of Nuclear Reactors using OpenFOAM and its Derivatives

- Open∇FOAM (openfoam.com) is an open-source toolbox for industrial-level computational fluid dynamics (CFD), and also a library for the finite-volume discretization and parallel solution of Partial Differential Equations (PDEs)

- Directly supports the education and training part of the ONCORE initiative.

August – October 2022; 12 lectures in the series covering:

➢ Overview of using OpenFOAM as a multi-physics library for nuclear reactor analysis

➢ Brief introduction to the use of finite-volume methodologies

➢ Basics of Partial Differential Equations (PDEs)

➢ Problem definition

➢ Geometry and mesh generation

➢ Introduction to OpenFOAM's source code and object-oriented programming

➢ ContainmentFOAM tool for system-scale CFD analysis of containment atmosphere pressurization, H2/CO mixing and mitigation.

➢ GeN-Foam tool as multi-physics solver in nuclear reactor design and safety analysis

➢ OFFBEAT tool, a solver for fuel behavior analysis in nuclear reactors. As a multi-dimensional code, it allows studying the evolution of the fuel in 1-D, 2-D or 3-D, and it can simulate both transient and steady-state conditions.

➢ GeN-ROM, a data-driven model-order reduction tool for nuclear applications based on GeN-Foam

Recordings of all lectures are available at:
https://elearning.iaea.org/m2/course/view.php?id=1286

Stephan Kelm, FZJ
Ivor Clifford, PSI
Carlo Fiorina, EPFL
Alessandro Scolaro, EPFL
Stefano Lorenzi, POLIMI
Ezequiel Oscar Fogliatto, PSI
Jean Ragusa, TAMU
Peter German, INL


```
<case>
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│   ├── controlDict      see section 6.1
│   ├── fvSchemes        see section 6.2
│   ├── fvSolution       see section 6.3
│   └── blockMeshDict    see section 4.1
├── constant
│   ├── xProperties      see chapter 5
│   └── polyMesh         see subsection 4.1.2
│       ├── boundary
│       ├── faces
│       ├── neighbour
│       ├── owner
│       └── points
└── time directories     see subsection 2.2.8
```