GEN IV International Forum

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Lead-cooled Fast Reactor Development Status & Perspectives

Dr. Mariano Tarantino, ENEA, Italy

05 December 2024

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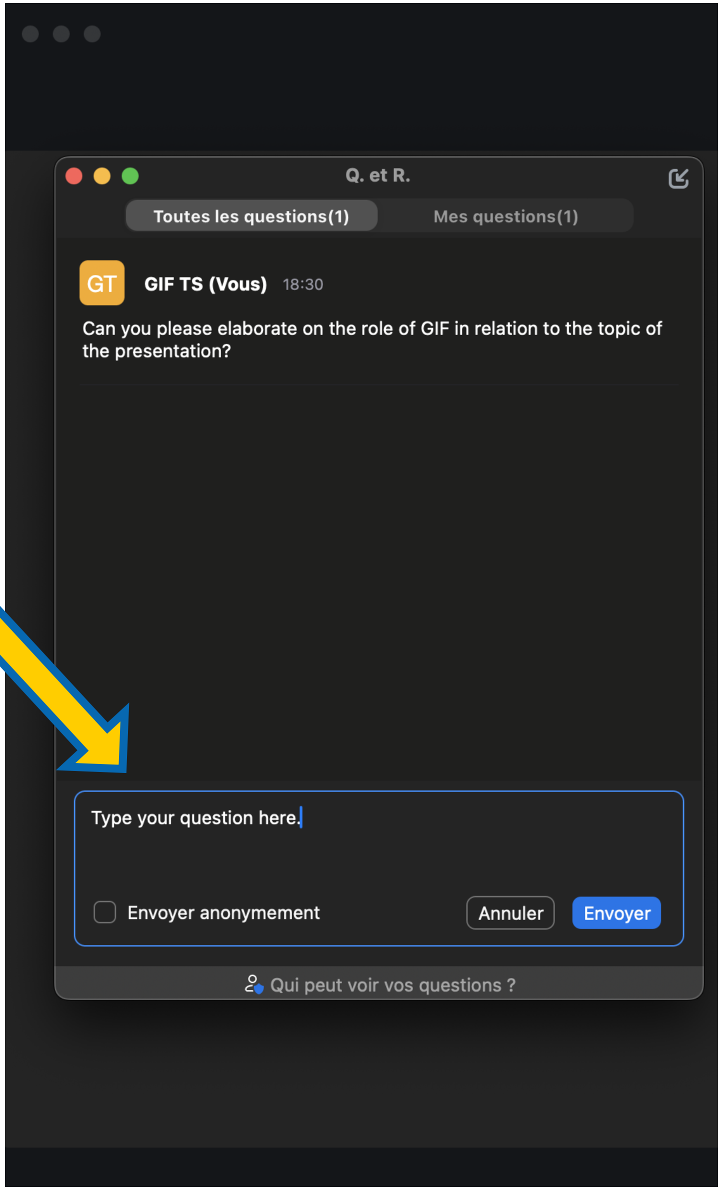

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Italian National Agency for New Technologies, Energy and Sustainable Economic Development

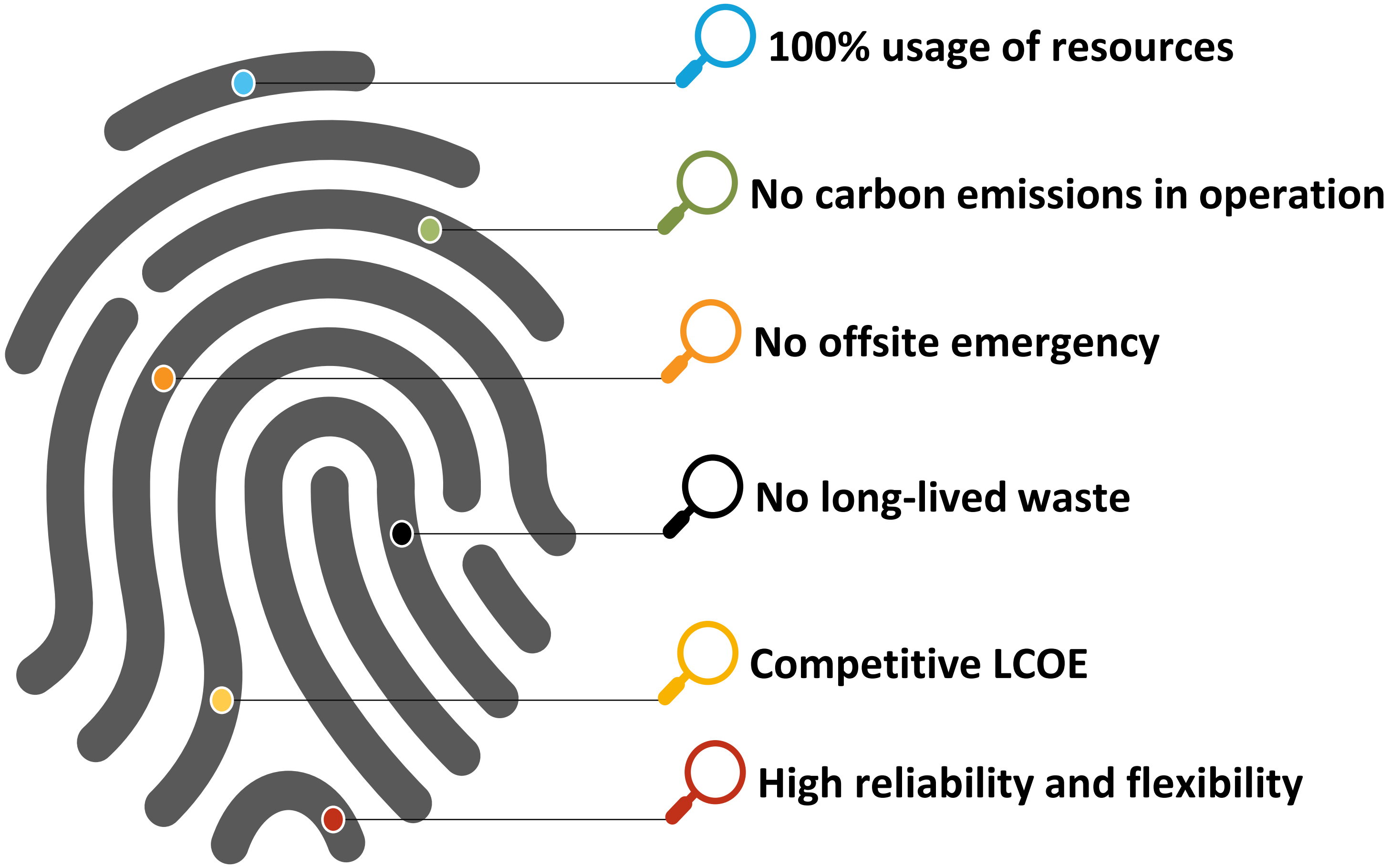
Meet the Presenter

Dr. Mariano Tarantino graduated in Nuclear Engineering from the University of Pisa in 2004. Ph.D. in Nuclear and Industrial Safety in 2008.
Since 2008 he has been a researcher at the Italian National Agency for New Technologies, Energy and Sustainable Economic Development – ENEA in the field of liquid metal technologies for nuclear applications, mainly related to Generation IV - LFR.
Currently he is the head of the Nuclear Energy Systems Division of the ENEA Nuclear Department, member of the Executive Board of FALCON Consortium devoted to ALFRED DEMO LFR construction, and member of the newcleo R&D steering committee, aiming at supporting the development of LFR-AS-30 and LFR-AS-200.
With a background in thermo-fluid dynamics, expert in nuclear technology and lead cooled fast reactors, with an experimental vocation, he coordinates various projects at a national and international level. Among those international efforts Dr. Tarantino is the **Co-Chair of the Generation IV International Forum provisional Lead Fast Reactors System Steering Committee LFR provisional System Steering Committee**.

Email: mariano.tarantino@enea.it

The «ideal» Nuclear Power Plant

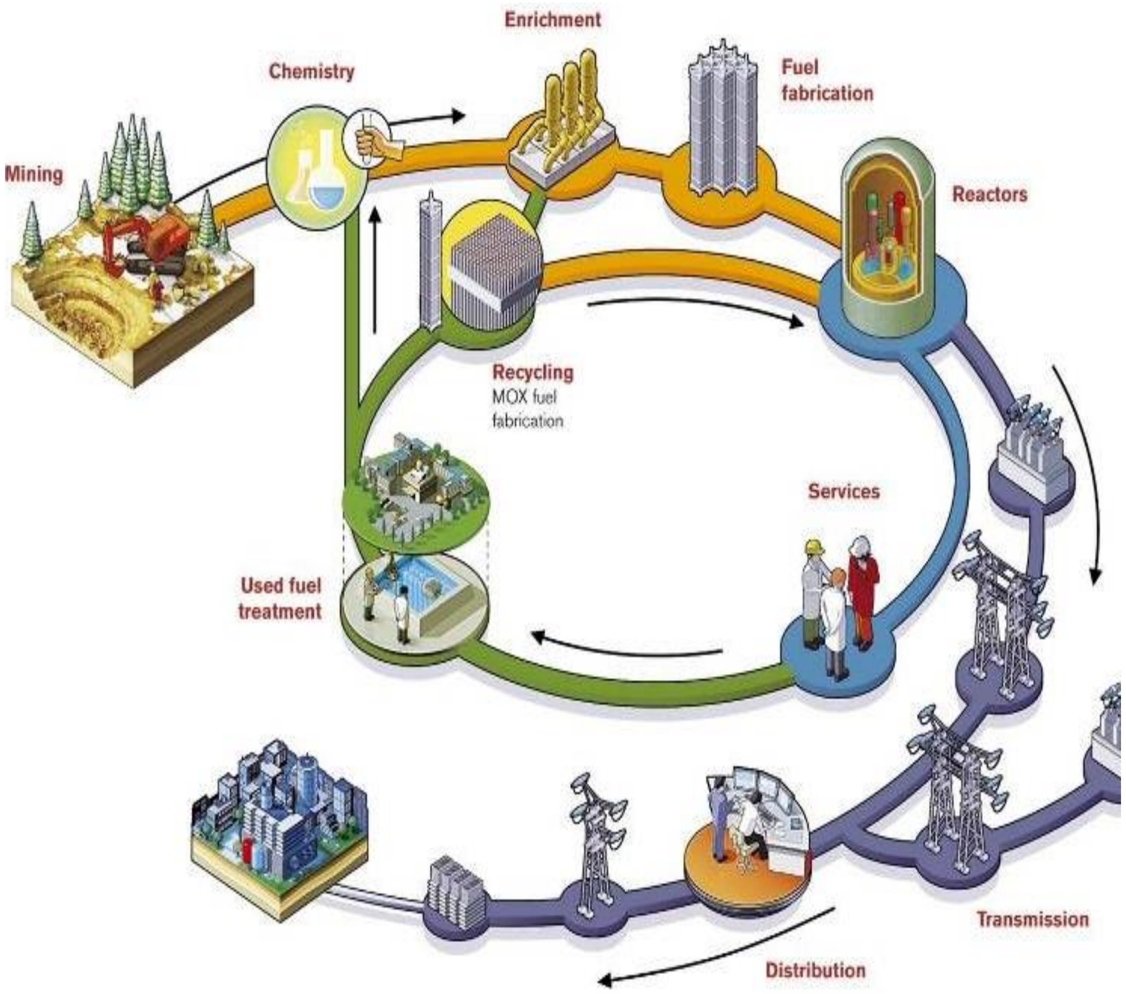
Fission Nuclear Power Plants of a new type are being developed for a short-term deployment (beyond 2030) to replace the current fleet and better integrate future hybrid energy systems: smaller, more flexible, economically competitive, able to produce more than purely electricity.



Closing the fuel cycle

The fission process used in nuclear reactors produces a **number of isotopes that can be toxic to human lives and the environment**.

Since the start of the large-scale deployment of nuclear energy, **disposal** of the long-lived isotopes has been an issue that has had a priority in most nuclear countries.



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Closing the fuel cycle

The Partitioning & Transmutation objectives can be summarized as:

- ❑ Minimization of waste mass sent to a repository,
- ❑ Reduction of the potential source of radiotoxicity
- ❑ Reduction of the heat load in the repository

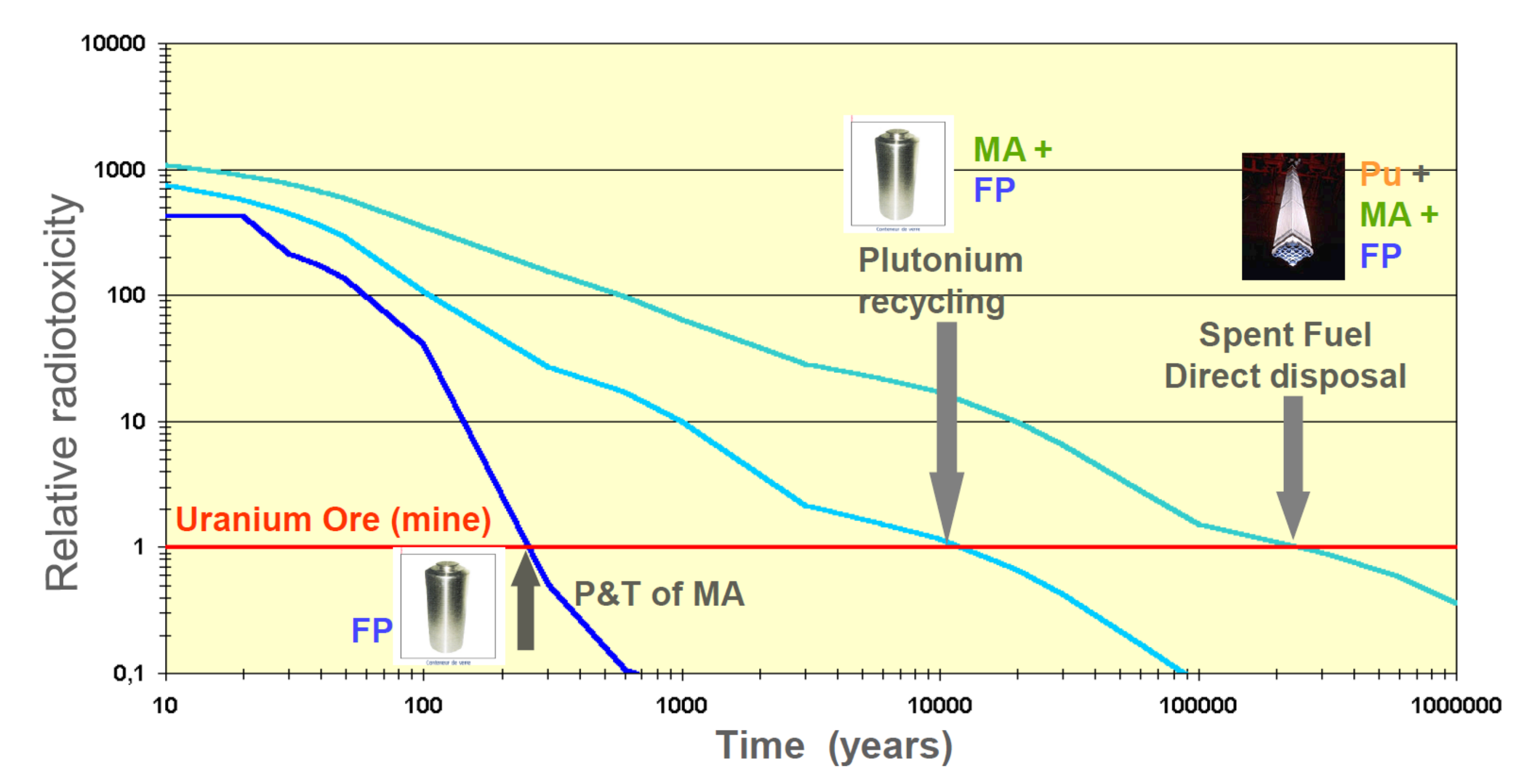
Strategies making use of P&T can be gathered into three categories:

- ❑ Sustainable development of nuclear energy and waste minimization (Pu as a resource)
- ❑ Reduction of MA inventory
- ❑ Reduction of TRU inventory as unloaded from LWRs

Fast neutron spectrum reactors are the most adapted technology and offer flexible options for implementation.

Source: Phillip Finck and Massimo Salvatores, INL, FUNFI-2, Frascati, October 2016

Closing the fuel cycle



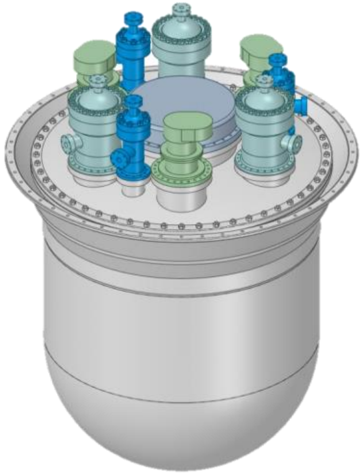
Recycle of all actinides in spent LWR fuel in fast reactors provides a significant **reduction in the time required for radiotoxicity to decrease to that of the original natural uranium ore used** for the LWR fuel (i.e., man-made impact is eliminated). From **250,000 years down to about 400 years** with 0.1% actinide loss to waste.

Lead-cooled Fast Reactors

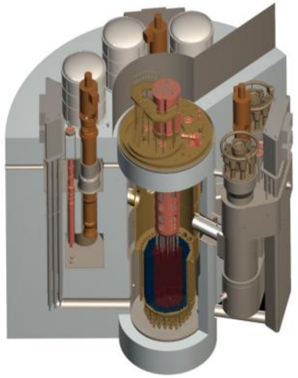
Main advantages and drawbacks of Lead

Atomic mass	Absorption cross-section	Boiling Point (°C)	Chemical Reactivity (w/Air and Water)	Risk of Hydrogen formation	Heat transfer properties	Retention of fission products	Density (Kg/m^3) @400°C	Melting Point (°C)	Opacity	Compatibility with structural materials
207	Low	1737	Inert	No	Good	High	10580 10580	327	Yes	Corrosive

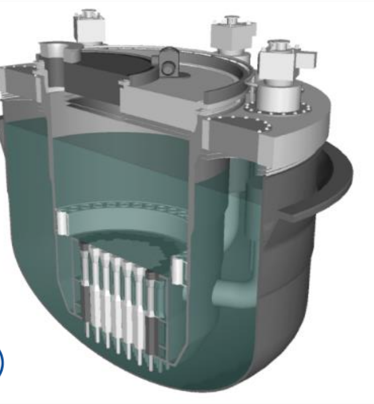
Lead-cooled Fast Reactors



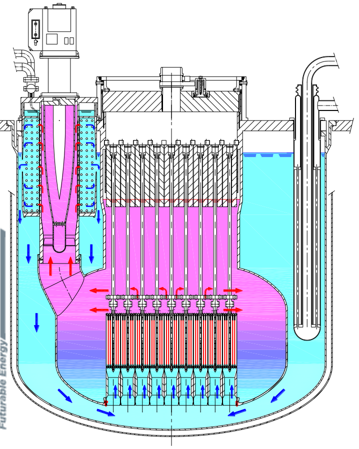
ALFRED
120 MWe, Romania - Italy
Under design



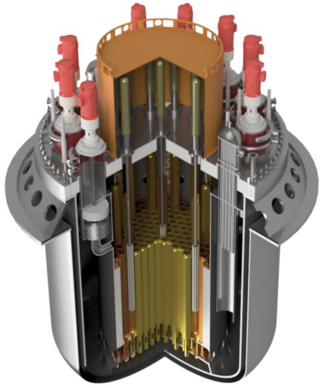
BREST-OD-300
300 MWe, Russia
Under construction



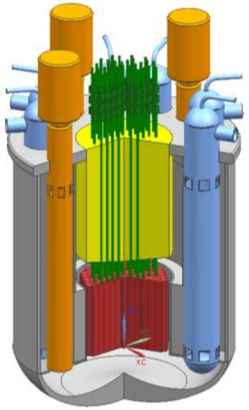
Westinghouse LFR
450 MWe, USA
Under design (suspended)



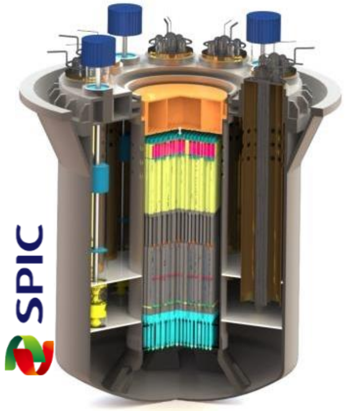
NewCleo LFR-AS-200
200 MWe, FRANCE
Under design



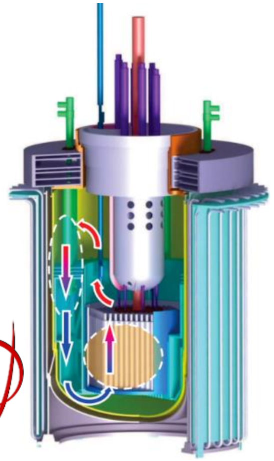
BlyKalla SEALER-55
55 MWe, Sweden
Under design



CLFR-300 and CLFR-10
300/10 MWe, China
Under design



BLESS
100 MWe, China
Under design

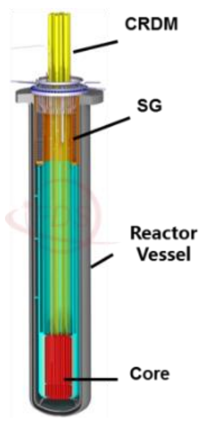


CLEAR-1
10 MWth, China
Under design

Micro-Uranus
60 MWth, Korea
Under design

Update on LFR Technology: China

- **CLEAR series LFR developed by International Academy of Neutron Science (IANS)**
  - **CLEAR-M**: Small modular transportable reactor with 10MWe
  - **CLEAR-400:** Small modular LFR with 400MWth
  - **CLEAR-A**: 1GeV/10mA proton accelerate coupled with 100 MW_{th} LFR
- **Validation platform for CLEAR**
  - **NIRVANA**: **Verification Platforms were built to support LFR engineering verification**
  - **CLEAR-M0**: pool-type integration verification facility, >5MWth, **started commissioning and core outlet temp. reaches 550ºC**



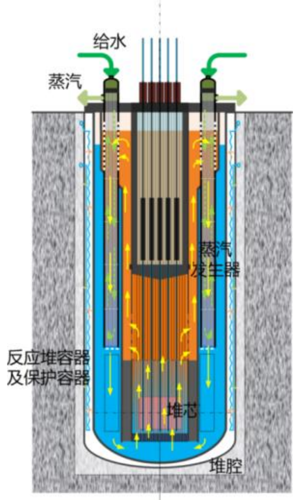
CLEAR-M reactor

NIRVANA

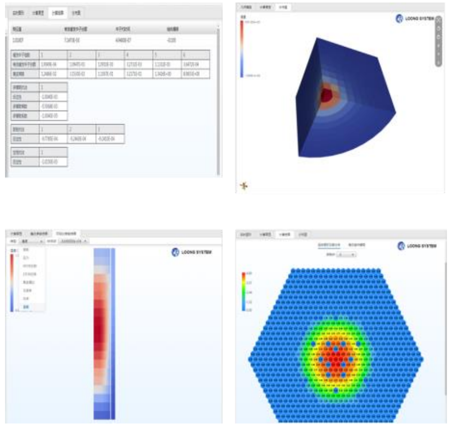
Update on LFR Technology: China

- **CiADS Led by CAS-IMP: the environmental impact assessment for the first phase of accelerator has been approved in 2022**
- **LFR fundamental research is more active, especially primarily conducted by universities (Xi' an Jiaotong University. , Lanzhou University., Shanghai Jiao Tong University, etc.)**
- **Nuclear power enterprises (CNNC, CGN, SPIC) were invested to the LFR conceptual design and validation activities in recently years**

LFR experimental platforms
by CNNC

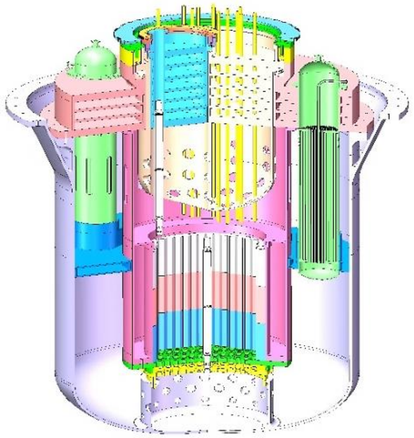


Long-Life full natural circulation SLFR
by SPIC



SARAX code for LFR
by Xi'an Jiaotong Univ.

Lead-water interaction experiment
by Shanghai Jiaotong Univ.

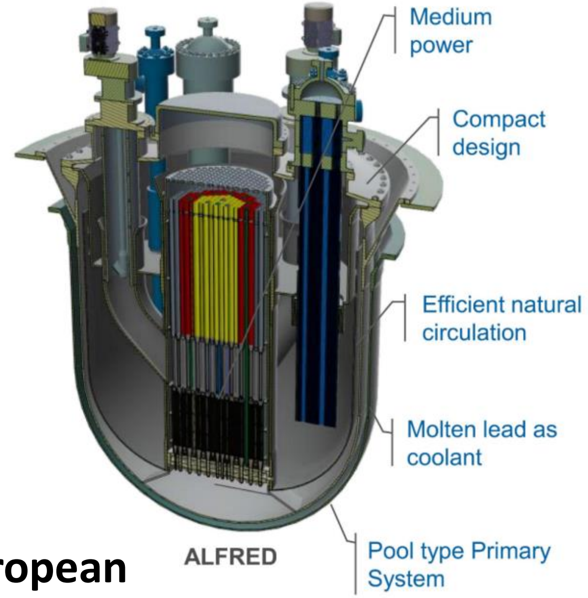


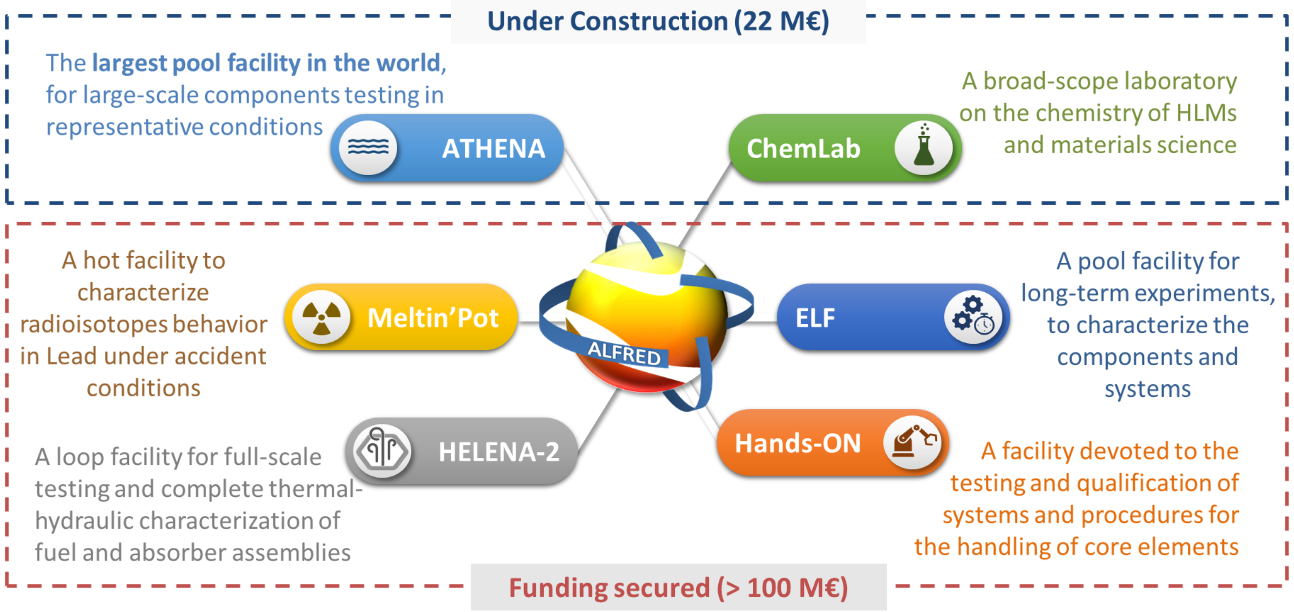
Offshore Floating LFR
by Lanzhou Univ.

Update on LFR Technology: EURATOM

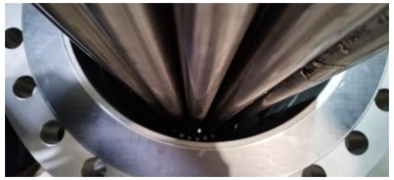
5,9 M€ 2024 48 M	LESTO	• **LESTO project** aims at providing a first assessment of the status of the LFR technology in correlation with energy mix including RES, increase the knowledge on the materials compatibility and the coolant control, prove the effectiveness in mitigating/preventing accidental scenario with in- and ex- vessel passive systems, provide a European platform of facilities & Simulation tools capable to support the industry and the regulators in the deployment of the LFR technology.
36,4 M€ 2024 60 M	CONNECT-NM	• **CONNECT-NM** is a CO-funded European Partnership. It is not a project, but a framework for R&D&I-connected activities & projects on Nuclear Materials: advanced materials development and manufacturing, material and component qualification, Non-destructive examination and materials health monitoring, advanced materials modelling and characterization.
4,5 M€ 2022 48 M	ANSELMUS	• **ANSELMUS aims** at supporting the safety assessment of ALFRED and MYRRHA; experimental validation of key safety related sub-systems including the safety rods, failed fuel pin detection and the coolant chemistry control system; improvement of the validation of numerical models describing the fuel assembly through experiments and simulations, and work on reactor safety monitoring and inspection of HLM systems focusing on high temperature vessel inspection
4,6 M€ 2020 48 M	PASCAL	• **PASCAL aims** at demonstrating the increased resilience to severe accidents of European HLM fast reactor demonstrators, ALFRED and MYRRHA; generation of evidences that can be directly used in the licensing-oriented discussion between the ALFRED and MYRRHA designers, and the corresponding safety authorities; increasing confidence in the capability of simulation models and codes to predict the safety-relevant behavior
8,4 M€ 2020 48 M	PATRICIA	• **PATRICIA supports** activities on advanced partitioning to efficiently separate Am from spent fuel, experimental and fuel performance code development work studying the Am-bearing fuel safety-related behavior; support to the preliminary safety assessment report (PSAR) of MYRRHA, ADS system safety

Update on LFR Technology: EURATOM





ALFRED is the European LFR demonstrator developed by the FALCON consortium together with European research organization and industries.



ATHENA, almost completed - the first step of ALFRED experimental infrastructure

- 2.21 MW Core simulator
- Full height bayonet tube heat exchanger
- Main Vessel hosting 800 tons of lead

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Update on LFR Technology: EURATOM

Italy

- Investing in LFR research since the 2000s.
- Discontinued national research program in 2018.
- But continued to support industrial research and Euratom projects.
- Now showing renewed interest in nuclear technologies.
- Very open to international collaboration.

Romania

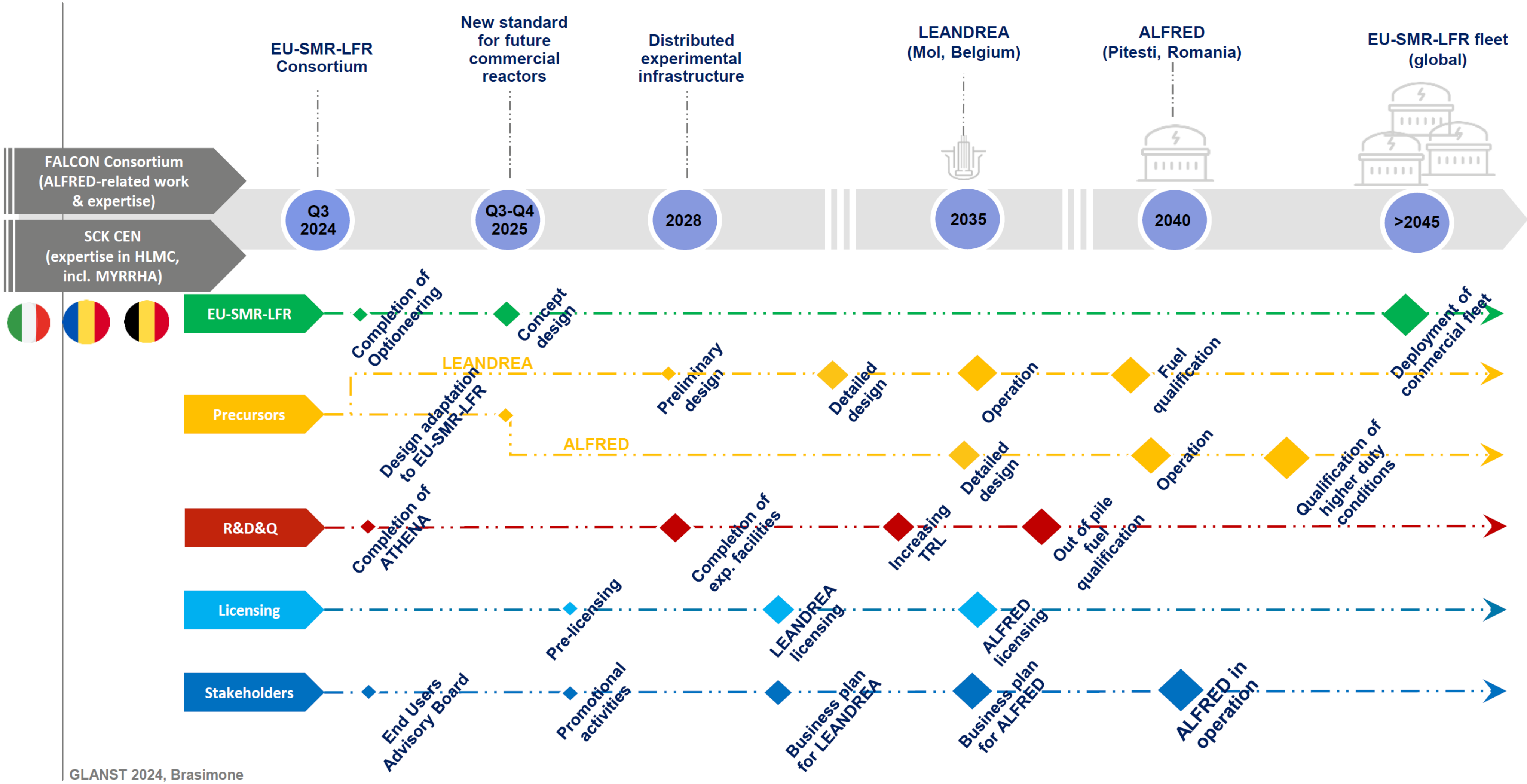
- RATEN-ICN center involved in European projects on LFR since about 2010.
- Declared interest in hosting the first LFR demonstrator (ALFRED) in 2011.
- Joined the FALCON consortium in 2013.
- Embedded ALFRED and the associated research infrastructure in multiple national strategy documents.
- Financing the largest experimental lead facility in Europe (ATHENA).
- Investment of additional €100 million over the next 4-5 years.

Belgium

- Traditionally focused on ADS LBE cooled solutions.
- In 2022, LFR selected as the best technologies to meet national targets.
- Investment of 100 M€ over 4 years.
- SCK CEN is in charge of the research and demonstration activities.
- Experience in licensing process with FANC/Bel-V.
- Managing a fleet of experimental HLM-based infrastructures.
- Experience with MOX fuel.

Partnership between nuclear national labs and industry leaders standing on a solid experience from the past and a shared vision for the future (MOU signed in Nov. 2023)

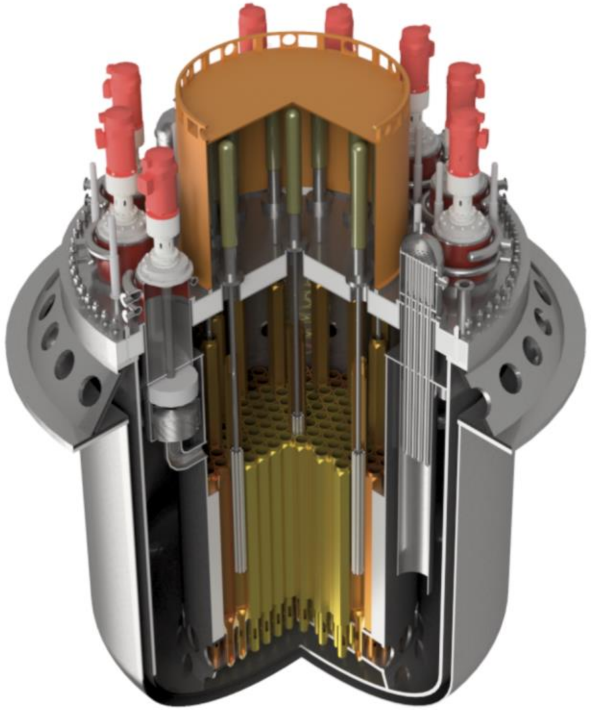
Update on LFR Technology: EURATOM



GLANST 2024, Brasimone

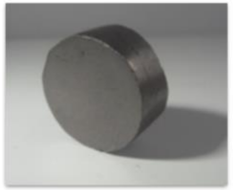
Update on LFR Technology: EURATOM

SEALER-55 (Swedish Advanced Lead Reactor)



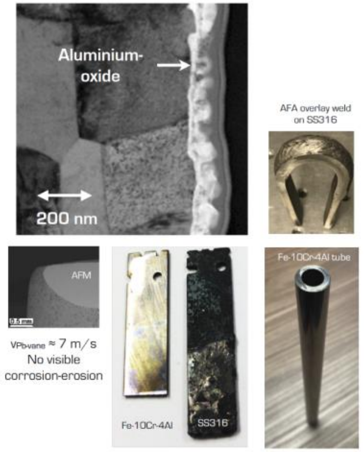
Item	Value
Power	140 MWth/55 MWe
Lead coolant mass flow	7400 kg/s
Lead inventory	800 tons
Core inlet/outlet temperature	420ºC/550ºC
Height	5.5 m
Diameter	4.8 m
Fuel	Uranium nitride (UN)
Fuel residence time	25 years

Manufacture of uranium nitride



- UN powder to be produced by direct ammonolysis of enriched UF_6 – minimizes process steps and residual impurities.
- KTH has successfully shown that uranium ammonium fluoride compounds can be synthesized by reacting gaseous UF_6 with NH_3 at 200°C
- Raising the temperature to 800°C in a tantalum lined furnace under flow of NH_3, UN_2 is obtained.
- Denitriding UN_2 at 1100°C in the same furnace under flow of Ar resulted in stoichiometric UN powder with 3% UO_2 impurity.

Corrosion tolerant steel



- Potential show-stopper for commercialisation of lead-cooled reactors: corrosion of stainless steels
- Blykalla's solution: aluminium alloyed steels:
  - Fe-10Cr-4Al-RE (RE = Zr, Ti, Nb, Y)
  - Alumina forming austenitic steels (AFA)
  - Alumina forming martensitic steels (AFM)
- Form 100 nm thin, ductile and protective alumina film on surfaces exposed to lead with low oxygen content.
- Fe-10Cr-4Al-RE successfully tested at 550ºC for 2 years & 850ºC for ten weeks.
- 140 Fe-10Cr-4Al tubes fabricated by Kanthal.

Update on LFR Technology: EURATOM

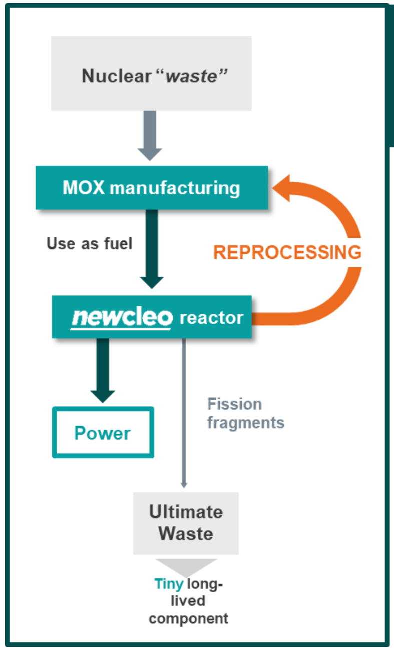
newcleo Futurable Energy

REACTOR DESIGN:
Small Modular Lead-cooled Fast Reactors

*new*cleo is working to design, build, and operate Advanced Modular Reactors exploiting fission

FUEL MANUFACTURING:
Mixed Uranium Plutonium Oxide

MOX and Fast Reactors allow the fuel cycle closure, using what today goes to *waste* as fuel



Fuel: MOX

- A clean solution to the issue of costly and long-lived nuclear **waste disposal**, using depleted uranium and plutonium, that today have little use
- The **long-term strategy** will eliminate the need to mine new uranium, enable energy independence, reduce the volume headed to geological repository
- Spent fuel will be **reprocessed** multiple times reducing byproducts: less than **1t of fission fragments** from one year's generation by a 1GWe *new*cleo LFR vs. **199t** that goes to waste from conventional reactors

CAPSULES operational since December 2023	Several tanks filled with O2-controlled lead and Argon, and with immersed specimens: corrosion of structural materials in molten lead
CORE 200 kW operational in March 2024	New loop-type test facility for corrosion/erosion testing of structural materials in molten lead
OTHELLO 2 MW conceptual design in progress	New thermal-hydraulics loop test facility: components performance testing, validation experiments
PRECURSOR 10 MW pending definition of detailed objectives and scope	New pool-type large-scale test facility: broad-scope investigations on LFR system transient behaviour, component testing/qualification, etc.
MANUT pending definition of detailed objectives and scope	Mechanical-type test facility: fuel handling systems and mechanisms (including rotating plugs) in air
CHEM-LAB	Chemical laboratory to support lead technology related investigations

NACIE-LHT procurement in progress	Test section at existing ENEA NACIE loop facility: lead cross flow heat transfer
CIRCE-SGTR with UniPi pending definition of detailed objectives and scope	One or more test sections at existing ENEA-CIRCE: thermal-hydraulics and fluid-structure-interaction phenomena involved in Steam Generator Tube Rupture (SGTR) scenarios in LFR
CIRCE-XXX pending confirmation of availability	Campaigns at existing ENEA CIRCE: endurance tests on axial flow pump bushings, control rods insertion/handling, components insertion/extraction, circulation transients
DIP COOLER at PoliTo detailed design in progress	New test facility mimicking dip cooler based Decay Heat Removal system: performance and start-up issues
ATHENA-XXX at RATEN-ICN pending confirmation of availability	Campaigns at existing pool-type ATHENA test facility with new test sections to be designed: thermal-hydraulics, lead chemistry control in large pools, SGTR tests with full-length tubes
MATERIALS LAB Environmental Park Turin pending confirmation of availability	Material laboratory, mechanical testing on structural materials

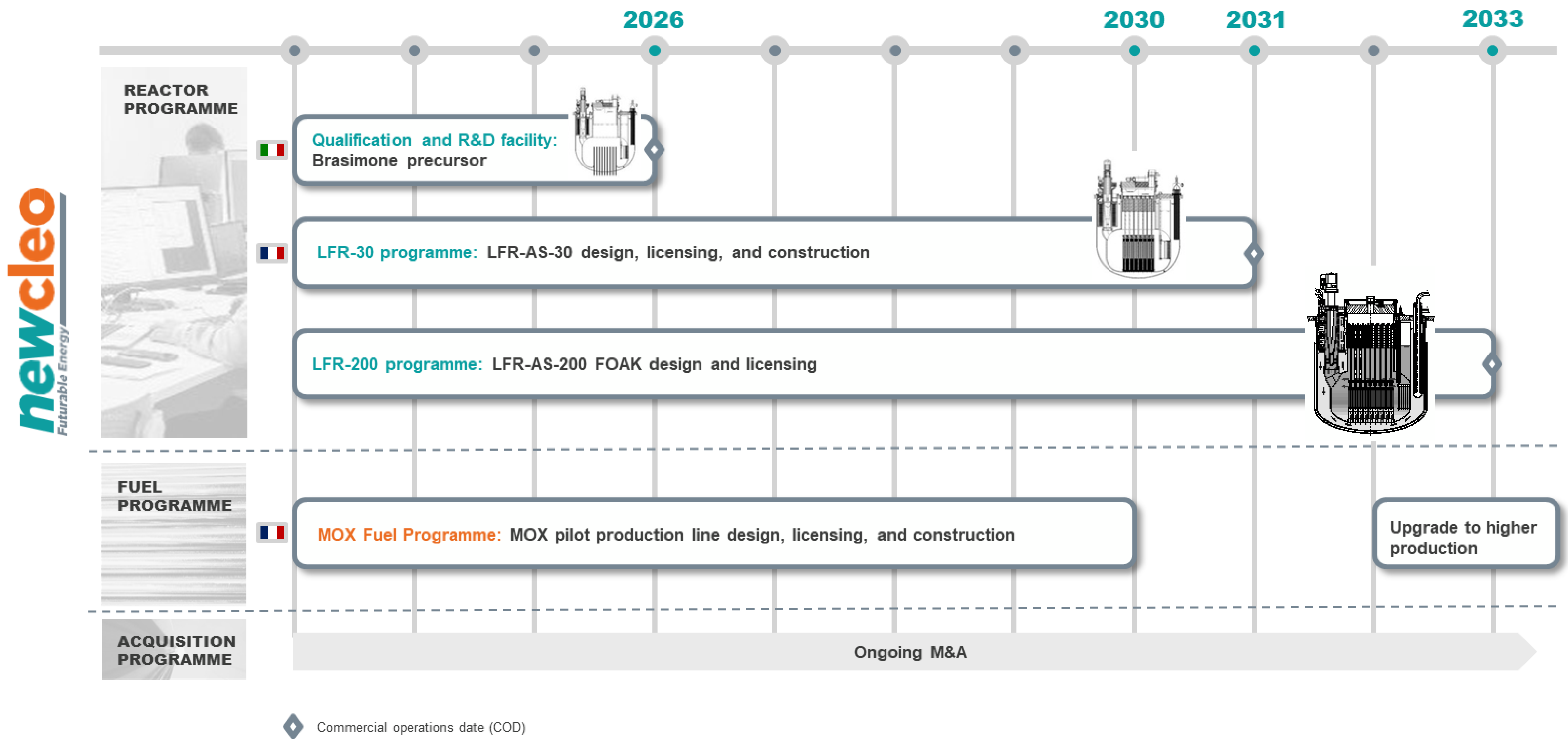
CAPSULES operational since December 2023

Facility to test various kinds of steel, bare and coated, in stagnant lead under oxygen-controlled concentration, essentially between 10^{-8} - 10^{-6} wt %; temperatures span between 450 - 750 °C

CORE operational in March 2024

Loop-type facility to test various kinds of steel, bare and coated, in fluent lead under oxygen-controlled concentration, essentially between 10^{-8} and 10^{-6} wt %; temperature in the corrosion test section 650 °C and velocity 1 m/s; in the erosion test section the temperature is 520 °C and the velocity 10 m/s. It will also be used to test the effectiveness of cold traps and mechanical filters

Update on LFR Technology: EURATOM



Update on LFR Technology: EURATOM

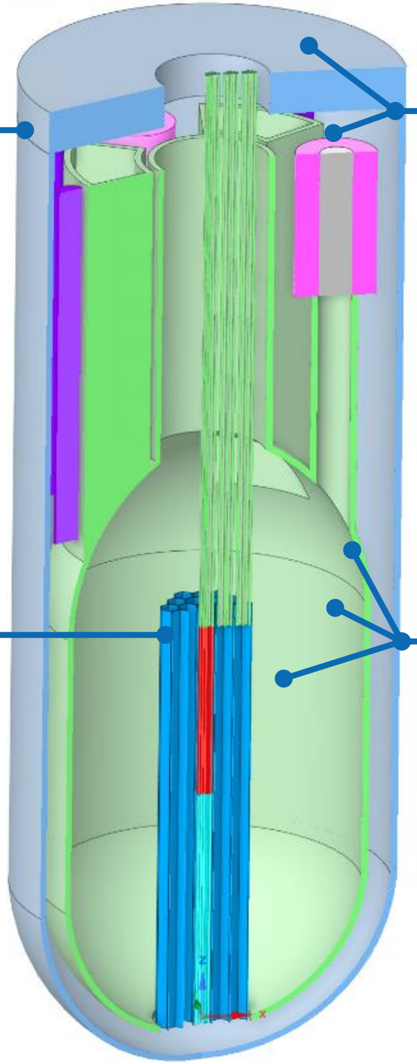
- PRECURSOR is a **10MWth (1/9 of LFR-AS-30) pool-type facility** that aims at investigating the thermal-hydraulic behaviour of the LFR-AS-30 reactor, with particular focus on:
  - **Normal Operating conditions**, **normal start-up/shut-down transients** and, to some extent, accidental transients
  - BOP transients/instability and Interactions with primary system
- Challenge to find the best tradeoff between **representativeness** (both at system and components level), **cost-effectiveness** and other **side constraints** (e.g., time, space)
- Consolidated **Power-to-Volume (P2V) scaling method** and **phenomena-driven approach** adopted

DHR:

- design obtained **preserving the single tube geometry** (number of tubes reduced). Solution to **minimise thermal-hydraulic distortions** (especially related to DHR secondary circuit).

eCore:

- designed to **comply with P2V** while ensuring primary flow shaping (19 FAs) and minimizing the number of heating rods.
- Electric supply from **above**
- Ongoing activities to design cooling systems for **parasite power generation due to Joule's effect**.



PRECURSOR facility, notional sketch

Pump and SG:

- SG designed to **minimise the radial footprint** (due to P2V constraints) while ensuring representative operating conditions of primary and secondary circuit
- Axial flow pump inside the SG as in LFR-AS-30

Pools and ASIV:

- PRECURSOR vessel and Amphora-shaped Inner vessel (ASIV) to **preserve ratio between hot and cold lead volumes**
- **Preserved** components and overall system **length** → time-preserving approach

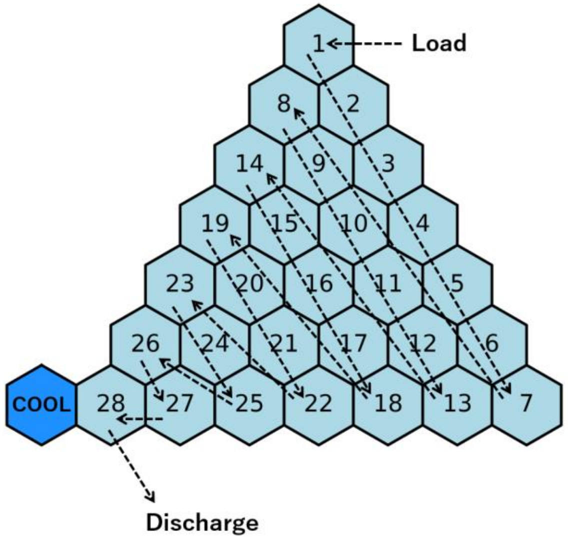
Update on LFR Technology: Japan

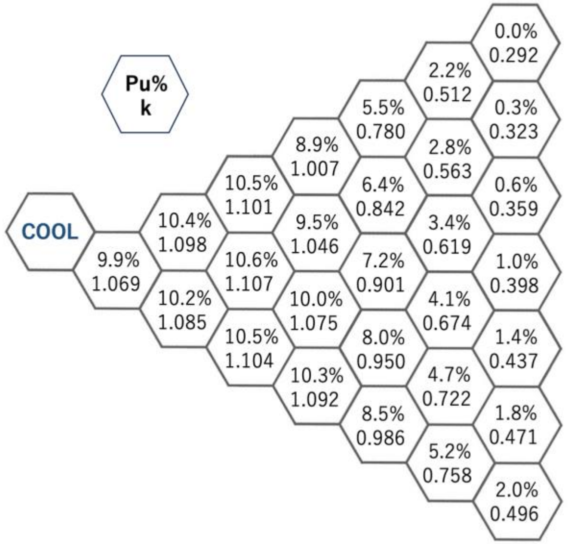
- Fundamental research for LFR in Science Tokyo
  - Design study of innovative LFR
  - Corrosion resistance of FeCrAl steel in flowing LBE

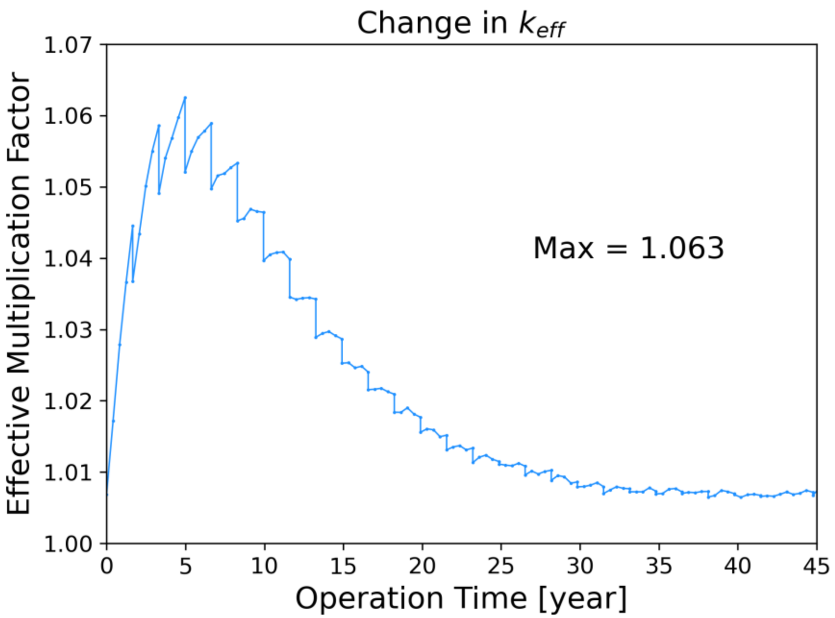
- ADS development study in Japan Atomic Energy Agency
  - ADS concept study
  - CFD analysis
  - LBE corrosion study by OLLOCHI

Update on LFR Technology: Japan

- Current innovative LFR study in Science Tokyo
  - Lead-cooled nitride fuel Breed-and-Burn fast reactor (RFBB-NL) concept
  - LBE cooled metallic fuel Breed-and-Burn fast reactor (RFBB-MLB) concept







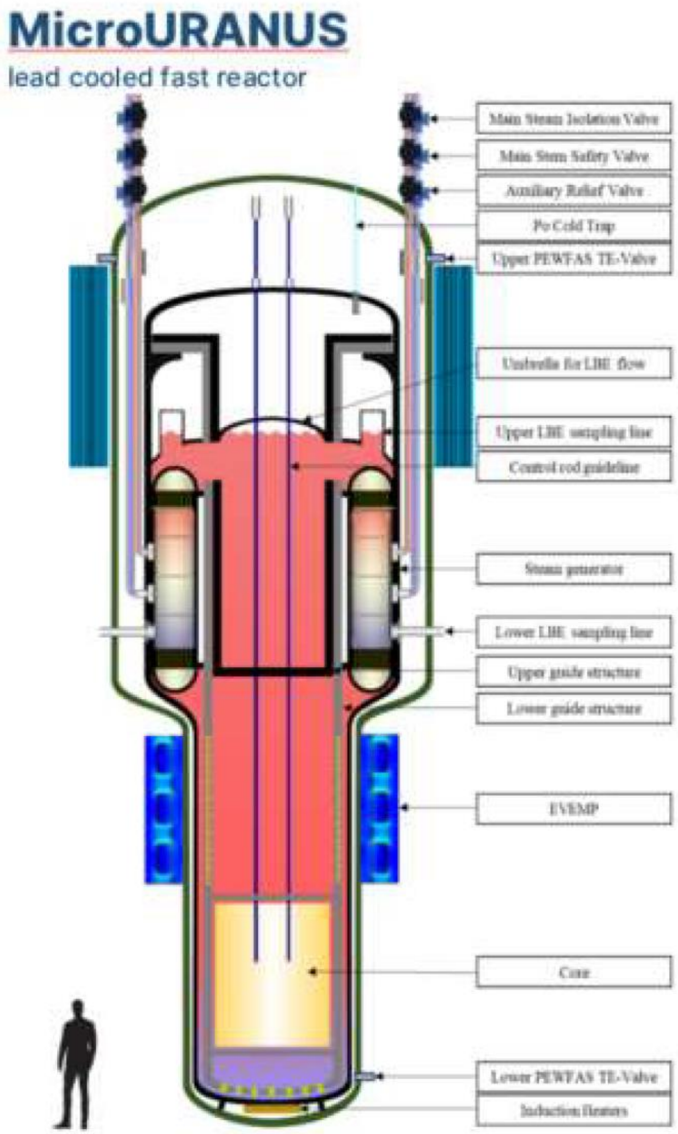
Update on LFR Technology: Republic of Korea

MicroURANUS R&D

I. Design Development

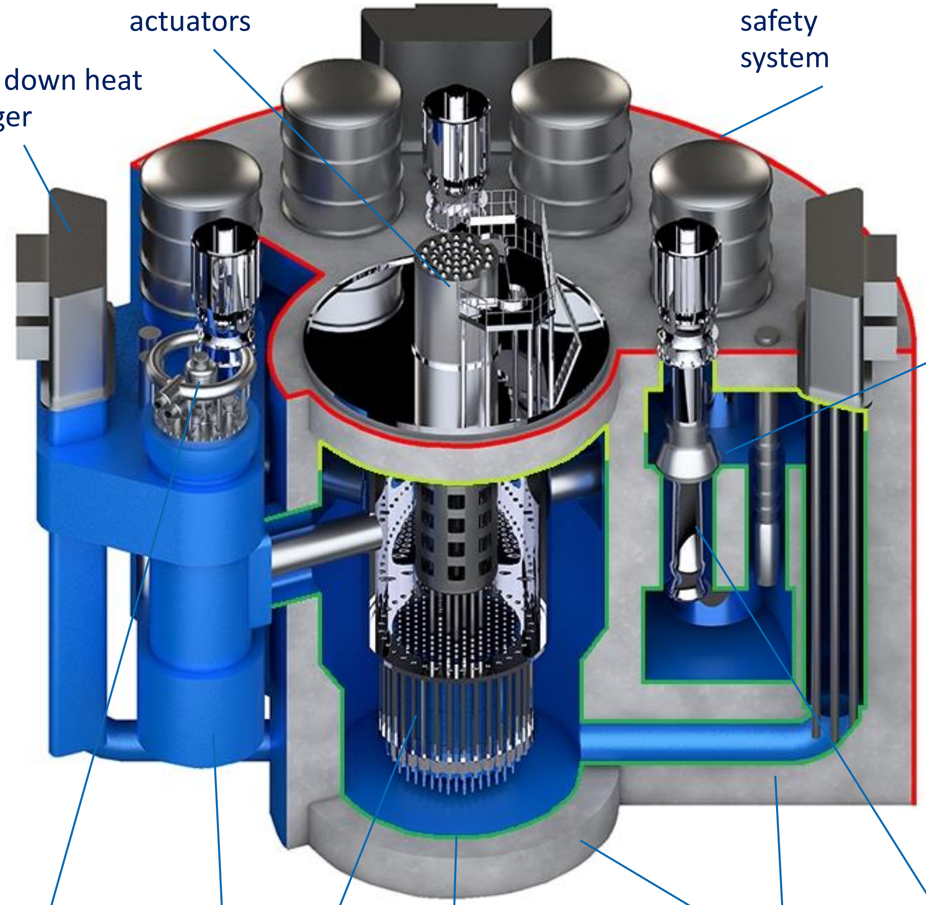
II. Materials Development
   I. AFATi
   II. Bimetallic Tubes

III. Applications
   I. LFR Fuel Cladding
   II. Steam Generators
   III. Condensers for Load Follow Operation



Update on LFR Technology: Russia

BREST-OD-300: design basis



- **Compliance with the requirements of regulatory documentation**;
- **Integral layout** with a multilayer metal-concrete vessel without shut-off valves in the coolant circulation circuit;
- **Reservation** of normal operation and safety systems;
- **Passive protective and localizing safety systems** are widely used
- **Lead coolant** with high boiling point, radiation-resistant, low activation, not entering into violent interaction with water and air in case of circuit depressurization
- **Mixed nitride fuel** with high density and thermal conductivity, allows ensuring full reproduction of fuel in the core (core reproduction ratio ~ 1.05) and compensation of reactivity at fuel burnout.

Update on LFR Technology: Russia

Construction status at PDEC site (August 2023)

Site (August 2023)
View of the reactor building and turbine hall

Site (August 2023)
Reactor building

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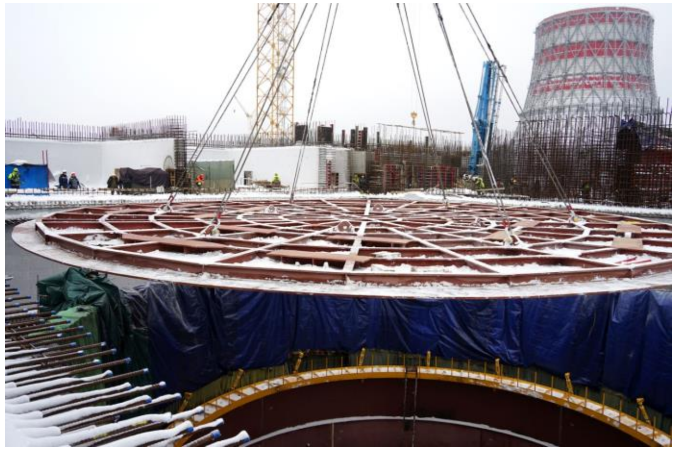
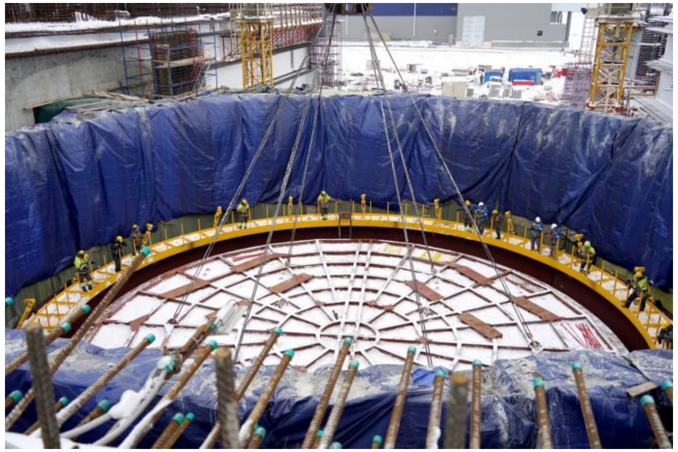
Update on LFR Technology: Russia

Construction status at PDEC site (December 2023)
Mounting of the BREST-OD-300 reactor began

The lower tier of the enclosing structure was immersed in the reactor shaft (December 2023)





Mounting of a steel base plate, weight 165 tons (December 2023)

Construction of electricity transmission lines began: installation of supports and installation of wires
(end of December 2023)

Update on LFR Technology: Russia

"Proryv" project: practical demonstration of all elements of the closed nuclear fuel cycle (CNFC) at the Pilot Demonstrational Energy Complex (PDEC)

Full Generation-IV technology of the Lead-cooled Fast Reactor and the CNFC will be demonstrated on the PDEC site

2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030

Construction and commissioning of the ***Fuel (re-) fabrication module***

Equipment manufacturing, construction of the nuclear power plant with the ***BREST-OD-300 lead-cooled fast reactor***

Construction and commissioning of the ***Reprocessing module***

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Update on LFR Technology: USA

➢ Westinghouse LFR

- **Westinghouse transitioned to a new position in Generation IV space, i.e., from LFR Developer to Top-Tier Service Provider to GenIV and Fusion developers, including LFR developers**

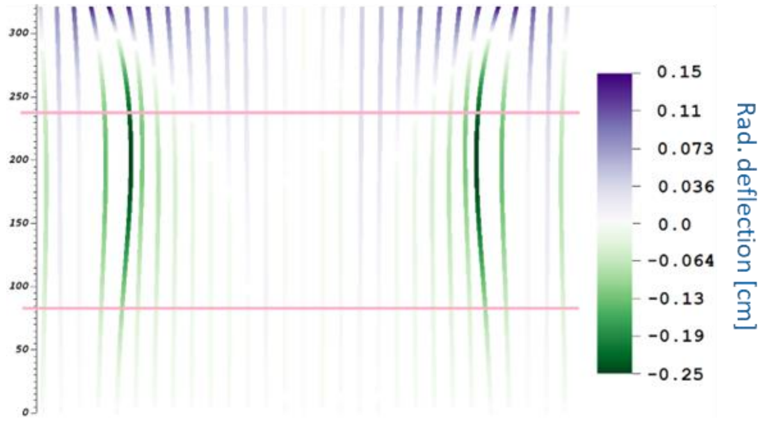
➢ Nuclear Energy University Projects

- **Simultaneous Corrosion/Irradiation Testing in Lead and LBE** - Massachusetts Institute of Technology (MIT)
  - *Status*: Completed triple-beam (He/Fe^{3+}/protons) irradiation testing of Fe-25Ni-16Cr-5Al-1Nb, FeCrAl, and Fe-20Cr. Post-test analysis is being finalized. Final report is in preparation.
- **Development of Versatile Liquid Metal Testing Facility for Lead-cooled Fast Reactor Technology** - University of Pittsburgh
  - *Status*: NEUP project completed. The new testing facility was installed at the University of Pittsburgh. Further collaborative research (ULV sensor testing, SAM code development) is on-going in collaboration with ANL and WEC.

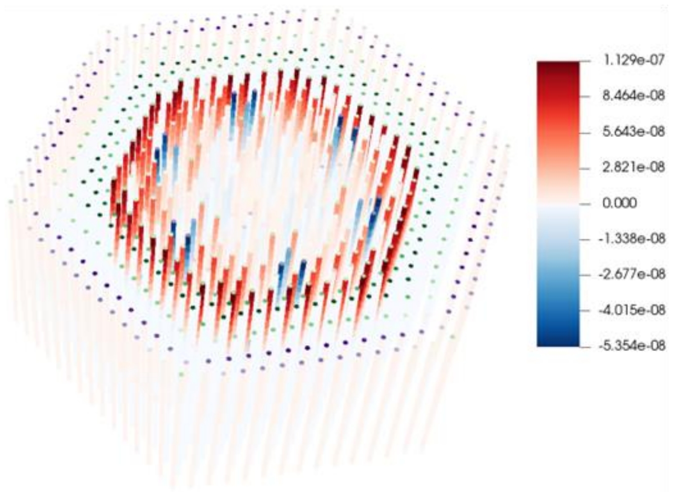
Update on LFR Technology: USA

- **T**echnology **C**ommercialization **F**und projects
  - **SAS4A/SASSYS-1 Improvements for Lead Fast Reactors** – Argonne National Laboratory/WEC
    - *Status*: Project completed. Performed the required testing for the recently developed oxide fuel model (OFUEL). Extended the SAS user interface to facilitate mechanistic source term analysis.
  - **Enhancement of PyARC for Westinghouse LFR Design and Modeling** – Argonne National Laboratory/WEC
    - *Status*: Major reorganization and improvement to NUBOW-3D (core deformation) code to streamline coupling with DASSH (sub-channel thermal hydraulics) and PERSENT (perturbation theory). Initial demonstration on the Westinghouse LFR.

NUBOW-3D results of LFR core bowing

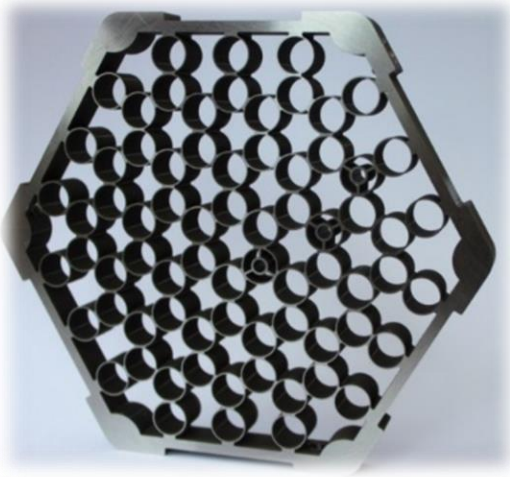


Corresponding LFR bowing reactivity worth



Status of Maturity : Safety Assessment

Fuel Assembly characterization in transient conditions including flow blockage



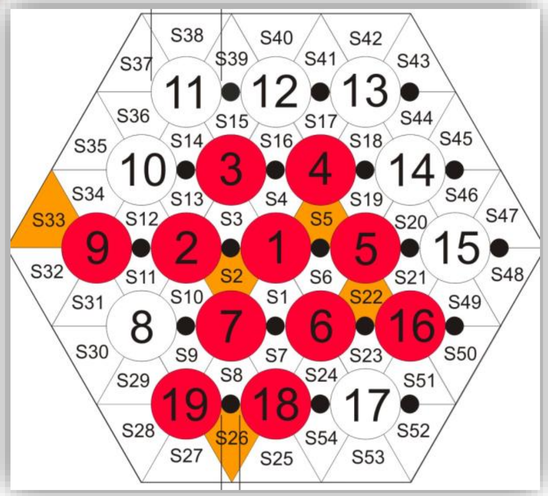
LFR
Integral Tests including SGTR

Status of Maturity : Integral Tests & Component Qualification

- Integral Test Experiments
- OCS testing in large pool
- Component qualification
- SG & Pump Unit Test

Status of Maturity: Performance

- HTC measurements
- OCS testing in loop
- Component qualification
- Instrumentation Test



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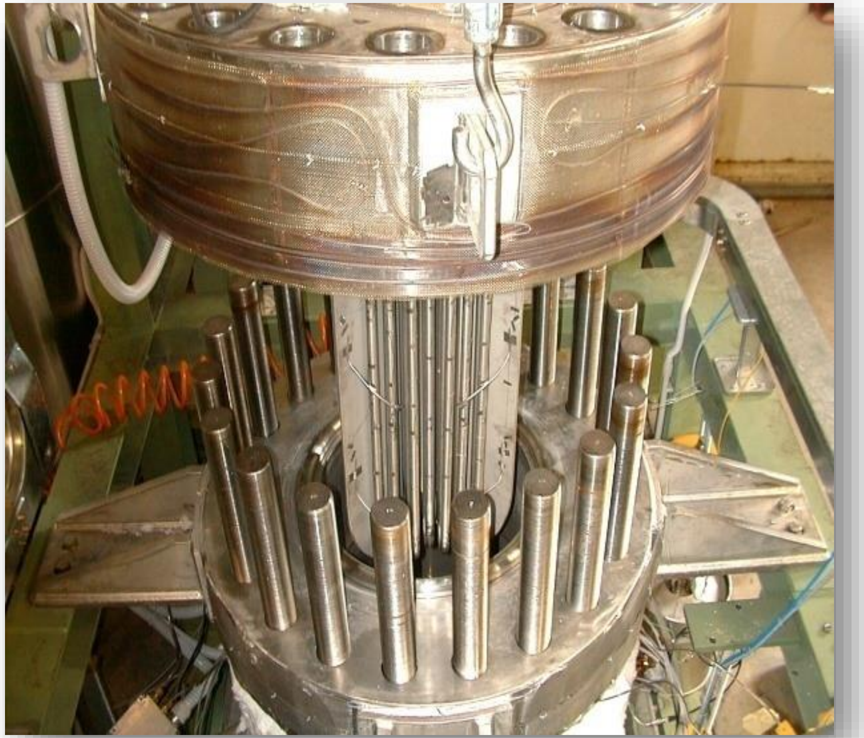
Status of Maturity: Separate Effect Experiments



- Code Validation
- Component & Instrumentation qualification

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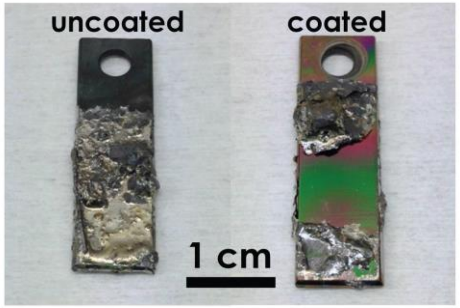
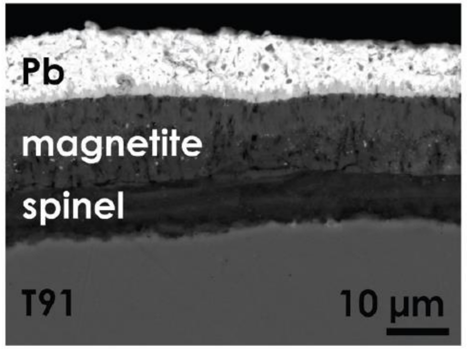
Status of Maturity: Materials & Coatings

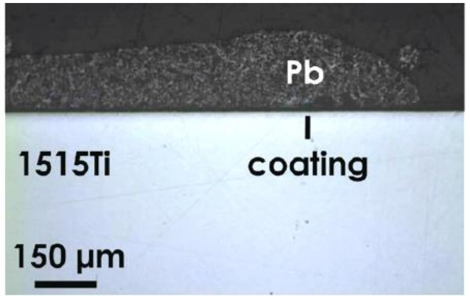
- Corrosion test in flowing lead
- OCS testing in loop
- Component qualification
- Instrumentation Test

1 µm Al_2O_3 coating
no buffer layer

Corrosion tests in static Pb:
550°C -1000 h - $10^{-8}/10^{-9}$ wt.% O 1 µm Al_2O_3 coating







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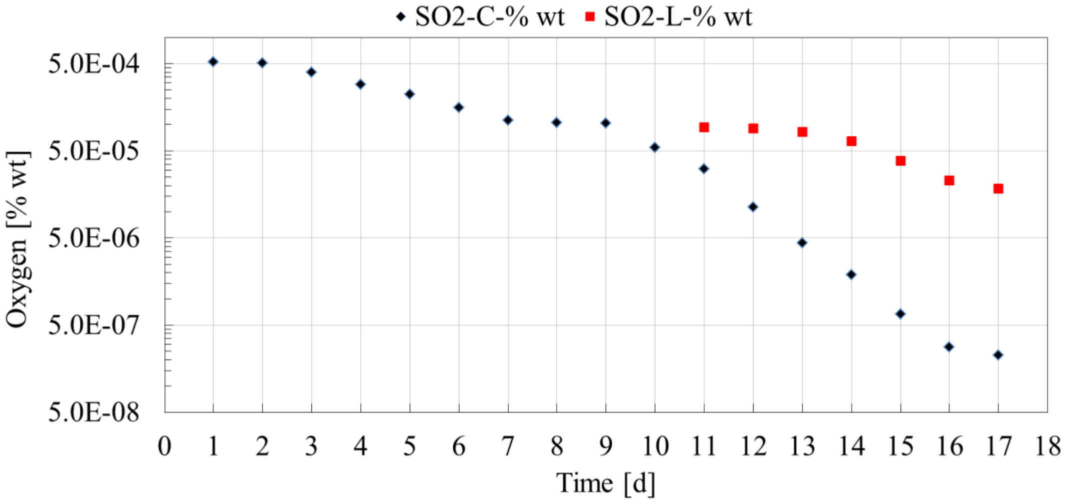
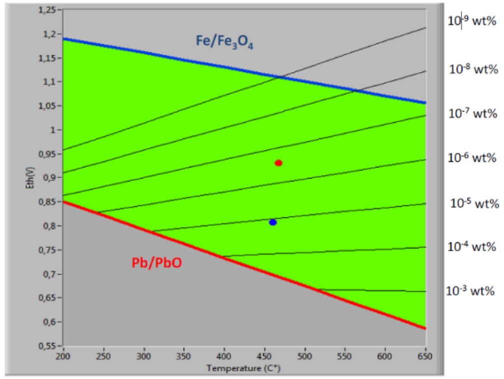
Status of Maturity: Coolant Chemistry

Oxygen sensors installed in the CIRCE vessel. In the hot (left) and cold (right) pool



Daily average value of oxygen concentration measured by the two sensors (black: SO2-C, hot pool; red: SO2-L, cold pool).



Instant values measured by the two sensors at day 18 (red dot: SO2-C, hot pool; blue dot: SO2-L, cold pool)

View of the hot pool after draining.
No lead-oxide are observed.

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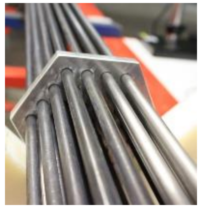
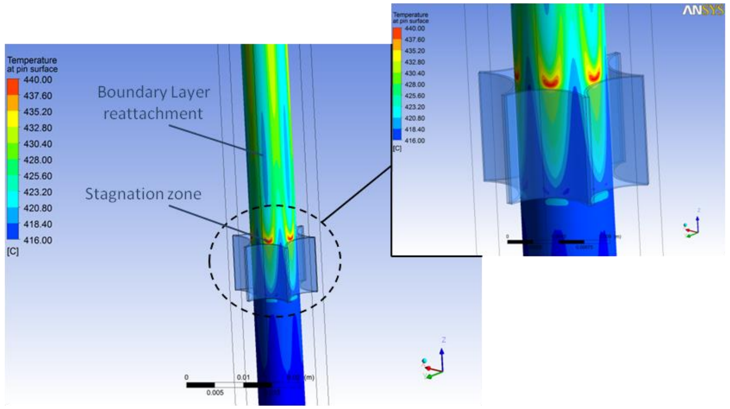
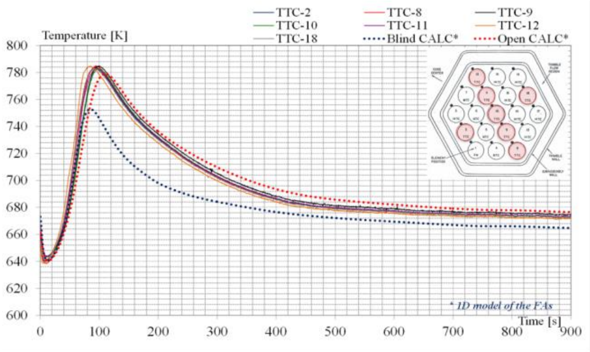
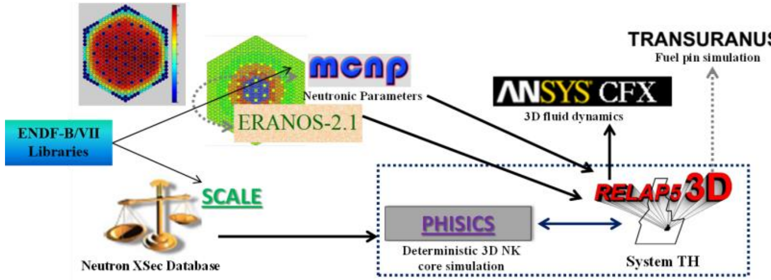
Status of Maturity: Modelling & Simulations



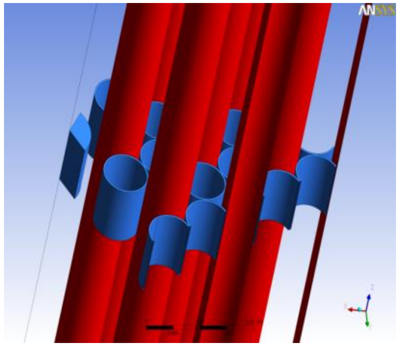


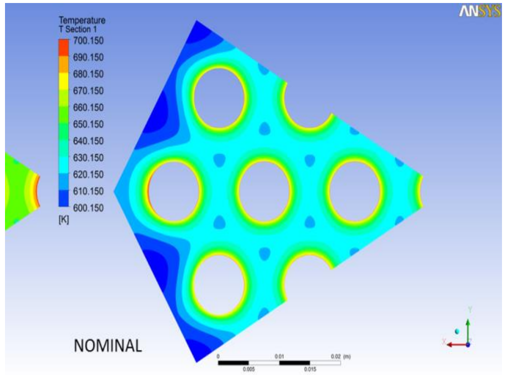


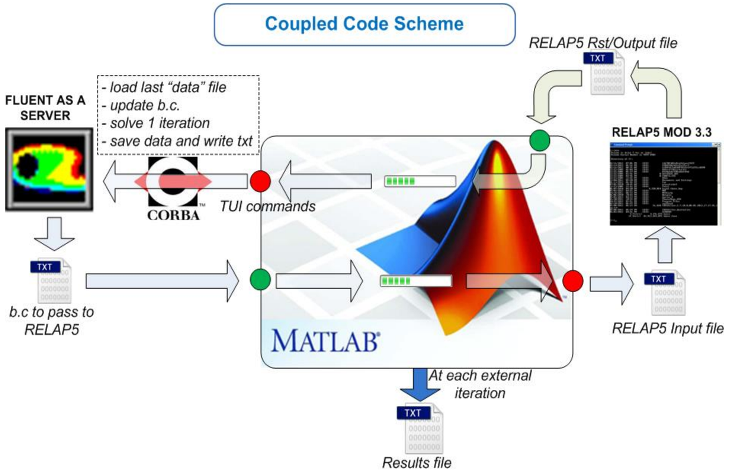
SYSTEM CODE (RELAP5)

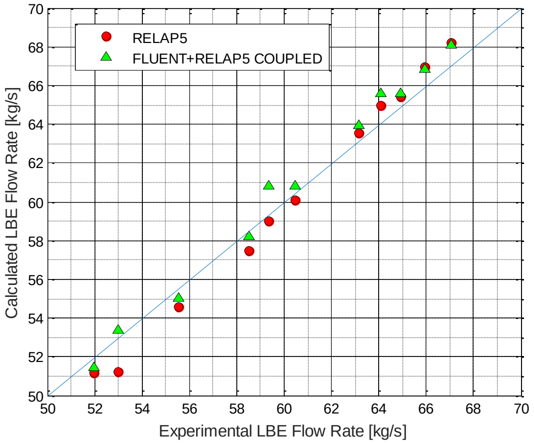


Multi-physics









System Code + CFD coupling

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LFR provisional SSC Update -Initiatives: New webinar series-

GIF talks with industry series #1 *new*cleo, #2 Blykalla, #3 Ansaldo Nucleare (Nov.7)
Around 90 people participated in each of 1st and 2nd webinar mainly from industry.

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Webinar
GIF talks with industry series #1
LFR Developers: *newcleo*
Hosted by the GIF LFR provisional SSC

Join us on June 20, 2024, 14:30 CEST (UTC+2)

newcleo's R&D Programme in support of Small Modular Lead-cooled Fast Reactor Technology Development and Deployment

Discover the developments in MOX-fueled SMR-LFRs by *newcleo*. They aim to commission a MOX production plant and a demonstrator in the early 2030s, followed by a 200MWe First-Of-A-Kind and a fleet.

newcleo highlights safety, simplicity, compactness, and cost competitiveness in their reactor design. These qualities are attributed to lead properties and innovative solutions, streamlining their design. Their broad R&D program supports an incremental strategy to refine technologies and address gaps.

Join us to learn more about *newcleo*'s R&D focus areas that include structural materials and coatings, primary components integrity and performance, handling systems, ISI&R and integral testing in large-scale facilities. Learn how specific R&D needs are addressed by *newcleo* through the refurbishment of existing ENEA infrastructure, and several new test facilities (e.g. CAPSULE, CORE, OTHELLO, DCI, MANUT). Challenges and successes in developing and bringing Generation IV reactor technologies to the market will be discussed as well as how organizations such as GIF can support those efforts. A Q&A session will provide you with opportunities to learn more and listen to firsthand insights on what making a Gen IV reactor a reality requires.

This webinar is the first of series where GIF will be discussing with representatives of the industry to link national and international R&D programs, industry needs and challenges, and work to identify ways for the GIF community to foster new avenues for fruitful cooperations with the industry.

Dr. Mariano Tarantino from ENEA, the co-chair of GIF LFR provisional steering committee, will facilitate this webinar.

Free webcast!

Register NOW at:
https://us02web.zoom.us/webinar/register/WN_f3AQd3lRQBaLCKB4GBx4vg#/registration

Or scan the code

June 20 – 2024
14:30 CEST (UTC+2)

Who should attend: policymakers, industry professionals, regulators, researchers, students, general public

Speaker

Dr. Fabio Moretti, Nuclear Engineer with a PhD in Nuclear and Industrial Safety, is the Head of *newcleo*'s R&D Thermal Hydraulics Unit, which carries out engineering studies relevant to the design and operation of experimental test facilities, as well as in support of design and safety assessment of the LFR.

Since 2014 he has been involved (as TH/CFD/FEM analyst, team leader, project manager, etc.) in many projects dealing with nuclear fission reactor safety assessment, nuclear power plant licensing, computer code validation, design and building of test facilities, etc., both in academic R&D frameworks and under industrial contracts, always in internationally oriented environments.

He has always been looking forward to a nuclear renaissance, as a breakthrough toward a cleaner and healthier environment and a really sustainable management of the world's energy resources.

For more information, please visit the GIF website www.gen-4.org

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Webinar
GIF talks with industry series #2
LFR Developers: Blykalla
Hosted by the GIF LFR provisional SSC

Join us on July 17, 2024, 14:30 CEST (UTC+2)

Status of Blykalla's commercial LFR development in Sweden

Join us for a GIF hosted webinar to discover the latest advancements in corrosion tolerant steels and uranium nitride fuel for Small Modular Reactors (SMRs) and Lead-cooled Fast Reactors (LFRs) by Blykalla. Learn about their innovative SEALER-One reactor design, comprehensive safety analysis, licensing process, and ongoing siting studies.

Blykalla is focusing its efforts on designing, licensing and building its first nuclear reactor, SEALER-One on a site in Sweden. This reactor, with an intended 70MWth of power, will utilize uranium nitride fuel with 9.9% enriched uranium. It will produce high quality heat for biomass pyrolysis as well as for production of hydrogen in high temperature electrolyzers.

This webinar will give you the opportunity to:

- Gain insights into Blykalla's research and development initiatives, including their industrialization program for corrosion tolerant steels and methods for qualifying uranium nitride fuel fabrication.
- Understand the process and challenges of licensing SEALER-One in Sweden and the current status of siting studies.
- Discuss the challenges and successes in developing and bringing Generation IV reactor technologies to market and how organizations like GIF can support these efforts.

A Q&A session will provide the room to build upon the initial presentation to further understand how Blykalla is working to bring a Gen IV reactor to reality.

This webinar is the second of a series where GIF engages with industry representatives to bridge national and international R&D programs, industry needs and challenges. It is also aimed at and exploring new avenues for fruitful cooperation within the GIF community.

Dr. Mariano Tarantino from ENEA, the co-chair of GIF LFR provisional steering committee, will facilitate this webinar.

Free webcast!

Register NOW at:
https://us02web.zoom.us/webinar/register/WN_ilokG5H2TjG9_7Jo3QmrHA#/registration

Or scan the code

July 17 – 2024
14:30 CEST (UTC+2)

Who should attend: policymakers, industry professionals, regulators, researchers, students, general public

Speaker

Prof. Janne Wallenius, professor of Reactor Physics at KTH Royal Institute of Technology, as well as cofounder and CTO of Blykalla.

His competence areas include lead-cooled reactor design and safety analysis, as well as advanced nuclear fuel development. He has more than 100 publications in peer-reviewed journals and an h-index of 27. He has written text-books on transmutation of nuclear waste and Fast neutron Generation-IV reactors.

In 2013 he co-founded Blykalla in order to commercialize the outcome of his research. In 2022 he was selected for the KTH Innovation Award, for his creativity, grit and courage in making innovations for a better society.

For more information, please visit the GIF website www.gen-4.org

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Webinar
GIF talks with industry series #3
LFR Developers: Ansaldo Nucleare
Hosted by the GIF LFR provisional SSC

Join us on November 7, 2024, 14:30 CET (UTC+1)

Ansaldo Nucleare leading a joint European roadmap towards a competitive LFR

Join us for a GIF hosted webinar to explore the development for a commercial EU-SMR-LFR through the European international collaboration at European level towards the construction of ALFRED, the Advanced LFR European Demonstrator, by Ansaldo Nucleare, as leader of the FALCON Consortium.

- ALFRED is a pool type LFR leveraging mature design choices and proven materials. This webinar will present how ALFRED project is implementing a staged approach in order to achieve operating conditions representative of a competitive commercial reactor. It will also discuss a set of existing experimental infrastructure supporting ALFRED and new facilities complementing existing ones under construction in Romania.
- FALCON is also engaging with SCK CEN (Belgium). Learn how the partners are combining expertise to define the reference design of a commercial EU-SMR-LFR. The webinar will explore the roadmap to deployment, supported by two precursors: LEANDREA in Belgium, devoted to material and fuel qualification for the following units, and ALFRED in Romania, demonstrator and prototype of the commercial reactor.
- EU-SMR-LFR: Discover how designers are striving for enhanced competitiveness through improved operating temperature, passive safety features and simplified design. The webinar will also discuss the importance of this development in terms of the closure of the fuel cycle for improved sustainability and security targets.

A Q&A session will follow the presentation, providing an opportunity to further understand how Ansaldo Nucleare and its partners are working to bring a Gen IV reactor to reality.

This webinar is the third of a series where GIF engages with industry representatives to bridge national and international R&D programs, industry needs and challenges. It is also aimed at and exploring new avenues for fruitful cooperation within the GIF community.

Dr. Mariano Tarantino from ENEA, the co-chair of GIF LFR provisional system steering committee, will facilitate this webinar.

Free webcast!

Register NOW at:
https://us02web.zoom.us/webinar/register/WN_tV43GjpKQtuZERivFsvs5Q#/registration

Or scan the code

November 7 – 2024
14:30 CET (UTC+1)

Who should attend: policymakers, industry professionals, regulators, researchers, students, general public

Speaker

Dr. Michele Frignani entered Ansaldo Nucleare in 2007 and is currently Head of Nuclear Technologies and Product Development. He covered multiple roles in the company, from technical coordination to management responsibilities of increasing complexity. He is now supporting the strategic plan, including the interface and synergies with the Ansaldo Group.

With 15+ years of experience in the nuclear field and 10+ years in coordination of innovative projects, he dedicated most of his career in bridging the gap between academia and industrial sector, with a focus on the management of engineering and testing programs for advanced reactor concepts and small modular reactors.

He has a PhD in Nuclear Engineering at University of Bologna, and recently attended the Key Manager High Education program by CdP Academy at SDA Bocconi, Headsprings and IESE Campus. With more than 30 publications in journals, he is also invited speaker at various international events on energy and nuclear technology.

For more information, please visit the GIF website www.gen-4.org

LFR provisional SSC Update -Initiatives: GLANST workshop-

45 participants, 28 contributions including 8 invited talks from several industry players.

- Date: **30 September – 2 October, 2024**
- Venue: **ENEA, Brasimone, Italy.**
- Target: **Experts** and **graduate students**.
- Technical program

Day	Program
1	• Opening Remarks and Introductory Lectures • Technical Tour of ENEA and *new*cleo's facilities.
2	• Session1: Modelling and Simulation • Session2: Coolant, Materials and Fuel
3	• Session3: Experiments and Code Validation • Session4: Design of Systems & Components

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GLNST: <u>G</u>lobal Symposium on <u>L</u>ead and <u>L</u>ead <u>A</u>lloy based <u>N</u>uclear Energy <u>S</u>cience and <u>T</u>echnology.
https://www.gen-4.org/gif/jcms/c_82829/workshops

Upcoming Webinars

Date	Title	Presenter
22 January 2025	Overview and Update of MSR activities within GIF	Jiri Krepel, PSI, Switzerland
12 February 2025	Overview and Update of VHTR activities within GIF	Gerhard Strydom, INL, USA
26 March 2025	Nuclear Power	Marta Gospodarczyk, IAEA