

## **Advanced Lead-cooled Fast Reactor European Demonstrator (ALFRED)**

### **A Research, Development and Innovation Infrastructure of pan-European relevance for Lead-cooled Fast Reactor technology demonstration**

Sustainable, safe and affordable energy supply is a major challenge we are facing worldwide. Europe in particular is strongly committed to lead the scenes, with extremely ambitious targets and policies. In this scenario, nuclear will play an important role in the energy mix, provided it demonstrates its capability to face the energy market requirements.

Boosted by research and innovation, Generation-IV nuclear energy systems are anticipating a sound, competitive and mature answer. For this reason, Romania shares the EU vision in selecting the Lead-cooled Fast Reactor (LFR) as one of the most promising Generation-IV technologies ([https://www.gen-4.org/gif/jcms/c\\_9260/public](https://www.gen-4.org/gif/jcms/c_9260/public)), and supports the ALFRED project as a mandatory strategic step.

The ALFRED project is a unique research infrastructure gathering a pan-European interest and support from academia, research and industry, aiming to prove the technical and economic viability, as well as the safety and sustainability of the Lead-cooled Fast Reactor technology for the new generation of nuclear systems, including Small Modular Reactors designs.

The ALFRED project consists of a reactor demonstrator of relevant power and a kernel of six R&D support facilities, complemented by the HUB and Lead School - Center of Excellence (CoE), all located in Romania. The support facilities are dedicated to the testing and qualification of materials, technologies and components to be used in the ALFRED reactor, as well as to the validation and verification of computer codes and models used in safety assessment. The Hub will coordinate the research activities in synergy with a network of the existing and future facilities distributed in Europe, while the CoE will deliver world-class education and training to researchers, technicians and students, as well as information to the general public.

This complex infrastructure is conceived to serve a threefold purpose:

- demonstrate the performances achievable by the LFR technology, as a cornerstone for the deployment of next generation nuclear energy systems;
- provide the largest and most relevant experimental environment, accessible to European scientists and technicians for basic to applied nuclear research and development;

support, in the medium and long-term, innovation for the safe and sustainable operation of future plants, sustaining the continuous upgrade of nuclear standards. The whole research infrastructure will boost innovation towards higher levels of technological readiness, also in a number of other sectors, sharing cross-cutting aspects determined by the use of lead and Heavy Liquid Metals (HLM). The key areas embraced by the ALFRED project are:

- materials science and engineering in HLM environment;
- HLMs physics and chemistry;

- HLM technology development;
- advanced components engineering for HLM-based systems (including development, testing and qualification);
- operation, inspection and maintenance procedures development and qualification for HLM-based systems.

Research communities, universities and nuclear industry from Romania and world-wide already expressed a strong interest in this project, both in implementation, facilities construction and operation, as well as in the associated research programme.

The reference site for the ALFRED research infrastructure is the Mioveni nuclear platform (15 km north-east from Pitesti) already hosting four organizations operating in the nuclear field: RATEN, RATEN-ICN, FCN (CANDU Fuel Plant), and a branch of ANDR (National Nuclear Agency and for Radioactive Wastes) with around 1000 people (researchers, engineers, and technical and support staff).

Established over 45 years ago, the Institute for Nuclear Research (RATEN-ICN, <https://www.nuclear.ro>) has a significant experience with the initiation and development of the nuclear power program in Romania. Important nuclear facilities operating on the platform such as a dual-core research reactor (TRIGA steady state core and pulsed core), post irradiation examination laboratories, radioactive waste treatment plant, nuclear material testing laboratories or out of pile testing facility played an essential role in building the competence that will be used and shared with all international users for the operation of ALFRED infrastructure and for the successful implementation the research and demonstration program.

The ALFRED demonstration programme, addressing licensing challenges and lack of nuclear operational experience, is therefore the last undertaking presently required to go for industrial deployment. The project is coordinated by the European consortium *FALCON - Fostering ALFRED Construction* signed by RATEN ICN, ANSALDONUCLEARE and ENEA.

Up to now, several European research projects have been dedicated to LFR topics: reactor conceptual design was completed and the preparatory works for the development of the support infrastructures, licensing, and funding documentation are ready or in progress. The target date for reactor commissioning is 2028, the ALFRED Project construction being based on a firm commitment by the Romanian Government and on the support of the Italian Government, in the European context.

Details on the ALFRED project can be found at <http://www.alfred-reactor.eu/> .