



The ALFRED Project: status, achievements and perspectives

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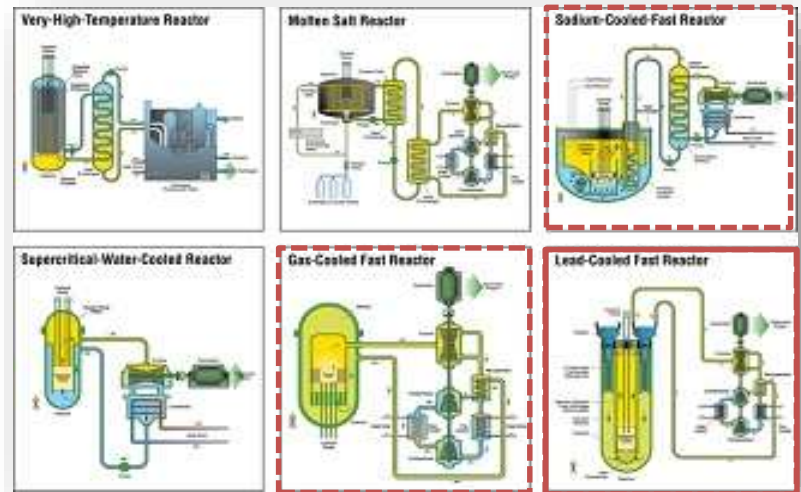
Nuclear 2018

The FALCON Consortium

- **FALCON** Consortium Agreement was established in 2013 to bring LFR technology to industrial maturity
- **FALCON** recently **evolved** to better cope with the European context.
- Main **objectives** will be:
 - Firm **commitment** to ALFRED as a **Major Project** in Romania,
 - **Finalization** of the **feasibility study** for the LFR demonstrator ALFRED,
 - Initiation of **construction** of supporting **R&D facilities** and **CoE**.
- **New members** sharing the **objective** of a rapid deployment of an LFR demonstrator, interested in the R&D supporting infrastructure and in the ALFRED industrial outcomes are **welcome to join**.



Advanced reactors and Generation-IV goals



More than **200 M€** invested in LFR technology in the last **10 years***

LFR technology can offer a **safe, sustainable** and **competitive** alternative to address market opportunities in the **time-window 2035-40**

* Euratom contribution to the GIF Systems in the period 2005-2014 and future outlook, JRC

Socio-economic benefits from ALFRED implementation



National Level

An opportunity for Romania to become the focal point in the LFR technology in Europe

- consolidation of the nuclear sector
- greater sustainability of the use of natural resources
- advanced management of spent fuel
- stimulation of the national research
- reduction of loss of high qualified human resources
- creation of new jobs, stimulation of development

Regional Level

ALFRED included in the Smart Specialization Strategy of South Muntenia, as a key factor for:

- economic growth,
- improved innovation,
- job creation,
- strengthening of RDI poles,
- creating the career opportunities for young talents,
- visibility and reputation

Local Level

Local Council and ALFRED Local Group considerations

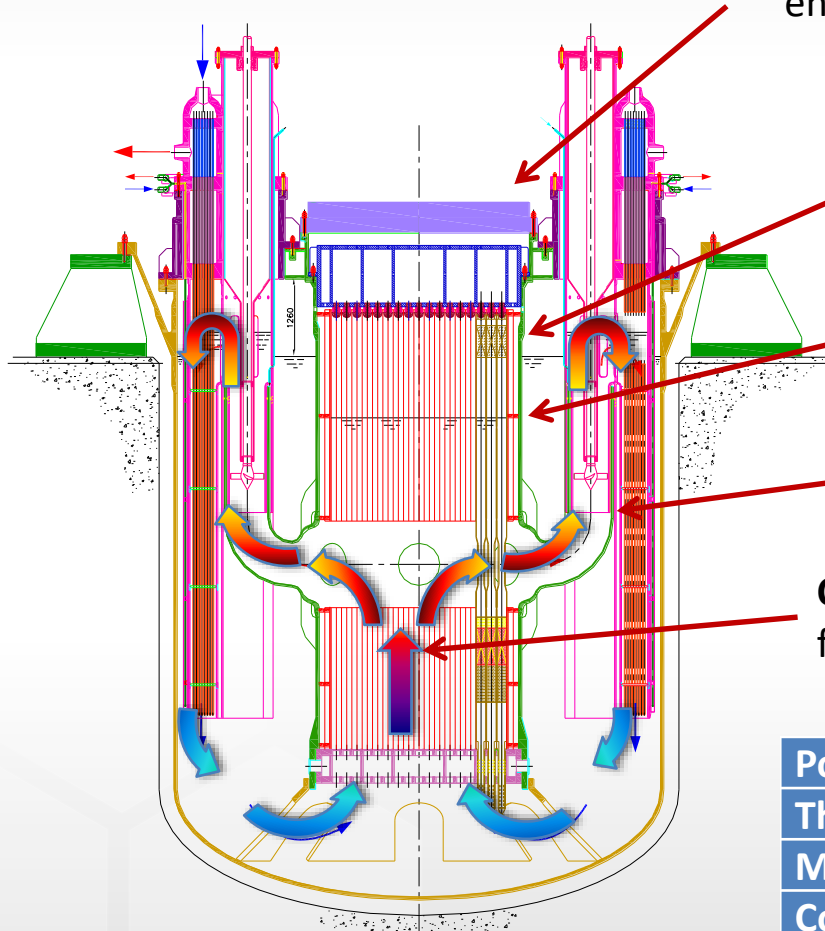
- growing of the local economy by a major investment
- new high specialization jobs
- set up of a high performance RDI infrastructure
- keep young talents in the community
- stimulation of innovation and quality of research
- increase the visibility and reputation of local community



Arges County

Region": 3 Sud-Muntenia

ALFRED Status: design review



Refueling: fuel assembly moved under lead to ensure passive cooling in case of stuck assembly

Revised primary system configuration: minimization of t/h issues typical of FRs

Lead temperature: limited for first operation - full materials compatibility

Main components: separated and extractable for out of vessel inspections

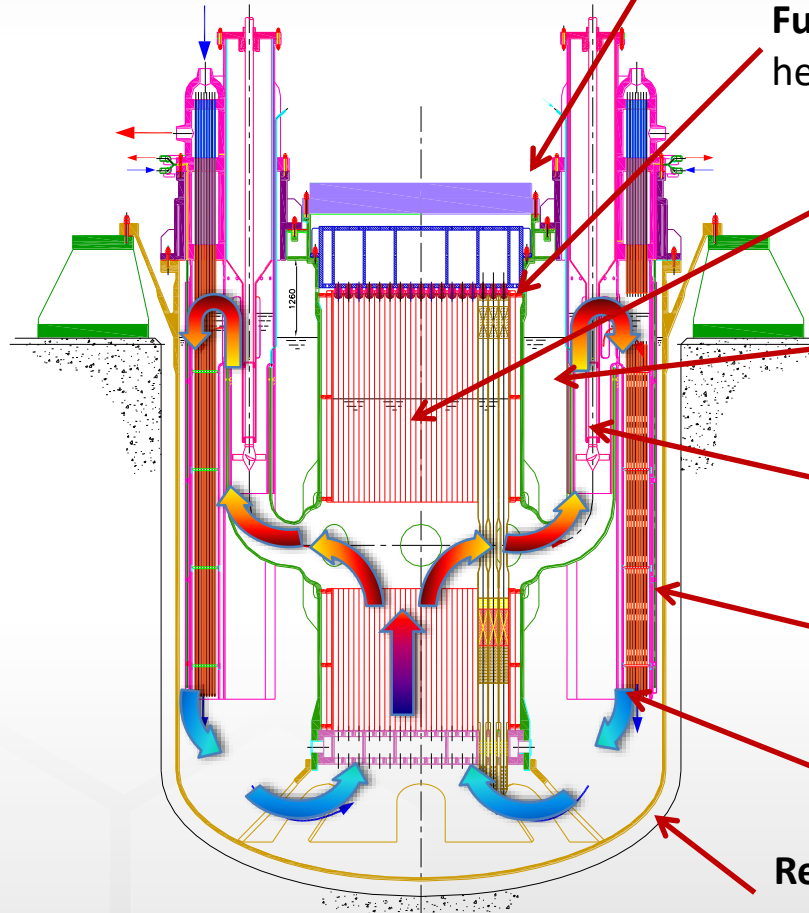
Core: optimized and provided with a hot channel for qualification of future stages

Power (final stage)	300 MWth
Thermal cycle (1 st stage)	390-430°C
Materials (1 st stage)	316L, 15-15Ti
Coolant chemistry control	$10^{-6} \div 10^{-8}$ O ₂ wt.%

ALFRED Status: design features



Easily scalable
Similar technological solutions



Reactor cover: Hot, standard flanged connections

Fuel assemblies: MOX fuel, grid-spaced, hexagonal, wrapped, extended stem

Reactivity control: Two diverse and redundant systems, control and shut-down rods

Primary system configuration: Pool-type, enhanced natural circulation in accident conditions

Primary Pumps: Mechanical, pull-type, in hot leg

Steam Generators: Once-through, helical or straight bayonet tubes

DHR: Isolation condenser connected to dip-coolers with straight, double-walled tubes

Reactor and Safety Vessels: Hanged, toroidal bottom head

ALFRED: Recent Achievements



Strategic Documents

- In April 2017, **ROMATOM** issued a **position paper**, titled “Why ALFRED Project in Romania ?”, in support to the implementation of the Project
- May 2017: **CESINA partnership**, gathering the main Romanian R&D and E&T actors for “collaboration in research and education in the field of innovative nuclear systems”.
- **CESINA** also signed an **agreement with ROMATOM** aimed at cooperation with national RDI organizations and FALCON members on ALFRED implementation.

ALFRED: Recent Achievements



Strategic Documents

- In July 2017 the **Italy “Position paper” on ALFRED** was issued with the endorsement of Italian Government, to support the R&D activities object of development in Italy and Romania.
- In September 2017 the [National Roadmap for Major Research Infrastructures](#) elaborated by Romanian Committee for Research Infrastructure (**CRIC**) included **ALFRED as an emergent research infrastructure** among those of the smart specialization “Energy, Environment, and Climate Changes”.
- In February 2018 the **Romania “Position paper” on ALFRED** was issued with the endorsement of the Romanian Government, to formalize at European level **the importance of implementing the ALFRED Project for Romania and Europe.**

ALFRED: Recent Achievements



Strategic Documents

- An **MOU CESINA-Nuclearelectrica (SNN)**, was signed in March 2018 with the general objective to provide know-how support for ALFRED licensing, construction and operation
- Industrial initiative: **Walter Tosto WTB proposal to POC** (Operational program for Competitiveness, EU structural funds) call on Support for industry organizations for innovation by RDI projects in partnership with research organizations. Project proposal title: Walter Tosto WTB Oltenita infrastructure for large mechanical components using advanced materials, deadline May 2018. RATEN general role is to provide support for the material behaviour during machining process.

ALFRED: Recent Achievements



ESNII Executive Board Support

- Following a request by the FALCON consortium formulated at the last ESNII Task Force meeting (January 2018) it was decided to set up an ESNII Executive Board to **evaluate the status of the ALFRED project**.
- The conclusion of the executive Board meeting on March 21st was to:

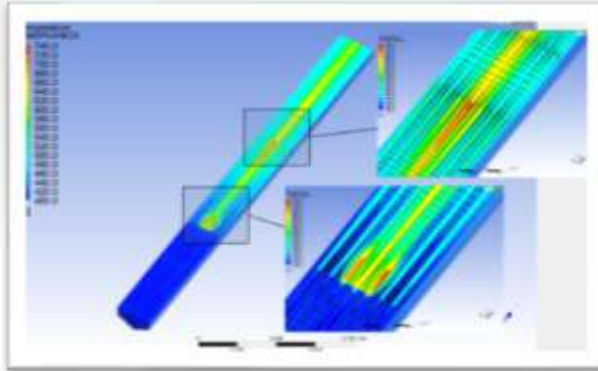
acknowledge the project advancement

recognize the project higher maturity

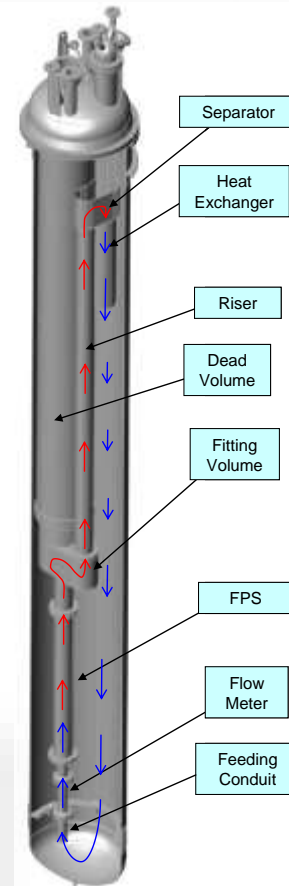
sustain the FALCON request of an higher support

The ALFRED project is now included in the fast track of European demonstrators

Achievements: Technology readiness



Experimental facilities construction and operation , test results and simulation tool developed to increase confidence in the Lead coolant technology



A long way walked...



- Many relevant activities performed at national and European level
- Relevant evidences collected to target the horizon objective
 - significant extension of the technological base
 - identification of solutions for the main issues, no longer seen as show-stoppers

**Awareness of a much
higher technology
readiness**

2035-2040

- proper time window to exploit this market segment
- shortened perspective raising industrial interest



J.M. Folon

ALFRED – operation strategy

First step used to qualify second



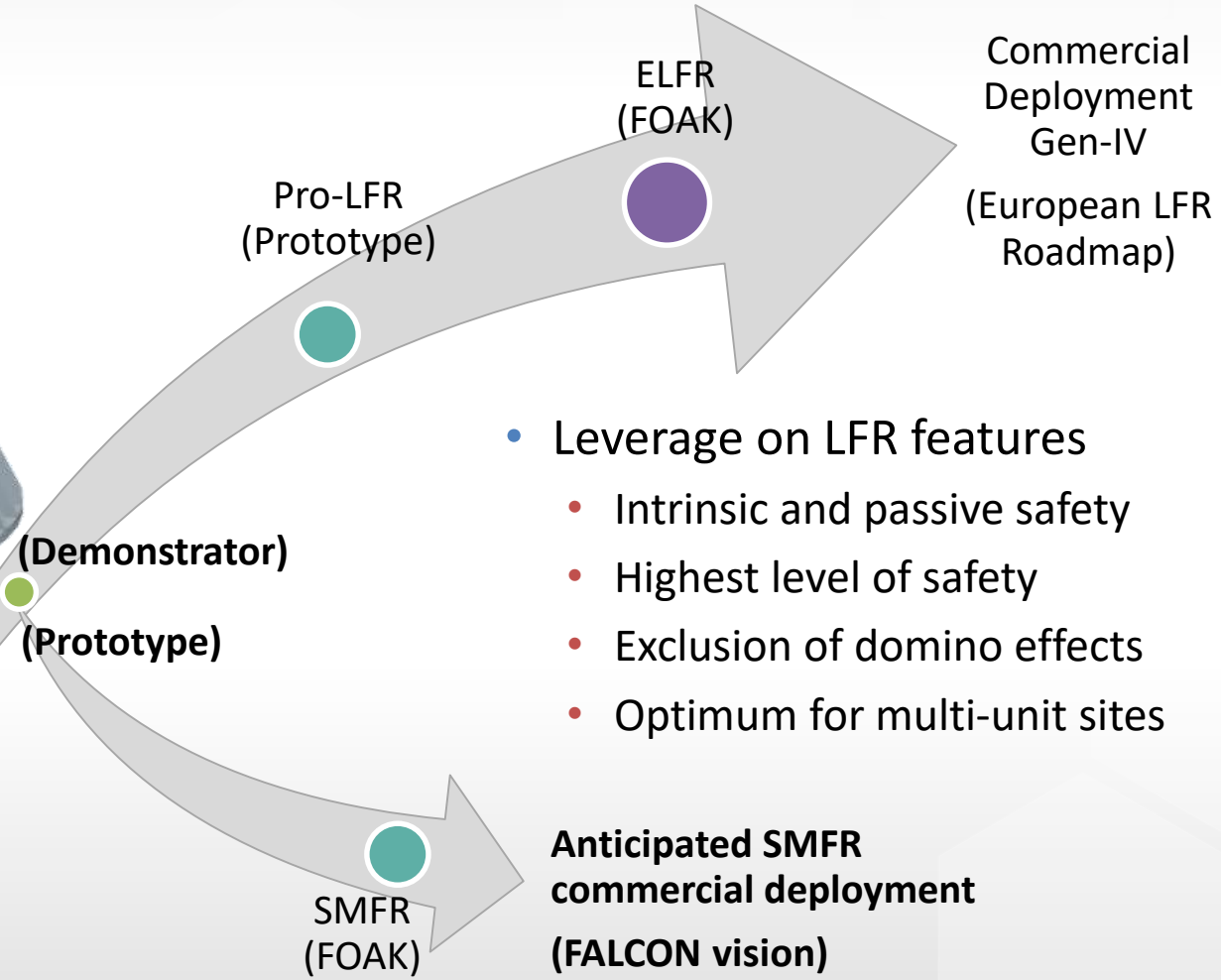
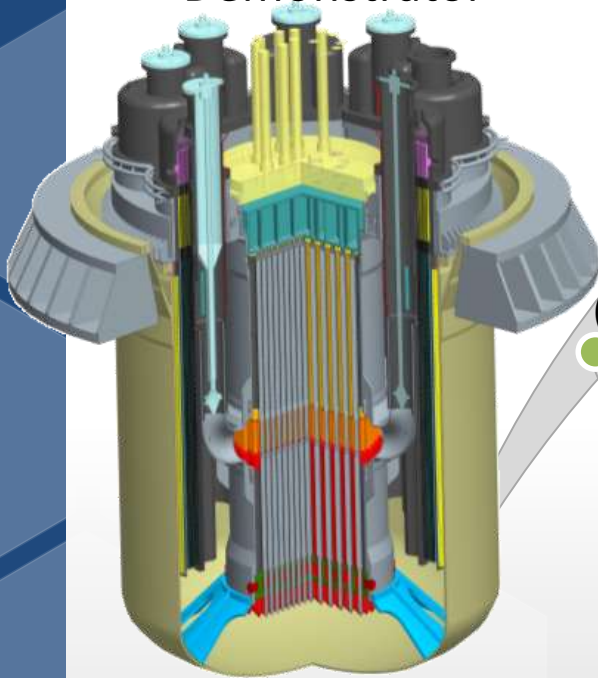
The operation of ALFRED will be based on a stepwise approach:

- phase 1: operation at **low power** in **low-temperature** range
 - presently existing proven materials working without corrosion protection
- phase 2: operation at **full power** in **high-temperature** range
 - coated materials fully qualified during phase 1

ALFRED: a new perspective, The LFR European demonstrator with SMR-oriented features



ALFRED
Advanced Lead-cooled
Fast Reactor European
Demonstrator



SMFR TIME WINDOW TARGET – 2035 - 2040

Announcement:

Generation IV Webinar on ALFRED



ADVANCED LEAD FAST REACTOR EUROPEAN DEMONSTRATOR, ALFRED

Alessandro Alemberti
Ansaldo Nucleare SpA
September 26th, 2018



*Thank you
for your attention*

