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and their applications
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*new*cleo's R&D Programme in support of LFR design and deployment

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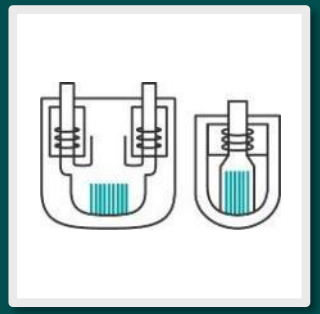
A *new,* innovative player in the field of nuclear energy



REACTOR DESIGN:

Small Modular (SMR) + Lead-cooled Fast Reactors (LFR) = AMR

*new*cleo is working to design, build, and operate Gen-IV Advanced Modular Reactors (AMRs) cooled by liquid lead

FUEL MANUFACTURING:

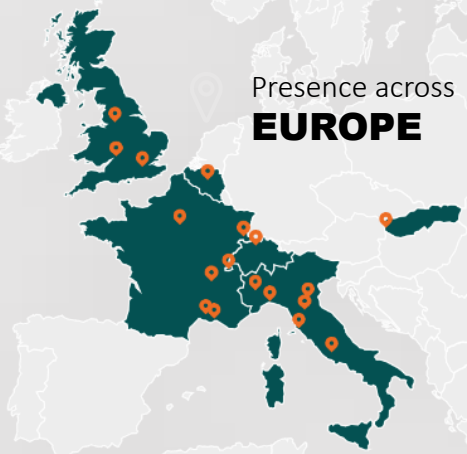
Mixed Uranium Plutonium Oxide (MOX)

MOX and Fast Reactors allow the multi-recycling of nuclear waste into new fuel with no new mining for generations

INTRINSICALLY SAFE

COMPETITIVE ENERGY COST

CIRCULAR NUCLEAR WASTE RECYCLING



Launched in **SEPTEMBER 2021**

Presence across **EUROPE**

€535+ million of private funds

~€50 million expected turnover in **2024**

French **first licensing stage completed** for the first reactor and the fuel production facility

Selected by **France 2030** and the **European Industrial Alliance on SMRs**

850+ EMPLOYEES

30+ YEARS OF R&D

14+ PATENTS

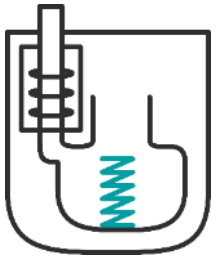
HIGHLY SPECIALISED EPC CAPABILITIES

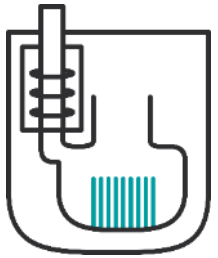
FUCINA ITALIA A *new*cleo company

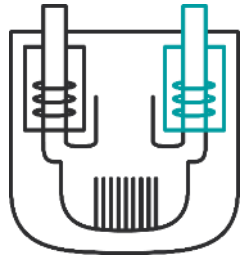
S.R.S. A *new*cleo company

RÜTSCHI A *new*cleo company

Our ambitious timeline







2026

2030

2031

2033

R&D and Precursor

Several R&D facilities, and a **10 MW** non-nuclear facility with turbo-generator

MOX production

FR-MOX production facility, starting from available (separated) material in France

LFR-AS-30

30 MWe nuclear irradiation reactor with core outlet at 440°C and later 530°C

LFR-AS-200

200 MWe FOAK, also for non-electrical uses (e.g. cogeneration and chemicals production)

Design, manufacturing and operation of the facilities according to the time schedule

Basic Design in progress
Pre-licensing "preparatory stage" ended in June 2024 in France

Conceptual design in progress
First meeting with ONR (UK) on 18-09-2024

Configuration of *new*cleo's LFR

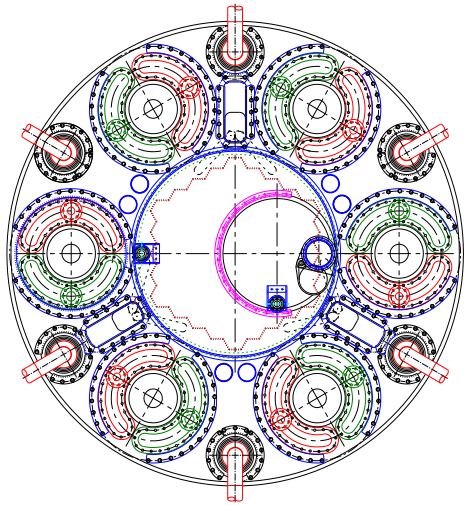
Economics

Compact primary system

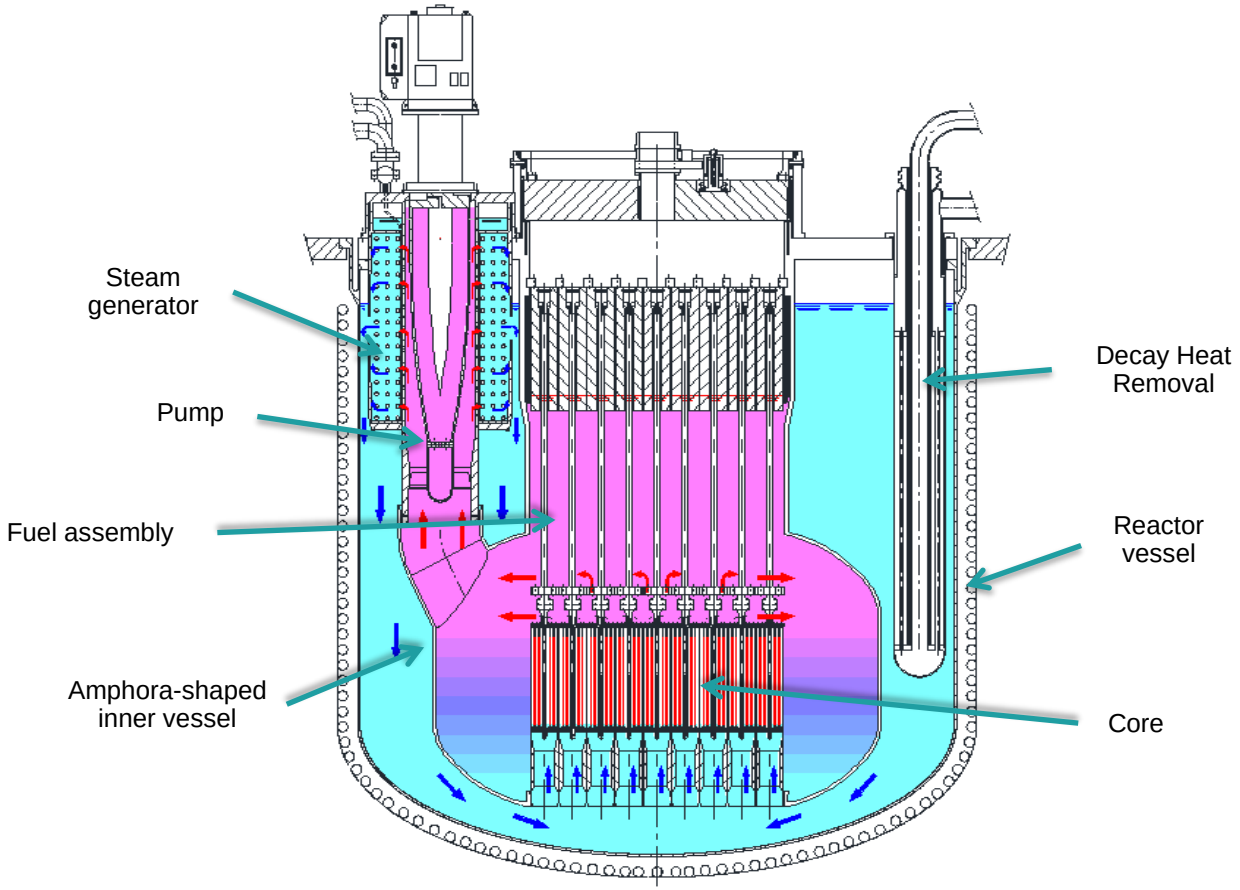
- Innovative components
- Elimination of components no more needed
- Reversal of traditional engineering solutions

Compact reactor building

- No intermediate loops
- Compact primary system
- No risk of LOCA



Plan view



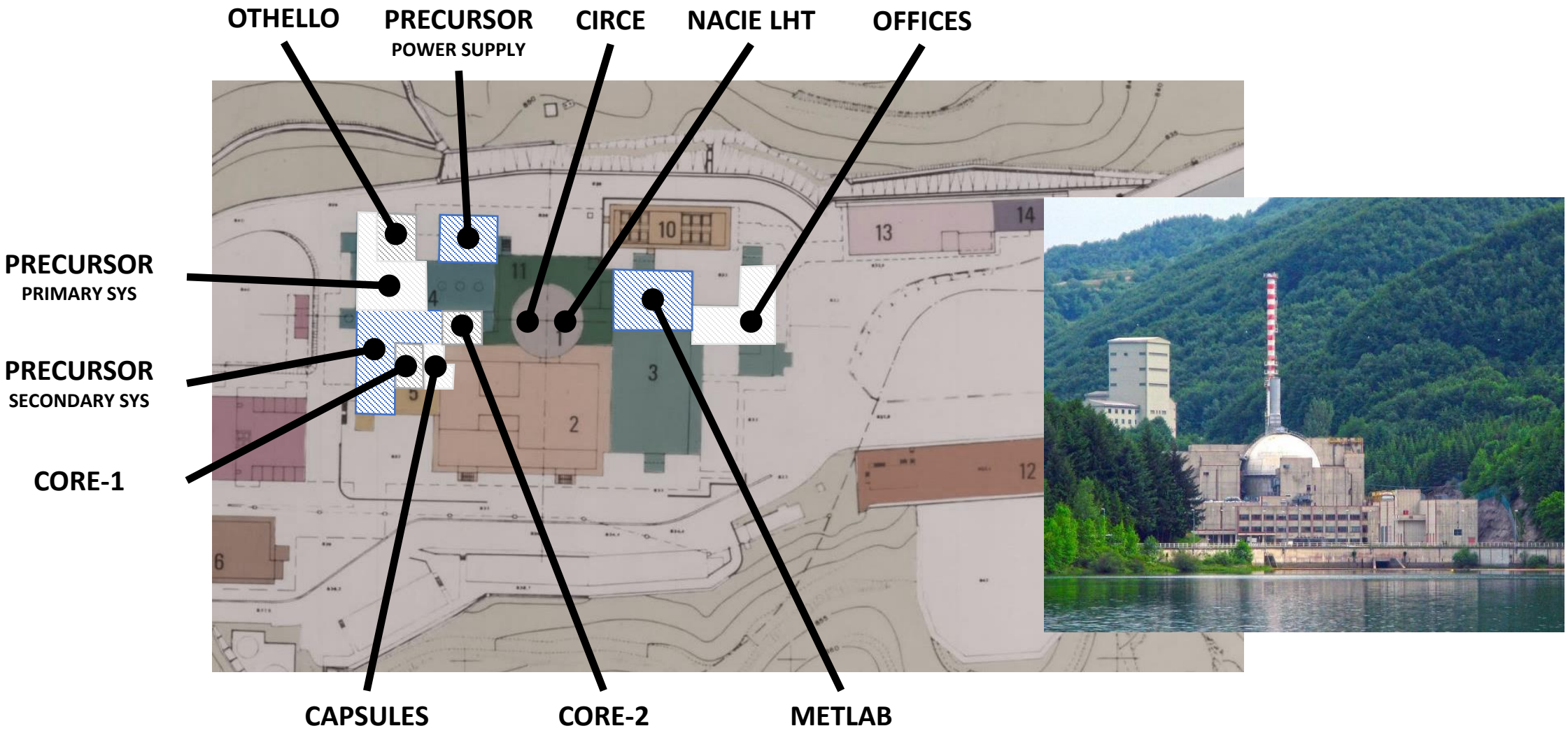
The LFR-AS-200 design

*new*cleo's broad R&D programme

*new*cleo has established and is rapidly deploying a broad R&D programme to consolidate mature technologies and validate our innovative engineering solutions, as well as evolve our commercial reactor offering. These are current and planned non-nuclear facilities

Experimental Facility / LFR Technical Domain	CORE1 & CORE2	CAPSULE	LEAD/CHEM LAB (BRA)	MAT LAB (TO)	MANUT in-lead	MANUT dry	EFESTO	NACIE-LHT	DCI	CIRCE-NEXTRA	OTHELLO	PRECURSOR
Structural materials and coatings	■	■	■	■								
Core, fuel and control/shutdown rods					■	■					■	
Coolant chemistry and auxiliary systems	■	■									■	■
Primary system integrity and component studies							■	■	■	■	■	■
Fuel and component handling					■	■						
Plant operation and accident response												■
Balance of plant and reactor-turbogenerator coupling												■

ENEA-Brasimone Facilities



Material R&D – programme and infrastructure

Static corrosion capsules

- **CAPSULES**: 6 skids of 3 capsules; 108 samples
- Active control of [O] and T (400-750°C)

Flowing Pb loops

- **CORE-1**: 32x corrosion (1 m/s, T<650°C) + 3x erosion (10 m/s, T<520°C) + cold-trap and mechanical filters
- **CORE-2**: 160 corrosion samples (1 m/s, T<650°C)

Laboratories

Mechanical tests in Pb

- Creep and fracture mechanics frames
- Tensile test/SSRT frame

Metallography and Microscopy

- Metals, corrosion layer thickness, morphology and chemical composition

Metrology

- Dimensional measurements with µm precision

Perform corrosion exposure experiments on steels, surface treatments and new materials, in static and flowing conditions and under mechanical stress

LFR Primary System: Thermal-hydraulics, components and structural integrity

- Thermal-hydraulic tests in normal and off-normal conditions
- Design validation and testing of components
- Instrumentation development

Fuel Assemblies

Steam Generator

Primary Pumps

Decay Heat Removal (DHR)

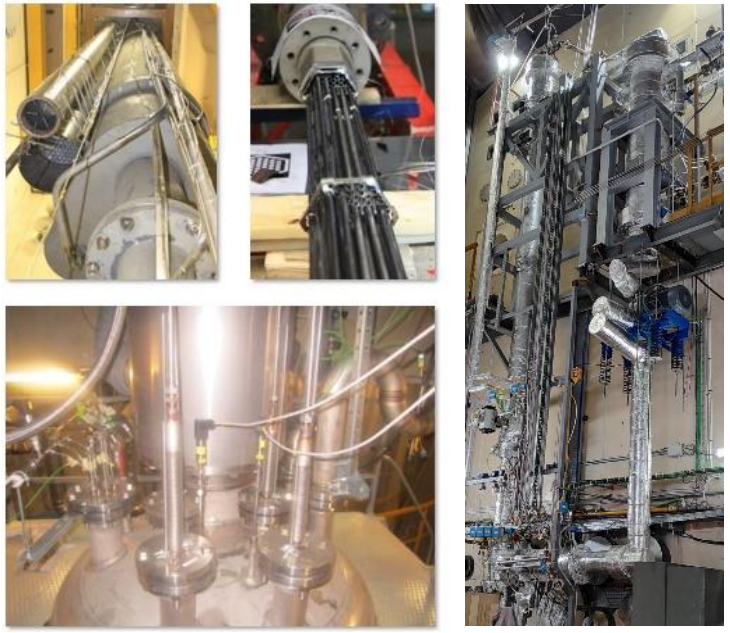
Primary system integrity

Refurbishment of ENEA facilities

NACIE-LHT	Test section to study lead cross flow heat transfer of the Steam Generator
CIRCE-NEXTRA	One or more test sections at existing ENEA-CIRCE: Component testing/qualification and Steam Generator Tube Rupture (SGTR) tests

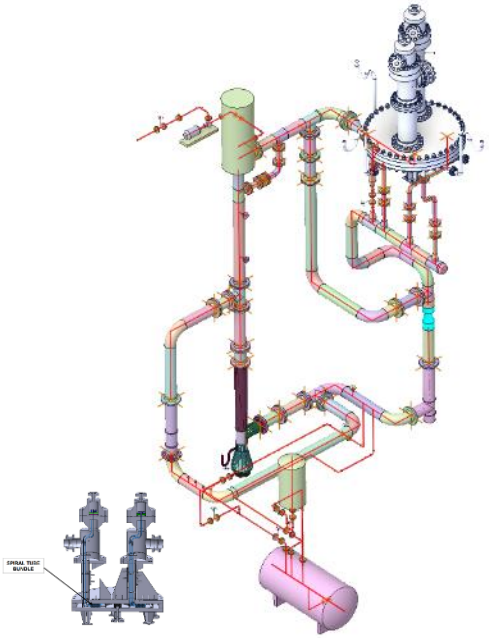
New test facilities

OTHELLO 2 MW	New thermal-hydraulics loop test facility for thermal-hydraulics and component performances
DIP COOLER INSTABILITY Turin	New test facility for TH investigation on Decay Heat Removal system
EFESTO	Fluid-structure interaction test: Earthquake and Sloshing

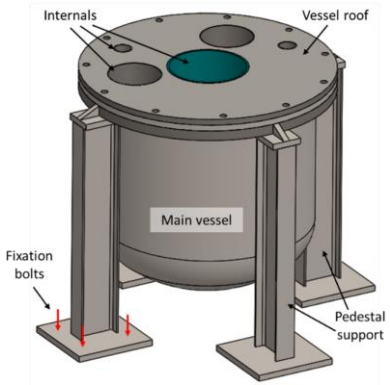


CIRCE and NACIE facilities

DCI test section



OTHELLO



EFESTO notional sketch

Fuel and Component handling / control rods / ISI&R

MANUT programme

- Mechanical design validation and equipment testing
- Instrumentation
- Functional tests and operations / procedures

Core design

Rotating Plugs

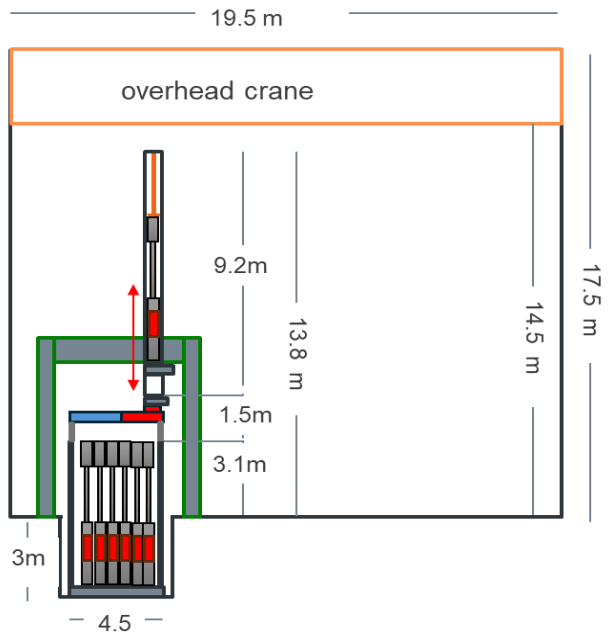
Fuel Handling Machine

Component handling and maintenance

Control Rods driving mechanism

Dry tests

- Tests in air on fuel and component handling



In-lead tests

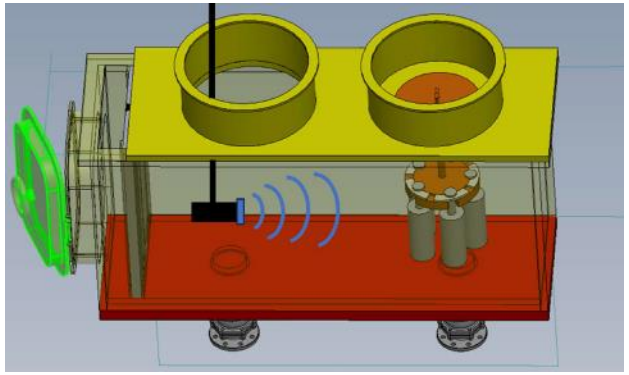
- Infrastructure under development @**Brasimone** site

HUSTLE

- Devoted to the development of ultrasonic technology for In-Service Inspection & Repair (ISI&R)
- Tests performed in a **tank filled by molten pure lead**

Phase 1 – US in hot air

Phase 2 – US in liquid lead



HUSTLE – Phase 2

PRECURSOR test facility

Integral-effect test facility representative of LFR-AS-30

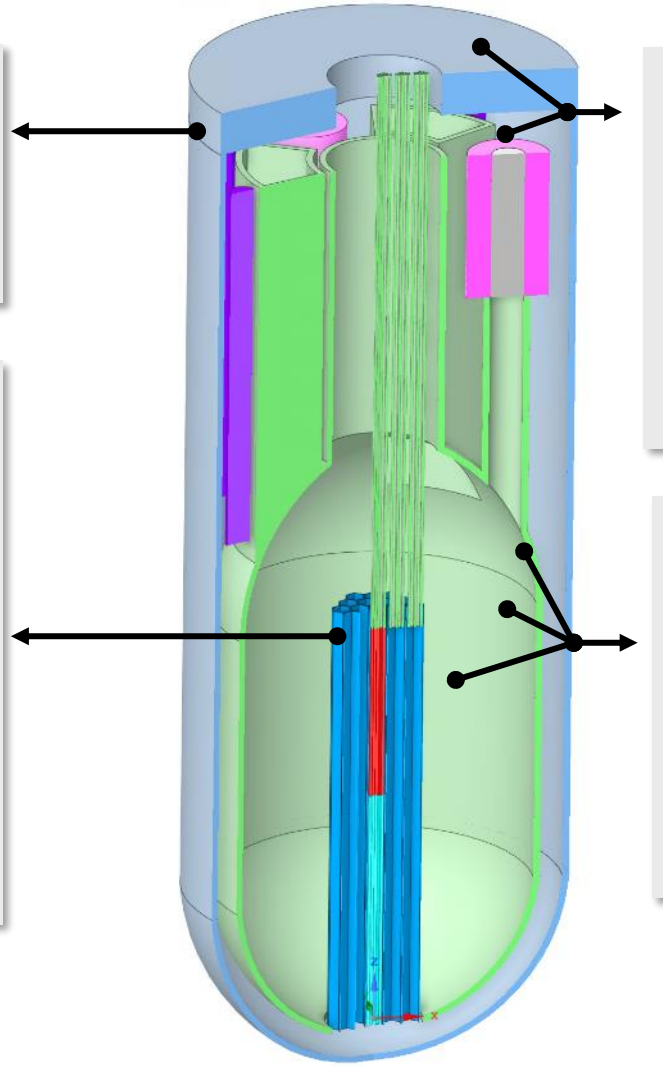
- PRECURSOR is a **10MWth (1/9 of LFR-AS-30) pool-type facility** that aims at investigating the thermal-hydraulic behaviour of the LFR-AS-30 reactor, with particular focus on:
  - **Normal Operating conditions**, **normal start-up/shut-down transients** and, to some extent, accidental transients
  - BOP transients, coupling with SG and test of its stability domain, 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

DHR2:

- three water-steam loops, each consisting of a dip-cooler, condenser and connecting piping

eCore:

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



Pump and SG:

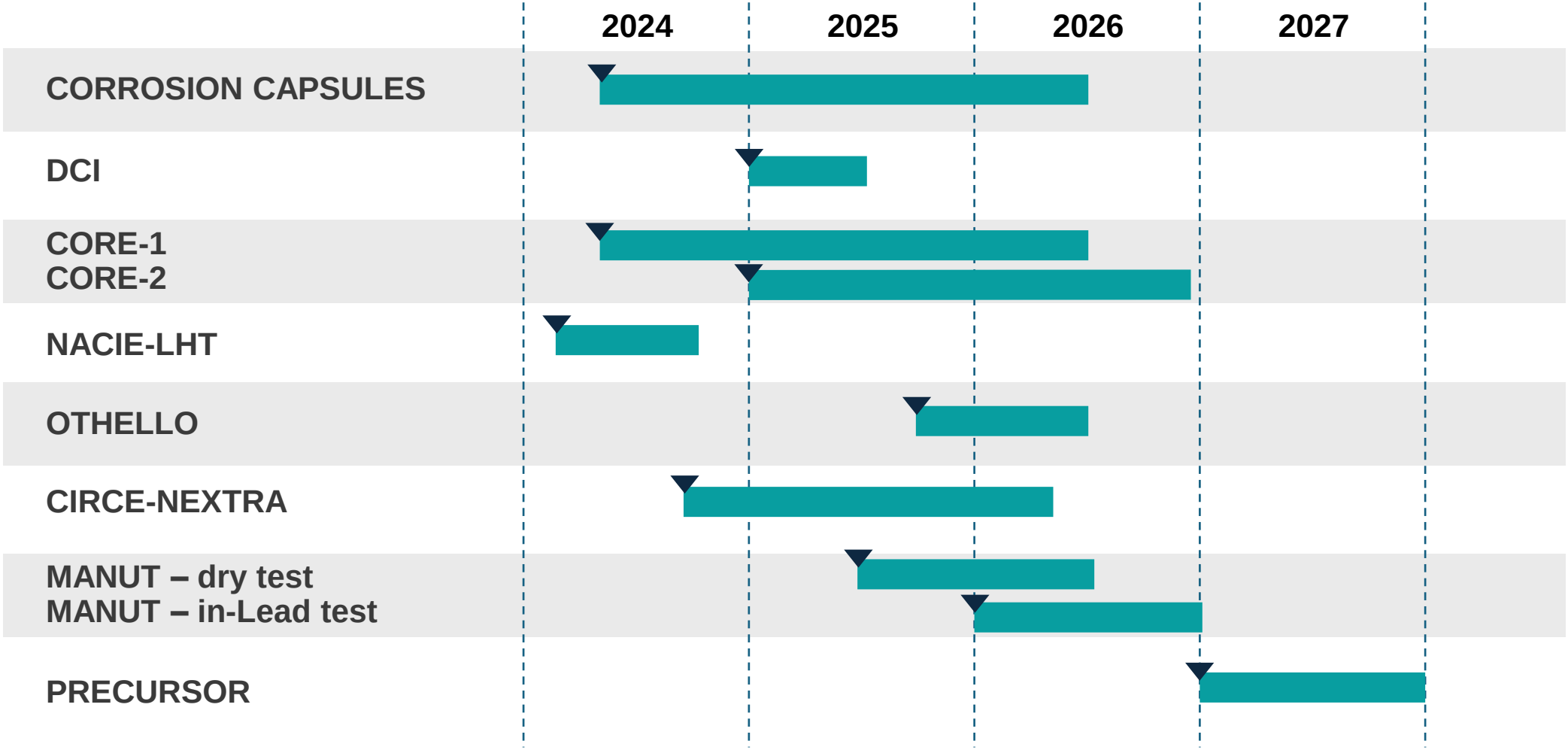
- SG designed to **minimise the radial footprint** (due to P2V constraints) while ensuring representative operating conditions of primary and secondary circuit
- Axial flow pump inside the SG as in LFR-AS-30

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**

PRECURSOR facility, notional sketch

*new*cleo's R&D Programme timeline driven by LFR-AS-30



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Futurable Energy

Thank you