



International Conference on

small modular reactors

and their applications

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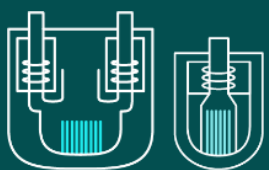
***newcleo's* Fuel Cycle Innovations for SMR-LFR including transport of fresh and spent fuels**

J.M. Marin, L. Cinotti, D. Favet, B. Nixon, C. Dupont

Fuel Programme Technical Director, *newcleo*

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A long-term vision centred on safety and sustainability



Reactor technology:
AMR: SMR - LFR

LEAD-COOLED

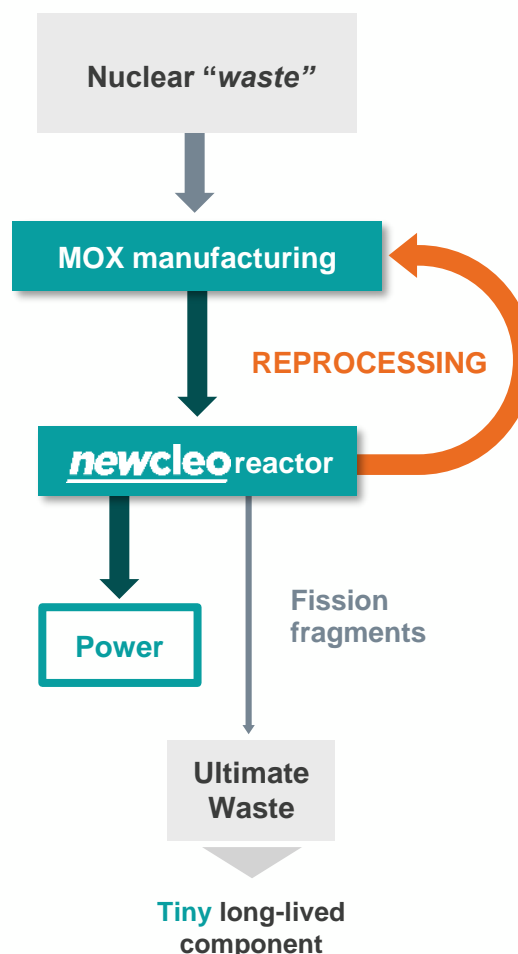
High performance | Compact and simple | Intrinsic safety

FAST

Efficient use of uranium resources | Able to recycle reprocessed spent fuel

SMALL MODULAR REACTOR

Plant manufactured | Site flexibility | Modularisation and economies of learning



Fuel: **MOX**

- A clean solution to the issue of costly and long-lasting 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, and reduce the volume headed to geological repository
- Spent fuel will be **reprocessed multiple times**, reducing drastically byproduct's volume and their radiotoxicity

Closing the fuel cycle



A novel approach is envisioned to better use the fissile nuclear material from the current fuel cycle

Advantages of MOX (Mixed Pu-U Oxides):

- cost-effective
- clean source of energy
- virtually inexhaustible production of nuclear energy
- no need of mining

Our programme contributes to Europe's decarbonised energy independence, the stabilisation of plutonium stocks and the reduction of the radiotoxicity of final waste

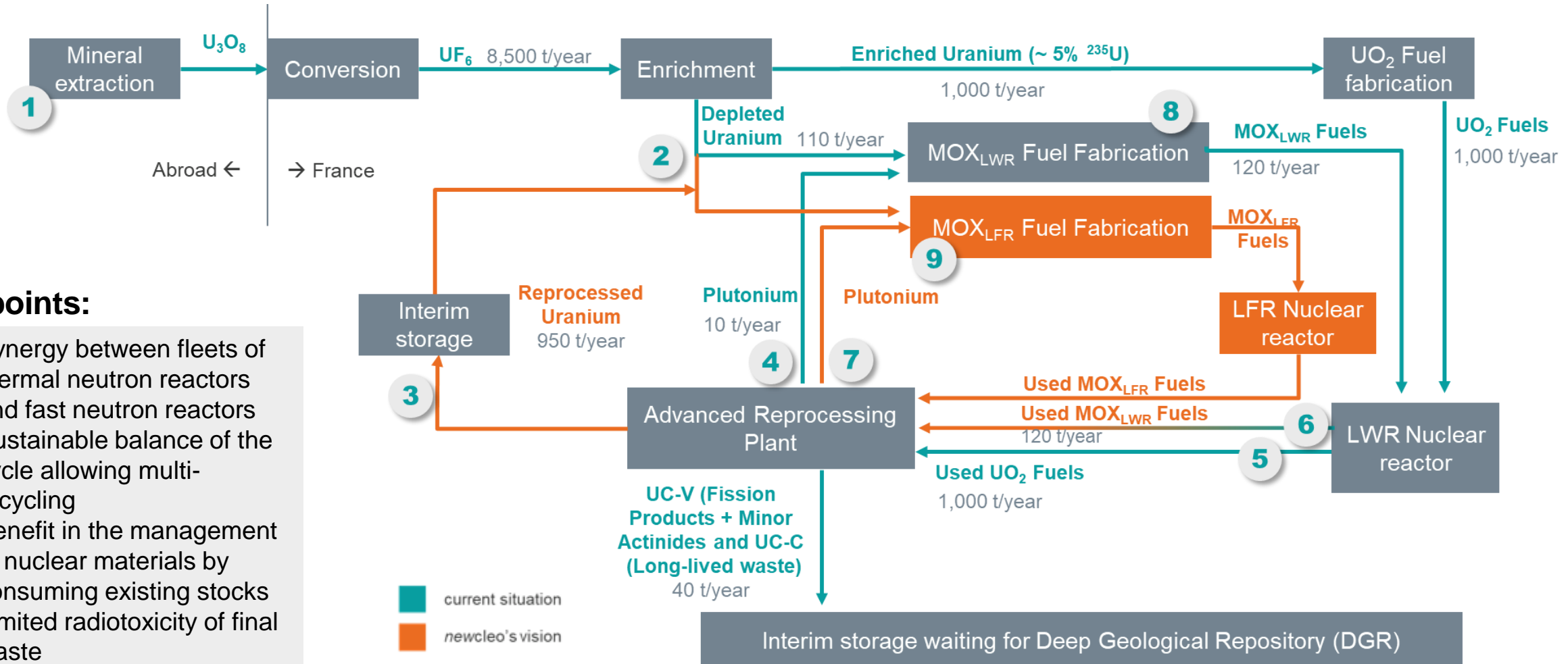
- *newcleo's* ambition is to contribute to the fuel cycle closure by deploying a Gen-IV LFR-SMR reactor combined with a MOX_{LFR} fuel fabrication plant
- A significant amount of the nuclear materials currently available in France and Europe **can be recycled in fast-neutron reactors** and are sufficient for the deployment of *newcleo's* LFRs by 2050, without disrupting EDF's current MOX_{LWR} processing / single-recycling scheme

The *new* fuel cycle: high level overview of current and MOX fuel cycles



Key points:

1. Synergy between fleets of thermal neutron reactors and fast neutron reactors
2. Sustainable balance of the cycle allowing multi-recycling
3. Benefit in the management of nuclear materials by consuming existing stocks
4. Limited radiotoxicity of final waste



MOX: composition and facilities

Composition

U

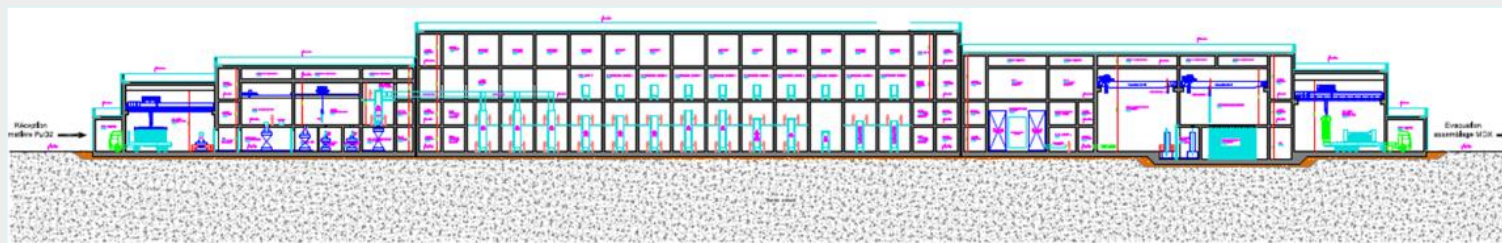
- Uranium is either **depleted** or from reprocessing (**RepU**)
- Our vision frees from the mining dependence of Uranium from foreign countries
- It also makes good use of the **large stocks of existing reprocessed and depleted Uranium** from past enrichment processes and traditional reactor cycles

Pu

- Pu is consumed in significant quantities (up to 35%)
- Traditionally difficult to recycle in LWRs without coupling to enriched U
- Made possible to recycle in LFRs since Pu and U are fissile isotopes in fast reactors; can then consume Pu without enriching U

Fabrication

newcleo MOX_{LFR} fuel **fabrication plant** design and licensing in progress



Plant principles:

High level of nuclear and operational safety, security and physical protection

High level of automation and robotisation for optimum protection of workers and the environment

Reprocessing

Reprocessing capacity will require:

- MOX_{LWR} fuel reprocessing unit
- MOX_{FNR} fuel reprocessing unit

Conclusions

- Starting in the early 2030s, *newcleo*'s ambition is to contribute to the fuel cycle closure by deploying a Gen-IV LFR-SMR Fast Neutron Reactor combined with a MOX_{LFR} fuel fabrication plant
- Our programme contributes to Europe's decarbonised energy independence, the stabilisation of plutonium stocks and the reduction of the radiotoxicity of final waste
- The paper is presenting the main features of *newcleo* LFR-SMR and the R&D programme initiated to validate both the material (steel and alloys) behaviour in lead environment

Thank you

