

# IAEA – Spent Fuel Management Sustainable Cycle Solutions

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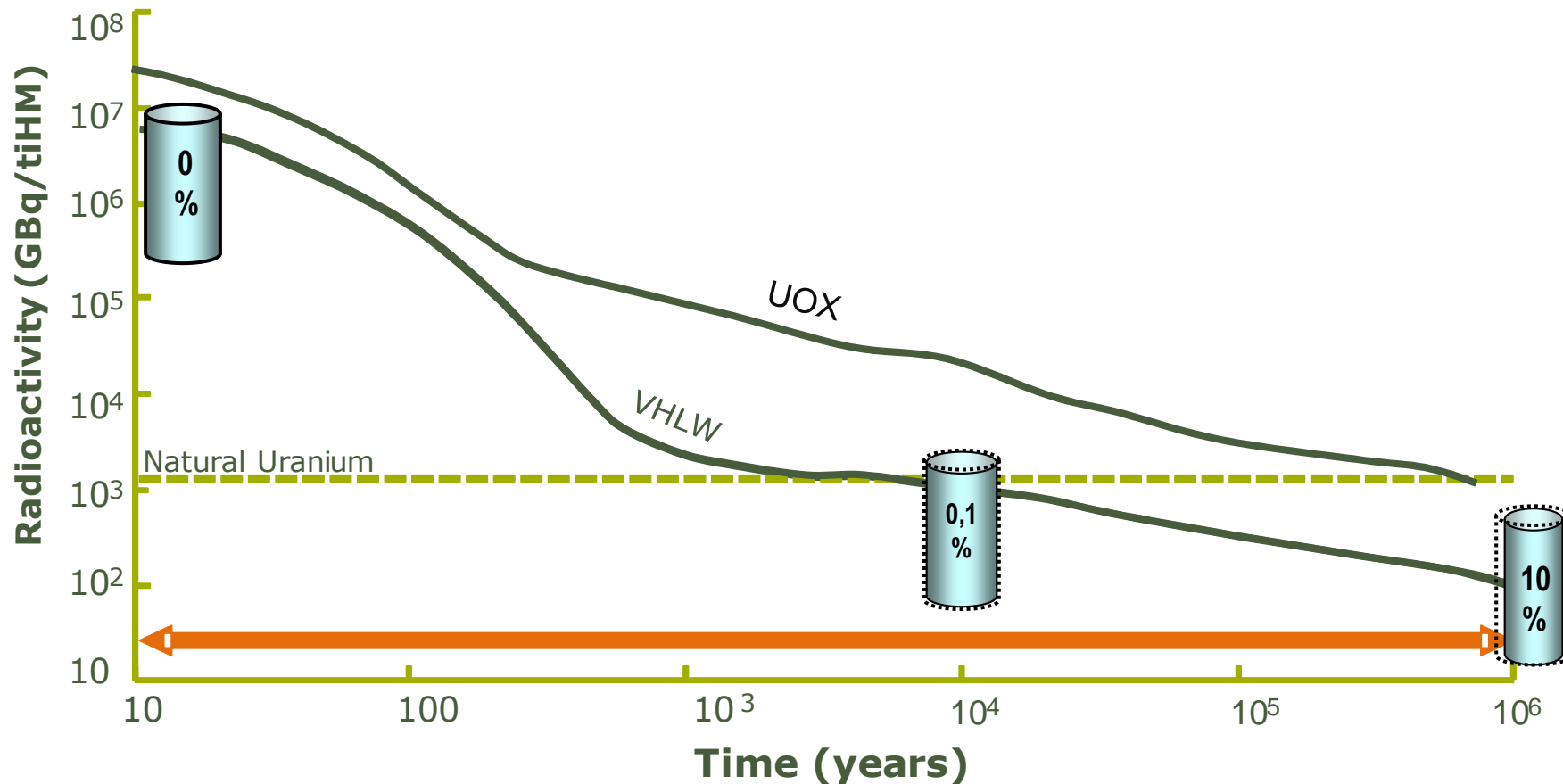


## An option for the management of used nuclear fuel is sustainable if it:

- ▶ Covers all the steps of used fuel management until final disposal, in accordance with an acceptable, practical plan
- ▶ Proves to be feasible with an acceptable impact level
- ▶ Includes a realistic and balanced financing plan
- ▶ Does not impose undue burdens on future generations








» Deep disposal with a safe and acceptable route

# Ensuring stability and containment for thousands of years



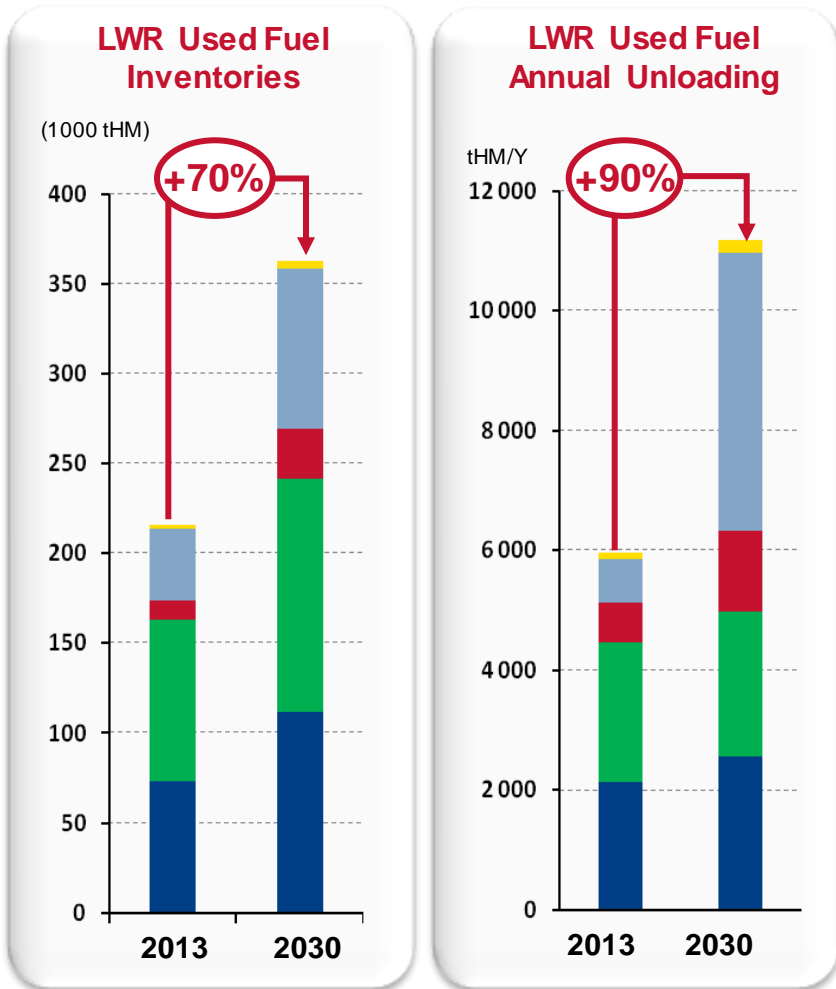
Glass has proven scientifically as a very robust matrix against alteration by water

# Challenge#1 : Implement deep geological repository

		Licence to build	Start of operations	Status
Closed cycle		2017	2026-2076	Siting in progress
		2025	2035	Two sites under discussion
		2030-2040	2050-2080	Under discussion
Open & Closed cycle		2026	2045-2060	Siting under discussion
Open cycle		2008	2048	Project stopped by the Obama administration in 2010 – New project expected for 2048
		2010	2025	Application submitted – Main criticality safety issues to be solved – Licence expected for 2017
		2012	2021	

» Anticipation, international cooperation and continuity of efforts

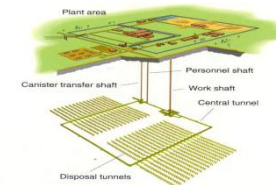
# Global nuclear capacity is expected to increase significantly by 2030



► **Deep geological repository will remain a scarce resource**



- Rest of the World
- Asia
- Russia & CIS
- Europe
- North America



**Optimizing the use of scarce resources is critical for the durability of the nuclear power**

# Challenge #2: Manage long term storage and avoid saturation



## Used Fuel Management

- ▶ Significant inventories
- ▶ Lack of (or major delay in developing) final disposal path
- ▶ Industrial interim systems not capable of bridging the gap
- ▶ Uncertainty over used fuels LT behavior

Reactors' life extension



Reactors' shut-down



New reactors



## Main issues

- ▶ Saturation of reactors pools and constraints on operations
- ▶ Safety demonstration
- ▶ Pool unloading for phase out
- ▶ Damaged fuels
- ▶ Difficulty to get new license

➤➤ Risks reduction: a short-term priority

# AREVA: Sustainable Solutions for an optimized, long-term and responsible management of used fuel

## Recycling and HLW storage



RECYCLING

## Interim options for used fuel

Dry storage



Wet storage



## Transport systems



## Sustainable Cycle Solutions



A smart mix of proven and evolving technologies tailored to stakeholders' priorities and constraints

# The Netherlands or how to use recycling to reduce risks?

## Situation

17 M inhabitants, 110TWh  
1 reactor, shut-down 2034  
1 storage facility : **HABOG**

## Ambitions / Challenges

**Strategy :**  
Surface storage **100 years**  
Responsible management  
Public acceptance  
Choice of the recycling



## AREVA solution

Precycling



No safeguards, no corrosion, no leakage, no safety issue, high public acceptance



Safe long term storage of glass canisters (>100 years) has a major value



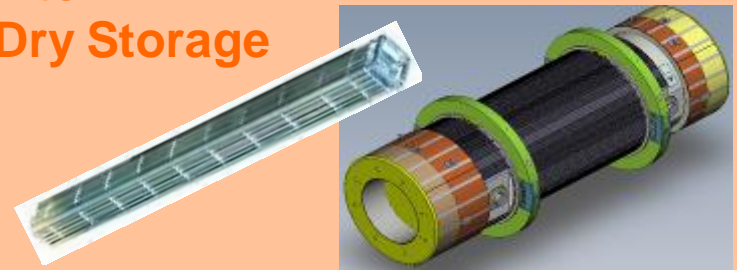
# AREVA solutions for managing defective fuels

## Transport



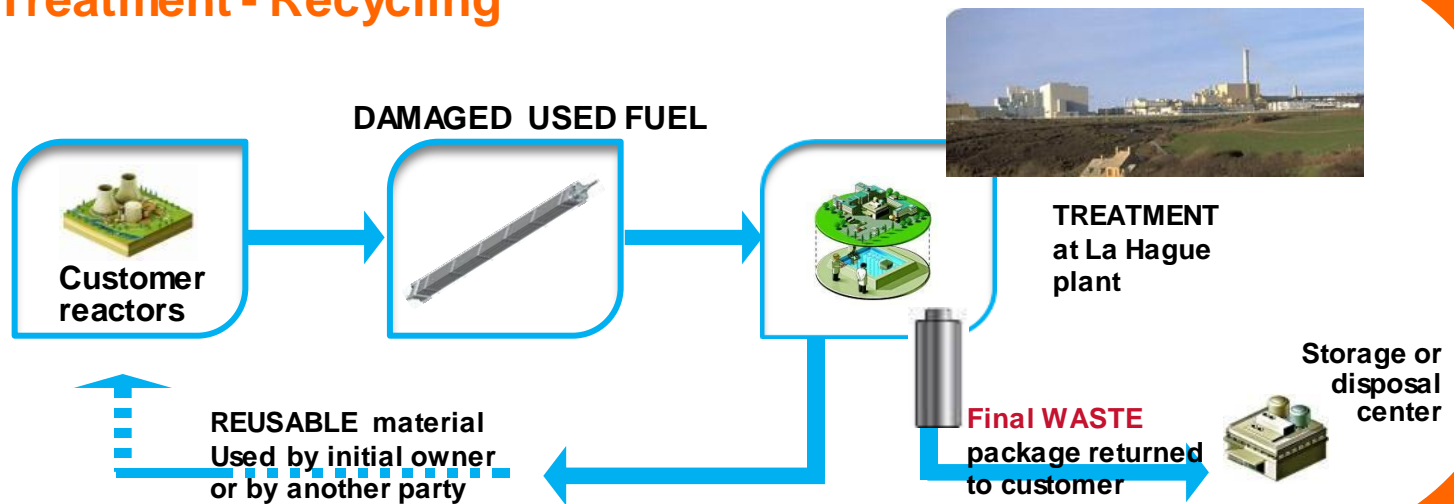
TN®117 cask

## Interim Dry Storage



Capsule Canister to be loaded in a TN®24E

## Treatment - Recycling



# Challenge #3 : Manage long term interim storage risks



Can you imagine this in **100 years?**

 *“Research on **long-term spent fuel integrity**, currently underway in the U.S. and elsewhere, will be critical to protecting public health and safety.”*

NRC Chairman Macfarlane ,17 november 2014

With Extension of dry storage well beyond original license, risks to be mitigated

- ➔ **Safety:**
    - ◆ Fuel integrity overtime
    - ◆ Aging of materials/storage components
  - ➔ **Security:**
    - ◆ With less radiation overtime, easier access to fuel
  - ➔ **Others:**
    - ◆ Loss of records especially on stranded sites (fuel, systems,..)
- Higher risks on stranded sites with no pool and “aging “expertise

➤➤ **Used fuel storage : from “commodity” to “critical system” requiring much focus and means**

# New solutions and business models under development

Ageing management early detection, monitoring and repair equipments

## ➔ Early Detection and Monitoring

Installed base: Detection and Monitoring

- ◆ Inspection models
- ◆ Tool development for welding integrity monitoring
- ◆ Corrosion monitoring and heat sensors

New systems:

- ◆ New materials with better resistance to corrosion, fabrication process,...
- ◆ Sensors for intern and extern monitoring

## ➔ Mitigation/Repair

Repackaging capabilities on-site

And: Consolidated Interim Storage Facilities (CIS)

CIS



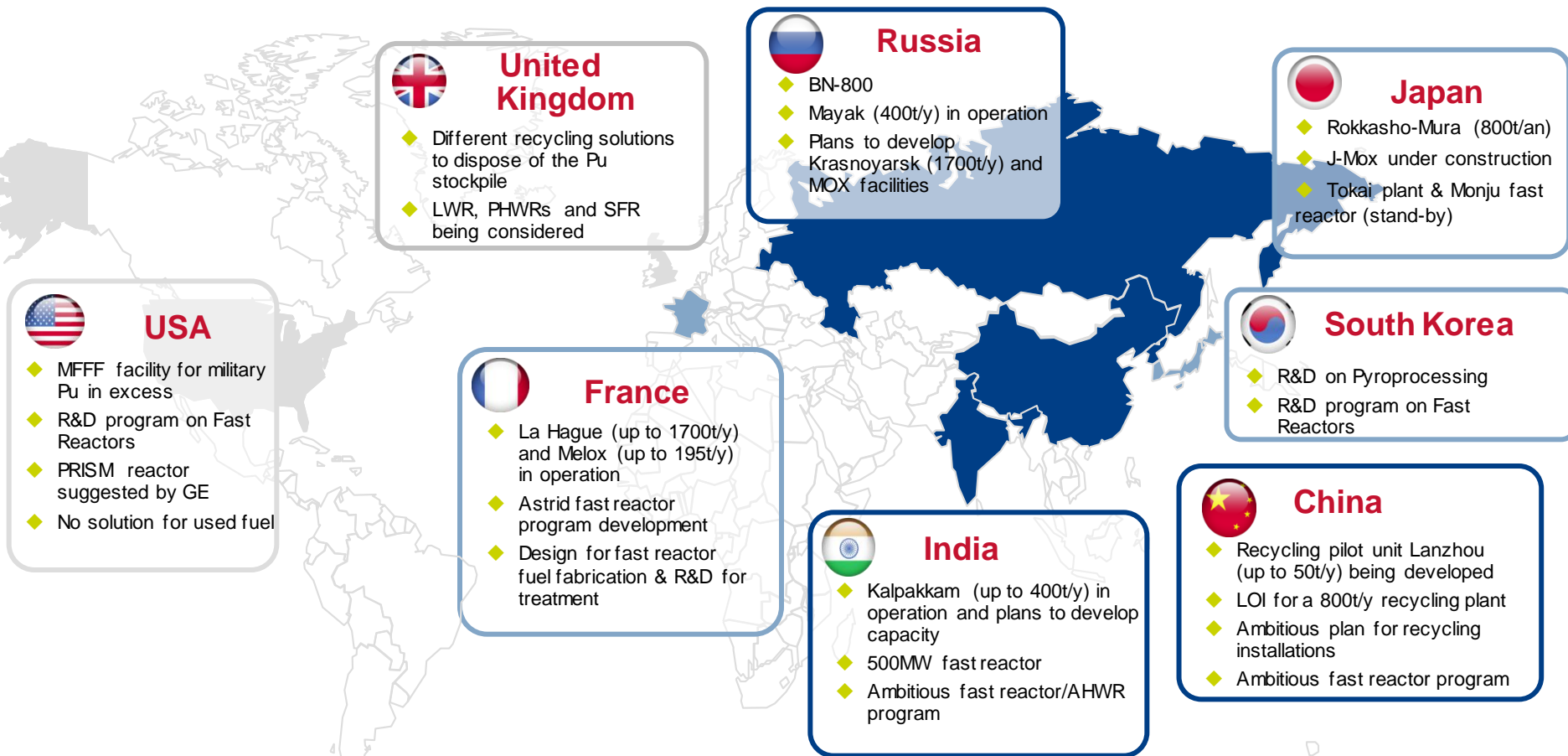
Consolidation of expertise and equipment (too complex and expensive on stranded sites) with capability of:

**Monitoring**

**Fuel retrievability and examination**

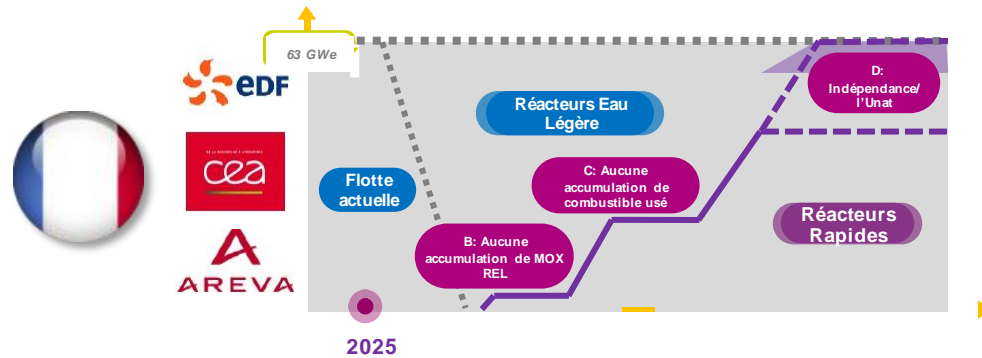
**Fuel repackaging**


# Challenge #4: Increase worldwide recycling capability and develop advanced solutions




➤ Support key nuclear developers in implementing real “industrial strategies”

# AREVA Solutions Technology, industrial experience and system design for a sustainable nuclear deployment





**Support to RRP  
and JMOX**



**MFFF design and  
construction**



**Pu management  
solution**



**Recycling platform**

- On going contracts
- Studies/offers in progress

➤➤ **Reducing risks and leveraging nuclear systems**

## Our mission:

**Provide Sustainable Cycle Solutions for optimized, long-term and responsible management of used fuel**



### **Reduce risks**

- ◆ Safety & security
- ◆ Environment impact
- ◆ Non proliferation



### **Increase value**

- ◆ Economic value
- ◆ Fleet performance



### **Favor acceptability, public acceptance**



**Responsible towards coming generations**



AREVA

l'avenir pour énergie