



materials ageing institute

International consortium driving excellence in nuclear long-term operation

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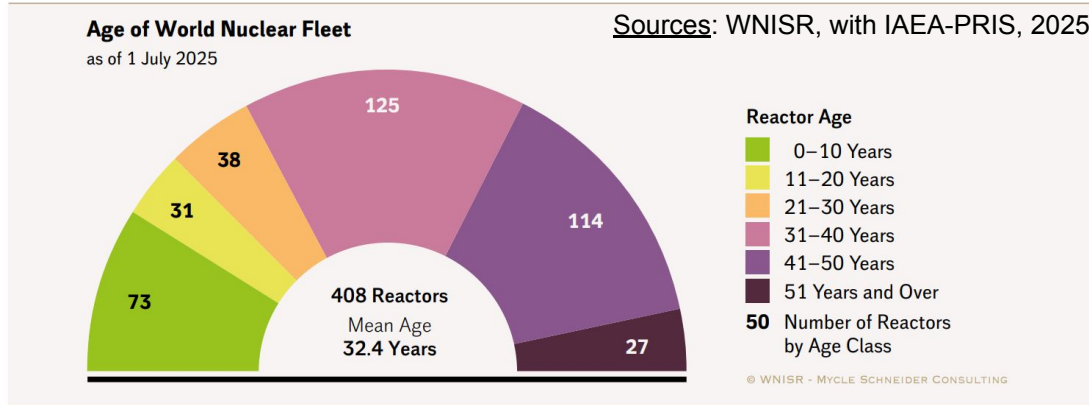
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‘ Connecting Nuclear ’



Material Ageing in Nuclear Power Plants



In 2025, 33% of the world's nuclear fleet was at least 40 years old (50% in 2030)



Materials issues have by far the largest impact on plants' safety, performance & availability



Need to understand and anticipate the degradation of key components' materials



Large R&D efforts needed to achieve these goals



Importance to share knowledge and R&D efforts at international level

The French nuclear fleet

- 18 nuclear power plants - 57 PWR in operation
- PWR Homogeneous fleet :
 - 32 x 900 Mwe
 - 20 x 1300 Mwe
 - 4 x 1450 Mwe
 - 1 x 1650 Mwe
- 1 EPR in operation

Age

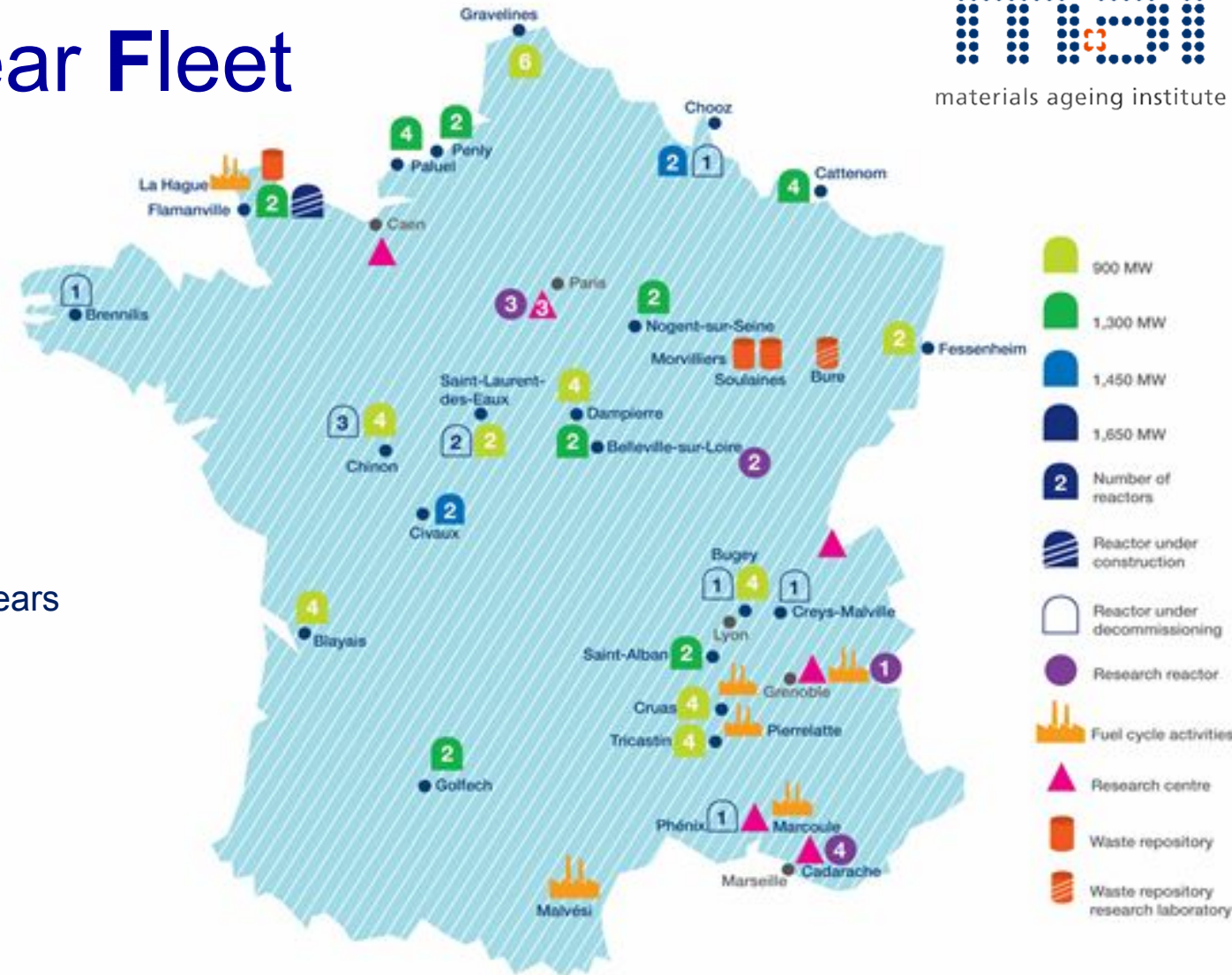
- Average of 39 years ; 17 units are older than 40 years

Fleet's lifespan

- No technical or regulatory limitation
- Every ten years a specific authorization must be granted by the regulator

The largest LTO Program in the world

- 49,4 billions €
- Mobilization of EDF Engineering divisions and R&D as well as major contractors and vendors



**Renewed interest for nuclear energy as independent energy
: “life extension as long as safe “
+ New EPR reactors planned**

French Energy Landscape in 2050

- **Announcement of the French President in Belfort – Feb. 2022** : “Within 30 years, make France the first major country in the world to end its dependence on fossil fuels and strengthen our energy independence while setting an example in terms of climate care”
- As part of EDF ambition to be a major actor for decarbonated energy, EDF aims at having a sustainable fleet

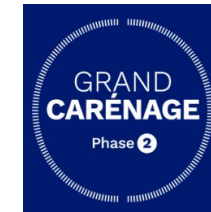
Consume less energy and be more energy efficient
-40% of energy consumption by 2050

Produce more low-carbon energy
+60% additional electricity by 2050

EDF industrial Programs
To support the energy transition

Industrial & residential energy efficiency – Reduction of fossil fuels – Uses electrification

**Development of renewable energies
Consolidation of nuclear fleet**



**EPR2
NUWARD**

LTO > 60 years
> 25 GW by 2050 out of which
6+8 EPR2 and SMR



Development of one of the major hydrogen industrial pole



Development of Renewables & Batteries in France



100 GW



40 GW



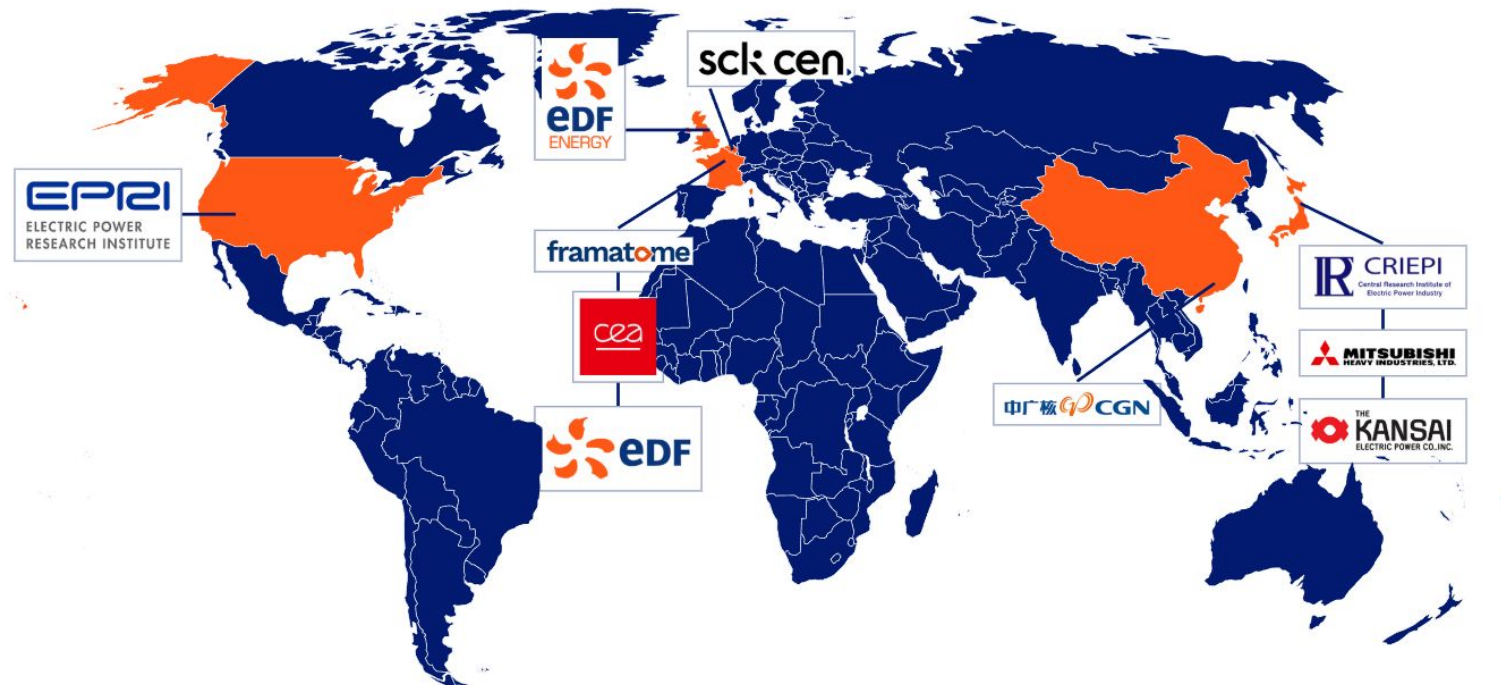
37 GW



A unique collaborative institute led by nuclear utilities

- Created 18 years ago, the MAI is now an international center of excellence on materials ageing, gathering utilities, vendors, and research centers from worldwide.

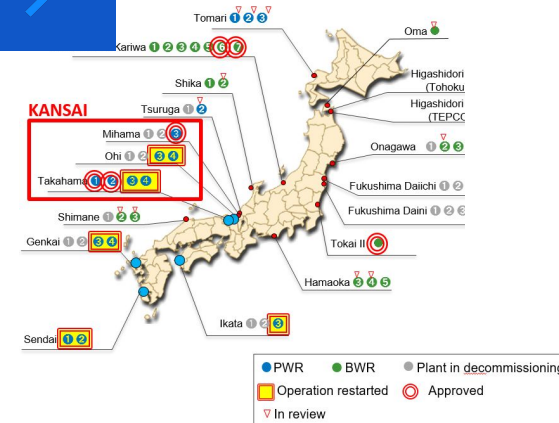
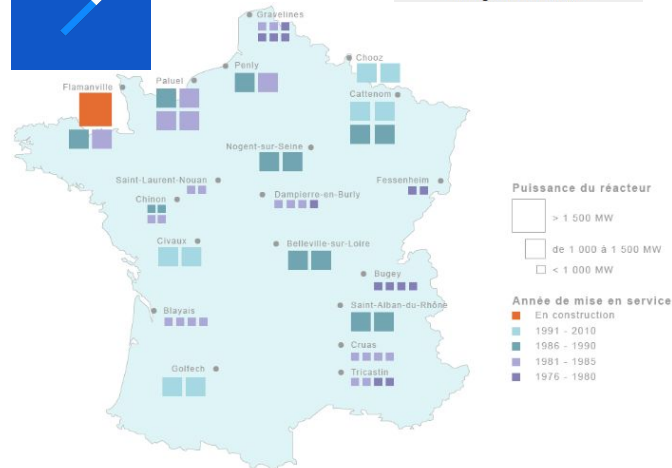
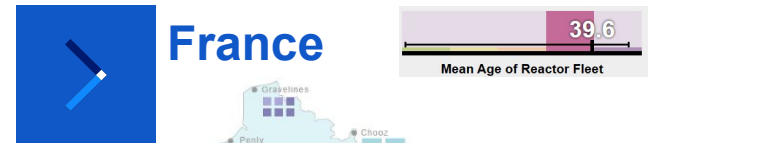
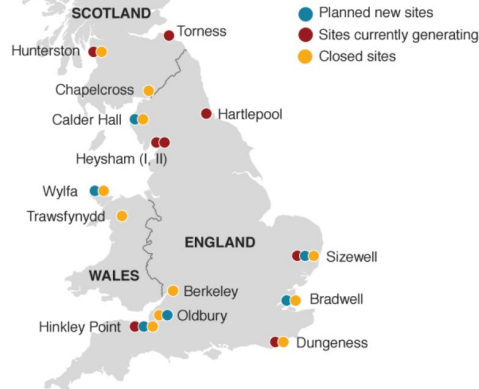
- The main purpose of this collaborative effort is to bring together scientific skills and research facilities to address aging of material used in nuclear power plants



materials ageing institute

MAI Members' Nuclear Fleet

Thousands years of reactor operating experience





Safe Long Term Operation of NPPs

Knowledge-based management of materials and components



Centralize and coordinate R&D

Feedback from NPPs, data, methods and models



Improve fundamental knowledge

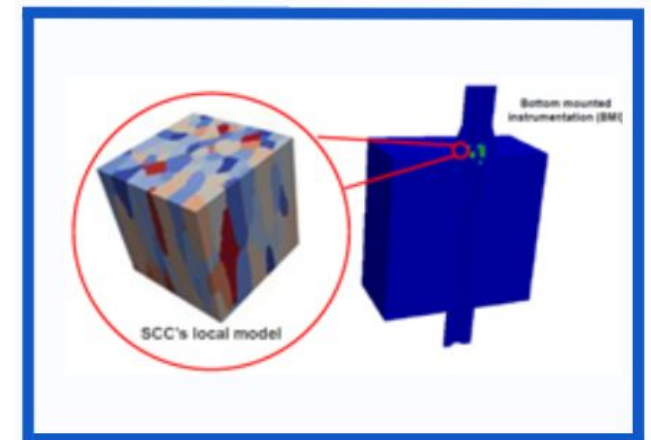
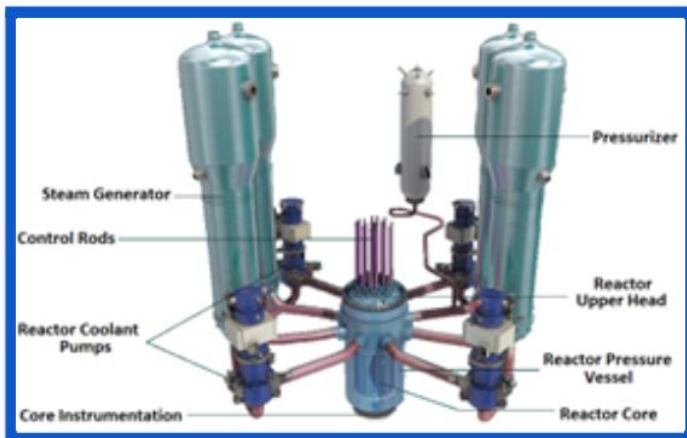
Study ageing mechanisms with the help of state-of-the-art experimental tools and capabilities



Training & Education

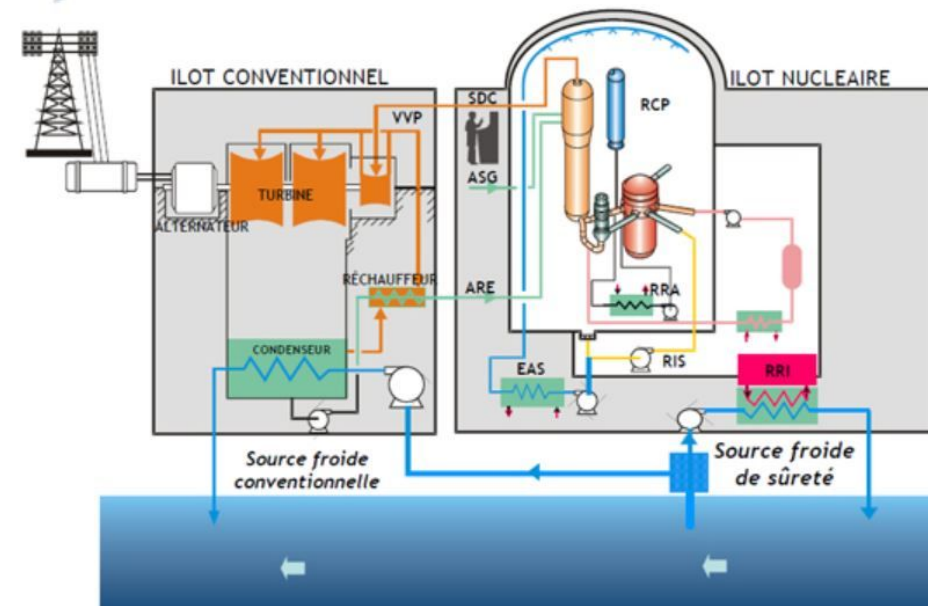
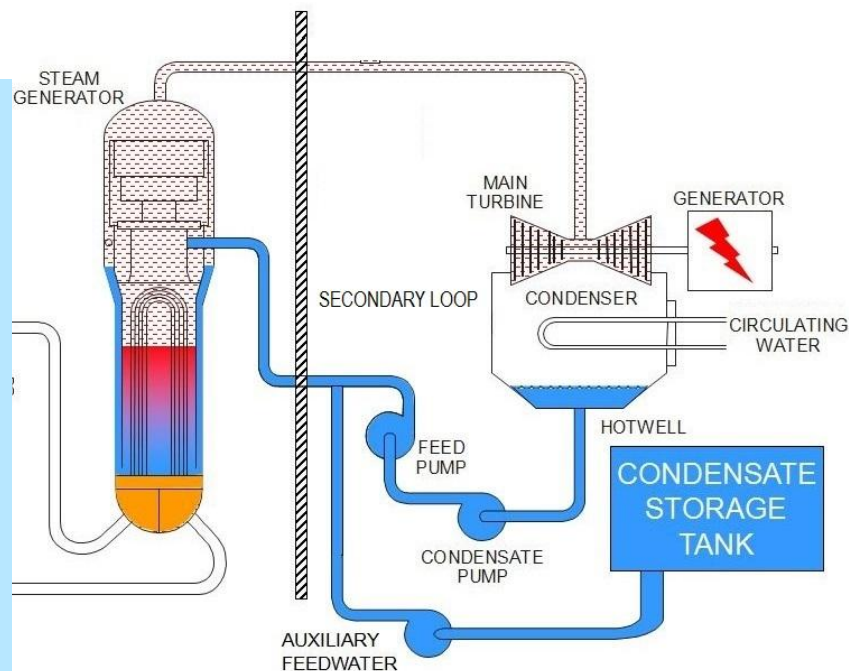
Train our next generation: courses, workshops and seminars in the field of material ageing

- Non-replacable components
- Difficult or expensive components to replace
- Chemistry in the primary and secondary circuits
 - Degradation and ageing mechanisms
 - Non-Destructive Examinations
 - Innovative processes



EPR2 use cases

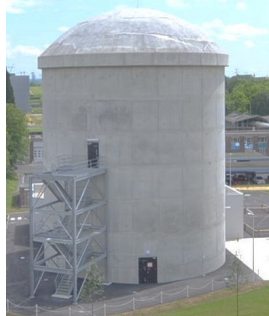
Optimizations of the water characteristics in the secondary circuit of the EPR2 PWRs during their construction and testing phase



HDPE pipes used for the buried cooling system - HDPE instead of steel: combination of numerous advantages

~80M€ Investments in experimental facilities at EDF

Lab



VERCORS

Studying in an accelerated way the concrete's behavior and the structure of the inner containment of a reactor building (aging, deformation and sealing)



Cold Spray

Making metal deposits by projecting powder at very high speed. This additive manufacturing process is used for applications to repair damaged parts or build coatings.



Fatcor 2

Studying the fatigue and corrosion properties of nuclear reactor materials in the primary environment.



Polymer Lab

Focus on polymer ageing: experimental studies, service-life monitoring, lifespan modeling, and testing of cables, pipes, paints, and coatings under controlled conditions.



BOREAL

Primary water chemistry mockup dedicated to the Release of steam generator tubes in Primary water



Microscopie Electronique

Understanding the aging of materials by focusing on the microstructure and local chemical composition of materials by electronic microscopy.

See other facilities on [Fundamental knowledge | EDF FR](#)



100 M€ of cumulative budget over the last 10 years



~100 researchers workforce all over the world



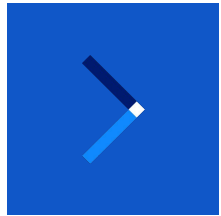
Thousands years of operating experience



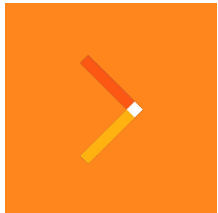
M€ of investments in experimental facilities



~40 technical reports / year and end-user Tools



Direct economic value – the MAI results can be used to shorten outages, reduce maintenance costs, lower dose exposures or extend life of components



Indirect economic value – the MAI results avoid additional regulatory requirements or inefficient operational practices



Implicit value through scientific credibility and public confidence with regard to safe long-term operations

Thank you



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Getting the best of what materials can give

About the MAI | EDF FR

