

FRENCH REGULATORY APPROACH AND EXPECTATIONS FOR LTO

NUCLEAR INNOVATION CONFERENCE, 2024

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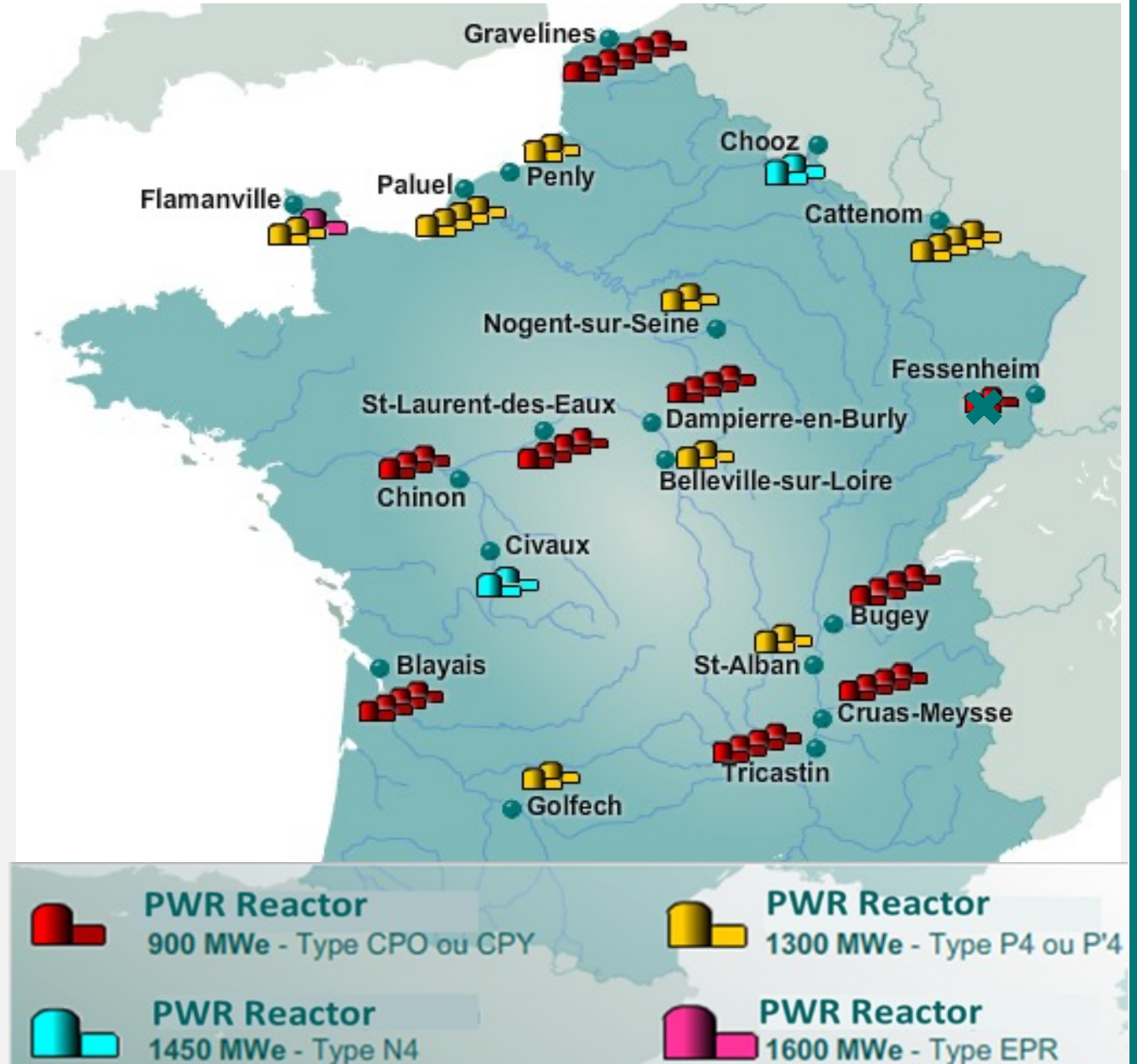




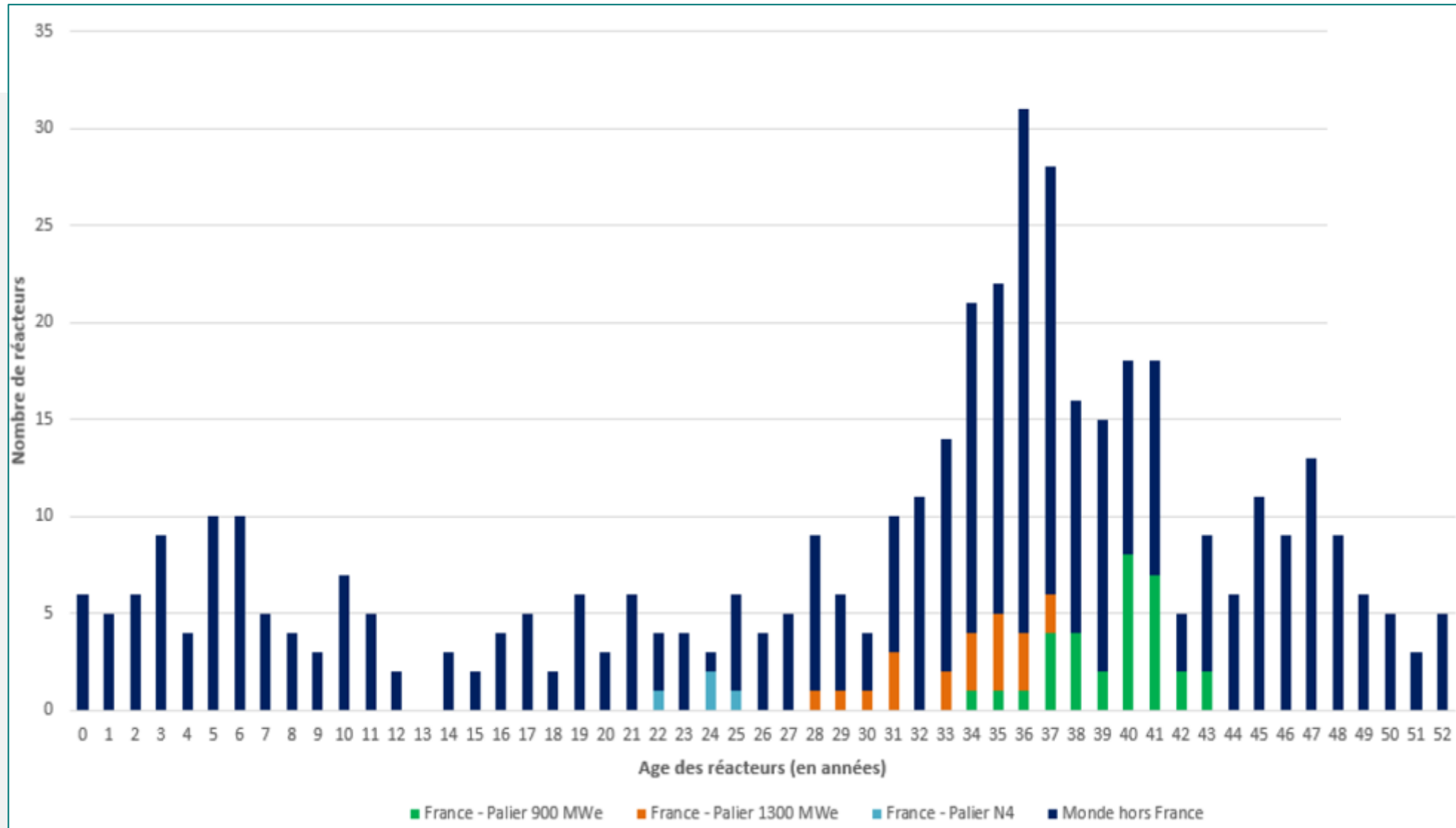
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FRENCH REACTOR FLEET

- A standardized fleet:
 - 56 PWRs in operation
 - *1 EPR reactor being commissioned*
 - 18 sites
 - 1 vendor (Framatome)
 - 1 licensee (EDF)
- 1979 - 1990: 3/4 of the fleet built
- Oldest reactor: 46-year old
- NPPs average age (/1st criticality)
 - 900 MWe: 32 reactors ⇨ 42 years
 - 1300 MWe: 20 reactors ⇨ 37 years
 - 1450 MWe: 4 reactors ⇨ 27 years



FRENCH REACTOR FLEET



World nuclear fleet in 2021

THE PERIODIC SAFETY REVIEWS

- French regulations do not provide for approval for long term operation: **no license renewal, but mandatory periodic safety reviews (PSR) every 10 years**
- ASN analyses the conditions necessary for continued operation every 10 years as part of PSRs
- EDF takes advantage of the **standardisation** of its reactors to conduct the PSRs in **2 stages** for each model:
 - ① **Generic stage** (8 years) : EDF carries out safety analyses and defines improvements common to all the reactors of each model
 - ② **Specific stage**: EDF takes into account the specific features of each site and each reactor and implements the controls and improvements defined
- ➔ The PSRs comprise two parts:
 - An examination of the **compliance of the facility** with applicable requirements and of its ageing
 - A **safety reassessment, which leads to modifications** of the facility to improve safety and reach the level of safety close to that of the most recent reactors. **This safety reassessment is considered necessary in France for social acceptability of nuclear power.**

INVOLVEMENT OF VARIOUS AUDIENCES

➤ ASN involves the public during the 2 phases of the PSR

■ Generic stage:

- ASN and IRSN hold **technical discussion meetings** with the members of the local information committees, which are set up for each NPP and representatives of environmental protection associations
- A **6-month national consultation** is being organised, with public meetings at each site and webinars
- ASN **consults the public before each of its decisions**
- In all, the ASN carries out public involvement activities specific to the review every year.

■ For the specific phase: a **public enquiry** (1 month) is held for each reactor

CONSIDERATION OF THE OBSERVATIONS RECEIVED

➤ ASN took the public's expectations and question into consideration:



✓ by making sure that the subjects raised had indeed been examined



✓ by modifying or clarifying some of the requirements of its resolutions



✓ by posting on its website a synthesis of the public's comments and contributions which accompany its resolutions, and by publishing educational documents to answer the main questions



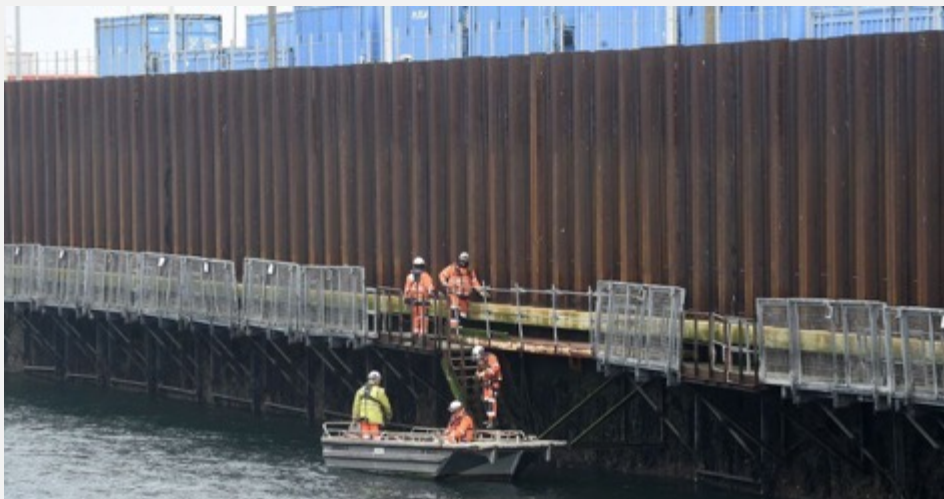
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4TH PERIODIC SAFETY REVIEW

- The 4th PSR corresponds to the **40 years** of the reactors:
 - 40 years correspond to the period taken into account for the design of some of the components
- ASN decided that during the 4th PSR **EDF must bring the safety level of its reactors close to that of generation III reactors**
- In 2021, ASN took a position on the conditions for the continued operation of the 32 units of 900 MWe

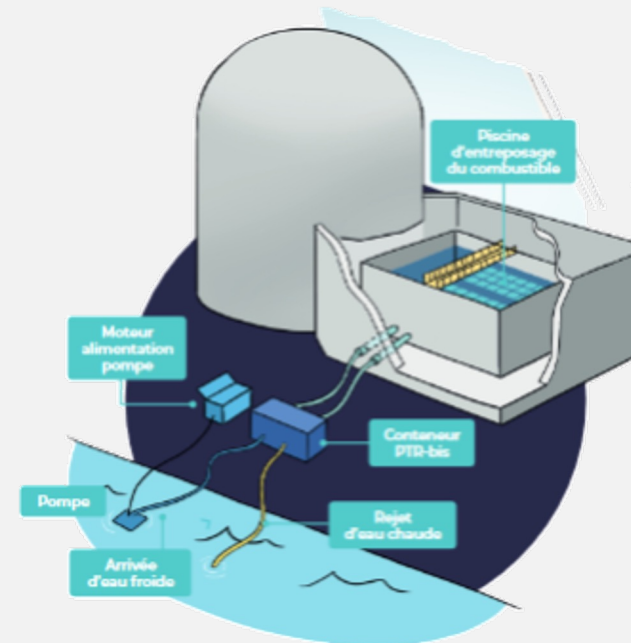
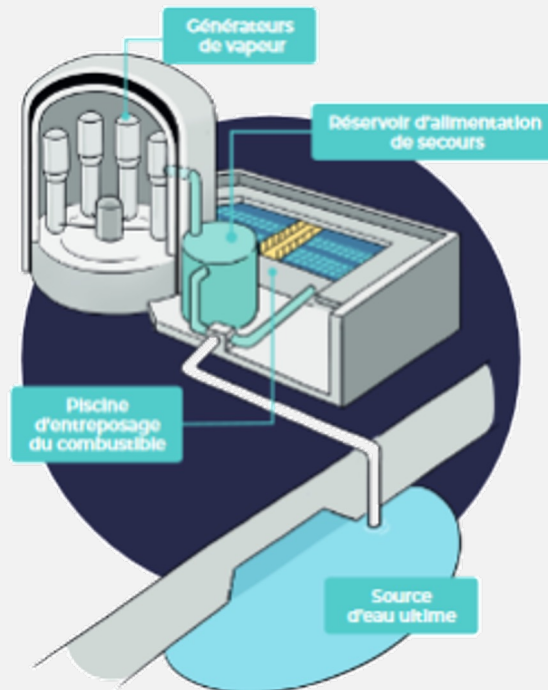
4TH PERIODIC SAFETY REVIEW OF 900 MWE REACTORS

- **4th PSR will bring the level of safety of the 900 MWe reactors close to that of the most recent reactors, in particular:**
 - By **checking**, across a broad perimeter, **the conformity** of the reactors with the safety rules that apply to them
 - By **improving the way hazards** are taken into account. The reactors will also be able to cope with more severe hazards than those hitherto considered
- ➔ **New provisions to counter natural hazards of extreme intensity** (earthquake, flood, tornado...)



4TH PERIODIC SAFETY REVIEW OF 900 MWE REACTORS

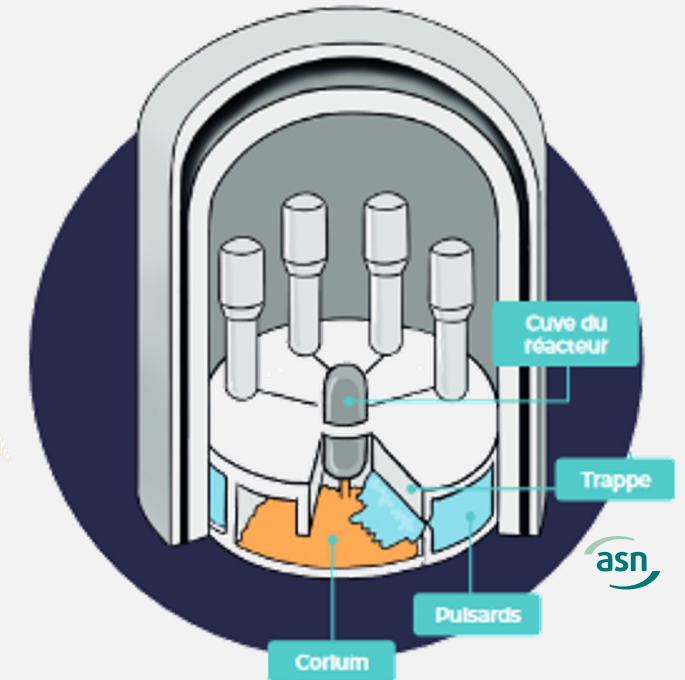
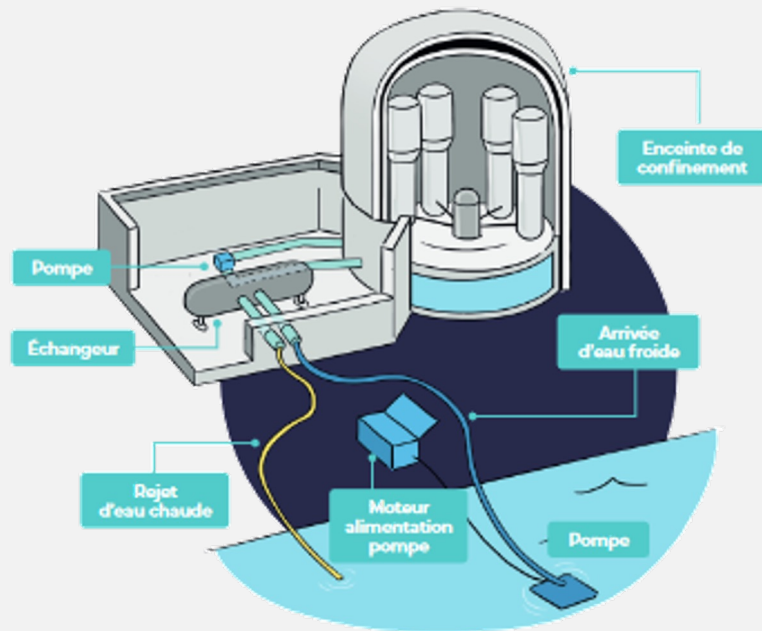
- By **limiting the radiological consequences** of the accidents studied in the safety analysis report. This will significantly reduce the occurrence of situations requiring population protection measures (sheltering, evacuation, ingestion of iodine)
 - By **improving the provisions** for managing accident situations affecting **spent fuel pools**
- ➔ **New water make-up and complementary pool cooling systems**



4th PERIODIC SAFETY REVIEW OF 900 MWE REACTORS

- By reducing the risk of an accident with core melt and mitigating the consequences of this type of accident:
 - ✓ by minimising situations which would require depressurisation of the containment
 - ✓ by reducing the risks of containment basement melt-through by the corium

➔ New containment-cooling system for cooling the corium





1. LTO OVERVIEW IN FRANCE
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3. **LTO UP TO AND BEYOND 60 YEARS**

FRENCH ENERGY POLICY

- **The French energy policy context has recently changed:**
 - Whereas a few years ago, the government wanted to close 14 reactors by 2035, discussions are now focusing on the operation extension of the nuclear fleet beyond 60 years
 - So far, ASN has only taken a position on an operation extension to 50 years for the first model of reactors (32 reactors of 900 MWe). At this stage, EDF has only defined its guidelines for operation beyond 50 years
- **The 10-year horizon of periodic safety reviews is too short in relation to the predictability needed to define energy policy in France and plan for future production resources**
 - **ASN has therefore launched a preliminary assessment on the long term operation of reactors up to and beyond 60 years.**
 - This preliminary assessment addresses the major technical issues identified.

LONG TERM OPERATION UP TO AND BEYOND 60 YEARS

- **ASN has identified the following technical issues to be investigated:**
 - Reactor pressure vessel – radiation-induced embrittlement
 - Cast stainless steel components in the main primary circuit – thermal aging leading to a decrease in fracture toughness and risk of failure in some transient operating conditions
 - Reactor vessel internals – wear and radiation-induced ageing
 - Containment performance – loss of prestressing due to drying, swelling of concrete, corrosion of steel (liner and cables)
 - Electrical cables – polymer evolution
 - Reactor cavity – radiation-induced damage in concrete
 - Underground pipes

LONG TERM OPERATION BEYOND 60 YEARS

■ ASN also plans to analyse:

- Extension of the qualification period
- Ageing and obsolescence management
- Margins in safety studies
- **Climate change - climatic hazards and water resources.**
75% of French reactors are located on riversides.

