**Sophie MOURLON**

ASN - France

# Control & supervision of safety of nuclear pressure equipment

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# Position of the French ASN

**Sophie MOURLON**

**Head of sub-directorate “Nuclear pressure equipment” (BCCN)**

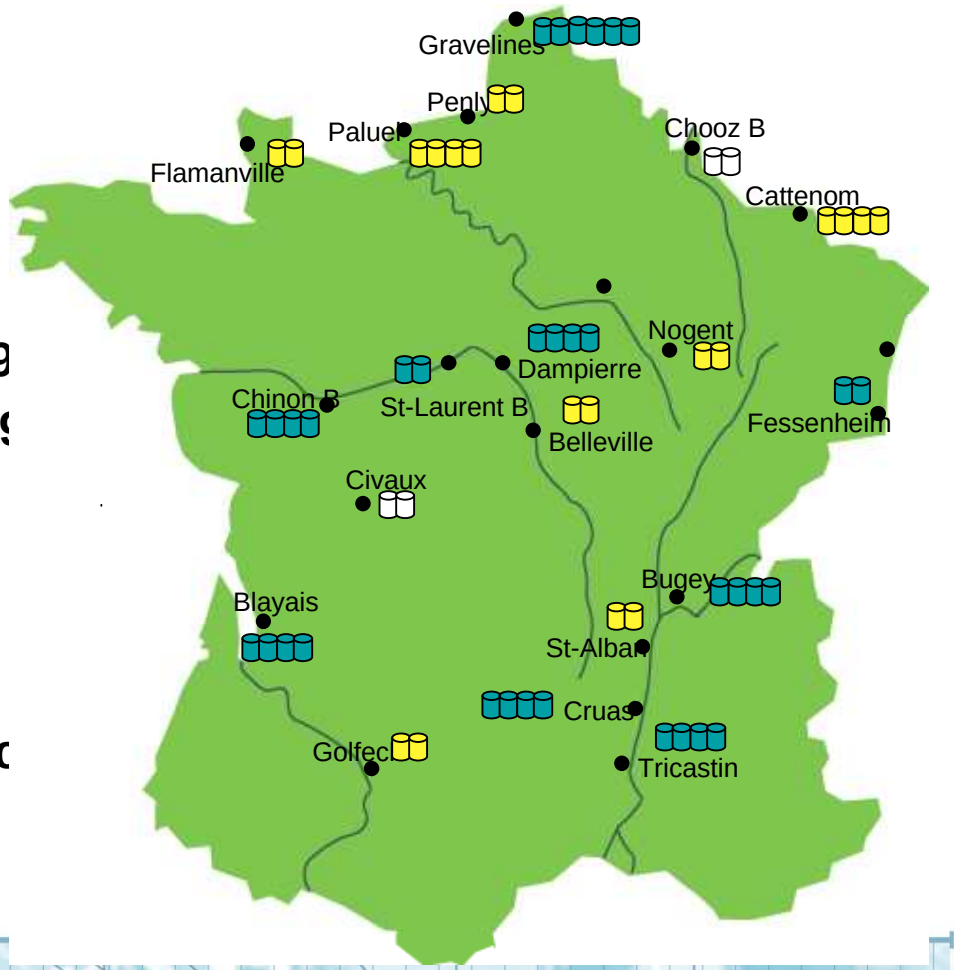
# Ageing issues for nuclear pressure equipment

- **Degradation of mechanical properties of materials:** thermal ageing, irradiation embrittlement...
- **Degradation of equipment:** stress corrosion, fatigue…
- **Loss of skills and know-how:** engineering teams of utilities, manufacturers, sub-contractors…

**=> challenge for safe operating lifetime**

# The French reactors

- 58 PWR reactors
- all similar in design (Framatome)
  - oldest: Fessenheim (19
  - most recent: Civaux (19
- Advantages:
  - feedback experience
- Drawbacks:
  - problems affect all reac
  - … at the same time



# Regulatory approach to ageing management (1)

- **No licensing lifetime**
- **Operator responsible for the safety of the plant**
  - **surveillance in operation**
  - **in-service inspection**
  - **repairs, replacements**
  - **safety demonstration**
- **ASN may:**
  - **require comprehensive review of safety**
  - **stop a reactor if safety is challenged**

# Regulatory approach to ageing management (2)

- **Periodic safety review (PSR)**
  - **every 10 years**
  - **check that safety requirements are still met ➔ *maintain safety***
  - **implement technical improvements on equipment & operation ➔ *improve safety***
  - **program defined by the utility, approved by ASN**

## Regulatory approach to ageing management (3)

# Nuclear pressure equipment

- **Order of November 10th, 1999 for main primary system (MPS) and main secondary systems (MSS)**

- **Defence-in-depth approach:**
  - **design**
  - **surveillance in operation**
  - **maintenance**
  - **feedback experience**

# Design & fabrication

- Materials and their fabrication
- End-of-life mechanical properties
- Prevent fatigue
- Favour in-service inspection

- RCC-M code, « Technical rules for construction »

# Operation (1)

- **Surveillance**
  - monitor relevant parameters (P, T, chemistry,…)
  - transient book keeping

  *check that operating conditions are consistent with design hypothesis*

- **In-service inspection**
  - detect degradations and flaws…
  - …before they challenge integrity...
  - …and before they lead to a leak.

  *check that materials behave as anticipated*

# Operation (2)

- **Ageing surveillance programmes**
  - for each degradation mode
  - approved by ASN
- **In-service inspection**
  - analysis of expected degradations
  - adaptation of NDE to flaws - performance demonstration
  - definition of frequency
  - sample checks
  - feedback experience

# Operation (3)

- **Nature is more imaginative than engineers**
  - ➔ sample checks
  - ➔ hydraulic test every 10 years
  - e.g. Bugey 3 RPV head
  - importance of national / international experience
- **Influence of operation procedures**

# Maintenance

- **Availability of repair techniques and repair equipment**
  - technical skills
  - availability of sub-contractors
  - industrial capacity
- **Repair cracks when detected**
- **Research on replaced elements**

## Regulatory approach to ageing management

# Position of ASN

- **The ASN considers that operation for 30 years is possible**
- **Beyond, a thorough analysis is required:**
  - **condition of the plant / ageing phenomena**
  - **demonstration that operation may proceed safely for 10 more years**
- **The utility submits « operation continuation aptitude cases » (DAPE)**

# Conclusion

- **Ageing management**
  - **good design**
  - **thorough surveillance & in-service inspection**
  - **repair & replace**
- **Anticipate**
  - **experience feedback**
  - **sample checks, hydraulic test**
  - **research, international experience**