



Control of “Time-Dependent Safety” The Role of ASN

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Workshop “Ageing of nuclear power plant: a threat to safety?”
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“Time Dependant Safety” Challenges

- **Ageing**

- Time dependent phenomena can result in degradation of materials and equipments
 - Corrosion, cracking, wear, neutron embrittlement, relaxation of concrete pre-stressing...
- Challenge: maintain compliance with current safety requirements

- **Safety Revaluation**

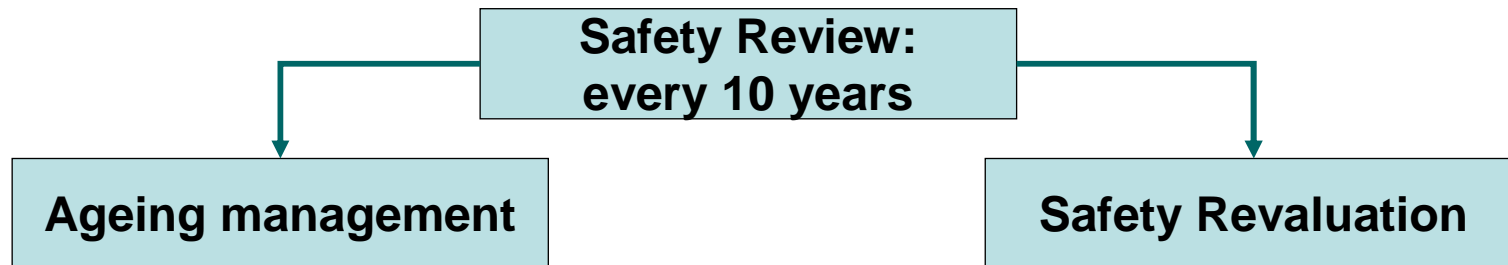
- Safety requirements for new installations are becoming stronger and stronger, increasing the relative safety differences between old and new installations
- Challenge: Enhancing as much as possible the safety of old installations compared to new ones





General Process

- Continuous control for ageing
- Periodic safety review for ageing and revaluation



Update appreciation of **risks and drawbacks** taking into account the **reactor state**

Article L.593-18 of the Environment Code

Update appreciation of **risks and drawbacks** taking into account:

- Operational experience
- New knowledge
- Requirements for new installations





Example of ageing related degradations

- Essential service water pipe



- RPV closure head degradation (Davis Besse)



- Retention of chemical products





ASN Control of Ageing Management Performed by Utility (1)

- **Control of ageing prevention at the design stage**
 - Utility has to prevent ageing from compromising safety
 - Choice of materials and arrangements during the design and fabrication of components
- **Control that adequate surveillance is performed by utility**
 - Utility must check that ageing is consistent with design assumptions (special focus on defects resulting from fabrication)
 - Utility must insure early detection of unexpected degradation mechanisms
 - Maintenance program, periodic testing, in-service inspection
 - Analysis of operating experience
 - Identification of obsolescent material





ASN Control of Ageing Management Performed by Utility (2)

- **Control that necessary repair, modification or replacement of equipment are performed**
 - Utility has to maintain the safety of its installation in spite of ageing
 - Replacement of reactor pressure vessels upper heads (achieved in 2009)
 - Replacement of the most sensitive steam generators before 3rd 10-year outage
 - Utility has to anticipate operations and insure that large programs are compatible with industrial capacity
- **Specific control of non replaceable equipment**
 - Reactor vessel (limit: fracture toughness)
 - Containment building (limit: maximum leak rate)





Role of ASN in the Ageing Management Process

- **Formal introduction of “ageing” initiated by ASN in 2001 as a response to the « lifetime management project » of EDF:**
 - Need of an overall technical ageing diagnosis of each reactor at 30 years
 - 30-year stage (3rd ten-year outages) has to be prepared specifically
- **Specific ASN requests in 2002 for developing a specific approach for ageing management:**
 - Justify that systems, structures and components concerned by one or more ageing mechanisms still comply with their design assumptions
 - Ensure that their safety functions are maintained over time



Safety Revaluation (1)

- **Safety revaluation is part of Periodic Safety Reviews required every 10 years by French law**
- **Reevaluate and improve safety of the installation with regards to:**
 - National and international operating experience
 - Evolution of knowledge (e.g. development of Probabilistic Safety Analysis)
 - Requirements for new installations (seismic hazards, severe accidents,...)





Safety Reevaluation (2)

- **New safety requirements**

- EPR type reactors will be commissioned in France In the coming years
- EPR design aims at achieving significant safety improvements compared to existing reactors (consistent with WENRA objectives for new reactors)
- WENRA objectives for new reactors are used as the reference to require reasonably achievable enhancements for reactors currently in operation





Safety Reevaluation (3)

- **Responsibilities:**

- Regulator: determination of new requirements for further operation of the installation
- Utility:
 - Decision whether cost of enhancement is economically acceptable, or shut down of the plant
 - Proposal of enhancements to be accepted by the Regulator (in case continued operation is the chosen option)

- **Operation beyond 40 years of 900 MWe French reactors**

- Proposed by EDF
- To be assessed (impossible to predict conclusion at this stage)



Improvements of the safety level

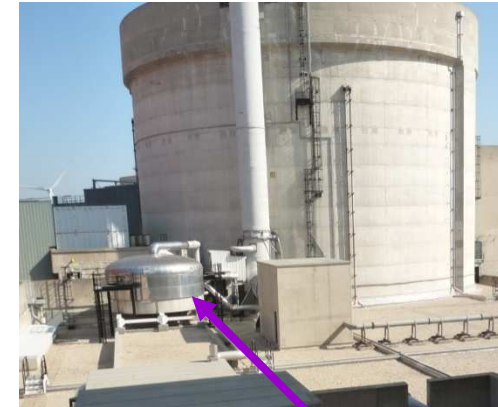
- **Examples of topics reevaluated**

- External flooding (Blayais)



Walls and underground screen

- Severe accident (TMI)



Venting filtration

- Prevention of criticality accidents (Chernobyl)
- Station black out prevention (result of PSA level 1)
- Seismic reinforcements,...





Conclusion

- **Importance of continuous control of ageing**
- **Importance of Periodic Safety Reviews**
 - Ageing management → maintain compliance with current safety requirements
 - Safety Revaluation → enhancement of safety by comparison with requirements applicable to new installations

