LONGLIFE is a collaborative project, which is aimed at:

- improving knowledge of long term operation (LTO) phenomena which determine RPV safe lifetimes of European light water reactors (LWRs)
- assessing the prediction tools, codes and standards applicable to the assessment of RPV integrity for LTO
- developing surveillance guidelines for LTO of RPV base materials and welds

Questions to be answered

- **High neutron fluence behaviour**: Are current trend curves for hardening, embrittlement and evolution of microstructure applicable for long irradiation times?
- **Late blooming effect (LBE)**: In low Cu and high Ni and/or Mn steels, damage clusters containing significant amounts of Ni and Mn are suspected to occur at high fluences, i.e. when a threshold fluence is exceeded. There is evidence for LBEs from thermodynamic calculations and from microstructural investigations. Are LBEs relevant to assessments of RPV safety for LTO conditions?
- **Flux effect**: How does the neutron flux affect the microstructure and the resulting hardening/embrittlement? Are the data obtained from specimens irradiated in materials test reactors under accelerated conditions transferrable to RPV in-service conditions?
- **Parameters governing irradiation embrittlement**: What are the main parameters governing irradiation embrittlement i.e. the role of Cu, Ni, P, Mn, Si and irradiation temperature for conditions of RPV LTO?
- **Effect of LTO on the temperature dependent fracture toughness**: Recent procedures for RPV integrity assessment mostly rely on the fracture toughness Master Curve approach. Is this concept applicable for high fluences?

Partners

- AEKI (Hungary)
- AREVA (Germany)
- CEA (France)
- CIEMAT (Spain)
- CNRS (France)
- EDF (France)
- FZD (Germany)
- JRC-IE (Belgium)
- NRI (Czech Republic)
- Oxford University (UK)
- Ringhals AB (Sweden)
- ROLLS ROYCE (UK)
- SCK-CEN (Belgium)
- SERCO (UK)
- TECNATOM (Spain)
- VTT (Finland)

Illustration of the late blooming effect. In low Cu steels, the irradiation induced defects develop slowly with increasing neutron fluence. Depending on the Ni and/or Mn contents of the steel, the defect formation might be significantly accelerated after exceeding a certain threshold fluence.

Illustration of the flux effect. Size distribution of irradiation induced defects for two different neutron fluxes. The high flux irradiation is representative of material test reactors, while the low flux irradiation represents the in-service conditions of RPVs.

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