NUGENIA
NUclear GENeration II & III Association

SOTERIA

Safe LTO of LWRs based on improved understanding of radiation effects in nuclear structural materials

OBJECTIVES

The overall aim of SOTERIA is to improve the understanding of the ageing phenomena occurring in reactor pressure vessel (RPV) steels and reactor internals in order to ensure safe LTO of existing European NPPs and provide crucial information to regulators and operators. SOTERIA has set up a collaborative research consortium which gathers the main European research centers and industrial partners who combine advanced modelling tools with the exploitation of experimental data to focus on four technical objectives: i) to carry out experiments aiming to explore flux and fluence effects on RPV and internals in PWRs, ii) to assess the residual lifetime of RPV taking into account metallurgical heterogeneities, iii) to assess the effect of the chemical and radiation environment on in internals and iv) to develop modelling tools and provide a single platform integrating developed modelling tools and experimental data for reassessment of structural components during NPPs lifetime. Building on industry-specific key questions and material, SOTERIA fills current gaps in safety assessment related to ageing phenomena, by providing a set of modelling tools directly applicable in an industrial environment. Guidelines for better use of modelling, material testing reactors and surveillance data are also an output of paramount importance. Another important objective is the education of the nuclear engineering and research community about SOTERIA results to improve and harmonise knowledge about NPPs ageing and thereby ensure a high impact of project results. The knowledge and tools generated in SOTERIA will contribute to improving EU nuclear safety policy, to increasing the leadership of the EU in safety related equipment and information and to contribute to improved NPP safety world-wide.

DESCRIPTION OF WORK

Work Packages (WP) 1 and 6 dealing with project management, dissemination, training and exploitation, the scientific and technical work of SOTERIA is carried out in WPs 2-5:

- WP2: Radiation effects on microstructural evolution of RPV & internals under different levels of fluence & flux,
- WP3: Evaluating uncertainties in fracture toughness measurement on irradiated RPV steels and mitigation approaches,
- WP4: Environmental effects on IASCC susceptibility and reactor internals,
- WP5: Development, validation & integration of models to assess RPV and internals under irradiation.

MAIN RESULTS / HIGHLIGHTS

SOTERIA expects to deliver the following results:

- Deeper understanding of initial microstructure heterogeneities effects on fracture models and radiation-induced degradation of reactor internal steels
- Database collecting the results from the experiments carried out in the project (microstructural characterisation such as defects cluster density/size/shape, chemical segregation, or mechanical properties)
- Guidelines on the integration of experimental data in modelling tools
- Models simulating the evolution of the irradiated microstructure and the mechanical behavior, taking into account flux effect to transfer radiation-induced phenomena observed in accelerated irradiation facilities towards structural components during service life
- Modelling platform embedding improved ageing models for reactor structural components,
- Specific industry-adapted version of the modelling platform to support the evaluation of reactor safety margins, assessed in a user environment
- Guidelines for better use of modelling, material testing reactors, and surveillance data in the prediction of radiation-induced ageing phenomena

DURATION

1 September 2015 – 31 August 2019
4 years

PARTNERS

CEA / AMEC FW / AREVA-F / AREVA-G / ARTTIC / CIEMAT / CNRS / CVR / EDF / HZDR / IRSN / JRC / JSI / KTH / PSI / PHIMECA / SCK-CEN / Tecnatom / UJV / UoM / UPC / Vattenfall / VTT / ENSAM

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