FRACTESUS

Fracture mechanics testing of irradiated RPV steels by means of sub-sized specimens

OBJECTIVES

Safety and operability of any nuclear system heavily relies on a defense in depth strategy where the integrity of structural material plays an essential role. Due to material availability and/or irradiation constraints, the use of small sized specimens to obtain reliable measurements of the resistance to fracture is needed by the nuclear industry to comply with the amended Nuclear Safety Directive. Small sized specimen fracture toughness measurement has already been shown to be possible in both unirradiated and irradiated conditions. However, some effort is still required to achieve European regulatory acceptance of this approach by demonstrating its applicability to a suitably large database covering a wide variety of materials and irradiation conditions representative of long-term operation conditions.

The goal of this project is to join European and international efforts to establish the foundation of small specimen fracture toughness validation and demonstration to achieve change in code and standards allowing to address the various national regulatory authority concerns. FRACTESUS is involving in a very early stage regulatory bodies, code and standardization committees, the industry and the international community for the consortium to optimize available resources and expertise.

EXPECTED IMPACTS

The FRACTESUS project will demonstrate the reliability and the enhanced confidence of using small size specimens to measure the fracture resistance of structural (particularly nuclear) materials, providing an innovative method to characterize high-performance materials against critical situations (structural failures). This will allow the European nuclear industry to operate in safer and more efficient conditions, especially in the case of operating Gen II reactors (concerning Long Term Operation (LTO) issues) and future GEN III reactors (at both design and operation stages). Moreover, once demonstrated, the regulatory and standardization bodies will also be able to incorporate this innovation to nuclear regulations, standards and procedures.

The economic impact on the existing European Nuclear Power Plants fleet is evident, as it not only reduces the cost of material characterization in LTO programmes, but it also prevents unexpected situations dealing with structural failures and operational shutdowns.

Moreover, the impact of FRACTESUS is not limited to GEN II and GEN III reactors: GEN IV reactors and nuclear fusion reactors also deal with highly demanding material characterisation and structural integrity programmes, with analogous limitations in terms of material availability as those found in current NPP's. The knowledge developed within FRACTESUS project will be easily applicable to these novel installations.

HIGHLIGHTS

- Development and validation (TRL5->TRL7) of an innovative method using miniature specimens to directly characterise fracture toughness of reactor materials
- Accessibility to direct fracture toughness measurements will definitely increase the safety of operating reactors (old and new technology)
- Better evaluation of residual lifetime of European nuclear reactors on the basis of the technology developed in the project with high confidence will increase safety, efficiency and competitiveness of European nuclear industry

PARTNERS

SCK CEN /NRI/VTT /CEA / IRSN /FRA-G /HZDR /KIT /BZN /EK /KTU /NRG /STUBA /CIEMAT /UC /PSI /NNL /UoB /CCFE /CRIEPI /CNL

DURATION

10/2020 – 09/2024 – 4 years
€ 4 666 061,25

CONTACTS

Technical Project Leader:
Tomasz Brynk (SCK CEN)
Email: tomasz.brynk@sckcen.be

EVENTS

Kick-off Meeting (06-07/10/2020), two FRACTESUS special sessions in relevant international conferences are planned to be organized in the 3rd and 4th year of the project.

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