

NOMAD

Nondestructive Evaluation (NDE) System for the Inspection of Operation-Induced Material Degradation in Nuclear Power Plants

OBJECTIVES

The long-term operation (LTO) of existing nuclear power plants (NPPs) has already been accepted in many countries as a strategic objective to ensure adequate supply of electricity over the coming decades. In order to estimate the remaining useful lifetime of NPP components, LTO requires reliable tools.

The objective of NOMAD is the development, demonstration and validation of a nondestructive evaluation (NDE) tool for the local and volumetric characterisation of the embrittlement in operational reactor pressure vessels (RPVs). In order to address these objectives, the following steps will be taken:

- Development and demonstration of an NDE tool for the characterisation of RPV embrittlement, especially accounting for material heterogeneities and exceeding the existing information from surveillance programmes.
- Extension of the existing database of RPV material degradation by adding correlations of mechanical, microstructural and NDE parameters as well as including quantification of reliability and uncertainty.
- Application of the developed tool to cladded material resembling the actual RPV inspection.

NOMAD takes into account the priorities of reactor operation, responding to stringent safety requirements from regulators, and seeks to foster convergence of nuclear safety approaches. The approach to be developed within NOMAD will deliver information complementary to and exceeding the information obtained by destructive tests of surveillance samples, which are currently assumed to represent the whole component and do not take into account possible local material variations. NOMAD aims to fulfil requirements for nuclear safety in the framework of assessment of lifetime operation. Thereby, it covers the specific challenge and scope of the call: Continually improving safety and reliability of Generation II and III reactors.

DESCRIPTION OF WORK

WP1: Description and delivery of the sample sets (including cladded material) and irradiation conditions, sample provision, microstructure characterization and determination of the mechanical properties

WP2: Non-destructive materials characterization (MC) and evaluation of the progression of the material properties

WP3: Advanced non-destructive evaluation tool for demonstration of materials characterisation

WP4: Application, Validation (Validation = proof of meeting the requirements regarding accuracy and performance; Application = demonstration and optimization of the developed NDE-tool (WP3) under realistic conditions)

WP5: Management, Dissemination & Exploitation

MAIN RESULTS / HIGHLIGHTS

The primary goals of NOMAD are:

- Development and calibration of an extremely important NDE tool for the in-situ inspection of cladded RPV material, which can have microstructure heterogeneities.
- Validation of the surveillance programs with respect to the actual vessel under LTO conditions (equivalence of radiation damage accumulation).

In order to reach these goals, multiple NDE methods will be applied to multiple scales of samples in neutron-irradiated condition. The results will be compared and combined across methods, samples and degradation parameters in order to define a hybrid approach and finally demonstrate it in a modular way. Non-irradiated material with different microstructures will be used for sensor optimisation without radiation hazard

DURATION

1 June 2017 – 31 May 2021

4 years

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