PROCEEDINGS PAPER

INCEFA-SCALE Project – Phase 1 and 2 of Testing Programme

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Abstract:

INCEFA-SCALE is a five-year project supported by the European Commission HORIZON 2020 programme. It is the successor to the INCEFA-PLUS programme that ran from 2015 to 2020. INCEFA-SCALE kicked off in September 2020. The objective is to advance the ability to predict lifetimes of Nuclear Plant components when subjected to Environmental Assisted Fatigue (EAF) loading.

It has been generally observed by nuclear plant operators that there appears to be a disconnect between the perceived difficulty of providing an acceptable assessment result with the current EAF methodologies and the good service experience with regard to this specific degradation mechanism. It is internationally recognised that a possible contributor to this discrepancy is the transferability of laboratory-scale tests to real nuclear components. This is the key knowledge gap addressed by INCEFA-SCALE. To address this gap, the project has identified specific loading, geometric and environmental conditions which are not fully understood and may be considered excessively pessimistically in assessment. The conditions include variable amplitude and multiaxial loading, stress raising features such as notches, and the transferability of results between air and PWR environments, and between specimens with differing surface finishes, under the complex loading scenarios under consideration. Test matrices have been designed to deepen the understanding of specific materials' (stainless steels) fatigue performance under these conditions, and the testing is well underway at the time of writing.

This paper will give an overview of the INCEFA-SCALE testing carried out to date, from the first two one-year phases of the testing programme. The testing and associated analysis has been designed to better understand the material behaviour at the component scale, and assess the applicability of models, developed elsewhere in the project, to predict the lives of these components, which are in turn informed by comprehensive characterisation of the material after failure. The test results are presented in a manner to allow comparison between the experimental fatigue lives and those predicted with standardised assessment procedures, such as NUREG/CR-6909, with comment on how more advanced models (addressed in a different paper), could be used to improve predictions.

Keywords: environmentally assisted fatigue, pressurized water reactor, variable amplitude, features testing, NUREG-6909

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