PROCEEDINGS PAPER

INCEFA-SCALE PROJECT AND INTERNATIONAL FATIGUE DATABASE: RELIABLE AND ROBUST FATIGUE LIFE PREDICTIVE MODELS

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Abstract:

INCEFA-SCALE is a five-year project funded by the European Commission under the HORIZON2020 program. As the successor to the INCEFA-PLUS project (2015–2020), it aims to bridge key gaps between the fatigue behavior of stainless steels observed under controlled laboratory conditions and the actual fatigue behavior encountered in nuclear components during actual operating conditions, providing guidance for improving fatigue assessments and understanding how to better predict material performance over time.

Through these efforts, both INCEFA-PLUS and INCEFA-SCALE have contributed extensively to the creation of a robust database that includes a wide array of influential parameters, such as strain amplitude, strain rate, temperature, surface roughness, hold times, and material chemistry. Upon signing the International Fatigue Database Agreement, this database is further enriched with shared fatigue data from international organizations across the United States, Korea, Japan and Europe.

This work has empowered INCEFA-SCALE members and the global research community to leverage the world's most extensive fatigue database for furthering studies in material durability. However, developing predictive models for fatigue life in environments such as air or light water reactors (LWRs) poses challenges for analysts. The database aggregates data from diverse sources with varied objectives and timespans, making it neither fully homogeneous nor entirely balanced, which complicates analysis and model generation.

In this paper, a description of the fatigue database is provided, along with the different tools and functionalities developed for data analysis. A user-friendly web application has also been developed, offering capabilities for both data visualization and analysis, and enabling the international community to generate and implement new predictive models for fatigue life. Finally, an evaluation of the database and tool expressions for predicting the fatigue life of stainless-steel specimens in air and light water reactor primary coolant conditions is provided. The conclusions and findings extracted from this database and data mining analysis are shown and compared with the current procedures most commonly used in environmental fatigue analyses of nuclear components and systems. This comparison offers an informed perspective on the strengths and the benefits of having an international fatigue database for developing more robust and reliable predictive models for fatigue life of nuclear components and systems.

Keywords: environmentally assisted fatigue, LWR, databases, data mining, predictors

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