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Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials

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Submitter Information

Name: Thomas Metais (EDF)
Address:
12-14 Avenue Antoine Dutriévoz
Villeurbanne, France, 69220
Email: thomas.metais@edf.fr

General Comment

p.5 – Paragraph under equation (12): it seems from former References(1)(2) that σy is the cyclic yield stress.
p. 48 – Figure 32:
1) What do the Data points "Several Heat" correspond to in relation to the data exposed in Table 1?
2) How are the categories of data points arranged together? Based on similar temperature loads, similar specimen type? This affects greatly the statistical analysis performed to obtain the coefficient A and should be clarified.
3) The hypothesis for performing the analysis with the t-distributions is the unbiasedness and the normality of the residuals: was these checked when running the analysis?
p. 49 – First paragraph: from a statistical point of view, it should not be authorized to withdraw a set of data points from the analysis, except if it is based on experimental or physical arguments. What is the reason for withdrawing the set of data pertaining to A216-Gr from the analysis?
p. 59 – "...than the monotonic yield strength of austenitic SSs most commonly used (approximately 303 MPa).": it seems from former References(1)(2) that the value given is the cyclic yield strength of austenitic steels. It is unclear in those References(1)(2) how the value of 303 MPa was obtained, and a more typical value of cyclic yield strength for austenitic stainless steels range from 180 MPa to 250 MPa: could NUREG/CR-6909 clarify this value?
p.98 – Equation 41: the paragraph 4.1.5 concludes on no environmental effect of dissolved oxygen for DO<0.04 ppm which is in contradiction with the equation 41 which gives a value of Fen of up to about 6 for DO<0.04 ppm. This seems inconsistent with the Rev. 0 as well as with the paragraph 4.1.5 of Rev. 1. It is also in direct

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contradiction with the Section 7 – Summary, p. 174, where it is stated "In the present report, the Fen expressions for carbon and low-alloy steels were revised so that the value of Fen was 1 (i.e. no environmental effects) when any one of the threshold conditions was not satisfied".
p.152 – Section 5.5: in the first paragraph, it is stated that the effects of various parameters are not cumulative because the various parameters affect life through the propagation of small cracks. It is then concluded that the parameter with the largest effect is therefore the controlling one. This should be clarified as it seems unclear why cumulating various aggravating parameters would not enhance crack initiation, even though the cracks are of a short size.
p.176 – First paragraph: it is stated that the behavior with complex type loadings is unique to the specific strain loading cycles used in the [AREVA] tests. This loading signal is nevertheless very close to what is experienced on real life components and this should be emphasized in the report rather than calling the results unique.
General comments:
1) The NUREG/CR-6909 document recognizes many detrimental effects in air such as surface finish, size effects, etc... Many of these effects have not been studied in PWR environment and many testing carried out around the world seems to indicate that some effects might be intricately linked to one another (e.g. surface finish and PWR environment as demonstrated by Le Duff et al. (3) and other organizations).
2) NUREG/CR-6909 does not recognize any effect of thermal gradients that may be beneficial on general fatigue life, as indicated in presentations made by Rolls-Royce during the 2013 EPRI Fatigue Workshop held in San Francisco from July 30th – August1st.

(1) Manjoine, M., Tome, R.E., 1983, "Proposed Design Criteria for High Cycle Fatigue of Austenitic Stainless Steel," International Conference on Advances in Life Prediction Methods, D.A. Woodford and J.R. Whithehead, eds, ASME, pp.51 – 57
(2) Jaske, C.E., Mindlin, H., and Perrin, J.S., "Cyclic Stress-Strain Behavior of Two Alloys at High Temperature," Cyclic Stress-Strain Behavior Analysis, Experimentation, and Failure Prediction, ASTM STP 519, American Society for Testing and materials, 1973, pp.13-27
(3) Le Duff J. A., Lefrançois A., Vernot J. P. And Bossu D., 2010, "Effect of Loading Signal Shape and of Surface Finish on the Low Cycle Fatigue Behavior of 304L Stainless Steel in PWR Environment," PVP2010-26027, ASME 2010 Pressure Vessels and Piping Conference, Bellevue, USA