

NRC Staff Assessment of ANP-10326

The transient testing performed by AREVA in ANP-10326 aims to provide a significant step toward improved understanding of the effects of environmentally assisted fatigue under light water reactor (LWR) conditions. [

The results from ANP-10326 attempt to provide a significant improvement in F_{en} determination for transient strain rate beyond the methodology described in NUREG/CR-6909, "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials."]

The staff's review of ANP-10326 and Request for Additional Information (RAI) responses dated October 2013 and May 2015 suggests that the findings and methodology proposed are not sufficiently conservative, and that the RAI responses were insufficient to address the primary focus of the staff's RAIs. The following is the staff's assessment of ANP-10326, including a discussion of the staff's chief concerns.

F_{en} Calculation

The modified strain rate methodology proposed in NUREG/CR-6909 results in conservative F_{en} values. Table 1 (below) provides a comparison between actual F_{en} values, as calculated from ANP-10326's testing results, and those actually proposed in ANP-10326. Columns (A), (B), (C), (D), and (G) of the table are extracted from ANP-10326. Column E lists the fatigue life cycles in air using the equation from NUREG/CR-6909. Actual F_{en} values were calculated using fatigue life cycle in air divided by fatigue life cycles in water and are listed in Column F. The staff notes that the discrepancy between AREVA's F_{en} values (Column G) and the actual F_{en} values (Column F) are significant. The staff also notes that ratio differences in the F_{en} values are not consistent. [

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Test Result Anomalies

Results from the limited in-air test data provided in ANP-10326 for 304L indicate several irreconcilable anomalies. [

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Limited Test Data

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.]]. A conclusion is then drawn []. Furthermore, this data also exhibits high levels of data scatter, which could necessitate additional data points before a meaningful conclusion can be drawn. In its current state, the staff concludes that ANP-10326 lacks the number of test samples needed to demonstrate its intended conclusion on the fatigue life of 304L. []

The staff concludes that while F_{en} values proposed by NUREG/CR-6909 are conservative, removing random conservatism [] to obtain Reduction Factors may not be sufficiently conservative, especially when taken in concert with other anomalies such as excessive data scatter and the very limited number of test samples and cases used to demonstrate acceptability. The methodology provided in ANP-10326, as currently proposed, does not demonstrate a sufficiently conservative approach to provide the requisite confidence needed to accept this fatigue life study and its conclusions.

Table 1

A	B	C	D	E	F	G
ϵ_a (%)	Strain Rate (%/s)	R_t (μm)	N_{25}	N_{air} $N_{air} = \exp(6.891 - 0.192 \cdot \ln(\epsilon - 0.112))$	[]	ANP-10326 TR Fen
[]	[]	[]	[]	6367	[]	[]
[]	[]	[]	[]	4057	[]	[]
[]	[]	[]	[]	4313	[]	[]
[]	[]	[]	[]	4404	[]	[]
[]	[]	[]	[]	4404	[]	[]
[]	[]	[]	[]	4594	[]	[]
[]	[]	[]	[]	4225	[]	[]
[]	[]	[]	[]	4225	[]	[]
[]	[]	[]	[]	27627	[]	[]
[]	[]	[]	[]	27627	[]	[]
[]	[]	[]	[]	4225	[]	[]
[]	[]	[]	[]	27034	[]	[]
[]	[]	[]	[]	4594	[]	[]