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Submitter Information

Name: David Tice
Address:
AMEC
Walton House, Birchwood Park
Warrington, Cheshire, United Kingdom, WA3 6GA
Email: david.tice@amec.com

General Comment

Comments on NUREG/CR-6909 Rev. 1

General comment
This is clearly a very useful update to the original document. However, because it's an update there are a number of confusing statements which arise from retention of text and figures from the earlier version of the report. For example references to the ASME-III air design line in some cases refer to the pre-2009 line and in others to post 2009. This is made clear in some of the figure captions but not all.

In Section 6, several "component-like" tests or tests using transients closer to those in plants are evaluated against the recommended ANL model. The overall conclusion drawn is that the data (with one exception) are consistent (within a factor of 2) with the model predictions and the inference is that the model is applicable to predicting fatigue damage in plant. The exception relates to the so-called stepped pipe test which is the only one of these tests to use thermal loading which produces decreasing through-wall stresses rather than the membrane stresses in the remainder of the tests. The stepped pipe loading is more representative of many (but not all) plant transients. In the report, these tests are dismissed on the basis of

Page 2, penultimate and final paragraphs. It is agreed that a 3mm crack is representative for the typical membrane loaded tensile specimens use to develop the database . It is then stated that this is "assumed to equate to crack initiation in an actual component". It is important that this should not be taken to infer that a cumulative usage factor of 1 corresponds to a 3mm crack in a component, since for many plant transients, the stress field will decrease away from the wetted surface.

Page 5. Should □y be cyclic yield stress?

Pages 6-8 provides a useful overview of occurrences of thermally-induced fatigue damage. Most of the observations have previously been explained without the need to include an environmental enhancement factor, despite the fact that many of the consequential transients referred to occur at strains rates below the threshold for environmental enhancement. Thermal transients of this type will result in substantial through wall stress gradients. This is likely to reduce fatigue damage compared to uniform stress conditions. The application of a Fen factor to an S-N curve based on membrane stressed test data may be excessively conservative for such transients.

Page 37. The final paragraph states that enhancement of fatigue crack growth of Alloy 600 and austenitic stainless steels in LWR environments are similar. This isn't consistent with much recent stainless steel data which shows much higher enhancement than Alloy 600 at longer rise times.

Page 59. A monotonic yield stress of 303MPa seems too high. Surely the fatigue limits relates more closely to the cyclic yield stress?

Pages 68 and 124. The discussion of surface finish effects for stainless steel in air excludes more recent data. Recent data in water are discussed but no attempt is made to determine whether or not effects of surface finish and environment interact – the recommended approach assumes the surface finish "adjustment factor" and Fen are multiplied.

Pages 77/78 and 110. The superseded Rev 0 equations presented here are open to misinterpretation by the reader. Modified equations are presented later but the earlier equations could easily be used in error.

Page 115. The justification for the strain rate threshold of 10%/s is unclear from the plotted data.

Page 141-144. For nickel-based alloys, it is unclear whether the quoted expressions on page 141 or the stainless steel equations in the previous section are preferred.

Page 176. The discussion about fatigue adjustment factors refers to a factor of 10 on life being supported by Monte-Carlo analysis, but a factor of 12 is recommended for use pending further validation with "applicable fatigue □-N data". It is unclear what validation data are required because the existing database is already large. No clear justification of the factor of 2 on stress is provided.