T73S02 Session 22B Homework – LbB

Mentor Guide K&S Questions:-

5.16 Explain the difference between a full Leak-before-Break (LbB) assessment and a "Detectable Leakage" argument.

5.17 Describe the major steps in a full LbB assessment, including the required knowledge about the initial state.

5.18 Explain the relevance of the re-characterisation rules for an LbB assessment, and how these may be modified for leakage rate assessment.

5.19 Describe how the crack opening area is calculated. How might this be affected by: (a) crack shape; (b) welding residual stresses; (c) through-wall bending stresses.

5.20 Describe the methods and computer tools available for calculating the fluid leakage rate through a crack. Distinguish between single phase and two-phase flows.

5.21 State what factors are most significant in estimating the lower bound and upper bound fluid leakage rates. Is a large fluid leakage rate a good thing or a bad thing?

5.22 Discuss how to estimate the length of time for which a leaking crack might remain stable. What key factors might be difficult to quantify?

5.24 Describe the benefits to be gained from a strength mismatch assessment of a weldment and broadly how this is accomplished within the R6 procedure.

5.26 Describe the key steps in a 'proof test' argument.

Numerical/Mathematical Questions:-

A pressure vessel containing CO_2 at 40 barg and 300^{o}C is made of austenitic material of thickness 25mm. It has suffered stress corrosion which has resulted in a through-crack of length 100mm (on both inner and outer surfaces). Calculations based on the known membrane and wall bending stresses have led to estimates of the average crack opening on the inner surface of 0.05mm and on the outer surface 0.35mm. The CO_2 is leaking to the normal atmosphere outside the vessel.

(i) Use the equations of R6 III.11.6.5.1 to estimate the leakage rate in kg/s considering the range of possible friction factors based on the surface roughness advice of R6 Table III.11.5.

(ii) How would the result change if the sign of the wall bending stress was reversed so that the average crack opening on the inner surface became 0.35mm and on the outer surface 0.05mm?

(iii) It has been suggested that the wall bending stress might be in error by ±35%. How sensitive would the calculated leakage rate be to this?