

## T73S06 Session 26 Homework – CMV Weld Rupture Assessment

Last Update: 17/11/14

### Mentor Guide Questions

Provide written answers to questions 3.1 to 3.5 and 4.1 to 4.4.

### Numerical Questions

A CMV pipe contains a butt weld made with 2.25%Cr1%Mo consumable, i.e., a 'standard' CMV weld. The weld used a narrow angle prep,  $<40^\circ$ , and was properly stress relieved. It has operated for 30 years. For the first 15 years it operated at  $532^\circ\text{C}$ , but at  $515^\circ\text{C}$  for the second 15 years. On average the plant operated for 80% of each year. Residual stress and system loads are negligible; the only significant loading is an internal pressure of 160 Barg. The pipe inner and outer diameters are 160mm and 204mm, and the dimensions at the weld can be taken to be the same.

Using the currently recommended methodology and materials data (consulting R66, the User Queries lists, etc., as required) address the following,

- [1] Calculate the (homogeneous) reference stress.
- [2] Calculate the (homogeneous) rupture reference stress.
- [3] Using lower bound rupture data for the parent material, find the MECT. Show that whether the old or new CMV rupture data is used makes a difference to the MECT of  $<0.1^\circ\text{C}$ .
- [4] Is the weld hoop or axial dominated?
- [5] Using the MECT from [3], assess the current life fractions for all weldment zones (weld, coarse HAZ, mixed HAZ, Type IV zone and parent). Note that the word "assess" implies the use of lower bound data, as per usual practice. Note the interim advice regarding the new and old CMV-Type IV rupture data – so the calculations need carrying out for both.

Hint: Use the Session 26 notes (or IMAN#4) to find the redistribution  $k$  factors. Use the prescription given in the Session 26 notes for the  $m$ -factors to use with mixed HAZ (equivalently use User Queries 133 and 153).

- [6] Assuming that future operation will be at the same temperature as the historic MECT, calculate the lower bound remaining life of the weldment. Compare old and new rupture data. Which is the limiting zone?
- [7] The reactor in question has a statutory outage in November 2015, and subsequently every 3 years. At which outage would inspection of this weld be required by TGN043? Contrast old and new data.
- [8] Does the lower bound rupture life reach unity within a 40 year life? If so, what action might be taken as a result?