

Title: Cyclic Fracture Studies on Dissimilar Pipe Girth Weldments at Operating temperature [SSP 36241]

Duration: September 2023 to February 2025

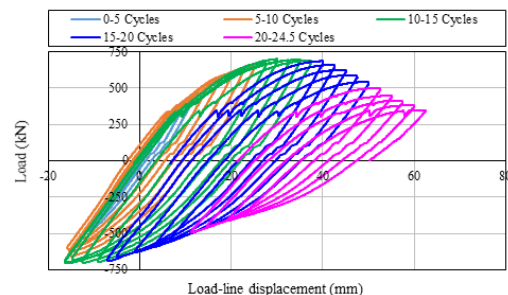
Deliverables: To study the monotonic and cyclic fracture studies on narrow gap/dissimilar pipe girth weldments at operating temperature of 300 °C.

Significant Achievements:

Fracture studies were carried out on six numbers of hot wire [Narrow Groove (NG)] welded and dissimilar metal pipe weld joints of 324 mm nominal outer diameter having circumferential through-wall notch in the centre of the weld. The pipe weld specimens were of 324 mm OD made of SA312 Type 304LN stainless steel / SA508 Grade 3 Class 1 carbon steel. The weld joint had a buttering layer on the low alloy steel portion; the buttering material was Nickel-based alloy (ENiCrFe-3). Subsequent to fatigue pre-cracking, two pipe weld specimens were subjected to monotonic loading and the other four pipe specimens were subjected to cyclic loading. All the fracture tests were carried out at an elevated temperature of 300 °C. The notch portion of the pipe weld was wrapped with heating elements covered with ceramic cloth. Fracture tests under monotonic loading were carried out under displacement control. In the case of cyclic fracture tests, four pipe weld joints were subjected to completely reversed constant amplitude cyclic (triangular waveform) load under load control. The cyclic load values for the two specimens were ± 640 kN, ± 615 kN and ± 550 kN. These values correspond to 80%, 75% and 68.7% of the static load carrying capacity of a similar specimen. One specimen was tested under a combination of load and displacement control. In the case of monotonic fracture tests, the maximum load values were 800.59 kN and 822.97 kN; the corresponding load-line displacement value was 101.42 mm and 131.69 mm. In the case of cyclic fracture tests, the number of cycles to failure of the specimens were 14, 12, 42 and 24.



Set-up for cyclic fracture test under cyclic loading



Load vs. load-line displacement curves under cyclic loading

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