MONTHLY HIGHLIGHTS

for

November 1978

Program: Stress Corrosion Cracking of PWR Steam Generator Tubing

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Testing initiated during the preceding months continued through November as planned. Construction of the circulation systems needed for the controlled chemistry environments is near completion and these experiments will begin near the end of this quarter.

U-bend and C-ring specimens of the tubing materials are continuing in test at 290°C, 325°C, 345°C and 365°C. There are now five heats of tubing which have cracked intergranularly at both 365°C and 345°C. Although the activation energy cannot be calculated with any degree of certainty until cracking occurs at the low temperatures, the results from the 365°C and 345°C test give an activation energy of approximately 33,000 cal/mal for the production tubing that has a carbon content of .03% to .05%. The special low carbon (.01%) tubing seems to have a lower activation energy. Both heats of this low carbon material have cracked at the two higher temperatures with very good correlation of failure times. This low carbon material, because of its somewhat longer time to failure compared to the production tubing, is being used in all tests designed to accelerate cracking, since it allows a margin for evaluating any reduction in failure time.

It was reported earlier that the constant extension rate tests at 365°C and 345°C showed a greater ductility and slower crack initiation as the temperature is lowered. A specimen tested at 325°C, with the same strain rate of $\sim 3 \times 10^{-7}$ sec^{-1}, confirmed this trend, and showed greater ductility and very shallow I.G.S.C.C. Since crack initiation is much slower at the lower temperatures, a test is now underway at 325°C with a strain rate of 10^{-8} sec^{-1}, in order to try and find out if a lower strain rate is responsible for service failures that have occurred at 290°C.

The constant deflection test, which was designed to stress a series of C-rings to a known level and give exact time to failure, has had some difficulties during the first tests. The design of the specimens and apparatus has been modified and the test restarted. This is an unforeseen delay in the experiments at known stress, and amounts to about 1 month or 6 weeks.

Controlled potential tests of a series of U-bends in a LiOH - H_3BO_3 solution is continuing. Cracking has now been established at 40, 80, 120 and 160 mv negative to the corrosion potential. The only specimens which have not cracked are at the corrosion potential and 200 mv negative.

Cyclic load tests in 365°C de-ionized H_2O using a sinusoidal wave form and a load range in tension of either 90% to 110% or 110% to 130% of the yield strength at 365°C have caused cracking. The frequency of 10^{-2} Hz or 10^{-3} Hz did not change the time to failure of the specimens even though the specimens exposed at the higher frequency received 10 times the number of cycles. These tests are also continuing.

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