INTERIM REPORT

Accession No._____

Contract Program or Project Title: Stress Corrosion Cracking of PWR Steam Generator Tubing

Subject of this Document: Monthly Highlights for May, 1980

Type of Document: Monthly Highlights

Author(s): T. Bulischeck and D. van Rooyen
Corrosion Science Group
Department of Nuclear Energy
Brookhaven National Laboratory

Date of Document: June 17, 1980

Responsible NRC Individual and NRC Office or Division: Dr. Joseph Muscara
Metallurgy & Materials Branch
Division of Reactor Safety Research
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Brookhaven National Laboratory
Upton, New York 11973
Associated Universities, Inc.
for the
U.S. Department of Energy

Prepared for
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under Interagency Agreement DE-AC02-76CH00016
FIN A-3208

MONTHLY HIGHLIGHTS

for

May 1980

Program: Stress Corrosion Cracking of PWR Steam Generator Tubing

Principal Investigator: D. van Rooyen

Reactor Safety Programs
Department of Nuclear Energy
Brookhaven National Laboratory
Upton, New York 11973

*Work carried out under the auspices of the U.S. Nuclear Regulatory Commission

MONTHLY HIGHLIGHTS

for

May, 1980

RSR Program - Stress Corrosion Cracking of PWR Steam Generator Tubing

T. Bulischeck and D. van Rooyen

Efforts are continuing to provide experimental data which will be applied to a predictive model for estimating the service life of steam generator tubing exposed to normal service conditions or abnormal conditions such as denting. The current status of the experimental program is as follows:

Efforts are continuing to provide experimental data which will be applied to a predictive model for estimating the service life of steam generator tubing exposed to normal service conditions or abnormal conditions such as denting. The current status of the experimental program is as follows:

1. Constant Deflection Tests

The following tests are currently in progress:

1. pure water at 325°C with 76 weeks exposure
2. pure water at 290°C with 103 weeks exposure
3. simulated AVT at 325°C with 14 weeks exposure
4. pure water at 365°C with 2 weeks exposure

Data other than previously reported is not available for tests #1 thru #3 at this time. Test #4 contains thermally treated materials which were not exposed in the previous test at this temperature and specimens of susceptible materials with localized dents of 5, 10 and 40 mils.

The localized dent specimens are constructed by inserting a 2" section of steam generator tubing into a 1" thick carbon steel block which has essentially 0 clearance with the tube outer wall. The dents are formed by a screw which forces a steel ball into the side of the tubing. These specimens will provide a correlation between dent size and crack initiation time for materials being studied in this program for comparison with field results.

2. Constant Extension Rate Tests

The effect of cold work on crack propagation rates is being explored by testing material that has 40% cold reduction, 10% cold reduction, minimal reduction but rolled flat from tube sections or in the as received condition. Most of the previously reported studies were carried out using material that had been carefully rolled flat from tube sections. Data received from several recent tests indicate that the activation energy for material tested in the "as received" condition is the same as that of the flat material, however, the k value in the model equation does shift. Crack velocities for the fiat sections are approximately twice that of the material without any cold work. Since the activation energy is unchanged, a few high temperature tests will determine the crack propagation rates at the lower temperatures for the materials without any cold work.

3. Constant Stress Tests

Tensile specimens from heat #2 (.05c) have been exposed to pure deaerated water at 365°C for 3 months. Stress levels of 140%, 150% or 160% of the yield strength have not produced any failures during this time. Since U-bends of this material failed in the same environment in less than two weeks, this tubing may be more susceptible to hoop stresses or complex stress patterns. It is felt that this is a point worth exploring, and a specimen cut from a tranverse section of the tubing will be placed in this test.

4. Cyclic Stress Tests

Data previously reported showed that varying the frequency of the applied load from 0 Hz to 10^{-1}, 10^{-2} or 10^{-3} Hz did not have any effect on the failure times of the specimen and several recent tests have confirmed this point. These tests also show that with maintaining all other parameters, but decreasing the load range from 110% - 130% to 90% - 110% increased the failure time from 192 hours to 556 hours. This rapid failure for a relatively low stress level emphases the detrimental effect of dynamic stresses since highly stresses U-bend specimens of this material requires four times this exposure period to produce SCC in the same environment.

June 17, 1980

Distribution List

L.S. Tong, NRC
C.Z. Serpan, Jr., NRC
J. Muscara, NRC
W.Y. Kato, BNL
U.S. NRC PDR (2 copies)
P. Wu