ENCLOSURE

HARTSVILLE NUCLEAR PLANT UNIT A1
CRACKS IN RPV SHIELD WALL
NCR HNP-A-091
REPORT NO. 2 (INTERIM)

On March 14, 1980, TVA informed NRC-OIE Inspector, R. W. Wright, of a potentially reportable condition under 10 CFR 50.55(e) regarding cracks in the reactor pressure vessel (RPV) shield wall structure supplied by Industrial Engineering Works (IEW), Trenton, New Jersey. This is the second interim report on this deficiency. TVA anticipates transmitting the next report on or before October 3, 1980.

Description of Deficiency

During fabrication of the RPV shield wall, it was discovered that there are base metal cracks in the RPV shield wall inner shell plates. Three cracks have been found, each approximately 18 inches in length. A portion of the base metal with a crack in it was removed by flame cutting and sent to Singleton Materials Engineering Laboratory (SME) for metallurgical testing. TVA removed the weld backing strip for the stiffener plate located at this position by arc-air gouging to allow evaluation of the stiffener weld penetration.

Evaluation of fracture surfaces revealed that the crack initiated at the toe of a tack weld bead of the backing strip. Scanning electron microscopy (SEM) of the crack surface exhibited a classical transgranular cleavage pattern. Slag and oxides due the effects of thermal removal of the backing strip obscured microstructural details of the initiation mechanism.

Charpy V-notch impact tests were conducted in the base metal regions. Orientation of the specimen and notch created fracture surfaces parallel to the observed crack. At low temperature values, a brittle mode of crack propagation is indicated. Ambient thermal stresses superimposed on residual welding, and possibly stresses due to straightening, would have been sufficient to propagate an existing crack in this material at low ambient temperatures.

Metallography and hardness testing was not conclusive. At the plate surface where the indicated fracture initiation site exists, the crack propagated primarily through weld metal. This sample displays a typical HAZ (heat affected zone) microstructure which is a transformation product, perhaps tempered martensite or bainite. Hardness measurements gave values that do not indicate a structure of sufficient hardness to be subject the underbead or hydrogen cracking.

Chemical analysis of the ASTM A441 base metal indicates that all product analysis requirements are met. Residual elements included in the analysis are within expected limits except for boron which occurs at a level of 0.0019 percent. The level observed in this element may be significant in welding this heat of steel and in explaining the observed low energy mode of crack propagation in the base metal.

The cause of the cracking was not established. Factors such as the boron content of the base metal, welding stresses, and possibly jacking stresses to correct distortion created during fabrication contributed to the failure. Propagation of the crack was by a brittle transgranular cleavage mode. A horizontal TVA field weld arrested the vertical growth of the crack. No other conclusions could be drawn from the test results.

Corrective Action

TVA and GE/CFBraun are in the process of determining how the RPV shield wall will be repaired and what other corrective action, if any, is required. We will provide additional information in our next report.