BABCOCK AND WILCOX REPORTS BAW-1363 AND 1364

CRACKING AND INDICATIONS IN REACTOR COOLANT PIPING FOR

DUKE POWER OCONEE UNIT 1

Docket No. 50-269

REPORT BAW-1363

The fissures found in the internal cladding of two pipe spools for the subject facility are typical for arc welding of austenitic stainless steel with inadequate control of the welding parameters. The report suggests that the low delta ferrite (assumed high temperature phase) is due to a chromium deficiency in the flux. Chromium addition in the flux is primarily for the purpose of acting as a deoxidizer, and fissuring is generally related to inadequate control of welding variables and the chemical composition of the weld. Since no tests were performed on the cladding material after grinding had removed the fissures, the weld chemistry below this level has not been determined.

however, by applying new cladding over the affected areas B&W has covered these areas with acceptable cladding material.

We find that the steps taken to rectify the cladding deficiency as identified in the B&W report are acceptable.

REPORT BAW-1364

A review of the subject report revealed that the defects in the cladding were the result of a series of manufacturing and processing errors. These were:

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(a) Contamination of the cladding surfaces by iron scale resulting from carbon steel spacer bars used in the heating cycle prior to the hot-forming operation.

(b) Pressing of these undetected contaminants into the cladding surface during hot-forming.

(c) The use of strong acidic type etchants, (i.e., Strauss Solution), to identify the areas of contamination.

The cladding procedure for pipe elbows is the Dupont DETACLAD, or explosion bonding, process. The type 304 stainless steel plate material is applied prior to hot-forming followed by quench and temper treatments, and the postweld stress relief after the elbow halves have been welded together. The cladding is subsequently sensitized wrought stainless steel material.

The indications, or fissures, found in two of the elbows can be traced to an accelerated stress corrosion attack because of the exposure to etchants and nitric acid solutions. In addition, a dilute Strauss solution has been used on some of the elbows to identify iron surface contamination in contact areas. These procedures have since been abandoned. The report indicates that the cladding was cooled slowly from about 1900^{o} which is the solution heat treatment temperature and also the hot-formings temperature; but omission is made of the temperature excursions to quenching-tempering and later stress relief temperatures. It can be concluded that any benefits from a solution heat treatment have been lost in the subsequent temperature excursions. Furthermore, no Strauss test has been performed to prove that the cladding material is not severely sensitized.

Because of the uncertainties with respect to the degree of sensitization present, we recommend that inservice inspection for pipe elbows be extended to include nondestructive examination of the cladding and its bond to the base metal. This augmented inspection should be performed within 4" bands adjacent to the welds in these elbows.

The examination should be conducted prior to plant startup and during at least the first two refueling outages. If no evidence of stress corrosion attack is observed during these inspections, the examination frequency may revert to the schedule specified in the ASME Inservice Inspection Code Section XI.