TENNESSEE VALLEY AUTHORITY
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January 9, 1985

BLRD-50-438/83-23

U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Dear Mr. O'Reilly:

BELLEFONTE NUCLEAR PLANT UNIT 1 - WELDS ON BAFFLE PLATES IN CORE SUPPORT ASSEMBLY BY BABCOCK & WILCOX - BLRD-50-438/83-23 - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector P. E. Fredrickson on March 2, 1983 in accordance with 10 CFR 50.55(e) as NCR 2267. This was followed by our reports dated March 30 and October 5, 1983 and February 17, 1984. Enclosed is our final report. We consider 10 CFR Part 21 applicable to this deficiency.

If you have any questions concerning this matter, please get in touch with R. H. Shell at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

E. McCloud for

J. W. Hufham, Manager
Licensing and Regulations

Enclosure
cc (Enclosure):
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ENCLOSURE

BELLEFONTE NUCLEAR PLANT UNIT 1
WELDS ON BAFFLE PLATES IN CORE SUPPORT ASSEMBLY BY BABCOCK AND WILCOX
10 CFR 50.55(e)
BLRD-50-438/83-23
NCR 2267
FINAL REPORT

Description of Deficiency

While performing onsite modifications to the unit 1 reactor internals (Babcock and Wilcox (B&W) field change package 194), defects were noticed in 12 of 20 wide baffle plates adjacent to the narrow baffle plates being modified. Former bolts are used to hold the baffle plates together. Nine of the twelve affected baffle plates have 24 bolts each and the other three have 48 bolts each, for a total of 360 bolts. The former bolts are prevented from backing out by the use of locking pins, which are secured by tack welding each end to its baffle plate. At 26 of the 360 locations, tack welds were found to be cracked. One of the 26 locking pins had cracked tack welds at each end. Additionally, three pins were welded to bolts, there was a lack of fusion indication on one pin, and one pin had a tungsten inclusion. The apparent cause of these defects is poor workmanship during fabrication at B&W of Lynchburg, Virginia.

Safety Implications

The locking pins perform no structural function, and there is a minimal side force applied on the pins since the pressure differential across the plates is only about 2 lb/in^2. Thus, a crack at one end of a locking pin should not be of concern as one weld will hold the pin in place. However, in a fueled core, if both ends of the pin have broken welds and if the bolt backs out, the bolt could cause spacer grid damage or damage to no more than two fuel pins. The bolt cannot back completely out of its hole and become a loose part, but the locking pin could be a loose part inside the reactor. Therefore, these defects could have adversely affected the safe operation of the plant had they remained uncorrected.

Corrective Action

Preliminary inspection and mapping of the unit 1 baffle plate to former bolt joints were performed shortly after the discovery of cracked locking pin welds. In addition to cracked welds, the inspection revealed defects such as porosity, inclusions, lack of fusion, and undersized welds. B&W's laboratory analysis of three cracked weld samples showed that the cracked welds were made with Inconel 600 filler metal instead of the required stainless steel 308L. Five 308L welds were analyzed and no evidence of cracks was found.

Shop records show that the Bellefonte Nuclear Plant (BLN) unit 1 core basket lock pin welds were made during the same time period and in the same shop bay as that for another job which utilized 1/16" Inconel 600 weld rod. The 308L weld rod being used for the BLN lock pin welds was also 1/16". It is

hypothesized that several pieces of the Inconel rod were inadvertently used on the BLN unit 1 core basket. The unit 2 internals were examined visually and with an alloy separator and no reportable indications were found. B&W also conducted a visual inspection of internals' locking pins on other contracts fabricated during the same general period as BLN units 1 and 2. No Inconel welds were found. Thus, B&W believes that inadvertent use of filler wire in lieu of stainless steel was an isolated incident affecting only BLN unit 1.

An inspection of all other locking device weld applications in the unit 1 core basket was performed to identify all defects. The attached table shows the results of this inspection (i.e., the number and types of defects and the disposition). All rework on these welds has been completed.

B&W has determined that the cause of the defective flow distributor to lower grid bolt locking pin welds (item 10 of the attachment) and the core barrel to former bolt locking pin welds (item 11 of the attachment) was a design error. The drawing requirement for 1/16" fillet weld over 180° of the lockpin diameter for the welds proved to be unachievable due to the lack of diametrical clearance in the counter bores. New drawing requirements (i.e., 1/16" fillet weld over less than 180° of the lockpin diameter) are addressed in B&W field change package (FCP) 256.

The cause of the other defects was improper welding practice and inadequate inspection by welding supervision during fabrication, and B&W shop processes now require a shop inspector rather than a weld inspector to sign off on acceptability of locking welds of this nature. B&W believes that the procedures now in use in the B&W shop are satisfactory to preclude defects similar to those identified in this deficiency.

ATTACHMENT

SUMMARY OF CORRECTIVE ACTION FOR NCR 2267, REVISION 2

Joint Identification	Number of Bolts	No. of Bolts With Defective Welds	Defects No.	Type	Disposition
1. Upper grid pad mounting screws	444	307	48	Partial Crack	A
			19	Partial Crack	B
			3	Solidification Crack	A
NOTE: All defects identified as corrosion, spatter, welds not 180° apart, and arc strike are acceptable as is.			2	Lack of Fusion	A
			1	Pin Hole	A
			1	Filler Metal Wire	C
			35	Insufficient Weld	A
			14	Insufficient Weld	D
			1	Insufficient Weld	B
2. Lower grid pad mounting screws	444	352	71	Lack of Fusion	A
			6	Lack of Fusion	B
			5	Insufficient Weld	A
			1	Insufficient Weld	D
NOTE: All defects identified as spatter are acceptable as is.			2	Tungsten Inclusion	A
			1	Partial Crack	A
			2	Crack	A
3. Column weldment flange to upper grid	356				E
4. Upper grid to plenum cylinder	56				E
5. Plenum cylinder to plenum cover	70	34	9	Washing	B
			3	Crator Crack	A*
			2	Tungsten Inclusion	B
NOTE: All defects identified as arc strike, corrosion, and overlap are acceptable as is.			1	Lack of Fusion	B
			4	Loss of Gas	B
			1	Linear Indication	B
6. Rod guide caps to plenum cover	162	71	5	Crack	F
			10	Crator Crack	F
			2	Pin Hole	F
NOTE: All defects identified as unacceptable contour, welds not 180° apart, overlap, arc strike, spatter, corrosion, and undercut are acceptable as is.			11	Lack of Fusion	F
			7	Linear Indication	G
			1	Underfilled	D
			3	No Bolt	H

*Reinspection showed previously noted crator cracks do not exist.

Joint Identification	Quantity of Bolts	No. of Bolts With Defective Welds	Defects No.	Type	Disposition
7. Vent assembly mounting screws	64				E
8. Baffle to former bolts	576		36	Through Cracks	H
			35	Partial Cracks	A
			2	Crator	B
			4	Porosity	B
			3	Tungsten Inclusion	B
			144	Insufficient Weld	D
			27	Lack of Fusion	B
Note: All defects identified as weld metal on bolt, weld spans bolt, minor melting of bolt, sloping out, overlap, arc strike, corrosion, splatter, undercut, and unacceptable contour are acceptable as-is.					
9. Support post to lower grid	52	51	5	Lack of Fusion	B
			7	Insufficient Weld	D
			4	Loss of Gas	B
NOTE: All defects identified as bolt head welded, arc strike, overlap, corrosion, and unacceptable contour are acceptable as is.					
10. Flow distributor to lower grid	134	134	65	Lack of Fusion	B
			3	Crack	B
			2	Linear Indication	J
NOTE: All defects identified as failure to meet drawing requirements are acceptable as is.					
11. Former to core barrel	992	992	153	Lack of Fusion	B
			1	Pin Hole	B
			13	Crack	B
NOTE: All defects identified as arc strike, overlap, undercut, spatter, corrosion, span crack, span lack of fusion, unacceptable contour, and not welded per drawing are acceptable as is.			5	Crator Crack	B
			1	Crack in Pinhole	B
			11	Linear Indication	J
			19	Low Fillet	D
			1	Loss of Gas	B
			4	Tungsten Inclusion	B
			1	Pin Protrudes	A
			1	Pin Too Short	A
			1	Weld Metal Protrudes Out of Counterbore	A
12. Brazement set screws	243	50	1	Crator Pin Hole	A
			1	Crack	B
			3	Weld Length Short	A
NOTE: All defects identified as undercut, overlap, arc strike, need brushing, bad contour, and welds not 180° apart are acceptable as is.					

13.	Brazement positioning dowel pins	81	16	2	Insufficient Weld	A
				5	Lack of Fusion	A
				4	Crack	A
				1	Crack	D

NOTE: All defects identified as spatter, unacceptable contour, welds not 180° apart, and overlap are acceptable as is.

Dispositions

A. Acceptable as is.

B. Grind out defect and add filler metal.

C. Remove as much free metal wire as possible, then leave weld as is.

D. Add filler metal.

E. These A286 bolts are being replaced with Inconel X750 HTH bolts. See NCR BLN NEB 8413.

F. Add weld adjacent to but not touching defective weld.

G. If crack, add weld metal. Otherwise, accept as is.

H. Replace bolt.

J. If crack, grind out defect and add filler metal. Otherwise, accept as is.