6/19/71

MR JOHN DAVIS - DIRECTOR
A.E.C. REGION II COMPLIANCE OFFICE
SUITE 818
230 PEACHTREE ST, NORTH EAST
ATLANTA, GA 30303

DEAR MR DAVIS

DUE TO THE CURRENT WESTERN UNION STRIKE WE ARE UNABLE TO SEND A TELEGRAM TO COMPLY WITH DPR-23 TECHNICAL SPECIFICATION 6.6.1.C. WE HOPE YOU ACCEPT THIS HANDWRITTEN LETTER AS A SUBSTITUTE.

A LEAK HAS BEEN DETECTED IN A STEAM GENERATOR. THIS FALLS UNDER ABNORMAL OCCURRENCE DEFINITION 1.8.e. THE PROBLEM IS BEING INVESTIGA[TED] BY OUR CONTRACTORS & IT HAS BEEN FOU[ND] THAT THE LEAK IS DUE TO CRACKING OF THE TUBE SEAL WELDS AT THE TUBE SHEET DUE TO A SEPARATION OF THE INCO[NEL] CLADDING FROM THE TUBE SHEET. THIS SEPARATION HAS BEEN FOUND IN TWO

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Exhibit C
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STEAM GENERATORS. WE ARE PROCEEDING WITH REPAIRS.

MR. DON KIRKPATRICK OF YOUR STAFF HAS BEEN KEPT FULLY INFORMED FROM THE TIME WE FIRST SUSPECTED THE LEAK. A DETAILED REPORT WILL FOLLOW WHEN AVAILABLE.

YOURS TRULY

Guy P. Beatty

Supt. H. B. Robinson Pl[illegible]

June 25, 1971
Dr. Stanley Weiss
4841 North Oakland
Milwaukee, Wisconsin 53217

Mr. William C. Seidle
Senior Reactor Inspector
U. S. Atomic Energy Commission
Division of Compliance-Region II
230 Peachtree Street, N. W.
Suite 818
Atlanta, Georgia 30303

Dear Mr. Seidle:

In reference to Report No. DC 89, "Inspection of Leaks and Cracks in the (A) Steam Generator at H. B. Robinson II," June 23, 1971, I would like to offer the following opinions and recommendations:

(1) Westinghouse is primarily placing the blame for this leakage and cracking problem on the inadequacy and reliability problems associated with the explosion bonding cladding process. There is justification in placing high suspicion on this process. Experience has indicated that inconsistent bond integrity has been obtained on large, relatively complicated parts. For example, bond adhesion problems might be expected to localize in the central and outer edge portions of a component such as the steam generator. Although the basic principles and potential of this process have merit, the application of the process to various components often presents considerable practical difficulties.

The process dates back to the late 1950's and early 1960's and, is generally based on the Cowan, G. R., Douglass, J. J., and Holtzman, A. H., U. S. Patent No. 3,137,937 issued June 3, 1964 and assigned to E. I. du Pont de Nemours and Co. A typical cladding arrangement, as well as the basic operating principles are illustrated in Figure 1. After the explosive is detonated, the prime metal is accelerated very rapidly to a high velocity (V_p) by the detonation pressure. As the detonation front (D) moves across the plate, an angle is established between its undeflected and deflected portions. When the deflected portion of the prime metal collides with the backer plate, the region of high-pressure collision moves across the plates at high speed. This velocity (V_c) equals the detonation

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velocity for the illustrated situation. Ahead of the collision region in each plate, high pressures cause surfaces of both metals to flow plastically into the space between the plates.

The jet which forms acts to remove surface films of oxides and of other materials normally detrimental to bonding. At the same time, the clean metal surfaces are subjected to high pressures in the collision region causing plastic deformation. The metals supposedly come into interatomic contact with each other, establishing a metallurgical bond.

Furthermore, difficulties have been experienced in the past in arriving at destructive testing techniques which result in obtaining reliable bond strength information.

Based on this failure and past experiences of manufacturers of large vessels, it is recommended that past and intended future application of this process be thoroughly reviewed.

(2) It is the writers opinion that the following factors contributed to this failure:

(a) Marginal clad bond integrity resulting from the explosive cladding process.
(b) High residual stresses resulting from welding of the divider plate to the clad tube sheet. These stresses probably further deteriorated the clad bonded interface and initiated separation.
(c) Operating and applied stresses then may have led to propagation of the clad bond separation resulting in failure and leakage.

(3) Undoubtedly boric acid solutions and residues have, by capillary action, penetrated up the sides of the tubing and along the propagating cladding cracks. At ordinary temperatures, 75^{o}F, the boric acid solution is only slightly acidic, reflecting the weak ionization of the borate ion. The corrosivity of the solution at this temperature toward ordinary system materials, e.g., stainless steels, inconel is insignificant and can be disregarded. However, the existing condition can present problems because of the contact which has been made with the underlaying forged steel tube sheet and the potential of higher temperatures. Also, aereated boric acid solutions resulted in significantly higher rates

of corrosion as compared to deaereated boric acid solutions.

It is recommended that efforts be undertaken to analyze the potential hazards of this condition and the difficulties associated with eliminating the condition.

(4) It is recommended that the stress analysis currently being performed by Westinghouse be submitted, as soon as possible, for review by an independent, outside consultant (e. g., Parameter, Inc.).

(5) It is the opinion of the writer that generic aspects of this problem exist. Evidence of this has already occurred at the Robinson II site where two out of three steam generators already exhibit the problem. Furthermore, as a result of our conversations, it was indicated that the problem is imminent at other sites.

(6) The following observations opinions and recommendations are offered regarding the Westinghouse proposed repair procedure:

(a) The removal of defective areas should be performed in a careful and planned manner so as to enable a rigorous fracture analysis.
(b) Although the repair completion was estimated as one month, it is believed that this estimate is overly optimistic. The man hours required and working conditions imposed will probably result in a multiplication factor of 1 1/2 to 2 times the estimate.
(c) No mention was made in the procedure of methods or attempts for removing the trapped boric acid solutions.
(d) Detailed "in-process" and "final" inspection procedures were not described. Obviously far more than just the code requirements will be necessary for this repair. Mention was made of a secondary hydrotest as a check for leaks.
(e) Westinghouse is arranging to subcontract the localized stress relieving operation (Cooper Heat was mentioned). They will attempt to accomplish a localized heat treatment of the deposited repair cladding by designing and building equipment capable of heating the area of interest to $1000^{\circ}F$. Westinghouse claims wide experience in accomplishing this type of weld stress relieve. This localized stress relief will result in high thermal gradients and stresses. Efforts

should be made to determine beforehand the effects this operation will have on the surrounding hardware (e. g. , remaining explosion bonded interfaces, metallurgical effects in the thermal gradient region, etc.).

Very truly yours,

Stanley Weiss

Dr. Stanley Weiss

cc: DC-89 file
S. Weiss
Lett. Comm "A" file

Fig. 1—In bonding, the explosive and prime metal are placed together and spaced slightly away from the backing metal. When the explosive is detonated, the prime metal collides with the backer. Jetting, which takes place ahead of the collision, acts to clean the joint zone. V_p indicates prime metal velocity, V_c collision velocity, and D detonation front.