

Attachment A  
POINT BEACH UNIT 2  
STEAM GENERATOR TUBE DEGRADATION  
SAFETY EVALUATION REPORT  
MATERIALS ENGINEERING BRANCH  
INSERVICE INSPECTION SECTION

BACKGROUND

On the evening of February 27, 1980, a primary to secondary leak developed in steam generator A at Point Beach Unit 2. The leak rate was approximately 1400 gallons per day (gpd) when the unit was removed from service. The unit's technical specification leak rate limit is 500 gpd.

Results of the ensuing steam generator inspection were submitted in Licensee Event Report (LER) 80-2 dated February 29, 1980 as subsequently updated on March 12, April 16, and May 16, 1980. Additional information was submitted by letter dated April 25, 1980 in response to specific questions raised by the staff. Preliminary results from a metallurgical examination of a tube specimen removed from Unit 2 during the April 1980 refueling outage were submitted by letter dated May 9, 1980.

DISCUSSION

Inspections performed subsequent to the shutdown on February 27, 1980 revealed one leaking tube located in Row 18, Column 37. The leak was through a defect located within the tubesheet, approximately nine inches from the primary (bottom) face of the tubesheet. Eddy current testing (ECT) of both steam generators was performed to the requirements of the technical Specifications using the multi-frequency technique. The inspection of steam generator A was expanded to a 100% inspection based upon the finding of a significant number of new defect

8006090 834

indications in excess of the 40% plugging limit. Besides the leaker, however, no additional ECT indications were observed within the thickness of the tubesheet in either steam generator. A summary of the inspections performed and results obtained for tubes which were plugged is given in Table 1.

Approximately 280 tubes were found with greater than 20% indications at the top of the tubesheet. Of these, 32 tubes contained defect indications equal to or greater than 39%, as noted in Table 1, and were plugged. The "top of tubesheet" indications were separated from the tubesheet entry signal using multifrequency techniques. The recent development of the multifrequency technique, which was used for the first time on Unit 2 during the March 1980 inspection, permits much better discrimination of low amplitude indications from the tubesheet entry signal. The licensee has reviewed the results of previous inspections, which were performed using the single frequency (400 KHZ) technique, for tubes with "top of tubesheet" indications equal to or greater than 39% and found that the majority of these indications were recorded previously as either distorted tubesheet signals or less than 20% indications. In some cases, they were not characterized as abnormal signals. For two tubes, R20-C47 and R21-C64, defect indications generally larger than 20% had been noted in previous inspections dating back to 1974, with a 30% indication observed in both tubes during the March 1979 single frequency inspection. The March 1980 multifrequency inspection identified these two (2) tubes to contain a 39% and 46% indication, respectively.

To establish whether the top of the tubesheet indications had been present in previous inspections, the 400 KHZ eddy current tapes for previous inspections,

TABLE 1  
POINT BEACH UNIT 2 EDDY CURRENT INSPECTION RESULTS

		No. of Tube Inspected	Eddy Current Indications	Elevation
S.G. A	Hot Leg	(100%)	1 leaker (R18-C37) 9 tubes - 39% 17 tubes - 40-49% 6 tubes - 50-59% 1 tube - 43%	** } Top of Tubesheet First Support Plate
	Cold Leg	~120 (3.6%)	0	
S.G. B	Hot Leg	~717 (22%)	0	-
	Cold Leg	~678 (21%)	1 tube - 41%	~1½" Above Tubesheet

\*\*Leaker is located approximately 9 inches above the tube end (inside tubesheet)

dating back as early as 1974, were reviewed and compared to the 400 KHZ signal from the 1980 multifrequency inspection for tubes with 39% indications or greater in 1980. These comparisons were submitted, at the request of the staff, in the LER 80-002/01T-2 dated May 16, 1980. The licensee has concluded on the basis of these comparisons that the majority of the (distorted) tubesheet entry signals for those tubes having been previously inspected were unchanged with respect to the 1980 400 KHZ signal. It was also concluded that the majority of these top of tubesheet defect indications have been present, but undetectable, in previous (single frequency) eddy current inspections.

The staff review of the 400 KHZ comparison data submitted by the licensee indicates that the 400 KHZ signals for 19 of 26 tubes inspected in 1977 or after (including R20-C47 and R21-C64), were unchanged relative to the March 1980 400 KHZ signals. The 400 KHZ signals for 13 of 27 tubes (including R20-C47) inspected in either 1974 or 1976 are unchanged relative to the March 1980 400 KHZ signals. Five of the 32 tubes found in 1980 to contain 39% indications or greater at the top of the tubesheet had not been previously inspected.

In excess of 200 tubes have been identified in previous inspections with indications at or above the top of the tubesheet, including at least two (2) defects identified at the first support plate. The great majority of these tubes containing ECT indications of 30% or smaller have occurred in steam generator B, whereas both steam generators have experienced a comparable number of indications greater than 30%. Prior to March 1980, 19 tubes in steam

generator A and 17 tubes in steam generator B containing defects at or above the tubesheet had been plugged.

The licensee's Annual Results and Data Report for 1979 indicated that 30 of 32 defect indications observed in steam generator A (hot leg) during the previous March 1979 inspection occurred within one inch at or above the tubesheet.

The fact that some defects at the top of the tubesheet were identified with single frequency ECT suggests that they were of sufficient volume to produce an identifiable signal against the background of the tubesheet entry signal. The use of multifrequency ECT during the March 1980 inspection has permitted more accurate quantification of these top of the tubesheet indications.

The licensee reported that the previously observed indications at and above the top of the tubesheet were essentially unchanged during the March 1980 inspection. A detailed comparison, given in Table 2, was submitted showing some fluctuation, both positive and negative, in these indications between inspections, but which in the evaluation of the staff are fully consistent with the scatter we would normally expect for eddy current error. As noted in Table 1, one tube in steam generator B, located  $1\frac{1}{2}$  inches above the tubesheet, was found to contain a 41% indication which slightly exceeded the 40% plugging limit.

Although the tube plugging limit in the Point Beach Unit 2 Technical Specifications is 40%, all of the tubes shown in Table 1 were plugged during the March 1980 repair outage except for two of the tubes containing 39% indications at the top of the tubesheet. These latter tubes were left unplugged on the hot leg side in anticipation of possibly removing these tubes during the scheduled April 1980

TABLE 2  
COMPARISON OF 1979 AND 1980 EDDY CURRENT RESULTS  
POINT BEACH NUCLEAR PLANT, UNIT 2

	1979	1980				
	<20%	Still <20%	No Defect Detected		Increased <10%	Increased 10-20%
"A" SG Inlet	21	10	10		0	1
"A" SG Outlet	14	9	5		0	0
"B" SG Inlet	10*	2	2		4	1
"B" SG Outlet	133	127	2		4	0
	20-29%	Same ±3%	No Defect Detected	Decreased >3%	Increased 3-10%	Increased 10-20%
"A" SG Inlet	5	1	0	3	0	1
"A" SG Outlet	1	0	0	1	0	0
"B" SG Inlet	3	1	1	0	0	1
"B" SG Outlet	92	66	0	18	7	1
	30-39%	Same ±3%	No Defect Detected	Decreased >3%	Increased 3-10%	Increased 10-20%
"A" SG Inlet	6	1	0	2	2	1
"A" SG Outlet	1	0	0	1	0	0
"B" SG Inlet	3	3	0	0	0	0
"B" SG Outlet	5	1	0	4	0	0

\*One tube not inspected.

outage. The licensee later decided not to remove these tubes and these two tubes were explosively plugged during the April outage.

Tube R18-C37, which contained the leaking defect in the tubesheet, was mechanically plugged on the inlet side (and explosively plugged on the outlet side) during the March 1980 outage. This tube was removed during the April outage for metallurgical examination and analysis.

#### PRELIMINARY RESULTS - METALLURGICAL EXAMINATION

The tube sample removed from Unit 2 during the April 1980 outage is presently being subjected to detailed metallurgical examination and evaluation. The licensee submitted the preliminary findings by letter dated May 9, 1980. Metallographic examination of a longitudinal sample extending 3/4 inch above and below the top of the tubesheet indicated no intergranular attack or corrosion. A transverse cross-section taken 16 inches below the top of the tubesheet (where the leak occurred) exhibited a through-wall stress corrosion crack plus some associated intergranular attack. Localized areas of intergranular attack (ranging from 2 to 30 mils) and associated cracks were observed at other areas around the circumference of the sample. A transverse cross section taken approximately 10 inches below the top of the tubesheet also exhibited localized intergranular attack (10 to 30 mils) and associated cracking. The licensee has also reported that radiographs for a tube section running through the thickness of the tubesheet showed a cracklike indication running from 3 inches below to 18 inches below the top of the tubesheet.

The licensee plans to submit its final report on this evaluation in four to six weeks.

#### EVALUATION

Eddy current testing of the Point Beach Unit 2 steam generators were performed to the levels required by the Technical Specifications using the state-of-the-art multifrequency technique. The inspection sample included 100% of the steam generator A tubes as dictated by the finding of a significant number of new defect indications, including one deep crevice indication in the leaking tube



and indications equal to or greater than 39% near the top of the tubesheet. In addition, the leaking tube from steam generator B, containing the deep crevice indication, has been removed for laboratory examination and analysis. Based upon our review of the inspection performed and the results obtained, we find that the inspection was adequate to establish the condition of the steam generators.

Deep crevice cracking at Point Beach Unit 2 is clearly at an early stage compared to two other domestic operating units where dozens of such deep crevice indications have been found and compared to Point Beach Unit 1 where hundreds of such indications have been observed. Preliminary results of the laboratory examination of the removed tube specimen from Unit 2 confirm that the condition of intergranular attack in the tube containing the deep crevice defect does not extend above the top of the tubesheet. This is consistent with the findings for tube specimens removed from Unit 1. The staff will continue its review of the laboratory results as they become available.

The staff position regarding the safety significance of the deep crevice phenomenon was set forth in detail in our safety evaluation issued in support of the November 30, 1979 Confirmatory Order for Point Beach Unit 1. In view of the low level of current deep crevice cracking activity at Unit 2, we do not recommend at this time imposing any of the additional operating restrictions (e.g., tighter limits on primary to secondary leakage, more frequent inspections) which were imposed on Point Beach Unit 1.

With regards to the approximately 280 indications at the top of the tubesheet the licensee has reevaluated the eddy current tapes from previous inspections

for those tubes containing 39% indications or greater. Based upon the results of this reevaluation, we believe that the majority of the top of tubesheet indications have been present in previous eddy current inspections dating back to the period 1974 to 1977. The region within a few inches of the tubesheet has been the scene of observed wastage and/or cracking activity dating back to this period. Based upon our review of the data presented in Table 2 and the recent plugging history at this unit, we have concluded that the defects in this region are in a generally stable condition, i.e., they are not developing at a significant rate. Thus, we conclude that the finding of 280 top of tubesheet indications, including 32 with indications above, or just slightly below the 40% plugging limit not to be indicative of a new or highly active corrosion mechanism at the top of the tubesheet. We also conclude that the finding of these indications can be attributed to the enhanced capability of multifrequency ECT, relative to previously employed single frequency ECT, to discriminate defect signals from the tubesheet entry signal.

On the basis of the above evaluation we find that the Point Beach Unit 2 steam generators have been adequately inspected, and that the condition of the steam generators is adequate to provide reasonable assurance of continued safe operation.

## ATTACHMENT B

### § 2.206 RESPONSE TO THE MARCH 13, 1980 PETITION FILED WISCONSIN'S ENVIRONMENTAL DECADE REGARDING STEAM GENERATOR TUBE DEGRADATION AT POINT BEACH UNIT 2

We have reviewed the March 13, 1980 petition filed by Wisconsin's Environmental Decade which seeks an Order to Show Cause and an Order enjoining the licensee from returning Point Beach Unit 2 to service. As stated in our attached Safety Evaluation (Attachment A), we find that the Unit 2 steam generators have been adequately inspected, and that the condition of the steam generators is adequate to assure continued safe operation.

The Petition cites as background previous filings dated November 14, 1979, November 26, 1979, December 17, 1979, January 8, 1980 and February 8, 1980. These earlier filings address the Petitioner's concerns regarding the consequences of a LOCA coincident with steam generator tube ruptures in light of significant tube degradation which has occurred at Point Beach Unit 1 within the tubesheet crevices and the more recent finding of defects at or slightly above the top of the tubesheet. The substantive issues raised in these filings have previously been addressed in our Safety Evaluations dated November 30, 1979 and April 4, 1980 for Unit 1.

#### Petition Statement

It has previously been believed that no significant tube problem existed in Unit 2.

#### Staff Response

To date, Point Beach Unit 2 has not experienced significant tube degradation compared to many other PWR steam generators including Point Beach Unit 1, nor have any special operating restrictions, such as those at Unit 1, been imposed. The finding of a deep crevice defect during the March 1980 steam

generator inspection, however, certainly suggests the potential for a significant problem in the future.

Unit 2 has previously experienced wastage and stress corrosion cracking at and above the tubesheet affecting well in excess of 200 tubes, of which 36 were plugged. As discussed in the attached SER, we believe these defects to be in a generally stable condition, i.e., they are not developing at a significant rate.

#### Petition Statement

Now the most recent experience at Unit 2 on February 28, 1980 similarly voids any basis for continued operation of that facility as well. On that day, one tube ruptured with a leak rate reported at 1400 gpd and subsequent eddy current test inspections identified 35 other tubes with defects in Unit 2 all of which were above the top of the tubesheet.

#### Staff Response

The 1400 gpd (gallons per day) primary to secondary leak which occurred recently at Unit 2 was a relatively small leak typical of those which have occurred at other PWR units as a result of through wall cracks. The term "rupture" is generally reserved for tube failures involving a sudden and violent opening of the tube generally accompanied by large plastic deformation and high leakage (e.g., fishmouth tube burst). No tube ruptures have occurred at Unit 2 to date, although one did occur at Unit 1 on February 26, 1975 (180,000 gpd) as a result of wastage and stress corrosion cracking above the tubesheet.

The findings of the March 1980 steam generator inspection at Unit 2 are addressed in the attached Safety Evaluation. Deep crevice cracking at Point Beach Unit 2 is clearly at an early stage compared to the situation at Point Beach Unit 1 (and other units), and continued operation can be supported within the justifications developed previously for Unit 1 (see November 30, 1979 SER for Unit 1). Should significant deep crevice cracking activity develop sometime in the future, we would not expect this activity to occur above the top of the tubesheet. This is supported by results of laboratory examinations of five tube samples removed from Point Beach Unit 1 and one sample (containing the deep crevice indication) removed from Unit 2 indicating that the general intergranular attack occurring within the tubesheet does not extend outside of the tubesheet. We consider confinement of deep crevice cracking to within the thickness of the tubesheet to be requisite for plants where this phenomenon is highly active, due to our concern regarding the detectability of deep crevice defects. The need for additional tube removals for laboratory examination will be considered by the staff should the deep crevice cracking phenomenon continue to develop at Unit 2.

As discussed in our attached Safety Evaluation, we have concluded that the finding of approximately 280 indications at the top of the tubesheet, including 32 indications of 39% or greater, is not indicative of a new or highly active corrosion mechanism occurring at or above the tubesheet. This is supported by a reevaluation of eddy current tapes from previous inspections for those tubes containing 39% indications or greater indicating that the majority of these indications have been present in previous inspections dating back to the period 1974 to 1977. The region within a few inches of the tubesheet has been

the scene of wastage and/or stress corrosion cracking activity dating back to this period. We attribute the finding of the top of the tubesheet indications in March 1980 to the enhanced capability of multifrequency ECT to discriminate relatively small amplitude defect signals from the tubesheet entry signal, relative to previously employed single frequency ECT.

Based upon the discussion regarding the issues above raised by the petitioners, we recommend that the petition be denied.