Commonwealth Edison Company
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ComEd

March 27, 1996

U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Document Control Desk

Subject: Additional Information Pertaining to
Braidwood Unit 1 Cycle Length
NRC Docket Number 50-456

Reference: Teleconference between the Nuclear Regulatory Commission and
the Commonwealth Edison Company

Per conversations with your staff, questions were asked pertaining to Byron and Braidwood Circumferential Cracks data and how it relates to Braidwood cycle length. This letter documents the discussions.

If you have any questions, please contact Denise Saccomando (708) 663-7283.

Sincerely,

Marcia T. Lesniak

Marcia T. Lesniak
Nuclear Licensing Administrator

Attachment

cc: H. Miller, RIII
R. Assa, Braidwood Project Manager - NRR
C. Phillips, Senior Resident Inspector - Braidwood
D. Lynch, LaSalle Project Manager - NRR

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1. **To extend the operating interval for Braidwood Unit 1, it was indicated that since all pulled tubes for Byron 1 met Regulatory Guide 1.121 structural criteria, it would be expected that all Braidwood 1 tubes would also meet these structural criteria given the similarities in operating conditions. Given that the pulled tube sample is limited (12 tubes) and the ability to size circumferential indications is limited, discuss the reasons for assuming the pulled tube samples included the most limiting indications from the Byron 1 steam generators.**

A panel of industry experts was assembled to identify tubes to be pulled from the Byron Unit 1 steam generators. One of the objectives was to identify tubes with top of the tubesheet (TTS) circumferential indications which could be used to assess the remaining structural/leakage margin of the tubes. The selection process for tube pull candidates was rigorous in attempting to find the most limiting tube for each selection category in steam generator A (SG A). An array of tubes was selected to assess the eddy current testing's (ECT) characterization of the tube as it relates to structural/leakage integrity. Three tubes were selected for this purpose: the deepest, the largest circumferential extent and largest mixed mode. The results of the metallographic (MET) examination supported these selections: the deepest indication was 100% throughwall, the largest circumferential extent was nearly 360°, and the largest mixed mode was 100% throughwall. The remaining seven tubes were pulled to demonstrate structural integrity and to develop a non-destructive examination sizing technique.

During identification of tube pull candidates a comparison was made of the size of the largest indications in SG A to the largest indications in SG C which were identified as the largest in the remaining three steam generators. The comparison was based upon sizing techniques available at the time (which included profiling the depth of the indication around the circumference of the tube). The comparison indicated that the size of the largest indications in SG A and SG C were comparable.

An evaluation of the TTS circumferential indications (over nine hundred) found in SG B during the Byron Unit 1 midcycle inspection (B1P02) and the 10 tubes pulled from SG A during Byron Unit 1 midcycle outage (B1P02) has been performed by Rockridge Technologies. One of the objectives of the evaluation was to assess the maximum indication depth, circumferential extent and the voltage of the indications. Preliminary results of the evaluation determined that the voltage of the indications from the two pulled tubes at Byron Unit 1 (R23C43 and R24C42), which had the most significant average crack depth (based upon MET results) , are greater than the voltages of the largest indications in SG B. The look back was performed on SG B because it has significantly more indications than the other steam generators. A discussion of the structural significance of voltage is presented under question 2.

Based upon this information it is highly probable that the most limiting tubes were pulled from Byron Unit 1 during B1P02. All the tubes pulled from Byron Unit 1 met the structural requirements. The TTS circumferential degradation at Braidwood Unit 1 is bounded by Byron in both the number of indications and the size of indications. This information supports that Byron Unit 1 bounds Braidwood Unit 1.

2. **It was cited that the eddy current amplitude of all Braidwood 1 circumferential indications were less than the amplitudes of the largest Byron 1 circumferential indications. It was further concluded, based, in part on this observation, that the Braidwood indications were smaller than the Byron tube pull eddy current**

indications. This conclusion assumes that the eddy current amplitude is somewhat related to the structural integrity of the tubes. Provide your basis for this assumption. In addition, since Braidwood 1 only operated for approximately 0.5 EFPY compared to the 0.87 EFPY at Byron, it would be expected that the sizes of the Braidwood 1 indications should be considerably smaller than the sizes at Byron 1 given the differences in operating time. Please address this observation.

Section 8.2 of Reference 1 compares the Byron B1P02 pulled tube with the largest indication to the Braidwood Unit 1 refueling outage (A1R05) tube with the largest indication. In order to compare the indication signal from the two sets of data, the amplitude signal of the roll transition was used as a reference to size and compare the indications. Although absolute sizing of the indications is distorted due to the interference of the signal from the roll transition, a comparison can be performed. Amplitude (volts) provides an indicator of the extent of degradation (material loss) in the TTS area which translates to reduced strength of the tube.

There is evidence that the extent of degradation can be quantified by the amplitude (volts) and is related to the structural integrity of the tubes. The Byron B1P02 tube pulls with the largest axial extent of degradation (R23C43, 0.3" axial band below tube fracture surface; and R24C42, 0.16" axial band below tube fracture surface) were the indications with the largest average crack depth (R23C43, 76%; R24C42, 62%). The amplitude (volts) of these two tubes (based upon preliminary data from the Rockridge Technologies look back evaluation) was the greatest of the tubes pulled, 1.25 volts and 1.17 volts, respectively. This provides evidence that for tubes with significant degradation, amplitude provides an indication of the structural integrity of the tubes. Presently there is not enough data to correlate the voltage of an indication to the burst pressure or leak rate. However, the amplitude does provide a measure of tube wall degradation at the TTS.

The second observation under question 2 addresses the comparison of the Braidwood A1R05 indications to the Byron B1P02 tube pull indications considering the different periods of operation of the two units. ComEd agrees with the observation that the Braidwood A1R05 indications would be expected to be smaller than the Byron B1P02 tube pull indications due to the difference in operating time between the two units. The intent of the discussion in Section 8.2 of Reference 1 is to demonstrate that the degradation at Braidwood Unit 1 is not accelerated when compared to Byron Unit 1 (i.e. the indications at Braidwood Unit 1 had not grown as large as Byron Unit 1's indications in a shorter period of time). Additionally, the look back of the Braidwood Unit 1 indications identified that all were present in some form in the previous A1M05 inspection. This indicates that they had been in service for a period of operation greater than 0.5 EFPY, and had not grown to the size of the Byron Unit 1 tube pull indications.

In summary the Braidwood A1R05 indications were not larger than Byron B1P02 indications and therefore, the operating period to the next inspection for Braidwood Unit 1 should be at least as long as Byron's cycle.

3. **In Section 5.2.1.5, it was indicated that one tube developed a leak of 320 gallons per day in the U-bend section of a tube. Please provide a description of the root cause of the leak including a description of the degradation mechanism.**

A leak occurred during 1993 in steam generator C of Braidwood Unit 1. The leak was caused by an axial crack in a free span region of the U-bend of tube R49C76.

From destructive examinations, it was determined that OD origin, intergranular stress corrosion cracking (IGSCC) occurred at a local deformation on the U-bend of tube R49C76. On the U-bend intrados, a long and narrow, flat surfaced band of reduced tube OD was observed. The origin of the band is judged to be related to the tube fabrication bending operation. The cold leg operational leak crack occurred eight to twelve inches above anit-vibration bar, AVB#4, in this axial band of reduced OD. This area, in which the crack occurred, showed high hardness increases (residual stresses). The corrosion was composed of a simple single axial crack with intersecting short cracks which formed "railroad track" features. The OD origin IGSCC at this location is judged to have been caused by a pure water corrosion mechanism (free span OD corrosion associated with gouges and dings) that was restricted to locations with high residual stress.