



August 20, 1996

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Document Control Desk

Subject: Braidwood Station Unit 1
NRC Docket Number: 50-456

Operating Interval Between Eddy Current Inspections for
Circumferential Indications in the Braidwood Unit 1 Steam
Generators

- References: 1. H. Stanley letter to the Nuclear Regulatory Commission dated August 2, 1996, transmitting Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1, Steam Generator Tubes
2. The Nuclear Regulatory Commission Meeting with the Commonwealth Edison Company dated August 15, 1996, regarding Braidwood Unit 1 Cycle Length Assessment Report

In the Referenced letter, the Commonwealth Edison Company (ComEd) provided the Nuclear Regulatory Commission (NRC) with the, "Braidwood Unit 1 Cycle Length Assessment Report Addendum" which justified operation of the Braidwood Unit 1 for a full cycle prior to steam generator tube inspection. This justification was discussed during the reference meeting between ComEd and the Staff. During this meeting, a section which was not included in the report, the "Conditional Burst Probability" was discussed. The use of the Conditional Burst Probability was recently discussed by the with NEI during an NRC Steam Generator Rule Making Meeting and due to the timeliness of this information it was not transmitted via the Referenced letter, but is attached for your review.

ComEd is looking forward to meeting with the NRC on August 26th to further address any questions that you have concerning the attachment.

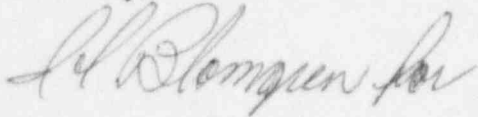
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If you have any questions concerning this correspondence please contact
Denise Saccomando, Senior PWR Licensing Administrator at (630) 663-7283.

Sincerely,



Harold Gene Stanley
Site Vice President
Braidwood Station

Attachment

cc:

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Conditional Burst Probability Assessment Braidwood Unit 1

Conditional Burst Probability

To demonstrate an adequate margin against burst the conditional probability of tube burst (for tubes with flaws at the structural limit) was computed and compared to a criterion that had been proposed by the NRC for generic application to deterministic steam generator tube integrity evaluations. The criterion is stated as, "for a flaw projected to be at the structural limit at next EOC, the associated conditional probability of burst is less than 10^{-4} ."

The probability of tube burst depends on the degradation level in the tube, the tube dimensions, and the tube material resistance to burst, which is proportional to the sum of the yield and ultimate strength, i.e., $(S_y + S_u)$. The relationship between the degradation level and burst pressure is determined by the bounding burst curves shown in Reference 1 Figures 5.5 and 5.6 (burst pressures in these curves have been conservatively reduced to account for Braidwood Unit 1 LTL properties at 650°F). The effect of tube dimensions is determined from the extreme values of the tolerance range for the tube diameter and wall thickness. The values of the mean and standard deviation for the heats of tube material at Braidwood were used to account for the strength property effects, and to assess the conditional probability of burst relative to the main steam line break (MSLB) pressure of 2,560 psi.

The pressure associated with the structural limit, was developed to comply with the margins specified in Regulatory Guide 1.121 and is 4,035 psi. The tolerance ranges for the steam generator tubes at Braidwood are: outer diameter from 0.744 to 0.754 inch, and wall thickness from 0.039 to 0.047 inch. The strength parameter, $(S_y + S_u)$ for the Braidwood specific heats of tube material corrected to 650°F has a mean of 145.62 ksi and a standard deviation of 7.477 ksi.

The following procedure was used to compute the conditional probability of burst (for tubes with flaws at the structural limit). Because the magnitude of the stress in the tube is determined by the ratio of tube radius, R , to wall thickness, t , the extreme values of R/t were determined from the dimensional tolerance to obtain a bounding tolerance effect. The upper bound limit for R/t is

$$R/t = 0.5(0.754 - 0.039)/0.039 = 9.167,$$

and the lower bound limit for R/t is

$$R/t = 0.5(0.744 - 0.047)/0.047 = 7.415.$$

The ratio of the lower to upper bound R/t values was used to adjust the pressure associated with the structural limit, or

$$4,035 \text{ psi} (7.415/9.167) = 3263 \text{ psi}.$$

The pressure of 3263 psi represents the lowest possible burst pressure for a tube in the steam generator relative to the burst pressure in Reference 1 Figures 5.5, and 5.6. The calculation conservatively assumes the 4035 psi structural limit is based upon the lower bound R/t .

The pressure adjusted for the extreme tolerance bound was then divided by the MSLB pressure to determine the margin on the tolerance adjusted pressure to tube burst, or

$$3263/2560 = 1.275.$$

The margin of 1.275 is the minimum or bounding margin in the steam generator relative to the bounding curves Reference 1 Figures 5.5, and 5.6.

The conditional probability of burst per tube was determined by computing the probability that the value of $(S_y + S_u)$ would be low enough to result in tube burst at the MSLB pressure of 2560 psi. The value of $(S_y + S_u)$ that would produce failure at MSLB pressure was determined by dividing the mean $(S_y + S_u)$ by the margin against burst of 1.275, or

$$145.62 \text{ ksi}/1.275 = 114.21 \text{ ksi}.$$

The number of standard deviations needed to have $(S_y + S_u)$ be equal to 114.21 ksi is

$$\# \text{ Std. devs.} = (114.21 - 145.62)/7.477 = -4.2$$

The conditional probability of burst per tube is equal to the probability that the material $(S_y + S_u)$ is -4.2 Std. devs. from the mean, or assuming a normal distribution, the conditional probability of burst per tube is 1.3×10^{-5} . This is considered a conservative bounding value based on using the bounding burst curve and bounding dimensional tolerance.

Because there are fractions of a tube at the structural limit at EOC the conditional probability of burst of the tubes at the structural limit is less than 1.3×10^{-5} , and the criterion of 1×10^{-4} is met.

References: 1. Braidwood Unit 1 Report to U.S. Nuclear Regulatory Commission Dated August 2, 1996, Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1 Steam Generators.