May 11, 2004

Mr. L. William Pearce
Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Post Office Box 4
Shippingport, PA 15077

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1) - REQUEST FOR ADDITIONAL INFORMATION CONCERNING LICENSE AMENDMENT REQUEST - STEAM GENERATOR REPAIR USING ALLOY 800 LEAK-LIMITING SLEEVES (TAC NO. MC1857)

Dear Mr. Pearce:

By letter dated January 27, 2004 (ADAMS Accession No. ML040300696), FirstEnergy Nuclear Operating Company (FENOC) requested a license amendment to modify the BVPS-1 Technical Specifications (TSs) to allow the use of Westinghouse Alloy 800 leak-limiting sleeves to repair defective steam generator tubes as an alternative to plugging the tubes.

The Nuclear Regulatory Commission (NRC) staff has reviewed the FENOC January 27, 2004, proposed TS change and has identified the enclosed request for additional information (RAI) needed to complete its review.

As discussed with and agreed to by your staff, we request your response within 30 days of receipt of this letter, in order for the NRC staff to support your requested review schedule. If you have any questions, please contact me at 301-415-1402.

Sincerely,

/RA/

Timothy G. Colburn, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-334

Enclosure: RAI

cc w/encl: See next page

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ACCESSION NO. ML041270513 *Input provided. No substantive changes made.

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REQUEST FOR ADDITIONAL INFORMATION (RAI)

BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1)

ALLOY 800 LEAK-LIMITING SLEEVE LICENSE AMENDMENT REQUEST

DOCKET NO. 50-334

By letter dated January 27, 2004 (ADAMS Accession No. ML040300696), FirstEnergy Nuclear Operating Company (FENOC, licensee) requested a license amendment to modify the BVPS-1 Technical Specifications (TSs) to allow the use of Westinghouse Alloy 800 leak-limiting sleeves to repair defective steam generator tubes as an alternative to plugging the tubes. The Nuclear Regulatory Commission (NRC) staff has reviewed FENOC's proposed TS change and is aware that the licensee does not expect the Alloy 800 leak-limiting sleeves to be in operation for more than one cycle due to planned replacement of the steam generators following Cycle 17. However, since unscheduled inservice inspections (ISIs) may require the inspection of Alloy 800 leak-limiting sleeve/tube assemblies before the steam generators are replaced, the NRC staff is requesting the following additional information concerning the licensee's proposed ISI requirements.

1. In the BVPS-1 proposed TSs, FENOC refers to the sleeves as both "Alloy 800 leak limiting sleeves" and as "Alloy 800 sleeves." Please modify the BVPS-1 proposed TSs to consistently refer to the sleeves as "Alloy 800 leak limiting sleeves."

2. The proposed TSs are not clear as to the disposition of Alloy 800 leak-limiting sleeves following Cycle 17 operation should the steam generators remain in service. If the proposed footnotes, which state, "Applicable only to Cycle 17," are intended to mean that steam generator tubes sleeved with Alloy 800 leak-limiting sleeves will be plugged before Cycle 18 begins (if the steam generators remain in service), then the footnotes should be clarified. For example: "All tubes with Westinghouse Alloy 800 leak limiting sleeves shall be plugged prior to the beginning of Cycle 18."

3. On page 7 of the enclosure to the submittal, the operational experience of Alloy 800 tubes and sleeves is discussed.

   Describe the operational experience (under any condition including operating conditions) in which Alloy 800 leak-limiting sleeves have leaked. If only sleeves have leaked, describe the conditions under which leakage was observed, and compare the magnitude of the observed leakage to the leakage values provided in WCAP-15919-P, Rev. 0.

4. In proposed TS 4.4.5.2.b.3, it is stated that all inservice Alloy 800 sleeves shall be inspected over the full length using a +Point™ coil or equivalent qualified technique during each refueling outage, and that the inspections would include both the tube and the sleeve.

ENCLOSURE

A. Historically, the NRC staff has not specified an exact technique for performing steam generator tube inspections, since the staff's interpretation of steam generator tube inspection requirements in the TSs in conjunction with Appendix B of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, is that the inspections are to be performed with techniques capable of detecting all flaw types which may potentially be present at the locations that require inspection. The NRC staff acknowledges there are some exceptions, particularly when the technique is important in assessing the severity of the degradation (e.g., the bobbin coil inspections required for implementation of the voltage-based repair criteria). Given that the proposed TSs specifically reference the +Point™ coil for performing the sleeve inspections, discuss the extent to which the +Point™ coil will be able to detect all forms of potential degradation in the sleeve/tube assembly. For example, discuss the effectiveness of the +Point™ coil in detecting 45° circumferential cracks, etc.

B. Clarify that it is FENOC's intent to perform eddy current inspections with equipment and techniques capable of detecting all flaw types which may potentially be present in the pressure boundary of the sleeve/tube assembly (the pressure boundary of the sleeve/tube assembly is discussed in WCAP-15919-P, Rev 0).

5. In proposed TS 4.4.5.4.a.6.d, it is stated that tubes with Alloy 800 leak-limiting sleeves will be plugged upon detection of any service induced imperfection, degradation, or defect in the sleeve and/or pressure boundary portion of the original tube wall in the sleeve/tube assembly. In TS 4.4.5.4.a.1, it is stated that, "... Eddy-current testing indications below 20 percent of the nominal tube wall thickness, if detectable, may be considered as imperfections." As a result, the wording in TS 4.4.5.4.a.1 leaves open the possibility that sleeves with indications up to 20 percent through-wall may not be classified as imperfections, and, therefore, left in service.

   A. If it is FENOC's intent to plug all tubes with indications in the sleeve/tube assembly, upon detection, regardless of indication depth, modify proposed TS 4.4.5.4.a.6.d to indicate so. For example: "All tubes repaired with Westinghouse Alloy 800 leak limiting sleeves shall be plugged upon detection of imperfections in the (a) sleeve and/or (b) pressure boundary portion of the original tube wall in the sleeve/tube assembly (i.e., the sleeve-to-tube joint). In the case of Westinghouse Alloy 800 leak limiting sleeve/tube assemblies, an imperfection is considered to include all eddy-current indications that are less than 20 percent of the nominal sleeve wall thickness."

   B. If it is not FENOC's intent to plug all tubes with indications in the sleeve/tube assembly, upon detection, regardless of indication depth, provide the technical basis for this defacto 20-percent plugging limit. In the RAI response, describe the testing programs used in determining the growth rate and nondestructive examination uncertainty used in the determination of this plugging limit.

6. Since both the WCAP report and FENOC response to the RAI questions reflect the technical basis for FENOC's license amendment request, discuss any plans for including references to FENOC's RAI responses in the TSs. For example, the

expression "... as clarified by letter dated ...." could be added to the appropriate locations in the TSs to refer to the RAI response letter.

Questions on Westinghouse Report WCAP-15919-P Rev. 0, August 2003 (for 7/8-in. sleeves)

7. On page 4-3, Section 4.3 (Sleeve/Tube Assembly), it is stated that an installed Westinghouse Alloy 800 leak-limiting sleeve may be re-rolled (for a rolled joint) or re-expanded (for a hydraulically expanded joint), if the sleeve does not meet the minimum requirements.

   A. Discuss in detail the sleeve installation steps necessary to minimize the need to perform re-rolls or re-expansions.

   B. On page 1-1, of Section 1.1 (Purpose), it is stated that tube plugs will be installed if a sleeve installation is unsuccessful or if there is degradation in the pressure boundary section of the sleeve or sleeved tube. List and discuss the installation conditions that would lead to a conclusion that the sleeve installation was unsuccessful.

   C. Discuss the limits on the number of re-rolls and re-expansions that can be applied to a sleeve. Discuss whether the cold work loads generated by the re-roll or re-expansion affect the structural integrity of the sleeve/tube assembly.

8. Discuss whether a pre-installation inspection, using a technique capable of detecting all potentially present flaw types, is performed on the parent tube at the locations where the sleeve joints are to be established to verify that these areas are free of degradation. If these inspections are not to be performed at all locations where sleeve joints will be installed, provide a technical basis.

9. On pages 4-6 and 4-7, of Section 4.5.6 (Nondestructive Examination), the WCAP-15919-P, Rev. 0, report, does not include any reference to visual examination of the tube inside diameter (ID) after installation of the sleeve was deleted. This visual examination is performed, in part, to verify that the conditioning process was successfully performed.

   Discuss how the successful completion of the conditioning process will be verified without visual examination of the tube ID after installation of the sleeve.

10. On page 5-2, of Section 5.1 (Background), it is stated that flaw detection capability was demonstrated for flaws $\geq$50% through-wall for the parent tube and $\geq$45% for the sleeve, based on cracking, in order to provide an operational margin between the detection limit and the structural limit for defect growth.

    Given that one of the possible sleeve degradation mechanisms is wall thinning, discuss what the structural limit is for sleeve wall thinning and whether the techniques to be used during the inspections are qualified to detect degradation at or below the wall thinning structural limit.

11. On page 5-2, of Section 5.1 (Background), the inspection detection capability for the sleeve and tube was discussed.

A. Clarify whether the eddy-current techniques intended for inspection of the sleeve/tube assembly are qualified to detect cracks that may by present, given the sleeve/tube configuration. Discuss the basis which shows that flaws can be reliably detected, given the sleeve/tube configuration. Discuss the number of sleeve/tube samples having stress corrosion cracking (SCC) flaws and the inspection results for these samples.

B. With regard to transition zone (TZ) sleeves, discuss the number of flaws situated in the portion of the parent tube that is adjacent to (i.e., behind) the sleeve's nickel band. Discuss (1) the size and location of these cracks; (2) the orientation of these cracks; (3) the effectiveness of the eddy current inspection method in detecting these cracks; and (4) if the eddy current technique is not effective at detecting these cracks, discuss which method will be used for this inspection and the technical basis for this method.

C. With regard to TZ sleeves, if there were no flaws situated in the parent tube behind the nickel band, provide a methodology (and technical basis) for addressing the structural and leakage integrity for the TZ sleeve/tube assembly, assuming that degradation (e.g., a 360°, 100% through-wall circumferential flaw) could be occurring in the portion of the tube that is adjacent to (i.e., behind) the sleeve's nickel band.

12. On page 6-2, of Section 6.2.1 (Primary Side Performance), it is stated that, "Some oxygen will initially be present within the sleeve/tube crevice, however any tendency to trap oxygen will be reduced with this design because of joint leakage at lower temperatures. Based on this, oxygen-rich crevice conditions are not considered to last long enough after startup to be of concern." This statement implies that there could be a path for oxygen or corrosive impurities to enter and exit the crevice/annulus between the sleeve and tube joint during heat-up and cooldown of the plant. Oxygen may not be trapped, but the impurities may be trapped in the annulus.

    Discuss whether there is a potential corrosion problem as a result of trapping corrosive materials in the crevice. Discuss whether these deposits could degrade the performance of the sleeve/tube assembly.

13. On pages 7-11 and 7-12, of Section 7.3.2 (Leak Test Evaluation), the assessment of leakage under post accident conditions is discussed.

    Provide your plant-specific limit for accident-induced primary-to-secondary leakage.

14. On page 8-19, of Section 8.3.3 (Effect of Tube Prestress Prior to Sleeving), the stress state of a locked-in tube is discussed.

    Clarify whether sleeve installation would add additional residual stresses to a locked-in tube, causing the tube to exceed the allowable stresses in the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code).

15. On page 8-25, of Table 8-4 (Tube Sleeve Expansion Section - Transients Considered for a Westinghouse “44", “44F”, or “51" Steam Generator), verify that the number of transient cycles in the licensee’s design basis is bounded by the number of applied transient cycles in the table.

16. On pages 8-27 to 8-32, of Section 8.51 (Analysis of Sleeve Material), higher thermal stresses were calculated for various transient conditions for the 7/8-in. sleeve/tube assembly than for the 3/4-in. sleeve/tube assembly. For example (per Table 8-5C for Westinghouse “51" steam generators), after a postulated reactor trip, the calculated value for skin thermal stresses was higher for the 7/8-in. sleeve/tube than for the 3/4-in sleeve/tube (see pages 8-38 and 8-39 of WCAP-15918-P, Rev. 0 (Nov. 2002)). From this data, the calculated maximum stress intensity ranges (Sxr) were calculated to be higher for the 7/8-in. sleeve/tube than for the 3/4-in. sleeve/tube (Westinghouse plants).

    Noting that the staff recognizes that Sxr for both the 7/8-in. and 3/4-in. sleeve/tube configurations is within the ASME allowable, discuss the reason and significance of the higher value for Sxr for the 7/8-in. sleeve/tube configuration.

17. On page 8-36, Table 8-8C (Accumulated Fatigue in Sleeve Material for Spxr [maximum peak stress intensity ranges] Peak Stress Range for Westinghouse “51" Steam Generator), the accumulated fatigue in the sleeve material for Spxr peak stress range for 7/8-in. sleeves was many times higher than that for 3/4-in. sleeves (see pages 8-50 and 8-51 of WCAP-15918-P, Rev. 0 (Nov. 2002)).

    Noting that the staff recognizes that the accumulated fatigue value for both 7/8-in. and 3/4-in. sleeves in Westinghouse steam generators is within the ASME allowable, discuss the reason and significance of the higher value for accumulated fatigue for the 7/8-in. sleeves.

Beaver Valley Power Station, Unit Nos. 1 and 2

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