May 16, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of		
CAROLINA POWER & LIGHT COMPANY AND NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY	Docket Nos.	50-400 OL 50-401 OL
(Shearon Harris Nuclear Power Plant, Units 1 and 2)		

APPLICANTS' MOTION FOR PARTIAL SUMMARY DISPOSITION OF JOINT CONTENTION VII (STEAM GENERATORS)

Carolina Power & Light Company and North Carolina Eastern Municipal Power Agency ("Applicants") hereby move the Atomic Safety and Licensing Board ("Board"), pursuant to 10 C.F.R. § 2.749, for partial summary disposition in Applicants' favor of Joint Contention VII. For the reasons set forth herein, Applicants respectfully submit that there is no genuine issue as to any fact material to parts 1, 2 and 3 of Joint Contention VII, and that Applicants are entitled to a decision in their favor on those parts of Joint Contention VII as a matter of law.

This motion is supported by:

1. "Applicants' Statement of Material Facts as to Which There is no Genuine Issue to be Heard on Joint Contention VII";

2. "Affidavit of Thomas F. Timmons" and Attachments 1-5 affixed thereto;

3. "Affidavit of Glen E. Lang" and Figure 1 and Attachment 1 affixed thereto;

4. "Affidavit of Michael J. Hitchler" and Tables 1-8 attached thereto;

5. "Affidavit of Alan B. Cutter" and Exhibits A and B attached thereto;

6. "Affidavit of Dr. William H. Wilkie" and Exhibits A and B attached thereto; and

7. "Applicants' Memorandum of Law in Support of Motions for Summary Disposition on Intervenor Eddleman's Contentions 64(f), 75, 80 and 83/84," dated September 1, 1983.

I. PROCEDURAL BACKGROUND

Joint Contention VII was admitted as a contention in this proceeding, pursuant to stipulation of the parties, in the Board's "Memorandum and Order (Reflecting Decisions Made Following Prehearing Conference)," Carolina Power & Light Company (Shearon Harris Nuclear Power Plant, Units 1 and 2), LBP-82-119A, 16 N.R.C. 2069, 2077-78 (1982). Joint Contention VII consolidates and supercedes a number of contentions originally submitted by Mr. Wells Eddleman and CHANGE/ELP. See 16 N.R.C. at 2077, admitting Joint Contention VII in lieu of Eddleman 19 and 112-114, and CHANGE/ELP 29-33 and 74. As accepted by the Board, Joint Contention VII is worded as follows:

> Applicants have failed to demonstrate that the steam generators to be used in the Harris Plant are adequately designed and can be operated in a manner consistent with the public health and safety and ALARA exposure to maintenance personnel in light of (1) vibration problems which have developed in Westinghouse Model D-4 steam generators; (2) tube corrosion and cracking in other Westinghouse steam generators with Inconel-600 tubes and/or carbon steel support plates and AVT water chemistry; (3) present detection capability for loose metal or other foreign objects; and (4) existing tube failure analyses.

Joint Contention VII is classified as a safety contention to be addressed during the second phase of the safety hearing with written direct testimony scheduled to be filed on August 9, 1984 and testimony scheduled to begin on October 10, 1984. Discovery on this contention commenced in January, 1984. See "Memorandum and Order (Ruling on Motions for Summary Disposition of Health Effects Contentions: Joint Contention II and Eddleman Contentions 37B, 8F(1) and 8F(2))," dated January 27, 1984. Since that time Applicants have served two sets of interrogatories on the Joint Intervenors. "Applicants' Interrogatories and Request for Production of Documents to Joint Intervenors (Sixth Set)," dated January 30, 1984; "Applicants' Interrogatories and Request for Production of Documents to Joint Intervenors (Seventh Set)," dated March 19, 1984. Joint Intervenors responded to these requests for discovery on February 22 (supplemented March 7) and April 12, respectively. "Joint Intervenors' Response to Applicants' Sixth Set of Interrogatories (on Joint I and VII)," dated

February 22, 1984 ("Joint Intervenors' February 22 Response"); "Joint Intervenors' Supplemental Answer to Applicants' Interrogatories and Requests for Production of Documents on Joint Contentions I and VII," dated March 7, 1984; "Joint Intervenors Response to Applicants Seventh Set of Interrogatories," dated April 11, 1984 (served April 12, 1984) ("Joint Intervenors' April 12 Response").

Joint Intervenors addressed one set of interrogatories to Applicants on March 19, 1984. "Joint Intervenors' General Interrogatories and Interrogatories on Contention 7(VII) to Applicants Carolina Power & Light et al. (First Set)." Applicants responded on April 9, 1984. "Applicants' Responses to Joint Intervenors' General Interrogatories and Interrogatories on Contention VII (First Set)." In conjunction with that response Applicants offered to produce numerous documents for inspection and copying by Joint Intervenors.

Joint Intervenors also have propounded interrogatories to the NRC Staff on Joint Contention VII and responses to those interrogatories have been provided by the Staff. "Wells Eddleman & Joint Intervenors' Interrogatories to NRC Staff (3d Set)," dated March 26, 1984; "NRC Staff Response to Interrogatories Dated March 28, 1984 [sic] Propounded by Wells Eddleman and Joint Intervenors," dated April 17, 1984.

In summary, all phases of discovery have been completed and every effort has been made to ascertain the bases for Joint

Intervenors' claims. Based on the information gained during the course of discovery, it is apparent that no material issue of fact has been raised with respect to parts 1-3 of Joint Contention VII.1/ Thus Joint Contention VII is ripe for partial summary disposition at this time.

II. ARGUMENT

A. Introduction

Applicants intend to use three steam generators designed by the Westinghouse Electric Corporation ("Westinghouse") to produce steam to drive the steam turbine to generate electricity at the Harris Plant. Affidavit of Thomas F. Timmons ("Timmons Affidavit") at ¶ 8. A steam generator is simply a heat exchanger which transfers heat from the primary (reactor heated) water to secondary boiling water to convert the secondary water into steam. A typical Westinghouse steam generator consists of several thousand heat transfer tubes bent into an inverted U-shape. The hot, high-pressure primary water flows through the inside of the tubes and heats and vaporizes the cooler feedwater flowing around the outside of the tubes to produce a high quality steam. The tubes

---

1/ Summary disposition of the fourth part of Joint Contention VII, concerning tube failure analysis, is not sought at this time because a Westinghouse Steam Generator's Owners' Group is developing a generic response regarding the proper assumption for isolation time of a steam generator after a postulated tube rupture.

of a steam generator provide a barrier between the radioactive primary coolant and the secondary water. See Commonwealth Edison Company (Byron Nuclear Power Station, Units 1 and 2), LBP-84-2, ("Byron"), slip op. at 16-17 (January 13, 1984). Joint Contention VII concerns the integrity of the Inconel-600 steam generator tubes in the model D-4 steam generators to be used at the Harris Plant.

The Affidavit of Michael J. Hitchler ("Hitchler Affidavit") sets forth in detail the historical experience of all nuclear power plants of Westinghouse design using Inconel steam generator tubes. As the Hitchler Affidavit explains, data are available for over four million tube years of steam generator operation. During that time only five tube rupture events have occurred in operating Westinghouse steam generators. Hitchler Affidavit at ¶¶ 11-12. Based on these figures, the tube failure rate to date has been only 1.6×10^{-6}/tube-year (with a factor of approximately two uncertainty). Id. at ¶ 14. Each of the three steam generators to be used at the Harris Plant contains 4578 tubes; thus, based on the historical average alone, this is equivalent to a failure rate of one tube per 45 years of operation.2/

2/ This figure is derived from:

$$\frac{1.6 \times 10^{-6} \text{ failure}}{\text{tube-year}} \times \frac{4578 \text{ tubes}}{\text{steam generators}} \times 3 \text{ steam generators} =$$

$$\frac{2.2 \times 10^{-2} \text{ failure}}{\text{year}} = \frac{1 \text{ failure}}{45 \text{ years}}$$

Although the historical record concerning the integrity of Westinghouse designed steam generators in itself is quite impressive, the model D-4 steam generators to be used at the Harris Plant contain a number of design features and will be operated under circumstances which should enhance their performance record and diminish even further the probability of steam generator tube failure events. The predicted tube failure rate for the Harris Plant is 0.6×10^{-6}/tube-year or one tube for approximately each 120 years of operation.3/ Hitchler Affidavit at ¶ 27; Affidavit of Dr. William H. Wilkie ("Wilkie Affidavit") at ¶ 8. These features and techniques are discussed in detail in the supporting affidavits attached hereto and are summarized in the following sections of this motion. As demonstrated by this motion and the materials filed in support hereof, Applicants' intended use of the Westinghouse D-4 steam generators with the described features is consistent with the state of the art, has been approved by recognized authorities in the field and by the NRC Staff, and is clearly consistent with public health and safety.

Joint Intervenors allege that Applicants have not demonstrated that the use of the Harris Plant D-4 steam generators will be consistent with protection of public health and safety or

---

3/ $\frac{0.6 \times 10^{-6} \text{ failure}}{\text{tube-year}} \times \frac{4578 \text{ tubes}}{\text{steam generator}} \times 3 \text{ steam generators} =$

$$\frac{8.2 \times 10^{-3} \text{ failure}}{\text{year}} = \frac{1 \text{ failure}}{122 \text{ years}}$$

with the As Low As is Reasonably Achievable ("ALARA") standard for exposure of maintenance personnel at the Harris Plant. The reasons for this claim are fourfold: (1) operating D-4 model steam generators allegedly have experienced problems with tube vibrations resulting in excessive wear of the steam generator tubes; (2) Westinghouse steam generators using Inconel-600 tubes and carbon steel support plates and All Volatile Treatment ("AVT") water chemistry allegedly have been subject to cracking and corrosion; (3) Applicants allegedly do not have the capability to detect loose metal or other foreign objects in the steam generators; and (4) Applicants' tube failure analysis is allegedly inadequate. This motion for summary disposition and the supporting documents demonstrate that with regard to the first three of these four claims there is no material issue of fact. The following sections of this motion discuss the stated reasons, where such reasons have been expressed, for Joint Intervenors' claims and show that those claims are not founded in fact and do not amount to issues of material fact that should be resolved in a hearing before the Board.4/ In addition, Applicants will make

---

4/ Joint Intervenors have for the most part pleaded ignorance in response to Applicants' interrogatories. In their first set of interrogatories Applicants asked thirty-three questions. Joint Intervenors' reply to fifteen of those questions was that "analysis is not complete" or that they "don't know at present." Joint Intervenors' February 22 Response at Response Nos. 3, 6, 10, 13, 17-20, 24-29, 31 and 32. Six weeks later Applicants propounded their second set of forty-eight interrog-

(Continued Next Page)

an affirmative showing that the Westinghouse steam generators adequately ensure personnel and public health and safety. Applicants respectfully submit that under these circumstances partial summary disposition should be granted in Applicants' favor.

B. Flow Induced Vibration in Westinghouse D-4 Steam Generators

The first of Joint Intervenors' claims concerns flow-induced tube vibration in steam generators. Steam generator tubes in certain of the earlier, preheater model steam generators manufactured by Westinghouse were found to be subject to wear due to vibrations resulting from the flow of highly pressurized water through the narrow gaps between the tubes in the preheater region. The only operating D-4 steam generators also were found to be subject to tube vibrations in the preheater region, albeit to a lesser degree than the earlier models.5/ Joint Intervenors

---

(Continued)

atories to Joint Intervenors. "Applicants Interrogatories and Request for Production of Documents to Joint Intervenors (Seventh Set)," dated March 19, 1984. The first question merely sought answers to those questions from the first set of interrogatories that had not been answered. Id. at Interrogatory No. 34. To this interrogatory and forty-five interrogatories or subparts thereof Joint Intervenors replied that they were "consulting experts" or "had not completed their responses". Joint Intervenors' April 12 Response at Response Nos. 34, 35-36, 37(b), 38, 39(a)(e)(f)(g), 40-42, 44-50, 51(c)(e), 53-55. Those non-substantive answers were served approximately one month prior to the deadline for motions for summary disposition. No supplementation has been provided since that time. This failure to provide responsive answers demonstrates the utter lack of any basis for the allegations made in Joint Contention VII.

5/ We note at the outset that the tube vibration problem affects less than 3% of the steam generator tubes -- approxi-

(Continued Next Page)

contend that this prior history of steam generator tube degradation due to vibration fretting demonstrates that the Westinghouse Model D-4 steam generators to be used at the Harris Plant also are inadequate to ensure personnel and public health and safety. Applicants will demonstrate, however, that the performance of earlier model Westinghouse steam generators and the first D-4 steam generators are not germane because the D-4 steam generators to be used at the Harris Plant have been modified to correct vibration problems. These modifications have been thoroughly analyzed and tested by Westinghouse and reviewed exhaustively by a third-party Technical Review Committee and by the NRC Staff.

As discussed in the Timmons Affidavit, the Westinghouse preheater steam generator line includes two general types of steam generators -- the earlier split-flow type and the counter-flow type, such as the model D-4. In the split-flow model, water enters at the midsection of the preheater and is directed both upward and downward. See Timmons Affidavit at ¶ 10. In the counter-flow type, incoming water flows in one direction -- counter to the flow of the primary water inside the tubes. The counter-flow type of steam generator, exemplified by the D-4 model to be used at the Harris Plant, exhibits less vibration than do the earlier split-flow models.

(Continued)

mately 124 tubes in the preheater section out of 4578 tubes. Timmons Affidavit at ¶¶ 8, 28.

Although the counter-flow type of steam generator is inherently less susceptible to the wear resulting from flow-induced vibration in the preheater section, Westinghouse nonetheless undertook an extensive program to determine the cause of vibration and tube wear in steam generator tubes and to develop modifications that would further diminish tube wear in the D-4 model. Id. at ¶ 12. Detailed descriptions of the tests performed by Westinghouse are found in the Timmons Affidavit at ¶¶ 12-40 and the Staff's Response to Interrogatory No. 140 propounded by Joint Intervenors. "NRC Staff Response to Interrogatories Dated March 28, 1984 [sic] Propounded by Wells Eddleman and Joint Intervenors," dated April 17, 1984. To summarize, Westinghouse performed full and partial scale model tests of steam generator tubes, conducted studies of analytical tube vibration models and also analyzed data obtained from the Krsko Plant in Yugoslavia, which is the only operating Model D-4 steam generator plant. Three basic types of data were obtained from the Krsko Plant: 1) data from analysis of tubes pulled from the operating steam generators, 2) data from eddy current testing ("ECT") and 3) data from accelerometers installed inside selected tubes of the operating steam generators.6/

6/ ECT is a method of testing that creates a magnetic field inside the steam generator tube which produces eddy currents in the tube walls. Any discontinuity or flaw in the walls can be observed because of a disturbance in the eddy currents. ECT

(Continued Next Page)

On the basis of the results from these tests, Westinghouse tested modifications to the Krsko steam generators that were intended to reduce further tube vibration in the Model D-4 steam generators. The first modification consisted of bypassing thirty percent of the flow from the main feedwater nozzle into the auxiliary feedwater nozzle. It was determined after a period of operation that this ratio of main/bypass feedwater flow would not result in tube wear such as to preclude extended plant operation at full capacity. Timmons Affidavit at ¶ 19.

In addition to the feedwater flow modification, Westinghouse tested another modification at Krsko that was designed to reduce further the slight tube wear which was observed even after implementation of the feedwater bypass. A tube expansion was performed at the baffle plate intersection of a steam generator tube. Id. at ¶ 20. This modification was determined to reduce tube vibration by an additional factor of five. Id. Results of the scale model testing and the analytical tube vibration model testing corroborated the actual data obtained from the Krsko Plant and allowed Westinghouse to make refined recommendations for future plants using the Model D-4 steam generators.

(Continued)

will detect discontinuities in conductivity and magnetic permeability resulting from denting, tube wall thinning, tube wear, pitting, cracking and intergranular attack. ECT has been recognized as an important and reliable method of testing tube integrity. See Byron, supra slip op. at 28; Safety Evaluation Report related to the D4/D5/E Steam Generator Design Modification, NUREG-1014 (October 1983) ("NUREG-1014") at 3-10.

Based on the results of this extensive analysis at Krsko, Westinghouse recommended that the Harris Plant Model D-4 steam generators be modified by: 1) expanding 124 tubes per steam generator at selected baffle locations and 2) bypassing eighteen percent of the flow from the main feedwater nozzle to the auxiliary feedwater nozzle. Id. at ¶ 28.7/ After Westinghouse made its recommendations, a third-party design review was initiated with the approval of the NRC staff. NUREG-1014 at 1-1. This third-party group -- known as the Counter Flow Steam Generator Owners Review Group ("CSGORG") -- consisted of representatives of six utilities, including CP&L. A Technical Review Committee ("TRC") of the group was formed under the Chairmanship of Dr. M.G. Zaalouk, who is currently a CP&L employee. After a detailed investigation, the TRC concluded that the modifications to the D4/D5 steam generators were effective and that modified steam generators can be operated safely at recommended capacity. The NRC Staff has accepted the report of the TRC. See NUREG-1014.

Applicants have committed to make the modifications recommended by Westinghouse and approved by CSGORG and the Staff. Affidavit of Alan B. Cutter ("Cutter Affidavit") at ¶ 8. Notwithstanding the fact that Applicants have committed to make these

---

7/ Tests performed by Westinghouse have demonstrated that an 18 percent bypass plus expansion of 124 tubes at the Harris Plant will achieve vibration reduction equal to the acceptable level observed with a 30 percent bypass at the Krsko Plant. Id. at ¶ 40.

improvements and that these improvements will substantially reduce the probability of tube degradation in the Model D-4 steam generators, Joint Intervenors apparently contend that the Harris steam generators still will experience unacceptable tube vibration. Joint Intervenors have been notably unresponsive about the specific basis for their claims about tube vibrations. Applicants posed numerous questions on that issue in an attempt to ascertain the focus of the concern, but, for the most part, Joint Intervenors simply stated that they were pursuing discovery on the issue. Joint Intervenors' February 22 Response at Response Nos. 3, 6, 7, and 10; Joint Intervenors' April 12 Response at Response Nos. 35-40, 42. From what Applicants can determine from Joint Intervenors' responses, however, it appears that Joint Intervenors claim that the expansion of steam generator tubes, as recommended by Westinghouse, actually will lead to decreased tube integrity in the D-4 generators. This charge is completely without merit.

Joint Intervenors have indicated, without any support, that they believe that: (1) cold-working weakens tubes by increasing brittleness; (2) thinner tubes are more likely to dent or rupture; (3) expanded tubes cannot be sleeved; (4) expansion may open cracks and pits in the outside surface of the tubes; and (5) the integrity of plugs in expanded tubes cannot be assured. Joint Intervenors' February 22 Response at Response Nos. 1-3; Joint Intervenors' April 12 Response at Response Nos. 37, 38.

The Timmons Affidavit discusses each of these issues in turn and demonstrates conclusively that these claims have no factual basis.

Westinghouse has developed a proprietary process for expanding steam generator tubes. Timmons Affidavit at ¶ 29. The process involves the insertion of tools into the tubes from the primary side of the steam generator tubesheet. It has been determined through extensive testing that the tube expansion process does not increase detectably the level of residual stress or the potential for stress corrosion cracking. After the expansion procedure has been performed, ECT is used to verify that no damage has been caused by the expansion process. Tests conducted by Westinghouse have verified the acceptability of the tube expansion performed at the Harris Plant. Id. at ¶ 30.

Extensive tests also have been conducted to determine whether the tube expansion affects the potential for denting or rupturing of the tubes. The results of these tests demonstrate that denting is not more likely in expanded tubes. Id. at ¶ 34. An evaluation of burst strength also has been performed to determine the effect of expansion of tubes on the plugging criteria. The evaluations indicate that the expanded tubes can satisfy plugging and sleeving criteria that are even more stringent than those contained in the Technical Specifications for the Harris Plant. Id. at ¶ 36. An evaluation also has been performed of the effect of tube expansion on repair by plugging or sleeving.

This evaluation indicated that the tube expansion does not adversely affect the ability to repair tubes by plugging or sleeving. The results of these tests have been studied and accepted by CSGORG and the NRC Staff. See NUREG-1014.

In summary, prior to recommending the expansion of steam generator tubes in the preheater section and the feedwater bypass in the steam generators for the Harris Plant, Westinghouse performed exhaustive studies on the efficacy of the measures and the possibility of undesirable side effects therefrom. The expansion of steam generator tubes and diversion of feedwater flow also have been reviewed extensively by the NRC Staff and by the CSGORG panel of experts and have been recognized as acceptable improvements in the D-4 steam generator design.8/ CP&L has taken a leading role in this review procedure. Mr. Alan B. Cutter, whose affidavit is filed in support of this motion, served as an executive member of CSGORG and Dr. M.G. Zaalouk, who is also employed by CP&L, served as the head of the TRC. Thus, Applicants are thoroughly familiar with all aspects of the proposed modifications and continue to draw on the expertise of these persons who are uniquely qualified to supervise the implementation of the

---

8/ In the Byron licensing proceeding, applicant had committed to implement the modifications described in NUREG 1014 in the Byron D-4 steam generators; there the Board found that the use of the D-4 steam generators, as modified, was adequate to ensure public health and safety and to satisfy the applicant's duty to comply with ALARA. Byron, supra, slip op. at 74-78.

modifications at the Harris Plant. Under these circumstances it is clear that the modifications will provide additional assurance of worker and public health and safety. Joint Intervenors' vague, unsubstantiated concerns about the modifications implemented at the Harris Plant simply are without merit.

C. AVT Water Chemistry

Joint Intervenors' second claim concerns the use by Applicants of AVT water chemistry in the secondary side of the Harris Plant steam generators. Joint Intervenors have been no more forthcoming with their responses to discovery on the water chemistry issue than they were with regard to the tube vibration claim. See Joint Intervenors' February 22 Response at Response Nos. 10 and 13; Joint Intervenors' April 12 Response at Response Nos. 45-49, 75-76, 78, 81. To the extent it is possible to glean responsive answers from Joint Intervenors, it appears that Joint Intervenors believe that, not only does AVT not suffice to mitigate problems with tube corrosion, but that the use of AVT actually may pose additional problems that contribute to the degradation of steam generator tubes. Id. at Response Nos. 45, 77. This clearly is not the case.

AVT water chemistry is a state-of-the-art technique that has been recommended by Westinghouse since 1974 for use in pressurized water reactor steam generators. Timmons Affidavit at ¶ 53. After extensive testing by Westinghouse, the chemistry control

technique was introduced as a means for minimizing the stress corrosion cracking and "thinning" of the tube walls that were observed in earlier steam generators using phosphate chemistry control.

The change to AVT by plants previously operating on phosphate chemistry was found to mitigate the problem of thinning of tube walls. Id. at ¶ 56. However, a form of corrosion known as "denting" was observed in some of those plants that changed from phosphate chemistry to AVT. Denting, as the name implies, is a reduction in the diameter of steam generator tubes, resulting from corrosion of the steam generator tube support plates. Id. at ¶ 57. After observing incidents of this form of corrosion at nuclear plants operating on AVT, Westinghouse and groups such as the Electric Power Research Institute ("EPRI") (under the auspices of the Steam Generator Owners' Group) conducted extensive testing in order to understand better the denting phenomenon. As a result of such studies by Westinghouse, EPRI and others, the denting phenomenon now is understood more completely and design and procedural modifications have been conceived and recommended to retard the denting process. Id. at ¶¶ 59-63; Cutter Affidavit at ¶ 10.

The denting corrosion process is related to a variety of factors such as the interrelationship between acid chlorides, reducible metal compounds such as copper oxides and oxygen. Timmons Affidavit at ¶ 58. Plants using brackish water or sea

water for condenser cooling have been especially prone to the denting form of corrosion because of the high concentration of acid-chloride forming constituents in that type of water. Id. at ¶ 57. Since the Harris Plant is designed to use fresh water for condenser cooling, it will, even absent other modifications, experience less problems with corrosion than have those plants which operate with sea or brackish water. Id. at ¶ 63; Cutter Affidavit at ¶ 22. As a result of the studies conducted by Westinghouse and EPRI, detailed guidelines for effective use of AVT chemistry were developed. The guidelines establish strict specifications for chemistry parameters and outline actions to be taken in the event these parameters are exceeded. Id. at ¶ 11. CP&L will implement these guidelines insofar as they are applicable to the Harris Plant. Id. Careful maintenance of proper chemistry conditions on the secondary side will minimize tube corrosion and cracking and permit long-term integrity of the steam generators. Id. at ¶ 12; Timmons Affidvait at ¶¶ 68-70.

Applicants, with Westinghouse's guidance, also have undertaken a number of design and procedural improvements that will result in a lower potential for corrosion of the steam generator tubes. These modifications are discussed in detail in the Cutter Affidavit and Attachment B thereto. To summarize, Applicants have reduced the concentration of copper corrosion products in the secondary system by using copper-nickel condenser tubes in lieu of admiralty tubes and by installing a deep-bed, full-flow

condensate polishers that can trap copper corrosion products before they enter the feedwater system. Cutter Affidavit ¶ 16. Corrosion will be reduced further by rolling (expanding) the tubes through the full length of the tubesheets to eliminate crevices in the tubesheet and the possibility of crevice corrosion. Id. at ¶ 14.

Applicants also intend to implement several design and procedural modifications that will minimize the ingress of impurities into the condensate by detecting their presence and eliminating them from the system. Id. at ¶¶ 17-20. Finally Applicants will implement measures to control the leakage of oxygen into the system. Id. at ¶ 21. Oxygen concentration has been linked to the presence of certain types of corrosion in steam generator tubes. Timmons Affidavit at ¶ 58. With the implementation of these modifications, Applicants will ensure that corrosion in steam generator tubes is controlled in an effective manner so as to increase the longevity of the steam generator tubes. Cutter Affidavit at ¶ 22; Timmons Affidavit at ¶ 70.

Although there may be some corrosion of steam generator tubes even using the most rigorous AVT water chemistry control, tube corrosion is not per se a safety issue because corrosion generally develops slowly and tube degradation should be detected during the required, periodic in-service inspections, and the affected tube can be plugged or sleeved before tube structural integrity limits are exceeded. Timmons Affidavit at ¶ 64. Even if

corrosion progressed to the point of a leak, Applicants' monitoring systems will ensure that a leak is detected, and if it exceeds Technical Specification limits, the Plant will be shut down for repair. Id.; Cutter Affidavit at ¶ 33-35. Because of the non-uniformity of the tube degradation that has been observed in operating plants and because of the inherent toughness of the Inconel 600 material, a tube subject to corrosion would be expected to leak rather than to be susceptible to rupture. Timmons Affidavit at ¶ 64. Thus, this "leak before break" quality of the tubes, combined with Applicants' monitoring capability and Technical Specification limits, permits early detection of steam generator tube degradation before tube failure is approached. Id.; Cutter Affidavit at ¶¶ 33-36. See also Byron, supra, at p. 33.

In summary, significant advances have been made in steam generator water chemistry control. Applicants have committed to implementation of AVT water chemistry in accordance with Westinghouse and EPRI recommendations. There is no basis for the allegation that Applicants' use of AVT water chemistry is inconsistent with the public health and safety.

D. Loose Parts Monitoring

The third part of Joint Contention VII concerns Applicants' ability to monitor for the presence of loose parts that can cause damage to the steam generators. Joint Intervenors apparently believe that Applicants' system for monitoring for loose parts may

be ineffective and that this inadequacy is likely to result in the undetected introduction of foreign objects into the D-4 steam generators, increasing the risk of tube rupture.

As described in the Cutter Affidavit, Applicants rely on two separate programs tc ensure that the steam generators will not be impaired by loose parts. First, and most importantly, Applicants have implemented Quality Assurance/Quality Control ("QA/QC") programs to ensure that foreign objects are not left in the steam generators during the construction phase and do not enter the steam generators during maintenance outages. Cutter Affidavit at ¶ 25.

Procedures have been established to control system and component cleanliness during construction; all personnel receive training which emphasizes the importance of preventing miscellaneous objects from being left in the steam generators. Id. In addition to the training program, the entrance into steam generators is closely monitored and procedural controls are instituted to document the number and types of parts and tools carried into and brought out of the steam generator area and the type of repairs that are performed.

Prior to operation, additional start-up testing, procedural controls and personnel training will be performed to prevent loose parts from entering the coolant system or breaking loose from the structure of the coolant system. Id. at ¶ 26. Tests will be performed during and after hot functional testing to

ascertain that any flow-induced vibration does not result in loose parts in the reactor coolant system. Id. A fiberoptics system will be used to inspect for loose parts both before and after hot functional testing. Id. at ¶ 27.

To ensure that loose parts do not remain in or enter the system after hot functional testing, Applicants intend to implement strict control over close-out procedures and train personnel in the importance of material and tool inventory control and the necessity of reporting loose objects suspected to have been dropped into the reactor coolant system. Id. at ¶ 28.

Applicants will comply with the requirements of Regulatory Guides 1.116, 1.37 and 1.38, with the clarifications explained in the FSAR at § 1.8. These Regulatory Guides set Quality Assurance standards for installation, inspection, testing and cleaning of equipment in nuclear power plants. This program will adequately ensure that loose parts do not enter the reactor coolant system and cannot jeopardize the integrity of the steam generator system.

Ample information about the preventive measures described above was available to Joint Intervenors prior to the introduction of Joint Contention VII. Thus, the thrust of the third part of Joint Contention VII apparently is that Applicants should have additional safeguards to ensure that loose parts are detected promptly so that removal can be effected before damage occurs to the steam generators. In fact, Applicants do have such a

system--the Westinghouse Digital Metal Impact Monitoring System ("DMIMS"). Cutter Affidavit at ¶ 30. After being made aware that Applicants had procured this system, however, Joint Intervenors did not withdraw the loose parts monitoring portion of their contention. See "Applicants' Interrogatories and Request for Production of Documents to Joint Intervenors (Sixth Set)," dated January 30, 1984 at Interrogatory No. 21. Instead, they have raised several vague and unsupported claims about the adequacy of the DMIMS. Joint Intervenors' Februry 22 Response at Response Nos. 17, 18; Joint Intervenors' April 12 Response at Response Nos. 50, 52.

The DMIMS to be used at the Harris Plant is described in detail in the Affidavit of Glenn E. Lang ("Lang Affidavit") and Attachment 1 thereto and in the FSAR at § 4.4.6.4. The system continuously monitors the reactor coolant system for the presence of loose metallic parts. Lang Affidavit at ¶ 4. A microprocessor automatically actuates audible and visual alarms if a signal exceeds the preset alarm limit. Id. Tests have been performed to measure the sensitivity of the system to various weights. The system produces acceptable responses for .25, .5, 1.0, 2.0 and 30 pounds. Id. at ¶ 7.

Joint Intervenors apparently believe that the DMIMS is inadequate because it is not composed of "safety grade materials," but this claim is completely without merit. As discussed in the Lang Affidavit, Class 1E ("safety grade") equipment is defined as

equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential to prevent significant release of radioactive material to the environment. Lang Affidavit at ¶ 9. The DMIMS serves none of these functions. It is instead a diagnostic aid to detect the presence of loose parts in the reactor coolant system. Id. Class 1E materials are not required because the use of such materials in the DMIMS could not possibly contribute to the safety of personnel or the public during an emergency situation.9/

The DMIMS has been reviewed and approved by the NRC Staff. Safety Evaluation Report related to Shearon Harris Nuclear Power Plant, Units 1 and 2, NUREG-1038 (November 1983) ("SER") at § 4.4.4. A Westinghouse DMIMS similar to the one used at the Harris Plant also has been installed at the Byron facility.10/ The Byron licensing board found that the installation of a loose parts monitoring system to guard against damage caused by loose parts and foreign objects contributed to the reasonable assurance that the [D-4] steam generators at Byron will maintain their

---

9/ The DMIMS is nonetheless designed to remain functional even during an operating basis earthquake and estimated radiation exposures from such an occurrence. Periodic on line channel checks and channel functional tests are incorporated into the DMIMS design to ensure reliability. Id. at ¶ 10.

10/ A DMIMS similar to the one at the Harris Plant has been installed in fifteen domestic and thirteen non-domestic nuclear plants. Lang Affidavit at ¶ 12.

integrity. Byron, supra, at 47-48. It is clear that Joint Intervenors' claims that the system is inadequate are without merit. Joint Intervenors have produced no evidence to the contrary.

E. Operation of Harris Plant D-4 Steam Generators Consistent with ALARA

Joint Contention VII alleges that the Harris Plant steam generators are inadequate, due to the alleged defects discussed above, both to ensure public health and safety and to comply with the ALARA criterion. As we have demonstrated, supra, none of Joint Intervenors' specific allegations relating to public health and safety are grounded in any factual basis whatsoever. In this section, we respond to the allegation that operation of the Harris Plant steam generators will be inconsistent with ALARA.

As an initial matter, it is important to reemphasize that Westinghouse steam generators using Inconel tubes have a well-documented record of safe operation. See Hitchler Affidavit. In over four million tube years of operation only five tube rupture events have occurred. Id. at ¶ 12. To further enhance the performance of the Harris Plant steam generators, Applicants have implemented a variety of programs and design modifications that will improve the integrity of the Model D-4 steam generators and preclude tube failures such as the few that have occurred at other plants. It is this improvement in steam generator integrity that will result in less worker exposure due to steam

generator repairs. This, of course, is entirely consistent with ALARA.

The Hitchler Affidavit demonstrates that in most cases steam generator tube failure events at other plants have been caused by the very occurrences which these programs and design modifications at the Harris Plant are intended to forestall. Hitchler Affidavit at ¶¶ 17-22. The tube failure event at Plant E, as shown on the attachments to the Hitchler Affidavit, was attributed to thinning of the tube walls caused by phosphate wastage. Id. at ¶ 16. At Plants I and bb, the steam generator tubes suffered stress corrosion cracking. Id. at ¶ 17. In the two other plants that have experienced a tube failure event, the leakage has been traced to the presence of loose parts in the secondary system. Id. at ¶ 21.

Harris Plant steam generators clearly will not be subject to phosphate wastage since phosphate chemistry will not be employed. As discussed in detail in the Timmons and Cutter Affidavits, the conditions conducive to such stress corrosion cracking are significantly less likely to occur at the Harris Plant, because: (1) the Plant will use fresh, rather than sea or brackish, water for condenser cooling and (2) the use of AVT water chemistry under the prescribed conditions from the time of first operation will reduce further the potential for corrosion. In addition to these elementary differences between the Harris Plant and other plants, design and program features have been implemented to (1)

ensure the most effective use of AVT water chemistry by reducing copper corrosion products in the feedwater system, monitoring for and removing impurities prior to ingress into the system and reducing the amount of oxygen in the system. In addition, in-service inspection and continuous monitoring will identify corrosion prior to tube failures. Hitchler Affidavit at ¶ 20; Timmons Affidavit at ¶ 64; Cutter Affidavit at ¶ 34, 35. The QA/QC programs at the Harris Plant, fiberoptic examination of the steam generator secondary side and the installation of a loose parts monitoring device also will reduce the potential for tube failure due to intrusion of loose parts. Id.11/ It is estimated that, due to these design and program features, a tube rupture event is likely to occur at the Harris Plant less than once every 120 years. Wilkie Affidavit at ¶ 8; See also note 3 above.

All of these improvements in the quality of the D-4 steam generator system will result in a decreased necessity for maintenance and repairs that expose workers to radioactive materials. Thus the uncontrovertible conclusion that must be drawn is that the modifications and design features are consistent with the ALARA criterion which requires that dose to workers be as low as is reasonably achievable. Wilkie Affidavit at ¶ 10, Byron,

---

11/ The risk reduction factor is actually a factor of 100, but a factor of two was used by Hitchler as a conservative estimate to account for other types of chemical wastage which have not been observed but theoretically might be possible.

supra, slip op. at 78 ("the Board concludes . . . that the changes and modifications to be made to the steam generators will, in the long haul, reduce occupational radiation exposure and will strengthen the Applicant's conformity to the principle of ALARA.").

Joint Intervenors' assertions to the contrary demonstrate their lack of understanding of the ALARA principle. ALARA does not mean that Applicants are required to make every modification that possibly might decrease the potential for exposure to radiation regardless of cost or effectiveness or without consideration of the context of plant operation as a whole. Id. at ¶ 11.12/

The two crucial facets of an effective ALARA program are set forth in the Wilkie Affidavit at ¶ 5: (1) the management must have a genuine commitment to maintaining exposures as low as is reasonably achievable and (2) the personnel must be continually vigilant for ways to reduce exposure. Dr. Wilkie states conclusively that CP&L has satisfied these requirements. Id. at ¶ 6; see also SER at ¶ 12.1. The implementation of the extensive modifications described in the sections above also is convincing

---

12/ As an example of their lack of understanding of ALARA, it is noteworthy that Joint Intervenors first claimed that Applicants were required to install a system such as the DMIMS, but upon learning that such a system would be used claimed that this could increase exposure because, if loose parts can be detected, workers will have to retrieve them, thus increasing exposure. Joint Intervenors' February 22 Response at Response No. 21. On the one hand the argument is circular; it also suggests that Joint Intervenors view any radiation exposure to workers as inconsistent with ALARA.

evidence that the ALARA criterion has been satisfied and Joint Intervenors have presented no evidence to the contrary. Thus summary disposition in Applicants' favor of Joint Intervenors' allegations regarding ALARA is appropriate at this time.

III. CONCLUSION

For all of the reasons set forth above, Applicants request that the Board grant summary disposition of parts (1)-(3) of Joint Contention VII in Applicants' favor.

Respectfully submitted,

Pamela H. Anderson

Thomas A. Baxter, P.C.
John H. O'Neill, Jr., P.C.
Pamela H. Anderson

SHAW, PITTMAN, POTTS & TROWBRIDGE
1800 M Street, N.W.
Washington, D.C. 20036
(202) 822-1148

and

Richard E. Jones
Samantha F. Flynn

Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602
(919) 836-7707

Counsel for Applicants

Dated: May 16, 1984