Westinghouse Electric Corporation
Energy Systems
Box 355
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February 17, 1993
CAW-93-416

Document Control Desk
US Nuclear Regulatory Commission
Washington, DC 20555

Attention: Dr. Thomas Murley, Director

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: WCAP-13088, Rev. 1 "Westinghouse Series 44 and 51 Steam Generator Sleeving Report, Laser Welded Sleeves" (Proprietary)

Dear Dr. Murley:

The proprietary information for which withholding is being requested in the above-referenced letter is further identified in Affidavit CAW-93-416 signed by the owner of the proprietary information, Westinghouse Electric Corporation. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.790 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Virginia Power.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-93-416, and should be addressed to the undersigned.

Very truly yours,

P. J. Moine/for

Mr. N. J. Liparulo, Manager
Nuclear Safety and Regulatory Activities

/cld
Enclosures

cc: M. P. Siemien, Esq.
Office of the General Counsel, NRC

CLD116:DLC/021693

CAW-93-416

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Peter J. Morris, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Peter J. Morris

Peter J. Morris, Manager
Strategic Safety and Regulatory Issues

Sworn to and subscribed
before me this 18th day
of February, 1993

Lorraine M. Pjolica

Notary Public

Notarial Seal
Lorraine M. Pjolica, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Dec 14 [illegible]
Member, Pennsylvania Association of [illegible]

068IC-DLC-1:021693

(1) I am Manager, Strategic Safety and Regulatory Issues, in the Nuclear and Advanced Technology Division, of the Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Energy Systems Business Unit.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Energy Systems Business Unit in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in "Westinghouse Series 44 and 51 Steam Generator Sleeving Report, Laser Welded Sleeves", WCAP-13088, Rev. 1, (Proprietary), January, 1993 being transmitted by the Virginia Electric and Power Company (VEPCO) letter and Application for Withholding Proprietary Information from Public Disclosure, Mr. W. L. Stewart, Senior Vice President, Nuclear, VEPCO, to Attention Dr. Thomas Murley. The proprietary information as submitted for use by Virginia Electric and Power Company for North Anna Unit 2 is expected to be applicable in

other licensee submittals in response to certain NRC requirements for justification of use of laser welded sleeving in steam generator tubes.

This information is part of that which will enable Westinghouse to:

(a) Provide documentation of the methods for laser welded sleeving of steam generator tubes.

(b) Establish applicable testing methods.

(c) Establish the use of fiber optics in laser welded sleeving applications.

(d) Establish applicable codes and standards which are to be applied to the process.

(e) Assist the customer to obtain NRC approval.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for licensing documentation.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar sleeving services and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing testing and analytical methods and performing tests.

Further the deponent sayeth not.

ATTACHMENT 5

SIGNIFICANT HAZARDS CONSIDERATION

VIRGINIA ELECTRIC AND POWER COMPANY

Significant Hazards Consideration

Steam Generator Tube Repair Using Laser Welded Sleeves
North Anna Power Station Unit 2

INTRODUCTION

A license amendment is proposed to permit the installation of Alloy 690 laser welded tube sleeves at degraded tube support plate intersections and within the tubesheet area of the North Anna Power Station Unit 2 steam generators. Per the current Technical Specifications, steam generator tubes with eddy current indications of 40% through wall or greater must be removed from service. Laser welded tube sleeves can be installed to repair degraded steam generator tubes either at the tube support plate intersections, within the tubesheet area, or a combination of both within the same tube.

DESCRIPTION OF THE AMENDMENT REQUEST

As required by 10 CFR 50.91(a)(1), this analysis is provided to demonstrate that a proposed license amendment to implement repair of tubes using laser welded tube sleeves for the North Anna Unit 2 steam generators represents no significant hazards consideration. In accordance with 10 CFR 50.92(c), implementation of the proposed license amendment was evaluated and found not to: 1) involve a significant increase in the probability or consequences for an accident previously evaluated, 2) create the possibility of a new or different kind of accident from any accident previously evaluated, or 3) involve a significant reduction in a margin of safety.

Maintenance of steam generator tube integrity is the prime objective of regular steam generator tube inspection programs. Due to the high impact that removal of tubes from service can have on overall plant availability and operability, a repair method has been developed which secures to the original tube a short length of tubing with an outer diameter slightly smaller than the inside diameter of the tube, spanning the degraded area of the parent tube. The tube support plate sleeve is attached to the degraded tube by producing an autogenous weld between the original tube and sleeve. Tube support plate sleeve welds are produced in the free span sections of the tube. The free span welds provide the structural joint between the tube and sleeve and also provide positive (leaktight) leakage integrity. The tubesheet sleeve is secured and supported structurally at the upper section by a free span autogenous weld performed identically to the tube support plate sleeve welds while the lower joint is secured by a mechanical hardroll. A seal weld can also be included within the tubesheet sleeve lower joint at an elevation coincident with the approximate midpoint of the tubesheet cladding. However, the hardroll area supplies the necessary structural requirements for the lower joint. Both the lower hardroll and free span laser weld joints (LWJ) provide structural integrity characteristics which exceed the structural requirements for the sleeve. Therefore, it can be postulated that a loss of structural

integrity in one of the sleeve joints will not result in a loss of structural integrity for the sleeve. The sleeve structural integrity requirements include safety factors inherent to the requirements of the ASME Code. Installation of tube support plate sleeves and/or tubesheet sleeves restores the integrity of the primary pressure boundary to a condition consistent with that of the originally supplied tubing. All welds must be produced a minimum distance of 1 inch from any detected tube degradation.

Tubes with indications of degradation in excess of the plugging criteria would have to be removed from service, according to Technical Specification tube plugging criteria without provision for tube repair by sleeving. Removal of a tube from service results in a reduction of reactor coolant flow through the steam generator. This small reduction in flow has an impact on the margin in the reactor coolant flow through the steam generator in loss-of-coolant accident (LOCA) analyses and on the heat transfer efficiency of the steam generator. Repair of a tube with sleeving maintains the tube in service and results in a much smaller flow reduction. Therefore, the use of sleeving in lieu of plugging would minimize loss of margin in reactor coolant system flow and assist in assuring that minimum flow rates are maintained in excess of that required for operation at full power. Any combination of sleeving and plugging utilized at North Anna Unit 2 up to a level such that the effect of sleeving will not reduce the minimum reactor coolant flow rate to below the current Technical Specification limit is acceptable. Also, minimizing the reduction in flow has operational benefits by limiting the increase in heat flux across the tubes remaining in service. Increased heat fluxes have been associated with an increased potential for tube corrosion.

The proposed amendment would modify Technical Specifications 3/4.4.5 "Steam Generators," and Bases B 3/4.4.5, "Steam Generators," to provide the sleeve/tube inspection requirements and acceptance criteria to determine the level of degradation that would require the sleeve to be removed from service.

EVALUATION

Sleeve/Tube Integrity

During the development of laser welded sleeving, Section III of the ASME Code was used for the minimum wall thickness determination and bounding stress and fatigue levels for the sleeve. By showing that the sleeve design meets all facets of the applicable subsections of Section III of the Code, the sleeve design meets the design requirements of the original tubing. Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," is used to develop the plugging limit of the sleeve determined by NDE, should sleeve wall degradation occur. Potentially degraded sleeves at the plugging limit were shown (by analysis) to retain burst strength in excess of three times the normal operating pressure differential at end of cycle conditions, per Regulatory Guide 1.121 guidelines. The structural analysis utilized a generic set of loading inputs which conservatively bound the operating regimes of all plants with Westinghouse Series 44 and 51 steam generators. In actuality, the operating pressure differential for North Anna Unit 2 results in a slightly

larger sleeve degradation plugging limit than determined by WCAP-13088, Rev. 1. The requirements of Regulatory Guide 1.83, "Inservice Inspection of PWR Steam Generator Tubes," are implemented, and a baseline eddy current inspection of the installed sleeves is performed prior to operation. An ultrasonic inspection of the free span weld joints is also performed prior to operation. The ultrasonic inspection is used to verify that the minimum acceptable fusion zone thickness of the weld is achieved. This minimum weld fusion zone thickness has been shown by analysis to satisfy the requirements of the ASME Code with regard to acceptable stress levels during operating and accident conditions. As stated previously, a generic set of loading conditions was used for structural analysis of the sleeved tube assembly. The values for primary-to-secondary pressure differential and T_{hot} and T_{cold} represented bounding or design values and are considered conservative for all plants with Series 44 or 51 steam generators. In addition, a fatigue analysis was performed for the assembly, the critical location being the free span laser weld. The loading cycles that were applied to the sleeve assembly analysis were those for a 40 year plant life cycle. Therefore, the fatigue analysis is conservative for an cperating plant. The results of the fatigue analysis indicate acceptable usage factors for the entire range of permitted weld thicknesses. A comparison of the number of loading cycles used in the generic analysis indicates that the generic conditions are conservative compared to North Anna Unit 2. For normal plant conditions, which include plant heatup/cooldown cycles, small step load changes, large step load changes, and hot standby operations, and all Upset and Test conditions, the generic conditions bound North Anna values. Only the number of turbine roll tests and steady state fluctuations were consistent between the generic and North Anna values. Using the generic inputs, the cumulative fatigue usage factor was found to be much less than 1.0. The pressure differentials used for the generic analysis were found to be conservative compared to North Anna values in all categories.

Leakage testing under conditions considered to be more severe than expected during all operating plant conditions has shown that the laser welded sleeve does not introduce additional primary-to-secondary leakage during a postulated steam line break event. Laser welded sleeved tube assemblies were subjected to thermal and fatigue cycling and then leak tested at pressure differences of up to 3110 psi, which far exceeds the expected North Anna Unit 2 steam line break pressure differential of 2335 psi to 2500 psi. No leakage was detected in any welded joint (both free span and tubesheet joints). Leakage testing has also shown that the seal weld of the tubesheet sleeve lower joint is not required in order to preclude leakage during normal operation or accident conditions at 600°F. Non-welded lower joint tubesheet sleeve/tube leakage test specimens were subjected to both fatigue and thermal cycling tests prior to final leak rate evaluation testing. The load level applied during the fatigue testing exceeded the maximum axial load applied to the sleeve during the most severe pressure loading condition. Thermal cycling tests simulated a standard plant heatup/cooldown cycle. No leakage was detected in any non-welded tubesheet sleeve lower joint at 600°F after both thermal and fatigue loading. Primary-to-secondary leakage through non-welded tubesheet sleeve lower joints would not be expected at 0% power (T_{hot} = 547°F).

Sleeving of Previously Plugged indications

The sleeve installation requirements applicable to active tubes which have been identified as containing degradation which exceeds the repair limit are no different for the sleeving of previously plugged tubes. A new "baseline" inspection of the entire tube length must be performed prior to sleeve installation in a previously plugged tube. The location of the identified tube degradation must be verified to be a minimum distance of 1 inch from the weld joints (same for active tubes). Historically, the areas of the tube which have suffered corrosion degradation are the tube support plate intersections, the expansion transition and the sections of tube within the thickness of the tubesheet where secondary side contaminants have collected due to the operating crevices. The sleeve free span (structural) weld joints are not located in these areas, and should not be affected by any previously identified degradation mechanism which caused the tube to be removed from service. The analysis has also supported sleeve installation in a separated tube, therefore, the extent of the originally identified degradation should not affect sleeve installation. Additionally, the area of the tube where the tube plug was installed must be visually inspected prior to sleeve installation. Surface finish requirements for this area have been developed which help to maintain the ability of the joint to form a leaktight seal. Conformance to the surface finish requirements for the lower joint will help to ensure a leaktight sleeve joint, regardless of whether or not the seal weld has been produced. The ability of the weld to sufficiently penetrate the tube wall has been shown by test in cases where a localized gap of several (up to 2 mils) mils existed between the tube and sleeve. The penetrating capabilities of the weld will also help to ensure a leaktight joint in cases where slight surface imperfections due to tube plug removal may be present.

LOCA Flow Margin

By reducing the numbers of tube plugs installed in the steam generator, the proposed amendment would minimize the loss of margin in reactor coolant flow through the steam generator during a postulated LOCA. Also, sleeving will provide margin above the required minimum flow for full power operation, than if equal numbers of tubes were plugged as opposed to sleeved.

ANALYSIS

Conformance of the proposed amendments to the standards for a determination of no significant hazard as defined in 10 CFR 50.92 is shown in the following:

1) Operation of the North Anna Power Station Unit 2 in accordance with the proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The tubesheet and/or tube support plate intersection laser welded sleeve configuration has been designed and analyzed in accordance with the

requirements of the ASME Code and Regulatory Guide 1.121. Fatigue and stress analyses of the sleeved tube assemblies produced acceptable results. Mechanical testing has shown that the structural strength of the Alloy 690 sleeves under normal, faulted and upset conditions is within acceptable limits. Leak testing has demonstrated that primary-to-secondary leakage is not expected during all plant conditions, including the case where the seal weld is not produced in the lower joint of the tubesheet sleeve.

A conservative leak-before-break evaluation has been performed for the sleeved tube assembly, using bounding values for operating regimes of Series 44 and 51 steam generators. The evaluation is considered conservative in that no credit for the parent tube is assumed in determining the burst pressure of the sleeved tube assembly. The leak-before-break criteria compares the postulated throughwall crack length which will leak at a specified value at normal operating conditions, thereby permitting adequate leakage detection and safe shutdown of the plant prior to the crack achieving a length equal to the critical crack length which could be postulated to burst at steam line break conditions. The North Anna Unit 2 Technical Specifications limit primary-to-secondary leakage. Additionally, North Anna Power Station maintains an administrative maximum allowable leak rate limit which bounds leak-before-break concerns during all plant operating conditions (Reference 4). This administrative limit was previously accepted by the NRC in letters dated March 7, 1991 and August 3, 1992 (References 5 and 6). These primary-to-secondary leak rate limits provide a large leak-before-break margin. Using the bounding conditions of the Westinghouse Series 44 and 51 steam generators, the WCAP-13088, Rev. 1, generic limiting leak rate satisfies the leak-before-break criteria for Alloy 690 sleeved tubes. For the leak-before-break evaluation, lower primary-to-secondary pressure differential results in a lower leak rate for a particular critical burst crack length. Thus, if the leak-before-break evaluation were performed at North Anna plant conditions, leak-before-break margin would be provided at even higher leak rates. The critical burst crack length is assessed at steam line break conditions, and is independent of the normal operating pressure differential.

Despite the fact that leak-before-break is considered to be applicable (historically no primary-to-secondary leakage or degradation has been evidenced in Westinghouse sleeves) to the sleeved tube assembly, the hypothetical consequences of failure of the sleeve would be bounded by the current steam generator tube rupture analysis included in the North Anna Power Station UFSAR. Due to the slight reduction in diameter caused by the sleeve wall thickness, it is expected that primary coolant release rates would be slightly less than assumed for the steam generator tube rupture analysis, and therefore, would result in lower total primary fluid mass release to the secondary system. Additionally, further conservatisms would be included if the break were postulated to occur at a location higher than a location where sleeves are installed. Combinations of tubesheet sleeves and tube support plate sleeves would reduce the primary fluid flow through the sleeved tube assembly due to the series of diameter reductions

the fluid would have to pass on its way to the break area. The overall effect would be reduced steam generator tube rupture release rates.

The proposed Technical Specifications change to support the installation of Alloy 690 laser welded sleeves does not adversely impact any other previously evaluated design basis accident or the results of LOCA and non-LOCA accident analyses for the current Technical Specification minimum reactor coolant system flow rate. The results of the qualification testing, analyses, and plant operating experience demonstrate that the sleeve assembly is an acceptable means of maintaining tube integrity. Plugging limit criteria are established using the guidance of Regulatory Guide 1.121. Furthermore, per Regulatory Guide 1.83 recommendations, the sleeved tube can be monitored through periodic inspections with present eddy current techniques. These measures demonstrate that installation of sleeves spanning degraded areas of the tube will restore the tube to a condition consistent with its original design basis.

Conformance of the sleeve design with the applicable sections of the ASME Code and results of the leakage and mechanical tests, support the conclusion that installation of laser welded tube sleeves will not increase the probability or consequences of an accident previously evaluated. Depending upon the break location for a postulated steam generator tube rupture event, implementation of tube sleeving could act to reduce the radiological consequences to the public due to reduced flow rate through a sleeved tube compared to a non-sleeved tube based on the restriction afforded by the sleeve wall thickness.

2) The proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Implementation of laser welded sleeving will not introduce significant or adverse changes to the plant design basis. Stress and fatigue analysis of the repair has shown the ASME Code and Regulatory Guide 1.121 allowable values are met. Implementation of laser welded sleeving maintains overall tube bundle structural and leakage integrity at a level consistent to that of the originally supplied tubing during all plant conditions. Leak and mechanical testing of sleeves support the conclusions of the calculations that the sleeve retains both structural and leakage integrity during all conditions. Sleeving of tubes does not provide a mechanism resulting in an accident outside of the area affected by the sleeves. Any hypothetical accident as a result of potential tube or sleeve degradation in the repaired portion of the tube is bounded by the existing tube rupture accident analysis. Since the sleeve design does not affect any other component or location of the tube outside of the immediate area repaired, in addition to the fact that the installation of sleeves and the impact on current plugging level analyses is accounted for, the possibility that laser welded sleeving creates a new or different type of accident is not supported.

The design of thermally treated Alloy 600 and Alloy 690 sleeved tube assemblies have performed well historically with regard to corrosion. There are no reported instances of sleeve degradation for the greater than 25,000 sleeves that Westinghouse has installed in the U.S. Accelerated corrosion test results show the free span laser welded joint (with post weld heat treatment) is capable of exhibiting a resistance to corrosion of greater than 10 times that of rolled tube transitions. Accelerated corrosion tests also show that non-heat treated laser welded free span joints exhibit resistance to stress corrosion cracking equal to or greater than rolled tube transitions. Corrosion testing of the tubesheet sleeve lower laser welded joints exhibits a resistance to corrosion cracking of three to four times that of rolled tube transitions. These factors suggest postulated sleeve degradation would occur at a rate less than rolled transitions, and the potential for a sleeve with accelerated degradation rate characteristics more severe than roll transitions is negligible. The North Anna Unit 2 steam generator tubes employ a partial depth hardroll expansion with full depth WEXTEX explosive expansion. Corrosion rates for WEXTEX expansion transitions are considered to be bounded by that of rolled transitions.

3) The proposed license amendment does not involve a significant reduction in a margin of safety.

The laser welded sleeving repair of degraded steam generator tubes as identified in WCAP-13088, Rev. 1 has been demonstrated to restore the integrity of the tube bundle under normal and postulated accident conditions. The safety factors used in the design of sleeves for the repair of degraded tubes are consistent with the safety factors in the ASME Boiler and Pressure Vessel Code used in steam generator design. The plugging limit criteria for the sleeve have been established using the methodology of Regulatory Guide 1.121. The design of the sleeve joints has been verified by testing to preclude leakage during normal and postulated accident conditions. Implementation of laser welded sleeving will reduce the potential for primary-to-secondary leakage during a postulated steam line break while maintaining available primary coolant flow area in the event of a LOCA. By removing from service degraded intersections through repair, the potential for steam line break leakage is reduced. These degraded intersections now are returned to a condition consistent with the Design Basis. While the installation of a sleeve causes a reduction in flow, the reduction is far below the reduction incurred by plugging. Therefore, far greater primary coolant flow area is maintained through sleeving. Use of Regulatory Guide 1.121 criteria assures that the margin of safety with respect to structural integrity is the same for the sleeves as for the original steam generator tubes.

The portions of the installed sleeve assembly which represent the reactor coolant pressure boundary can be monitored for the initiation and progression of sleeve/tube wall degradation, thus satisfying the requirements of Regulatory Guide 1.83. Portions of the tube bridged by the sleeve joints are effectively removed from the pressure boundary, and the sleeve then forms the pressure boundary in these

areas. The areas of the sleeved tube assembly which require inspection are defined in the Bases to the North Anna Unit 2 Technical Specifications.

In addition, since the installed sleeves represent a portion of the pressure boundary, a baseline inspection of these areas is required prior to operation with sleeves installed.

The effect of sleeving on the design transients and accident analyses have been reviewed based on the installation of sleeves up to the level of steam generator tube plugging coincident with the minimum reactor flow rate. Currently the North Anna Technical Specifications limit minimum reactor coolant flow rate at 284,000 gpm total. Virginia Electric and Power Company has submitted a proposed license amendment to lower the minimum measured flow rate to 275,300 gpm (Reference 3). The installation of sleeves is to be evaluated as the equivalent of some level of steam generator tube plugging. The North Anna Unit 2 steam generator plugging level is approximately 7% (average), and loop flow was last measured to be 293,321 gpm in April 1992. Evaluation of the installation of sleeves is based on the determination that LOCA evaluations for the licensed minimum reactor coolant flow bound the effect of a combination of tube plugging and sleeving up to an equivalent of the actual steam generator tube plugging limit. Information provided in WCAP-13088, Rev. 1 describes the method to determine the flow equivalency for all combinations of tubesheet and tube support plate sleeves in order that the minimum flow requirements are met.

For North Anna Unit 2, a ΔP of 1490 psia (P_{steam} = 760 psia) at a bounding T_{hot} for normal operating conditions was used in the sleeve minimum wall thickness calculations. The generic evaluation determined the level of sleeve wall degradation (depth by eddy current determination) that would require the sleeve to be removed from service is 32%, which includes an allowance of 10% for eddy current uncertainty and 10% for growth, although sleeve wall degradation has not been observed to date in Westinghouse sleeves. The sleeve plugging limit based on throughwall penetration of degradation for North Anna Unit 2 is determined to be 33%. As stated previously a primary-to-secondary pressure differential of 1490 psia across the steam generator tubes with a steam pressure of 760 psia was used. This value is taken from an extended tube plugging analysis performed for Unit 1, and is considered to be bounding for North Anna Unit 2 at a minimum reactor coolant system flow rate of 275,300 gpm. The pressure stress equation of Section NB 3224.1 of the ASME Code was used to establish the minimum wall thickness which helps to define the sleeve plugging limit as determined by eddy current. The minimum wall thickness established for the normal operation case bounds the calculated minimum wall thickness values for Upset and Faulted conditions at a minimum measured reactor coolant system flow rate of 275,300 gpm. Therefore, the 33% plugging limit is still bounding for all anticipated plant conditions upon issuance of the Technical Specifications change supporting a minimum measured reactor coolant flow of 275,300 gpm.

CONCLUSION

Based on the preceding analysis, it is concluded that operation of North Anna Power Station Unit 2 following the installation of Alloy 690 laser welded sleeves at the tube support elevations and within the tubesheet region of the steam generators, in accordance with the proposed amendment does not result in the creation of an unreviewed safety question, an increase in the probability of an accident previously evaluated, create the possibility of a new or different kind of accident from any accident previously evaluated, nor reduce any margins to plant safety. Therefore, the license amendment does not involve a significant hazards consideration as defined in 10 CFR 50.92.

REFERENCE DOCUMENTS

1) WCAP-13088, Rev. 1, "Westinghouse Series 44 and 51 Steam Generator Generic Sleeving Report - Laser Welded Sleeves," November 1992.

2) WCAP-13619, "Specific Application of Laser Welded Sleeves for North Anna Unit 2 Steam Generators," January 1993.

3) Virginia Electric and Power Company letter, Serial No. 92-721, "North Anna Power Station Unit 2 Proposed Technical Specifications Changes - Reduction in Minimum Measured RCS Flow Rate" (to 275,300 gpm), dated December 4, 1992.

4) Virginia Electric and Power Company letter, Serial No. N-92-11, Licensee Event Report No. 50-339/92-005-00, dated April 9, 1992.

5) NRC letter to Virginia Electric and Power Company, "Approval for Restart - Category C-3 Status of Steam Generators, North Anna Unit No. 1 (TAC No. 79783)," dated March 7, 1991.

6) NRC letter to Virginia Electric and Power Company, "North Anna Power Station, Unit No. 1 - Steam Generator Operating Cycle Evaluation (TAC No. M83715)," dated August 3, 1992.