### VIRGINIA ELECTRIC AND POWER COMPANY RICHMOND, VIRGINIA 23261

March 20, 1990

U.S. Nuclea/ Regulatory Commission Attention: Document Control Desk Washington, D.C. 20555

Serial No.: 90-104 NL&P/JYR:jbl R3 Docket No.: 50-339 License No.: NPF-7

Gentlemen:

0.2775

### VIRGINIA ELECTRIC AND POWER COMPANY NORTH ANNA POWER STATION UNIT 2 STEAM GENERATOR TUBE PLUG REPAIR

Currently, Virginia Electric and Power Company plans to take appropriate action to remove the plugs affected by NRC Bulletin 89-01, dated May 15, 1989, entitled "Failure of Westinghouse Steam Generator Tube Mechanical Plugs." However, as stated in Attachment 1 it may be necessary to approach the NRC and request approval for one fuel cycle relief to defer the plug removal workscope to the next refueling of North Anna Unit 2 so that other steam generator remedial activities may be performed during the 1990 refueling outage. Deletion of the sentinel plug workscope from the 1990 refueling outage schedule will enable us to focus resources on the remedial measures aimed at addressing steam generator tube integrity considerations and to minimize radiation exposure during the outage while still preserving the option to recover (return-to-service) most of these sentinelly plugged tubes. A technical basis, as well as a basis for considering plug removal deferment is provided in Attachment 1. We intend this letter to provide notice of the technical basis for a potential sentinel plug removal deferral request.

Attachment 2 of this letter contains information proprietary to Westinghouse Electric Corporation, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit 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, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the supporting Westinghouse Affidavit should reference CAW-89-067 and should be addressed to R. A. Wiesemann, Manager of Regulatory & Legislative Affairs, Westinghouse Electric Corporation, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

9003280335 900320 PDR ADOCK 05000339 PDC PDCK 05000339 APOL 1/10 WCAP-12265 Non Prop Change: LPDR. 1 INP 10 WCAP-12265 Prop Change: LPDR. 1 INP NRC PPR 1 INP

Should you have any other questions or desire to arrange a meeting to discuss this topic, please do not hesitate to contact us.

Very truly yours,

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W. L. Stewart Senior Vice President - Nuclear

Enclosures

- 1. Attachment I, Basis for Deferring Plug removal
- 10 copies of WCAP-12265 entitled "North Anna Unit 2 Evaluation For Tube Vibration Induced Fatigue" (Proprietary).
- 10 copies of WCAP-12266 entitled "North Anna Unit 2 Evaluation For Tube Vibration Induced Fatigue" (Non-Proprietary).
- 4. Westinghouse authorization letter, CAW-89-067, Proprietary Information Notice, and accompanying Affidavit.
- cc: U.S. Nuclear Regulatory Commission Region II 101 Marietta Street, N.W. Suite 2900 Atlanta, Georgia 30323

Mr. J. L. Caldwell NRC Senior Resident Inspector North Anna Power Station

# ATTACHMENT I

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# BASIS FOR DEFERRING PLUG REMOVAL

NORTH ANNA POWER STATION UNIT 2

### INTRODUCTION

NRC Bulletin 89-01, dated May 15, 1989, entitled "Failure of Westinghouse Steam Generator Tube Mechanical Plugs," required licensees to determine whether certain mechanical plugs supplied by Westinghouse were installed in steam generators and, if so, implement an action plan to ensure that these plugs would continue to provide adequate assurance of reactor coolant system (RCS) pressure boundary integrity under normal operating, transient, and postulated accident conditions. NRC Bulletin 89-01 identified the plug failure susceptibility as a result of the investigation into the North Anna Unit 1 1989 tube leak event. During the North Anna Unit 2 1989 refueling outage, extensive maintenance activities were completed to resolve the plug degradation issues raised as a result of both the North Anna Unit 1 1989 tube leak event and NRC Bulletin 89-01. Activities performed at North Anna in response to Bulletin 89-01 were completed consistent with the North Anna Plug Top Release Event Report submitted to the NRC on May 26, 1989.

#### Requested Consideration

During the North Anna Unit 2 1987 refueling outage, a total of 118 tubes across the three steam generators were sentinelly plugged as a preventive measure which would provide early warning of a fatigue failure similar to the Unit 1 1987 tube rupture event. Each of these tubes was removed from service with mechanical plugs later determined to be susceptible to the degradation described in NRC Bulletin 89-01.

During the North Anna Unit 2 1989 refueling outage, hot leg plugs with the suspect heat numbers (identified in NRC Bulletin 89-01) were removed and replaced as part of the corrective actions performed following the North Anna Unit 1 1989 tube leak event. Each of the hot leg plugs with suspect heat numbers installed in conventionally plugged tubes were removed and replaced. In addition, five (5) of the 118 hot leg plugs in sentinelly plugged tubes were removed and replaced because evaluations determined these tubes to be potentially susceptible to U-bend fatigue. The remaining 113 susceptible hot leg plugs in sentinelly plugged tubes were evaluated and determined acceptable for continued operation. Our technical justification for leaving these plugs installed and our action plan for final removal of the plugs were provided in the North Anna Plug Top Release Event Report submitted May 26, 1989.

Consistent with our action plan, we intend to address the remaining 113 sentinelly plugged tubes in the upcoming 1990 refueling outage. However, it is now our intent to remove the susceptible hot leg plugs and their companion cold leg plugs, then return these tubes to service after performance of appropriate eddy current testing. Additionally, we intend to remove the plugs from three (3) of the five (5) sentinelly plugged tubes previously determined to be potentially susceptible to U-bend fatigue. Further analysis performed has reduced the number of tubes with fatigue concerns to two (2), thereby, permitting recovery of the remaining three (3) tubes. Each of these tubes will also be returned to service following performance of appropriate eddy current testing.

The total number of tubes being considered for return to service per steam generator is listed below:

Steam Generator	Number of Tubes
A	44
В	28
C	44

Table I contains a Row, Column listing of the tubes sentinelly plugged in 1987. We intend to return each of these tubes to service with the exception of the two tubes designated. The technical basis for returning these tubes to service is contained in Westinghouse WCAP-12265, entitled "North Anna Unit 2 Evaluation for Tube Vibration Induced Fatigue," enclosed.

An additional activity under evaluation for the North Anna Unit 2 1990 refueling outage is steam generator tube support plate stress relief. We have performed extensive qualification efforts on this endeavor and have concluded that the process may ameliorate the condition that exists at dented tube support plate locations. These conditions have eventually led to degradation and tube plugging on our North Anna Unit 1 steam generators. We believe that through the performance of the tube support plate stress relief effort, future tube plugging rates due to primary side stress corrosion induced by denting at the tube support plates can be reduced. This is supported by extensive laboratory testing comparing the corrosion performance of stress relieved and nonstress relieved intersections.

In the event that either significant technical problems or mechanical plug removal problems occur during the outage, we may approach the NRC requesting a deferral of the remaining plug removal efforts in favor of performing the stress relief program. This will enable us to more effectively manage radiation exposure during the outage and at the same time maximize the long-term benefit to the steam generators. The technical basis for deferring the sentinel plug removal is provided below.

#### Technical Basis for Deferring Plug Removal

In order for a plug top release event to occur, sufficient potential energy (in the form of a pressure differential) must exist to propel a degraded tube plug with sufficient velocity to perforate a tube in the U-bend region. For tubes with sentinel plugs, this pressure differential is equal to the small difference between the hot and cold legs of the steam generator (approximately 35 psi). Additionally, the fluid above the plug must be air to permit the plug top to obtain the required velocity for tube perforation. As noted above, use of a sentinel plug assures the presence of water behind the plug which resists movement of the plug top through the tube precluding perforation of the inactive tube.

Reanalysis of these plug locations shows that the tubes are not susceptible to fatigue identified in NRC Bulletin 88-02 entitled "Rapidly Propagating Fatigue Cracks in Steam Generator Tubes." The potential for primary-to-secondary leakage due to plug degradation was also reviewed. The sentinelly plugged tubes were plugged as a preventive measure during the 1987 refueling outage. No pluggable eddy current indications were identified in any of these tubes prior to plugging. As these tubes are not operating under heat transfer conditions and are not believed to be susceptible to

fatigue, no active tube degradation phenomenon is expected. Furthermore, any leakage through a potentially degraded hot leg plug would be bounded by the leakrate through the existing cold leg sentinel plug.

Finally, the potential for plug degradation to generate a primary system loose object was assessed. A total of 65 plugs have been removed and metallographically examined from 16 operating units. Of the total number of plugs removed, 19 exhibited some form of degradation. Circumferential degradation was noted below the expander in 7 of the 19 plugs. No plugs exhibited 350 degree circumferential degradation below the expander. Two plugs exhibited semi-continuus cracking extending approximately 150 to 180 degrees, while the remaining five showed short, intermittent degradation below the expander. One of the two plugs exhibiting the large extent of circumferential indications below the expander has been discounted as an anomaly in the plug evaluation effort. This plug is from a heat generally regarded in France and the U.S. as being highly resistant to PWSCC based on its microstructure and otherwise consistent field performance.

No primary side loose parts have been seen to date due to mechanical plug degradation. This includes over 1200 domestic plugs which have operated beyond their lifetime, which is measured in effective full power days (EFPD), without generating a loose part in the primary system. Loose parts generation during the additional cycle of operation is considered unlikely.

If it is necessary to implement corrective actions at North Anna Unit 2 during the projected 1992 refueling outage, it is estimated that these plugs will go from a -650 EFPD (negative sign indicates these plugs are beyond their lifetime) to minimum ligament (estimated at the end of Cycle 7 operation) to approximately -1055 EFPD to minimum ligament remaining (estimated at the end of Cycle 8 operation). These calculations reflect a T-hot reduction of approximately six degrees implemented at the end of October 1989.

#### Summary

Currently, Virginia Electric and Power Company plans to take appropriate action to remove the plugs affected by NRC Bulletin 89-01. However, as stated above, we may approach the NRC and request approval for one fuel cycle relief to defer the plug removal workscope to the next refueling of North Anna Unit 2 so that other steam generator remedial activities may be performed during the 1990 refueling outage. Deletion of the sentinel plug workscope from the 1990 refueling outage schedule will enable us to focus resources on the remedial measures aimed at addressing steam generator tube integrity considerations and to minimize radiation exposure during the outage while still preserving the option to recover (return-to-service) most of these sentinelly plugged tubes at a later refueling outage.

# TABLE I

### NORTH ANNA UNIT 2 STEAM GENERATOR TUBES WITH SENTINEL PLUGS

### Steam Generator A

Row	Column	Row	Column	Row	Column
8	3	9	43	9	62
8	4	9	44	9	63
8	91	9	45	9	66
8	92	9	46	9	70
9	10	9	47	9	71
9	11	9	48	9	77
9	12	9	49	9	78
9	13	9	50	9	79
9	14	9	51	9	80
9	15	9	52	9	81
9	16	9	53	9	82
9	35	9	54	9	83
9	40	9	55	9	84
9	41	9	60 *	9	85
9	42	9	61	10	60

### Steam Generator B

Row	Column	Row	Column	Row	Column
8	3	9	35 *	9	49
8	4	9	40	9	50
8	91	9	41	9	51
8	92	9	42	9	52
9	14	9	43	9	53
9	15	9	44	9	54
9	19	9	45	9	60
9	31	9	46	9	92
9	33	9	47	9	93
9	34	9	48		

 Denotes tubes that will remain sentinelly plugged due to potential susceptibility to fatigue.

# TABLE I (Continued)

# NORTH ANNA UNIT 2 STEAM GENERATOR TUBES WITH SENTINEL PLUGS

### Steam Generator C

Row	Column	Row	Column	Row	Column
8	91	9	51	9	84
8	92	9	52	9	85
9	35	9	53	10	35
9	39	9	54	10	42
9	40	9	55	10	43
9	41	9	56	10	44
9	42	9	57	10	45
9	43	9	60	10	46
9	44	9	61	10	47
9	45	9	62	10	49
9	46	9	79	10	50
9	47	9	80	10	53
9	48	9	81	10	56
9	49	9	82	10	60
9	50	9	83		



Westinghouse Electric Corporation **Energy Systems** 

Nuclear and Advanced Technology Division

Box 355 Pittsburgh Pennsylvania 15230-0355

VRA-89-557

May 3, 1989 NS-OPLS-OPL-II-89-282

Mr. W. R. Cartwright, Vice President Nuclear Operations Virginia Power Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, Virginia 23060

### VIRGINIA POWER NORTH ANNA POWER STATION - UNIT 2 CONTRACT RELEASE NO. PM-CL6001-012 STEAM GENERATOR TUBE FATIGUE ANALYSIS

Dear Mr. Cartwright,

This letter transmits (10) copies each of proprietary (WCAP-12265) and non-proprietary (WCAP-12266) versions of the "North Anna Unit 2 Evaluation For Tube Vibration Induced Fatigue", dated May, 1989 for your submittal to the NRC for review and approval.

In addition to the proprietary and non-proprietary WCAPs, there are two other enclosures for your use:

- 1. Information which should be included in your NRC transmittal letter.
- Westinghouse letter "Application for Withholding Proprietary Information from Public Disclosure" (CAW-88-067) with Affidavit CAW-88-124.

Please transmit the original of item (2) to the NRC in your transmittal.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

Donald & Boynows

R. N. Easterling, Manager Steam Generator Maintenance Agreement

RHG/mlt

VRF-89-557 NS-OPLS-OF1-11-89-282 May 3, 1989

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cc: H. L. Miiler G. L. Pannell W. R. Runner, Jr. R. F. Saunders/9 copies W. A. Thornton J. L. Wilson W. M. Adams M. L. Bowling/1 copy R. O. Enfinger D. A. Heacock G. E. Kane D. C. Martin W. R. Matthews R. W. Riley W. W. Wigley A. H. Stafford J. A. Stall V. C. West R. W. Calder



#### ATTACHMENT TO VRA-89-557

#### VIRGINIA POWER Letter for Transmittal to the NRC

#### Enclosed are:

- 10 copies of WCAP-12265 entitled "North Anna Unit 2 Evaluation For Tube Vibration " \_\_\_\_ced Fatigue" (Proprietary).
- 10 copies of WCAP-12266 entitled "North Anna Unit 2 Evaluation For Tube Vibration Induced Fatigue" (Non-Proprietary).

Also enclosed is a Westinghouse authorization letter, CAW-89-067, Proprietary Information Notice, and accompanying Affidavit.

THE FOLLOWING PARAGRAPHS SHOULD BE INCLUDED IN YOUR LETTER TO THE NRC:

As item 1 contains information proprietary to Westinghouse Electric Corporation, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit 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 Section 2.790 of the Commission's regulations.

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