ATTACHMENT 1

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENTS

4.4.10.1.1 In addition to the requirements of Specification 4.0.5, 1) the Reactor Coolant pump flywheels shall be inspected per the recommendations of Regulatory Position C.4.b of Regulatory Guide 1.14, Revision 1, August 1975 and 2) the flow straighteners in each steam generator-to-RCP elbow shall be ultrasonically examined whenever a RCP shaft deflection of greater than 20 mils is indicated and at least once per 18 months.

4.4.10.1.2 In addition to the requirements of Specification 4.0.5 , at least one third of the main member to main member welds, joining A572 material, in the steam generator supports, shall be visually examined during each 40 month inspection interval.

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3/4.4.10 STRUCTURAL INTEGRITY

3/4.4.10.1 ASME CODE CLASS 1, 2 and 3 COMPONENTS

The inspection programs for ASME Code Class 1, 2 and 3 the Reactor Coolant System components ensure that the structural integrity of these components will be maintained at an acceptable level throughout the life of the plant. To the extent applicable, the inspection program for components is in compliance with Section XI of the ASME Boiler and Pressure Vessel Code.

ATTACHMENT 2

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

REACTOR COOLANT SYSTEM

3/4.4.10 STRUCTURAL INTEGRITY

ASME CODE CLASS 1,2 & 3 COMPONENTS

LIMITING CONDITION FOR OPERATION

3.4.10.1 The structural integrity of ASME Code Class 1, 2 and 3 components shall be maintained in accordance with Specification 4.4.10.1.

APPLICABILITY: ALL MODES.

ACTION:

a. With the structural integrity of any ASME Code Class 1 component(s) not conforming to the above requirements, restore the structural integrity of the affected component(s) to within its limit or isolate the affected component(s) prior to increasing the Reactor Coolant System temperature more than 50°F above the minimum temperature required by NDT considerations.

b. With the structural integrity of any ASME Code Class 2 component(s) not conforming to the above requirements, restore the structural integrity of the affected component(s) to within its limit or isolate the affected component(s) prior to increasing the Reactor Coolant System temperature above 200°F.

c. With the structural integrity of any ASME Code Class 3 component(s) not conforming to the above requirements, restore the structural integrity of the affected component(s) to within its limit or isolate the affected component(s) from service.

d. The provisions of Specification 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.4.10.1.1 In addition to the requirements of Specification 4.0.5, the Reactor Coolant pump flywheels shall be inspected per the recommendations of Regulatory Position C.4.b of Regulatory Guide 1.14, Revision 1, August 1975.

4.4.10.1.2 In addition to the requirements of Specification 4.0.5, at least one third of the main member to main member welds, joining A572 material, in the steam generator supports, shall be visually examined during each 40 month inspection interval.

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ATTACHMENT 3

REQUEST FOR REMOVAL OF STEAM GENERATOR SUPPORT HEATERS AND INSULATING TENTS

NORTH ANNA STATION
UNITS 1 & 2

VEPCO NOD/O&MS

References:

a. NUREG 0577, Revision 1, October 1, 1983

b. NUREG/CR-3099, SAND 78-2347

c. NRC - ACRS Transcript, subcommittee meeting on North Anna Steam Generator, Units 1 & 2. Washington D.C., Wednesday 13 October, 1976; Pages 1-83; Attachments Pages 1-258.

d. NRC-ACRS Transcript, Advisory Committee on Reactor Safeguards, North Anna subcommittee meeting, Washington D.C., Wednesday 7 July, 1976; Pages 1-222; Attachments Pages 1-169.

e. North Anna UFSAR, Volume VIII, Attachment 1 to Appendix 5B Tables 10 and 11.

f. North Anna UFSAR, Volume VII, Section 5.5.9.2.2 Steam Generator and Reactor Coolant pump supports. Pages 5.5-60 through 5.5-65.

g. Vepco letter of May 15, 1978 to Mr. Edson G. Case, Office of Nuclear Reactor Regulation, Serial No. 425A/091477. Docket Nos. 50-280 and 50-281. Enclosure to letter, page 2, response to question 4.

I. BACKGROUND

The North Anna Unit 1 and 2 Steam Generator Supports are frame structures, constructed primarily from heavy beams jointed by welding. The supports are stiff and highly redundant in load path capability. Materials used for the support beams are ASTM A36 and ASTM A572 grades 42 and 50.

The North Anna Unit 1 and Unit 2 Technical Specifications Section 3.4.10.2.a and .c require that with pressurizer pressure greater than 1000 psig, the temperature of the steam generator supports shall be greater than 85°F for ASTM A36 beams and greater than 225°F for ASTM A572 beams. The A36 beams are monitored in the lower region of the supports at a bottom level corner, and the A572 material is monitored at a middle level corner during unit operation and at a top level corner during unit startup. The Technical Specifications Section 3.4.10.2.b, also require that the temperature monitored at the top level corner be less than 355°F.

These Technical Specification requirements are based on improvements achieved in fracture toughness of the A36 and A572 beams in the supports as a result of use of the material at elevated temperature. In order to achieve these elevated temperatures, the supports are insulated by use of tent-like enclosures and heated by resistance space heaters.

The temperature of the support materials required by the technical specifications was based on recommendations of the ACRS, and an ASLB

Decision issued during the licensing of the North Anna units. The ACRS addressed the minimum temperature of the A572 material in their October 26, 1976 report, "Report on Partial Review of North Anna Power Station Units 1 & 2". The ASLB addressed the minimum operating temperature of the A36 material in their Decision of December 13, 1977.

Subsequent to these requirements, now reflected in the North Anna technical specifications, the NRC staff formulated Task Action Plan A-12 to resolve Generic Issues Task A-12. This generic issue related to the potential for low fracture toughness of PWR steam generator and reactor coolant pump supports and the concern over lamellar tearing raised by the North Anna supports. NUREG 0577, Revision 1, was issued October 1983, and based on the information and conclusions presented in NUREG 0577, Revision 1, Unresolved Safety Issue A-12 is considered complete by the NRC, and the issue is resolved. In part, the findings of the NRC as presented in NUREG 0577, Revision 1, Section 2.4, dealing with support fracture toughness are that modifications (including heating) to existing support structures could not be justified in light of the results of the NRC value-impact analysis.

In addition, the NRC stated that the lamellar tearing subtask of the A-12 issue was resolved. Specifically, the NRC noted that in the North Anna supports the lamellar tears were detected during inspection and removed by rewelding the supports.

II. TECHNICAL BASIS FOR REMOVING STEAM GENERATOR SUPPORT HEATERS AND INSULATION TENTS

The requirement to operate the North Anna station, Units 1 and 2, with steam generator supports at an elevated temperature was implemented prior to the NRC generic review of the support fracture toughness issue. The generic review has resulted in the NRC completing two actions:

(1) Issue NUREG 0577, Revision 1, for information, and

(2) Issue a new standard review plan for future stations.

Vepco has performed a review of previous analyses of the steam generator supports, but now employing Section 2.3 of NUREG 0577, Revision 1, as acceptance criteria. The results of this new review indicate by NDT Evaluation, Section 2.3.2 for A36 material, and by "consequence analysis", Section 2.3.5 for A572 material, that the supports are acceptable without elevated temperature use. This conclusion is developed based on the requirements of NUREG 0577, Revision 1, Section 2.3.5 which states:

> "Materials with satisfactory toughness according to any one of the technical findings detailed in Sections 2.3.1, 2.3.2, 2.3.3, and 2.3.4 require no further action to demonstrate acceptability. If the toughness is unsatisfactory, analyses may be conducted to demonstrate that the support will continue to function under design-basis accident loading despite the assumed failure of the most highly stressed member of those that do not satisfy the fracture toughness criteria. Under these conditions, the predicted displacements,

including the effects of redundancy provided by piping or contact with adjacent structures, must not:

(1) impair the functions of the steam generators or reactor coolant pumps required for safe shutdown and cooldown, or

(2) rupture the pressure boundary of either the primary or secondary system severly enough to prevent safe shutdown and cooldown.

If analyses fail to demonstrate that consequences (1) and (2) above will be avoided, there are several corrective measures that could be considered and evaluated on a cost-effective basis."

In order for Vepco to perform a reference a. analysis of support toughness, it is desirable to establish the minimum support temperature which would be achieved under the operating conditions which could generate faulted condition loads. Since it was the intent of Vepco during unit licensing to operate the steam generator supports at North Anna with insulating blankets and heaters, neither detailed calculations nor measurements of support temperatures without these devices was made. There are, however, other indicators of minimum support temperature.

The minimum temperature of one metallic support component without insulation or heaters under assumed worst case start up containment ambient air conditions of 70°F was determined and presented in reference c. The component was the reactor coolant pump column

supports below the pumps and toward the cubicle floor, which is an indicator of the temperature of the steam generator supports in this general location. The minimum temperature calculated for the pump column was 86°F. Also, the North Anna technical specifications require a minimum average containment temperature of 80°F during operation. This temperature is the average of a number of containment readings including the steam generator cubicles. On January 3, 1984, readings were taken in the North Anna 1 and North Anna 2 steam generator cubicles of ambient air temperature. Both units were at 100% power, and the average ambient cubicle temperature in Unit 1 was 84.2°F, and the average in Unit 2 was 91.03°F. These temperature readings were taken in the cubicles at historically low temperature locations above the supports.

Numerous support temperature readings were taken at the Surry station by Vepco for the AIF Materials Subcommittee in 1981. These readings clearly showed that in the subatmospheric containment of the Surry station, which is similar to North Anna, at hot standby and normal operation, support temperatures at all locations were equal to or higher than ambient temperatures. It is therefore assumed that for the North Anna Station the temperature of the steam generator supports will be no lower than the ambient cubicle air temperatures during operation of the units.

Also, in connection with developing information for the North Anna support problem, temperatures of ambient air in the Surry Unit No. 2 containment adjacent to the steam generator supports were measured

during operation at 100% power. These temperatures ranged from 83.2°F minimum in October 1975 to 91.6°F minimum in August 1975. This information was presented to the NRC in reference g.

Based on the above information, the North Anna steam generator support minimum temperature will be conservatively placed at 80°F, under normal operation and hot standby conditions, which are considered the earliest conditions achieved in plant start up capable of generating faulted loading conditions (including LOCA loads) in the steam generator supports. However, the actual minimum temperature of the coldest beams in the supports under these conditions is likely as much as 10°F higher than the assumed 80°F value.

A review of the properties of the A36 and A572 materials in the steam generator supports with minimum operating temperature established, and in-light of the analysis methods presented in reference a., Sections 2.3.1, 2.3.2, 2.3.3 and 2.3.4 reveals the following general conclusions concerning the demonstration of adequacy of support materials:

(1) The A572 beams, because of their section thickness and measured maximum NDT (100°F) would not meet the requirements of Section 2.3.2 for NDT evaluation of material with yield strength of 180 ksi or less.

(2) The A36 beams, however, all met the NDT criteria of Section 2.3.2.

(3) Charpy V-Notch (CVN) data is not acceptable to reference a. for either the A36 or A572 material because of the required high charpy values for the greatest section thickness of the beams.

(4) The linear elastic fracture mechanics technique identified in Section 2.3.4 of reference a. would be difficult to employ for either material because of the lack of weld metal and HAZ data correlation between CVN data and KIC data for the support material. Also, there are questions concerning the quantification of residual stress values.

(5) The overall review leads to the "consequence analysis", Section 2.3.5, of reference a. as the method by which the A572 material in the supports must be shown acceptable.

(6) The A36 material is shown acceptable by the Section 2.3.2 NDT analysis. Also, the A36 material is considered acceptable because of the consequence analysis for the A572 material. Because the A572 material represents the most highly stressed beams with unacceptable fracture toughness, technically only the A572 material must be shown acceptable to meet the reference a. requirements.

III. SPECIFIC EVALUATIONS

A. NDT Analysis for A36 Material

Numerous NDT values were recorded for A36 material in the North Anna supports. These values are recorded in reference d., and the highest values were +40°F. This value is totally consistent with the reference b., Table 4.4 value of NDT +1.3 σ of +39°F. Therefore, for A36 material in the North Anna supports, NDT will be considered +40°F, for worst case beams.

In compliance with NUREG 0577, Revision 1, Section 2.3.2 under "NDT Evaluation Procedure", The NDT value of +40°F is required to be below the lowest service temperature of the supports by an amount indicated by the NUREG Figure - 1 curve. The Figure - 1 curve is based on thickness, and for the North Anna supports the thickest A36 materials are three inch (3") flanges of 426 lb. per foot beams. For three inch (3") thickness material, Figure - 1 requires a 40°F margin between NDT temperature and lowest service temperature. The lowest service temperature of the steam generator supports is considered 80°F, as noted previously. Therefore, the required margin of 40°F between the NDT temperature of +40°F and the lowest service temperature of 80°F is achieved. Based on this analysis the A36 material in the steam generator supports is considered acceptable. This analysis, however, is redundant as the A36 material is not the most highly stressed material in the supports which does not satisfy the fracture toughness criteria. An acceptable reference a. "consequence analysis" for the A572 material is considered also to qualify the A36 material as acceptable.

P. Consequence Analysis for A572 Material

The following guidelines were employed by Vepco in review of the supports for the "consequence analysis" allowed by reference a. to demonstrate support adequacy under design basis accident loading:

a. Loads employed in the analysis are extremely conservative as they are those generated in the support member analyzed as a

result of deadweight (DW), plus LOCA, plus design basis earthquake (DBE). This was the original design basis (faulted condition) employed in licensing the units.

b. In lieu of showing that the support displacements would be acceptable, Vepco has chosen to show that with the failure of the most highly stressed member, loads in other members would not equal or exceed 0.9 times the material yield strength (Sy). With this condition there would be no deformation of the support members to which component loads were shifted and therefore no displacement of components. The North Anna steam generator supports are of the frame design, which are extremely stiff and highly redundant in load path capability. When a member(s) is analytically considered to be broken, the load path changes and other members assume the load of the disabled member(s).

c. The "consequence analysis" was restricted to the ASTM A572 beams. The A572 beams showed the unacceptable toughness properties and could not be qualified by methods other than the "consequence analysis". Several A572 members were assumed to be failed and resultant stresses calculated during plant licensing in 1976. One analysis performed in 1976 now meets the NUREG 0577, Revision 1, criteria for a "consequence analysis".

d. The redundancy or "consequence analysis" of the supports performed in 1976 was in answer to NRC Staff and ACRS questions in support of the licensing efforts for North Anna 1 and 2. No new calculations have been performed for this submittal. All submittals to support the conclusions

described in this request were reviewed previously by the NRC staff, but prior to the concept of a "consequence analysis" now allowed in NUREG 0577, Revision 1.

A total of four (4) steam generator support redundancy evaluations were performed for Vepco by our A-E, Stone and Webster Engineering Corporation, in 1976 and submitted to the NRC (See Figure - 1). Of these four, one is specifically applicable to the "consequence analysis" required by NUREG 0577, Revision 1, Section 2.3.5. A second analysis is of general interest because it demonstrates the extreme redundancy of the supports in alternate load paths. This analysis does not consider the most highly stressed members, however, and is therefore not specifically applicable to reference a., Section 2.3.5. Reference a., Section 2.3.5 requires that the analysis show that: ". . . the support will continue to function under the design-basis accident loading despite the assumed failure of the most highly stressed member of those that do not satisfy the fracture toughness criteria." All A572 material is assumed not to meet the fracture toughness criteria.

The two redundancy evaluations previously performed which are either of interest or specifically applicable to the "consequence analysis" criteria are:

Evaluation 1 General interest but not specifically applicability to reference a. "consequence analysis";

One full interior corner support is removed under loading of dead weight (DW) plus design basis earthquake (DBE), plus LOCA. The resultant stress in each remaining member

of the support must be less than 0.9 times material yield strength.

Evaluation 2 Specific applicability to "consequence analysis" of reference a.;

A top side rail (605 pound beam) is severed under loading of DW plus DBE, plus LOCA. The resultant stress in each remaining member must be less than 0.9 times material yield strength.

From Table 11 of reference e., many of the A572 beams are at stress levels representing the higher stress values in the supports during faulted condition loading of DW, plus DBE, plus LOCA. These beams are:

Member Number	Faulted Condition Stress	Member Size
43	26.9 Ksi	426 lb. beam
45	26.6 Ksi	426 lb. beam
46	30.6 Ksi	426 lb. beam
47	29.3 Ksi	426 lb. beam
3	29.9 Ksi	605 lb. beam
49	25.4 Ksi	426 lb. beam
88	26.8 Ksi	605 lb. beam

The Evaluation 1 analysis eliminated one interior corner including A572 members 88, 44, and 45. Members 88 and 45 are among the most highly stressed of the A572 beams. Their removal along with four (4) A36 members results in a redistribution of stresses in the steam generator supports. The new stresses are provided in Table 10, reference e.

Table 10 clearly indicates that the resultant stresses in the remaining members of the support are less than 0.9 times material yield strength. While neither member 88 or 45 represents the most highly stressed A572 member, both are representative of highly stressed A572. Also, material properties for all members of A572 can be considered approximately the same at the lowest possible temperature of interest which is 80°F. The material properties are presented in detail in references c. and d., and these references indicate lower bound impact energy values at 80°F of approximately 5 ft. lbs., by Charpy V-notch testing. The maximum NDT as determined by Drop Weight test is 100°F for the A572 material.

This analysis clearly indicates the extreme redundancy of the steam generator supports. Although it does not specifically satisfy the reference a. requirements for a "consequence analysis".

The Evaluation 2 analysis represents the specific "consequence analysis" required by NUREG 0577, Revision 1. Member 3, a large 605 lb. A572 beam, is considered severed under loading conditions of DW, plus DBE, plus LOCA. The stress level in the beam is 29.9 Ksi which represents the most highly stressed 605 lb. beam. One A572, 426 lb. beam is stressed to 30.6 Ksi, but the fracture resistance of the 4" flange of the 605 lb. beam is considered lower than that of the 3" flange of the 426 lb. beam. Therefore, the small difference in maximum stress level of 0.7 Ksi for the 426 lb. beam is not the dominant consideration and reference a. will be addressed by analysis of the 605 lb. beam. This approach is further supported by NUREG 0577, Revision 1, Figure-1, "Margin Between the NDT Temperature and Lowest Service

the degree requiring replacement in the near future. Based on replacement of all blankets every 7 years, a total of 200 man-rem will be expended performing this task.

Weld inspections with the tents in place will account for another 140 man-rem and removal for access to the steam generator primary manways will add another 6 man-rem. Collectively, a total of over 346 man-rem will be incurred at North Anna due to the insulation tents alone. In addition, all work around the blankets creates a potentially radioactive airborne area due to the contaminated nature of the blankets. This necessitates the wearing of respirators which adds to the exposure a worker will expend doing a given task in the area.

Replacement cost of blankets for the life of the plant (five cycles) amounts to $4,845,000. Disposal costs associated with the burial of the spent radioactive blankets amount to $300,000. Electrical cost to heat the supports and then cool the containment of the excess heat created by the heaters is estimated at $938,000.

Total cost directly related with the insulation blankets for the life of the units amount to $6,083,000 in 1983 dollars.

V. CONCLUSIONS

As a result of the NUREG 0577, Revision 1 NDT Analysis of the A36 material in the steam generator supports, this material is considered acceptable without heating or temperature monitoring.

Temperature as a Function of Component Thickness". This figure requires the addition of 40°F to NDT for the 3" flange, but 50°F to NDT for the 4" flange. Since the maximum NDT for all A572 in the supports can be considered the same worst case value (100°F), a 10°F penalty in NDT is required for the 4" flange of the 605 lb. beam, over that required for the 3" flange of the 426 lb. beam. This indicates the lower fracture toughness of the 605 lb. beam.

The final results of the Evaluation 2 analysis (i.e., stresses in remaining members did not exceed 0.9 times material yield strength) was presented to the ACRS in reference c. by the NRC staff. The result of the analysis as stated by the NRC was that the design was adequate.

The Evaluation 2 analysis satisfies the NRC criteria of reference a. to demonstrate that the North Anna steam generator supports are acceptable without elevated temperature use.

IV. REDUCED EXPOSURE AND COSTS BY REMOVING HEATERS AND INSULATION TENTS

At the present time, all steam generator supports in both units are heated and each support employs an insulating tent to maintain the supports at the required technical specification temperatures. Technical Specification temperatures require the use of 90 KW of electrical energy per support at startup and 50 KW per support during plant operation.

The North Anna 1 insulating tents have been in service since 1978, and the North Anna 2 tents have been in service since 1980. Through normal use, these blankets have become contaminated and have deteriorated to

As a result of the NUREG 0577, Revision 1, "consequence analysis" of the A572 material in the steam generator supports, this material (as well as the A36 material) is also considered acceptable without heating or temperature monitoring.

The NRC, in NUREG 0577, Revision 1, has concluded that modifications to existing supports could not be justified in light of the results of the value-impact analysis. While Vepco has previously implemented modifications (heating and insulation tents) to the supports, costly rework of the insulating tents will be required within 2 years and approximately every seven years thereafter. These rework costs combined with electrical energy costs to operate the heaters over the life of the station are expected to exceed six million dollars.

In addition to the direct costs in rework and operation of the insulating tents and heaters, at least 346 man-rem exposure will result over the life of the station if the insulating tents and heaters are not removed.

Based on the above conclusions, Vepco requests approval from the NRC to remove the insulating tents and heaters from North Anna Units 1 and 2. The proposed Technical Specification changes reflect a revision to Technical Specifications 3.4.10.2.a, b, and c for Limiting Conditions for Operation, Specifications 4.4.10.2.1 and 4.4.10.2.2 for Surveillance Requirements and BASES Section 3.4.10.2. These changes delete the requirements for minimum and maximum temperature limits for A36 and A572 beams in the supports and delete verification requirements for determination of beam temperatures. The inservice inspection

requirements for beam inspection on a 40 month basis are not proposed to change, and will provide a reasonable degree of assurance of the integrity of the support structure.

The probability of occurrence or the consequences of a malfunction of equipment important to safety and previously evaluated in the FSAR will not be increased if the requirement for elevated temperature use of ASTM A36 and ASTM A572 beams in the steam generator supports is eliminated. Elevated temperature use of the ASTM A36 beams is not required based on the NUREG 0577, Revision 1, NDT analysis. The NUREG 0577, Revision 1 "consequence analysis" has been satisfied for use of the ASTM A572 material and ASTM A36 material without heating. For the A572 material, failure of the most highly stressed beam with the greatest section thickness (lowest fracture toughness) was shown not to adversely effect component support integrity.

The possibility of a different type of accident or malfunction than was previously evaluated in the FSAR has not been created because no loss in support integrity will occur in the event of failure of the most highly stressed low fracture toughness A572 beam. The A36 beams pass NDT analysis and will not fail.

The margin of safety as described in the BASES section of any part of the Technical Specifications is not reduced because the analysis of the steam generator supports has met the requirements of NUREG 0577, Revision 1 for determination of steam generator support integrity.

FIGURE 1

FOUR EXPLICIT REDUNDANCY EVALUATIONS (S.G. FRAME)

1. ONE FULL INTERIOR CORNER SUPPORT REMOVED [D.W. + DBE + LOCA (BK-7)]
2. ALL LOWER INTERIOR SUPPORT DIAGONALS REMOVED [D.W.]
3. ALL A-572 MATERIAL REMOVED (8 MAJOR BEAMS) [D.W.]
4. TOP SIDE RAIL (605 LB. BEAM) SEVERED [D.W. + DBE + LOCA (BK-7)]

CONCLUSION: ALL STRESSES $< .9S_y$

LICENSING REF.: ETH. I Q 1. (PARTIAL)
Q S.5.68 AMEND. 54, 57 (1. ONLY)
ETH. II Q 5. (a)