

January 19, 1977

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Docket No.: 50-280

Virginia Electric & Power Company  
 ATTN: Mr. W. L. Proffitt  
 Senior Vice President - Power  
 P. O. Box 26666  
 Richmond, Virginia 23261

Gentlemen:

The Commission has issued the enclosed Amendment No.29 to Facility Operating License No. DPR-32 for the Surry Power Station Unit No. 1, in response to your letters dated October 25, 1976, January 3 and 14, 1977.

The amendment adds a condition to the license related to the repair program for the steam generators of Surry Unit No. 1 and restricts operation of the reactor to 20 equivalent power days pending submittal of and NRC review and approval of your response to our request for additional information as identified in the enclosed Safety Evaluation. We concur that the repair program for the steam generators of Surry Power Station Unit No. 1 is adequate subject to the conditions of this license amendment.

Copies of the Safety Evaluation and the Federal Register Notice are also enclosed.

Sincerely,

*Original signed by*

Karl R. Goller, Assistant Director  
 for Operating Reactors  
 Division of Operating Reactors

Enclosures:

1. Amendment No. 29 to DPR-32
2. Safety Evaluation
3. Federal Register Notice

cc w/enclosures: See next page

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Virginia Electric & Power Company

cc w/enclosure(s):

Michael W. Maupin, Esq.  
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Swem Library  
College of William & Mary  
Williamsburg, Virginia 23185

Mr. Sherlock Holmes, Chairman  
Board of Supervisors of Surry County  
Surry County Courthouse  
Surry, Virginia 23683

Chief, Energy Systems  
Analyses Branch (AW-459)  
Office of Radiation Programs  
U. S. Environmental Protection Agency  
Room 645, East Tower  
401 M Street, S.W.  
Washington, D.C. 20460

U. S. Environmental Protection Agency  
Region III Office  
ATTN: EIS COORDINATOR  
Curtis Building (Sixth Floor)  
6th and Walnut Streets  
Philadelphia, Pennsylvania 19106

cc w/enclosures and incoming  
dtd.: 10/25, 1/3 and 1/14  
Commonwealth of Virginia  
Council on the Environment  
903 9th Street Office Building  
Richmond, Virginia 23219



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

VIRGINIA ELECTRIC & POWER COMPANY

DOCKET NO. 50-280

SURRY POWER STATION UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 29  
License No. DPR-32

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The facility will operate in conformity with the provisions of the Act, and the rules and regulations of the Commission;
  - B. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - C. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;  
and
  - D. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, the license is amended by adding a new Paragraph 3.E. as follows:
  - E. Steam Generator Repair Program

The plant shall be brought to the cold shutdown condition within 20 equivalent days of operation from January 19, 1977, unless acceptable responses to the two requests for additional

information given in Appendix A of the enclosed Safety Evaluation are received and further operation is approved by the Nuclear Regulatory Commission. For the purpose of this requirement, equivalent operation is defined as operation with a primary coolant temperature greater than 350°F.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Robert W. Reid, Chief  
Operating Reactors Branch #4  
Division of Operating Reactors

Date of Issuance: January 19, 1977



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 29 TO LICENSE NO. DPR-32

VIRGINIA ELECTRIC & POWER COMPANY

SURRY POWER STATION UNIT NO. 1

DOCKET NO. 50-280

Introduction

By letters dated January 3, 1977 and January 14, 1977, Virginia Electric and Power Company (VEPCO) submitted an analysis of steam generator tube integrity for Surry Unit No. 1. This information expanded upon the previous analyses concerning the U-bend cracking phenomenon in the steam generators of Surry Unit No. 2. VEPCO has performed corrective action to prevent further occurrences of U-bend cracking in the steam generators of Unit No. 1 and proposes to return Unit No. 1 to power for two effective full power months (EFPM).

Discussion

The laboratory examination by Westinghouse, the steam generator manufacturer, of 71 U-bends at flow slot locations in rows 1, 2, and 3 from Surry Units Nos. 1 and 2 and Turkey Point Unit No. 4 has shown that intergranular cracking at the U-bend apex was found only in the row 1 tubes. Consequently, all the row 1 tubes in the steam generators of these PWR units have been plugged.

Of the 71 tubes removed from the three most severely affected operating reactors, no cracks have been found in tubes with computed equivalent strains less than 13.5%. This indicates the strain level for which rapid development of stress corrosion cracking of tubing in these steam generators could occur.

For Surry Unit No. 1, VEPCO has calculated the equivalent strains for the tubes in rows 2, 3, and 4. With complete slot closure, the maximum equivalent strain for any tube in row 2 is 10.1% to 10.9%, 7.4% to 8.3% for any tube in row 3, and 6.3% to 7.1% for any tube in row 4. Therefore, the susceptibility for intergranular cracking of tubes beyond row 1 would be substantially less because of the larger U-bend radius, less plastic pre-straining, and smaller residual stresses.

As a further corrective action to prevent the possibility of intergranular cracking at the U-bend apex for tubes beyond row 1, VEPCO has installed stainless steel 304 alloy blocks in each of the six flow slots in the top tube support plate of all three Surry Unit No. 1 steam generators. These blocks will prevent further closure of the flow slots and inward displacement of the legs of the U-bends, thereby preventing further straining at the U-bend apex of those tubes in rows 2 and beyond. As a result, intergranular stress corrosion cracking of the tubes in row 2 and beyond is not anticipated during operation for a limited period of time.

However, the introduction of the flow slot blocking devices results in potential strain redistribution in the tube support plate. To estimate these effects, VEPCO has also provided results of preliminary calculations to evaluate the effects of installing flow slot blocking devices. First, the calculations were made for three loading conditions corresponding to the uniform in-plane growth of the top support plate at 0.014 and 0.021 inch per inch strains, and an uneven in-plane growth of the top support plate at 0.042 and 0.030 inch per inch strains in the hot and cold sides, respectively. Results of these three cases are quite similar; all indicating maximum strain rates in the hard spot regions. Hard spot tubes are those tubes located in the tube lanes between flow slots and near all wedge locations. There are no significant changes in the regions of high strain in going from 0.014 to 0.042 inch per inch strain. These three analyses were performed without the flow slot blocking devices and, therefore, represent the in-plane growth of the top support plate during past operation.

In order to evaluate the effects of the flow slot blocking, further analyses were made for a loading condition, corresponding to the 0.021 inch per inch strain, applied to the already deformed plate that had been subjected to the loading condition corresponding to 0.014 inch per inch strain, with and without the blocking devices. Results of these two analyses indicated a negligible amount of increase in strain and a small amount of deformation of the perimeter of the plate. Therefore, VEPCO concluded that:

- (1) the expansion of the periphery is not in direct proportion with the increased expansion, and
- (2) the expansion of the plate at the perimeter is not worse with the flow slots blocked than it is without the blocks inserted.

These analyses are preliminary and are based on a number of simplifying assumptions. Nevertheless, the effects of continued corrosion observed in the past would not lead, in a period of a few weeks, to straining and consequent strain redistribution which would require a more complex and complete analysis. For longer term operation the staff identified some of the additional information that may be needed (See Appendix A).

To further alleviate concerns over the integrity of tubes in the hard spot regions, preventive plugging of these tubes was accomplished. The so-called hard spot tubes are those tubes near the tube lane and near all wedge locations. The plugging criteria were established on the basis of field data, the finite element analysis, and relate to prevention of tube leaks at dented locations.

Another consideration is that due to insertion of the flow slot blocking devices additional loads are transmitted to the steam generator shell through the load path of the support plate, wedge, wrapper, and channel spacer. Based on preliminary "crush" tests performed by Westinghouse, the maximum load that can be developed along this load path is 60,000 pounds. Analysis of the bearing stress along this load path indicates that all stresses are less than the yield strength. Such stresses on the steam generator shell are highly localized and self limiting and will not adversely affect the integrity of the shell under accident conditions. Again, however, more complex considerations must be given to the potential for significant increases in tube support plate damage and consequent effects on tube integrity, but, the rate of corrosion at this facility is such that for a period of a few weeks, little further support plate damage would occur.

The NRC staff has concluded based on a preliminary analysis of the information submitted to date, that Surry Unit No. 1, may operate for 20 full power days (EFPD), i.e., coolant temperature in excess of 350°F. Authorization for further operation will be considered upon submittal of additional information to support the safety of any further operation including the information specified in Appendix A to this Safety Evaluation.

The information reviewed by us which lead to this evaluation is discussed above in detail and may be summarized as follows:

1. Laboratory examinations of 71 tubes removed from Surry Units Nos. 1 and 2 and Turkey Point Unit No. 4 steam generators indicate that cracking was confined only to row one tubes.
2. All tubes in row one are plugged.
3. Effective U-bend strain is 30-50% lower in row 2 than in row 1.
4. Flow slot blocking devices have been inserted to arrest further flow slot closure.
5. Preliminary analyses of the support plate expansion (with flow slot blocking device) indicated small hard spot strain increases and plate perimeter deformations.
6. The number of tubes plugged in the hard spot areas was increased.
7. Wedges, wrapper, channel, and shell stresses are below the yield strength.

For these reasons, we conclude that operation during a limited period (while further analyses may be performed) would not result in significant degradation of steam generator tubes and tube support plates.

#### Environmental Conclusions

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR §51.5(d)(4) that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

#### Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: January 19, 1977

APPENDIX A

REQUEST FOR ADDITIONAL INFORMATION

- (1) VEPCO's response to our telecopied request:

"Provide the details of the calculations used to plot the strain maps (two figures) of Figure 5-2, i.e., the operating time equivalent to the strain rates employed. Provide legible figures."

does not explicitly state the manner by which VEPCO correlated operational time with the support plate expansion strain, especially for a blocked flow slot. Details of this correlation are required. In addition, the 0.021 in/in expansion accounts for only 0.8 months of expansion with blocking devices. VEPCO should provide an analysis which justifies two months operation with these devices. VEPCO should also quantify the effect of such an expansion on the strain in the tubes or demonstrate that tubes with excessive hard spot strain are plugged.

- (2) A summary of the Westinghouse experimental programs regarding denting, intergranular stress assisted corrosion, corrosion rate, etc., the results to date, and the schedules and milestones for future work are required.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-280

VIRGINIA ELECTRIC & POWER COMPANY

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY  
OPERATING LICENSE

The U. S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 29 to Facility Operating License No. DPR-32, issued to Virginia Electric & Power Company (the licensee), for operation of the Surry Power Station Unit No. 1 (the facility) located in Surry County, Virginia. The amendment is effective as of its date of issuance.

The amendment adds a condition to the license related to the repair program for the steam generators of Surry Power Station Unit No. 1, limiting operation to twenty equivalent days.

The Commission has made appropriate findings as required by the Atomic Energy Act of 1954, as amended, and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Prior public notice of this amendment was not required since the amendment does not involve a significant hazards consideration.

The Commission has determined that the issuance of this amendment will not result in any significant environmental impact and that pursuant to 10 CFR §51.5(d)(4) an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with issuance of this amendment.

For further details with respect to this action, see (1) the licensee's submittals dated October 25, 1976, January 3 and 14, 1977, (2) Amendment No. 29 to License No. DPR-32, and (3) the Commission's related Safety Evaluation. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C. and at the Swem Library, College of William and Mary, Williamsburg, Virginia.

A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland, this 19th day of January 1977.

FOR THE NUCLEAR REGULATORY COMMISSION



Robert W. Reid, Chief  
Operating Reactors Branch #4  
Division of Operating Reactors