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VIRGINIA POWER

June 17, 1985

Mr. Hugh L. Thompson, Jr., Director
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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Docket Nos. 50-280
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Gentlemen:

VIRGINIA POWER
SURRY AND NORTH ANNA POWER STATIONS
RESPONSE TO GENERIC LETTER 85-02

We have reviewed Generic Letter 85-02, "Staff Recommended Actions Stemming From NRC Intergrated Program for the Resolution of Unresolved Safety Issue Regarding Steam Generator Tube Integrity," dated April 17, 1985. Attachment 1 is the description of our overall program for assuring steam generator tube integrity and tube rupture mitigation. Attachment 2 describes our steam generator inspection sampling program and our recommendations pertaining to Category C-2 inspection results obtained during initial sampling.

Should you have any questions concerning this matter we would be happy to discuss them with you.

Very truly yours,

R J Hardwick Jr

for W. L. Stewart

Attachments

cc: Dr. J. Nelson Grace
Regional Administrator
Region II



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ATTACHMENT 1

VIRGINIA POWER RESPONSES TO NRC STAFF
RECOMMENDED ACTIONS REGARDING STEAM
GENERATOR TUBE INTEGRITY

1.a PREVENTION AND DETECTION OF LOOSE PARTS (INSPECTIONS)

Staff Recommended Action

Visual inspections should be performed on the steam generator secondary side in the vicinity of the tube sheet, both along the entire periphery of the tube bundle and along the tube lane, for purposes of identifying loose parts or foreign objects on the tubesheet, and external damage to peripheral tubes just above the tubesheet. An appropriate optical device should be used (e.g., mini-TV camera, fiber optics). Loose parts or foreign objects which are found should be removed from the steam generators. Tubes observed to have visual damage should be eddy current inspected and plugged if found to be defective.

These visual inspections should be performed: (1) for all steam generators at each plant at the next planned outage for eddy current testing, (2) after any secondary side modifications, or repairs, to steam generator internals, and (3) when eddy current indications are found in the free span portion of peripheral tubes, unless it has been established that the indication did not result from damage by a loose part or foreign object.

For PWR OL applicants, such inspection should be part of the preservice inspection.

For steam generator models where certain segments of the peripheral region can be shown not to be accessible to an appropriate optical device, licensees and applicants should implement alternative actions to address these inaccessible areas, as appropriate.

Licensees should take appropriate precautions to minimize the potential for corrosion while the tube bundle is exposed to air. The presence of chemical species such as sulfur may aggravate this potential, and may make exposure to the atmosphere inadvisable until appropriate remedial measures are taken.

Reference

Section 2.1 of NUREG-0844.

Response

Virginia Power performs steam generator secondary side visual inspections of the steam generators in accordance with approved procedures each refueling outage following completion of sludge lancing operations. This inspection uses appropriate optical devices, typically mini-TV cameras with recorders, and covers the vicinity of the tube sheet, both along the entire periphery of the tube bundle and along the tube lane.

Loose parts or foreign objects which are found are removed from the steam generators, if possible. Foreign objects which cannot be removed are evaluated to insure they present no potential for loss of steam generator tube integrity prior to placing the steam generator in operation. The Steam Generator Vendor is intergrally involved in the evaluation process.

Tubes observed to have visual damage are eddy current inspected and will, by procedure, be plugged if found to be defective, or meet the plugging criteria.

The steam generators at the four Virginia Power nuclear units underwent steam generator secondary side visual inspections during their most recent refueling outages. Our existing inspection program and procedures require that visual inspections be performed following secondary side modifications or repairs to steam generator internals. Under our existing program, eddy current indications found in the free span portion of peripheral tubes are evaluated and, if damage from loose parts or foreign objects could not be eliminated, a visual inspection of the secondary side is performed.

As part of the Virginia Power steam generator operating philosophy, special effort is made to limit the exposure of the tube bundle to air. During outage conditions, when activities requiring the steam generators to be drained are not being performed, the steam generators are placed in wet layup. Our secondary water chemistry program contains specified limits on impurity levels during wet layup for species such as chloride, sulfate, and sodium.

JWO/jlm/8/OGREN

1.b PREVENTION AND DETECTION OF LOOSE PARTS (QUALITY ASSURANCE)

Staff Recommended Action

Quality assurance/quality control procedures for steam generators should be reviewed and revised as necessary to ensure that an effective system exists to preclude introduction of foreign objects into either the primary or secondary side of the steam generator whenever it is opened (e.g., for maintenance, sludge lancing, repairs, inspection operations, modifications). As a minimum, such procedures should include: (1) detailed accountability procedures for all tools and equipment used during an operation, (2) appropriate controls on foreign objects such as eye glasses and film badges, (3) cleanliness requirements, and (4) accountability procedures for components and parts removed from the internals of major components (e.g., reassembly of cut and removed components).

Reference

Section 2.1 of NUREG-0844.

Response

Station procedures are in place that address cleanliness control of plant systems and components. The procedures include:

(1) Detailed accountability procedures for tools and equipment used during an operation.

(2) Appropriate controls on foreign objects such as eye glasses and film badges.

(3) Cleanliness requirements.

These procedures also require the Quality Control Group to verify independently the cleanliness prior to final closeout.

In addition, controlling procedures (e.g., maintenance procedures, design change packages, modification procedures) provide specific detailed instructions for components and parts removed from the internals of major components. The controlling procedures also alert the worker to the necessity of maintaining cleanliness and provide specific Quality Control Hold Points.

Condenser preventive maintenance is not presently included in the Virginia Power preventative maintenance programs. However, certain preventive maintenance type activities, such as visual inspections of condenser internals during refueling outages and replacement of condenser boots when they near the end of their service life, are routinely performed on the condensers.

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2.a INSERVICE INSPECTION PROGRAM (FULL LENGTH TUBE INSPECTION)

Staff Recommended Action

The Standard Technical Specifications (STS) and Regulatory Guide 1.83, Part C.2.f, currently define a U-tube inspection as meaning an inspection of the steam generator tube from the point of entry on the hot-leg side completely around the U-bend to the top support of the cold-leg side. The staff recommends that tube inspections should include an inspection of the entire length of the tube (tube end to tube end) including the hot leg side, U-bend, and cold leg side.

This recommended action does not mean that the hot leg inspection sample and the cold leg inspection sample should necessarily involve the same tubes. That is, it does not preclude making separate entries from the hot and cold leg sides and selecting different tubes on the hot and cold leg sides to meet the minimum sampling requirements for inspection.

Consistent with the current STS requirement, supplemental sample inspections (after the initial 3% sample) under this staff recommended action may be limited to a partial length inspection provided the inspection includes those portions of the tube length where degradation was found during initial sampling.

Reference

Section 2.2.2 of NUREG-0844.

Response

The current practice at Virginia Power is to schedule approximately 714 (21%) tubes per steam generator in two of the three steam generators to be inspected each refueling outage. These tubes, except those in the small radius U-bend area, are inspected full length (tube end to tube end). The small radius U-bend area tubes are inspected over the U-bend to the top support on the cold-leg side. Therefore, approximately 550 tubes (16%) in each steam generator inspected are inspected full length.

If previous inspections have shown evidence of potential tube degradation, this minimum inspection program will be expanded to schedule the inspection of more tubes per steam generator, inspection of the third steam generator, or inspection of both additional tubes and the third steam generator. If additional tubes per steam generator are added to the inspection plan, they will typically be examined over the area of interest based on prior examination results.

2.b INSERVICE INSPECTION PROGRAM (INSPECTION INTERVAL)

Staff Recommended Action

The maximum allowable time between eddy current inspection of an individual steam generator should be limited in a manner consistent with Section 4.4.5.3 of the Standard Technical Specifications, and in addition should not extend beyond 72 months.

Reference

Section 2.2.4 of NUREG-0844.

Response

The Virginia Power steam generator inservice inspection program insures that the maximum allowable time between eddy current inspections of an individual steam generator does not exceed the interval specified in Section 4.4.5.3 of the Standard Technical Specifications and does not exceed 72 months.

Virginia Power has four operating units with three steam generators per unit. The Virginia Power steam generator inservice inspection program specifies that at least two steam generators per unit be inspected at each refueling outage, with the steam generators selected for inspection each outage being alternated such that over a two refueling outage cycle all three steam generators will normally be inspected at least one time. Therefore, each steam generator will normally undergo eddy current inspection at least once every 18 to 36 months. Recent history indicates that the interval between eddy current inspections for each of our steam generators has not exceeded 30 months.

3.a SECONDARY WATER CHEMISTRY PROGRAM

Staff Recommended Action

Licensees and applicants should have a secondary water chemistry program (SWCP) to minimize steam generator tube degradation.

The specific plant program should incorporate the secondary water chemistry guidelines in SGOG Special Report EPRI-NP-2704, "PWR Secondary Water Chemistry Guidelines," October 1982, and should address measures taken to minimize steam generator corrosion, including materials selection, chemistry limits, and control methods. In addition, the specific plant procedures should include progressively more stringent corrective actions for out-of-specification water chemistry conditions. These corrective actions should include power reductions and shutdowns, as appropriate, when excessively corrosive conditions exist. Specific functional individuals should be identified as having the responsibility/authority to interpret plant water chemistry information and initiate appropriate plant actions to adjust chemistry, as necessary.

The referenced SGOG guidelines above were prepared by the Steam Generator Owners Group Water Chemistry Guidelines Committee and represent and consensus opinion of a significant portion of the industry for state-of-the-art secondary water chemistry control.

Reference

Section 2.5 of NUREG-0844.

Response

In order to provide maximum chemical protection to the secondary system components and to minimize steam generator tube degradation, a Virginia Power Nuclear Operations Department Policy has been established that incorporates the "PWR Secondary Water Chemistry Guidelines" into the appropriate station procedures at the operating plants. Specifications have been adopted from the Steam Generator Owners Group Guidelines (SGOG) that address four unit conditions:

1. Wet Layup: The steam generators will be placed in wet chemical layup when maintenance schedules allow. The chemistry specifications are listed in Table I.

2. Unit Startup: Prior to heatup, the steam generator should meet the values listed in Table II. A chemistry hold will be implemented at ≤5% reactor power and again at ≤30% reactor power to ensure that the specifications are met prior to power escalation.

3. Unit Operations: Table III lists the control parameters for power operation with associated Action Levels.

4. Unit Shutdown: A chemistry hold at 350°F will be implemented at each planned unit shutdown when the plant is being brought to cold shutdown condition to enhance impurity hideout return/steam generator cleanup.

For each of the above unit conditions, the SGOG Guidelines have been implemented. To ensure system integrity, Action Levels have been established for at power out-of-specification conditions. Action Level responses are summarized as follows:

Action Level 1: Return parameter to within normal value range within one week or Action Level 2 is initiated.

Action Level 2: Reduce power to 30% or less within six hours of initiation of Action Level 2. Return parameter to within normal value range within 100 hours or go to Action Level 3.

Action Level 3: Shutdown within six hours after entering Action Level 3.

Station procedures that implement this policy, delineate the management responsibilities and the necessary corrective actions for out-of-specification parameters have been developed.

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TABLE I
COLD SHUTDOWN/WET LAYUP LIMITS
STEAM GENERATORS

| Parameter | Normal Value | Initiate Action |
|---|---|---|
| pH @25°C | 9.8-10.5 | <9.8 |
| Hydrazine, ppm | 75-200 | <75 |
| Sodium, ppm | ≤1.000 | >1.000 |
| Chloride, ppm | ≤0.500 | >0.500 |
| Sulfate, ppm | ≤1.000 | >1.000 |

TABLE II
START-UP LIMITS
STEAM GENERATORS

| Parameter | Value Prior to Leaving 200°F | Value Prior to Power>5% | Value Prior to Power >30% |
|---|---|---|---|
| pH @25°C | - | - | 8.5-9.0(1) |
| Cation Conductivity, µS | - | ≤2.0 | ≤0.80 |
| Sodium, ppm | ≤0.100 | ≤0.100 | ≤0.020 |
| Chloride, ppm | ≤0.100 | ≤0.100 | ≤0.020 |
| Sulfate, ppm | ≤0.100(2) | ≤0.100(2) | ≤0.020(2) |
| Silica, ppm | - | - | ≤0.300(2) |

(1) pH value of ≥7.0 at North Anna
(2) Diagnostic values for North Anna only at this time; the Action Level time clock begins when the unit is escalated above 30% power.

TABLE III
POWER OPERATION
STEAM GENERATORS

| Parameter | Normal Value | Action Level | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| pH @25°C | 8.5-9.0(1) | <8.5,>9.0(1) | - | - |
| Cation Conductivity, µS | ≤0.80 | >0.80 | >2.0 | >7.0 |
| Sodium, ppm | ≤0.020 | >0.020 | >0.100 | >0.500 |
| Chloride, ppm | ≤0.020 | >0.020 | >0.100 | - |
| Sulfate, ppm(2) | ≤0.020 | >0.020 | >0.100 | - |
| Silica, ppm | ≤0.300 | >0.300 | - | - |

(1) North Anna 7.0-9.2

(2) The Action Level clock for North Anna on sulfates applies only when the unit is >30% reactor power.

3.b CONDENSER INSERVICE INSPECTION PROGRAM

Staff Recommended Action

Licensees should implement a condenser inservice inspection program. The program should be defined in plant specific safety-related procedures and include:

1. Procedures to implement a condenser inservice inspection program that will be initiated if condenser leakage is of such a magnitude that a power reduction corrective action is required more than once per three month period; and is required more than once per three month period; and

2. Identification and location of leakage source(s), either water or air;

3. Methods of repair of leakage;

4. Methodology for determining the cause(s) of leakage;

5. A preventive maintenance program.

Reference

Section 2.6 of NUREG-0844

Response

Virginia Power has implemented a secondary side inservice inspection program which includes inspection of the condensers. This program includes eddy current examination of a number of condenser tubes each refueling outage, with the selection of tubes to be examined based on historical records of condenser performance.

As part of the Virginia Power secondary water chemistry program, secondary chemistry is closely monitored and indications of condenser leakage will result in initiating procedures to identify and correct the source of either water or air leakage.

The procedures used to identify, locate and repair condenser leaks are approved plant specific procedures, however, our condensers are not classified safety related.

At present, Virginia Power has no specific procedures detailing the methodology for determining the cause of condenser leakage. However, as a matter of practice, the occurrence of condenser leakage of such a magnitude that power reduction corrective action is required will initiate an investigation to determine the cause of the leakage. As an example, Virginia Power has recently completed an investigation of the causes of an increased incidence of condenser tube leaks at the North Anna Power Station during January and February 1985. Based on the results of this investigation, actions (e.g., evaluation and initial engineering) are presently in progress to correct the causes of the tube leaks.

4. PRIMARY TO SECONDARY LEAKAGE LIMIT

Staff Recommended Action

All PWRs that have Technical Specifications limits for primary to secondary leakage rates which are less restrictive than the Standard Technical Specifications (STS) limits should implement the STS limits.

Reference

Section 2.8 of NUREG-0844.

Response

The primary to secondary leakage rate limits currently contained in the Technical Specifications for all four of the Virginia Power units are identical to the Standard Technical Specification limits of 1 gpm through all steam generators not isolated from the reactor coolant system and 500 gpd through any one steam generator not isolated from the reactor coolant system.

5. COOLANT IODINE ACTIVITY LIMIT

Staff Recommended Action

PWRs that have Technical Specifications limits and surveillance for coolant iodine activity that are less restrictive than the Standard Technical Specification (STS) should implement the STS limits. Those plants identified above that also have low head high pressure safety injection pumps should either: (1) implement iodine limits which are 20% of the STS values, or (2) implement reactor coolant pump trip criteria which will ensure that if offsite power is retained, no loss of forced reactor coolant system flow will occur for steam generator tube rupture events up to and including the design basis double-ended break of a single steam generator tube, and implement iodine limits consistent with the STS.

Reference

Section 2.9 of NUREG-0844.

Response

The coolant iodine activity limits currently contained in the Technical Specifications for all four of the Virginia Power units are identical to or more restrictive than the Standard Technical Specification limits for coolant iodine activity.

All four Virginia Power units have both high head safety injection/charging pumps and low head safety injection pumps. Therefore, the use of coolant iodine activity limits that are 20% of Standard Technical Specification values is not applicable to Virginia Power.

6. SAFETY INJECTION SIGNAL RESET

Staff Recommended Action

The control logic associated with the safety injection pump suction flow path should be reviewed and modified as necessary, by licensees, to minimize the loss of safety function associated with safety injection reset during an SGTR event. Automatic switchover of safety injection pump suction from the boric acid storage tanks (BAST) to the refueling water storage tanks should be evaluated with respect to whether the switchover should be made on the basis of low BAST level alone without consideration of the condition of the SI signal.

Reference

Section 2.11 of NUREG-0844.

Response

All four Virginia Power units have high head safety injection/charging pumps which take a suction from a Volume Control Tank during normal operation. The control logic for the high head safety injection/charging pump automatically transfers suction from the Volume Control Tank to the refueling water storage tank on either a low Volume Control Tank level or a safety injection signal.

Reset of the safety injection signal will not affect the high head safety injection/charging pump suction alignment. Realignment to the Volume Control Tank can only be restored manually using the motor operated valve controls.

Therefore, the present control logic associated with high head safety injection/charging pump suction minimizes the loss of safety function associated with safety injection signal reset during a SGTR event.

ATTACHMENT 2

# VIRGINIA POWER RESPONSE TO NRC STAFF REQUEST FOR INFORMATION CONCERNING CATEGORY C-2 STEAM GENERATOR TUBE INSPECTIONS

## Information Requested

The enclosed draft NUREG-0844 Section 2.2.1.2 describes certain limitations which the staff believes to be inherent in the present Technical Specification steam generator ISI requirements pertaining to Category C-2 inspection results. Licensees and applicants are requested to provide a description of their current policy and actions relative to this issue and any recommendations they have concerning how existing Technical Specification steam generator ISI requirements pertaining to Category C-2 inspection results could be improved to better ensure that adequate inspections will be performed. This description should include a response to the following questions:

1. What factors do, or would, the licensee or applicant consider in determining (a) whether additional tubes should be inspected beyond what is required by the Technical Specifications, (b) whether all steam generators should be included in the inspection program, and (c) when the steam generators should be reinspected.

2. To what extent do these factors include consideration of the degradation mechanism itself and its potential for causing a tube to be vulnerable to rupture during severe transients or postulated accident before rupture or leakage of that tube occurs during normal operation.

## Reference

Section 2.2 of NUREG-0844.

## Response

As was described in Section 2.a of Attachment 1, the current Virginia Power practice is to schedule approximately 714 tubes (21%) per steam generator in two of the three steam generators for eddy current inspection each refueling outage. This number is based on performing a thorough inspection in those areas of the steam generator which have been identified as being of generic concern based on past industry experience for our model steam generators and, in addition, inspecting a sufficient number of randomly selected tubes to indicate overall steam generator condition.

If the steam generators of a particular unit have shown indications of tube degradation during previous inspections, or there are other reasons to believe that increased inspection is necessary, the initial inspection plan will be expanded to include more tubes per steam generator, the third steam generator, or both additional tubes per steam generator and the third steam generator.

Virginia Power has formed an advisory committee composed of members with experience in chemistry, metallurgy, non-destructive examination techniques, operations, maintenance, and includes a representative from the steam generator manufacturer. The committee's purpose is to monitor steam generator performance at Virginia Power and in the industry, and make recommendations to management on steam generator operation and maintenance. This committee, for example, recommends the number of tubes and number of steam generators to be inspected during the next inspection.

In formulating these recommendations, the committee considers various factors such as past inspection results, chemistry history, industry experiences, the results of industry research programs, vendor recommendations, and unit operating history. It is the intent of Virginia Power to have a steam generator inspection program which, along with other efforts such as the secondary chemistry program, reduces the potential for a tube rupture, and also reduces the potential for the leakage during normal operation. It is our goal to eliminate tube degradation in our steam generators.

Consideration of the degradation mechanism plays an important part in the development of steam generator tube inspection plans. Our current plans are to pull a number of sections of tube from one of the steam generators during the upcoming refueling outage at North Anna Unit 1 to perform analyses to characterize the degradation mechanism that is present. While the degradation presently occurring in these steam generators is not severe and, in our judgement, poses no threat of causing a tube to be vulnerable to rupture during transients or postulated accidents; it is prudent to identify the degradation mechanism so that appropriate corrective actions may be initiated.

Virginia Power believes the present Technical Specification steam generator ISI requirements pertaining to Category C-2 inspection results are adequate and that the proposed changes are overly restrictive. Assume, for example, that Virginia Power had elected to inspect only one of the three steam generators during a refueling outage. The initial 3% sample would consist of 305 tubes. Under the proposed rule, the discovery of a single tube with an indication of a 40% through-wall defect, a mere 0.33% of the tubes inspected and 0.03% of the total tubes in the steam generator, would require that a 100% inspection be performed in that steam generator and that the other two steam generators be opened up for an inspection of 6% of the tubes. This, obviously, involves a considerable increase in radiation exposure.

It is not uncommon to have only one tube in a steam generator that shows a pluggable indication. Therefore, it would appear much more reasonable to expand the inspection to inspect an additional 6% of the tubes in one steam generator to verify that the indication is indeed an anomaly, rather than immediately expanding to 100% of the tubes and two additional steam generators given the additional radiation exposure involved.

It is our view that these changes are not necessary. However, if any change to the existing requirements is felt to be necessary, it may be more reasonable to go to Category C-3 requirements if the results of the 3rd sample inspection are categorized as C-2.

JWO/jmj/OM3-18