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

April 30, 1992

Docket No. 50-338

LICENSEE: Virginia Electric and Power Company (VEPCO)

FACILITY: North Anna Power Station, Unit No. 1 (NA-1)

SUBJECT: MEETING SUMMARY OF NOVEMBER 18, 1991

On November 18, 1991, VEPCO and Westinghouse (W) met with the NRR staff in Rockville, Maryland to provide justification for continued operation of NA-1 through the end of the current cycle (April 1992) without a mid-cycle steam generator (SG) inspection outage.

After an extensive SG inspection in January and February 1991, the NRC granted approval for restart for NA-1. NRC approval for restart was required by the NA-1 Technical Specifications (TS) 3/4.4.5 as a result of all three SGs being classified as C-3 (greater than 1% of SG tubes plugged). The NRC letter of May 7, 1991, which granted restart approval, specified that a number of issues identified by the licensee must be addressed before full-cycle operation of the NA-1 SGs could be approved by the NRC without a mid-cycle SG inspection commencing in January 1992. These issues were: (1) evaluation of a tube specimen (containing support plate circumferential crack indications) which was removed from the field, (2) the potential for burst pressure reduction due to combined axial plus circumferential cracks, (3) the potential for crack propagation due to tube vibration, and (4) the potential leakage from a postulated steam line break for the projected end-of-cycle crack distribution.

W stated that considerable data had been accumulated over the past 6 years from the NA-1 SG inspections which provided a basis for analyzing NA-1 SG tube degradation. Included in this data bank were many eddy current (EC) probe profiles (bobbin, 8x1 and RPC) and five tube pulls for indications at tube support plates (TSP) and tube sheets (TS). Microscopic observations from tube pulls indicated that outer diameter stress corrosion cracking (ODSCC) circumferential cracks at TSP locations were not uniform and sizable ligaments existed between multiple circumferential cracks. Also, at TSP and TS locations, primary water stress corrosion cracking (PWSCC) axial cracks had ligaments which indicated that burst pressure exceeds the 3ΔP and steam line break (SLB) limits. W further stated that the data bank provided end-of-cycle projection of degraded tubes by deterministic assessment for 95% probability that showed projected crack size would be smaller than needed to exceed tube burst or vibration propagation. Finally, probabilistic assessment showed an acceptably low chance in a 18-month cycle that a corrosion crack might propagate by tube vibration.

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VEPCO stated that primary-to-secondary leakage has been low over the last three cycles. Maximum leakage over the last cycle was about 15 gallons per day (GDP) and current leakage is about 2 GDP for each SG. State-of-the-art primary-to-secondary leakage monitoring capability includes N-16 continuous monitoring in each SG as well as the main steam header. Also, additional leakage monitoring is provided by the condenser air ejection monitor, the blowdown radiation monitor on each SG blowdown line, grab samples on condenser air ejector, and SG blowdown samples.

VEPCO further indicated that current administrative operational limits are more restrictive than the current NA-1 TS which, in turn, are more restrictive than the standard TS.

In conclusion, VEPCO stated that the NA-1 SG tubes can withstand significant degradation without challenge to their structural limits. This statement is supported by the deterministic assessment of crack growth rates where conservati[illegible] used in the analysis show an acceptably low probability that crack growth rates would exceed tube burst parameters at end-of-cycle operation. In addition, if a crack should lose ligaments by corrosion or vibration, leakage detection will permit plant shutdown prior to tube rupture.

At the close of the meeting, the NRC staff indicated to the licensee that the staff was still evaluating the licensee's submittals justifying continued operation at NA-1 without a mid-cycle SG inspection. Finally, the staff thanked the licensee for the information provided and indicated the licensee would be advised of the staff's findings in the very near future.

/S/

Leon B. Engle, Project Manager
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cc: See next page

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ENCLOSURE 1

Attendance List

Meeting with Virginia Electric and Power Company

November 18, 1991

NA-1 SG Management Meeting

NRC

H. Berkow
L. Engle
G. Johnson
K. Karwoski
G. Lainas
F. Miraglia
E. Murphy
J. Partlow
J. Richardson
S. Varga

VEPCO

M. Bowling
H. Fonticellia
R. Saunders
W. Stewart
B. Throckmorton

Westinghouse

V. Esposito

VIRGINIA POWER

North Anna Unit 1
Steam Generator Management Meeting

November 18, 1991

ENCLOSURE 2

Agenda

North Anna Unit 1
Steam Generator Management Meeting
November 18, 1991

• Introduction	W. L. Stewart
• Overview of Steam Generator Analysis and Integrity	V. J. Esposito - W
• Operating Performance and Restrictions	M. L. Bowling
• Conclusions	M. L. Bowling

VIRGINIA POWER

Introduction

W. L. Stewart
Senior Vice President - Nuclear

Introduction

- Purpose
- Background on requirement for mid-cycle inspection
- Impact of mid-cycle inspection on Virginia Power
- No safety issues with operation for an additional 3 months
- Steam generators will be replaced in 1993

Westinghouse

Overview of
Steam Generator Analysis and Integrity

V. J. Esposito
Manager - Steam Generator Service
Nuclear Services Division

S/G Performance/Integrity
North Anna Unit 1

- **Significant data has been generated over the last 6 years to understand and analyze S/G tube degradation**
  - Multi-eddy current probes (Bobbin, 8 x 1, RPC) used for inspection
  - 5 tube pulls ('85 - '91) (TSP and TS)

- **Observations from tube pulls**
  - At TSP, ODSCC circumferential cracks are not uniform, sizeable ligaments exist between multiple circumferential cracks
  - At TSP, PWSCC axial cracks with remaining ligaments
  - At tubesheet, PWSCC at WEXTEX transition, cracks with remaining ligaments
  - Burst pressure exceed 3 Δ P and SLB limits

S/G Performance/Integrity
North Anna Unit 1
continued

- **Analysis**
  - Using conservative growth rate, detection threshold and eddy current uncertainty, EOC (9/92) projection of degraded tubes is evaluated
  - Deterministic assessment (95% probability case) shows projected crack extent is smaller than needed to exceed tube burst or vibration propagation
  - The potential for accident condition (SLB, SSE loads, LOCA + SSE loads) propagation does not exist
  - Probabilistic assessment shows an acceptably low chance in an 18 month cycle that a corrosion crack might propagate by tube vibration (turbulence with modest growth rate)

S/G Performance/Integrity
North Anna Unit 1
continued

- **Conclusions**
  - Tubes can withstand significant degradation without challenging the structural limit
  - Prior operating cycles have successfully operated with <50 GPD leakage with similar degradation and inspection with less sensitive detection thresholds
  - If a crack loses ligaments by corrosion or vibration, leakage detection and trending will permit plant shutdown prior to tube rupture
  - Lessons learned have been incorporated into inspection plan
  - Previous plant operation supports continued operation

VIRGINIA POWER

North Anna Unit 1
Steam Generator Operating Performance and Restrictions

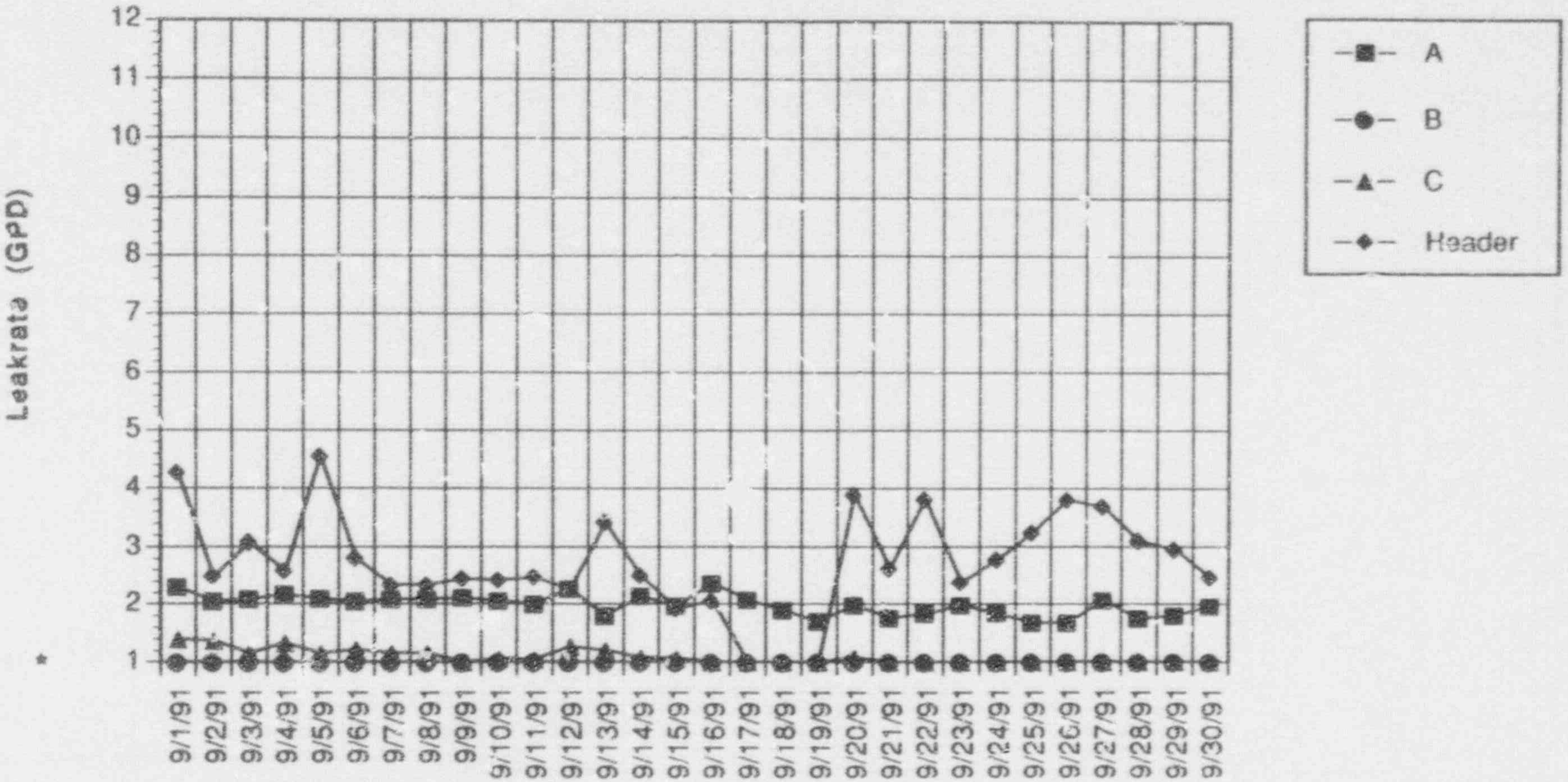
M. L. Bowling
Manager - Nuclear Licensing & Programs

North Anna Unit 1 Steam Generator Operating Performance and Restrictions

- Low primary-to-secondary leakage for last 3 cycles
  - Previous operating history supports current operation. Since November 1985 refueling outage, there have been no forced outages for the major active degradation mechanisms, even with leakage limits lowered by a factor of 10.
  - Maximum leakage experienced was ~15 GPD over the last cycle.

- Current primary-to-secondary leakage is low (< 7 GPD total, ~ 2 GPD per S/G).

North Anna Unit 1 Primary-to-Secondary Leakrate
N-16 Radiation Monitors
September 1991



* Leakrates less than 1 GPD cannot be monitored. Plotted as 1 GPD.

North Anna Unit 1 Steam Generator Operating Performance and Restrictions

- Extensive inspection during 1991 refueling outage

  - Bobbin Coil Probe - 100% full length (hot and cold leg) in each steam generator

  - 8 x 1 Probe - 100% of tubes in each steam generator through at least the 4th tube support plate (hot leg)

  - RPC Probe - 100% WEXTEX expansion zone
    - 100% Row 2 U-bends
    - Verification of all Bobbin and 8 x 1 indications

North Anna Unit 1 Steam Generator Operating Performance and Restrictions

"State of the art" primary-to-secondary leakage monitoring capability

- Individual steam generator N-16 monitor indication (Continuous)
- Main steam header N-16 monitor indication (Continuous)
- Main steamline (NRC) radiation monitors on each steamline (Continuous, record data every 4 hours)
- Condenser air ejector radiation monitor indication (Continuous, record data every 4 hours)
- Blowdown radiation monitor indication on each S/G blowdown line (Continuous during blowdown)
- Grab samples taken on condenser air ejector (Daily)
- Steam generator blowdown samples taken (Every 72 hours)

North Anna Unit 1
Steam Generator Operating Performance
and Restrictions

Current Administrative Operational Restrictions

- If a rapid increase in primary-to-secondary leakage of greater than 100 GPD in an individual steam generator occurs within a 30 minute period, then trip the reactor.

- If the primary-to-secondary leakage exceeds or will apparently exceed either:

  (1) 150 GPD total leakage from all steam generators, or

  (2) 50 GPD leakage from an individual steam generator,

  then reduce power to less than 50% RATED THERMAL POWER within 90 minutes AND below MODE 1 within two hours from detection.

- If none of the primary-to-secondary leakage detection systems (as required by Tech. Specs. are available, then reduce power to less than 50% RATED THERMAL POWER within 90 minutes AND below MODE 1 within two hours of determining now available leakage detection systems.

VIRGINIA POWER

Conclusions

M. L. Bowling
Manager - Nuclear Licensing & Programs

North Anna Unit 1
Steam Generator Management Meeting

Conclusions

- Virginia Power and Westinghouse consider operation through April 1992 without a mid-cycle shutdown to be acceptable.
  - Extensive programmatic inspection and repair has been performed at North Anna.
  - Tubes can withstand significant degradation without challenging the structural limit.
  - Several conservatisms exist in the analysis, including the analyzed vs. planned operating interval and estimates of growth for the next cycle. These are further supported by unit operating history.
  - Virginia Power plans to replace these steam generators as soon as possible. The next cycle of operation will be 9 to 10 months. This will further minimize any risk of future operation.