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 50-287 Oconee Nuclear Station, Unit 3, Duke Power Co.

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 RECIP.NAME: DENTON, H.R. RECIPIENT AFFILIATION: Office of Nuclear Reactor Regulation, Director
 SATOLZ, J.F. Operating Reactors Branch 4

SUBJECT: Forwards steam generator operating history, info valid through 821231.

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October 13, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

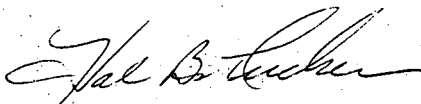
Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4

Re: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

As part of our continuing response to your request for steam generator operating experience updates dated December 9, 1977, please find attached the steam generator Operating Histories for all three Oconee units. The information is valid through December 31, 1982.

Very truly yours,



Hal B. Tucker

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Attachment

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ATTACHMENT 1

OCONEE NUCLEAR STATION

UNIT 1

STEAM GENERATOR OPERATING HISTORY

OCONEE NUCLEAR STATION

UNIT 1

I. BASIC PLANT INFORMATION

Startup Date: July 15, 1973
Utility: Duke Power Company
Location: Seneca, South Carolina
Thermal Power Level: 2568 MWt
NSSS Supplier: Babcock and Wilcox (B & W)
Number of Loops: 2
Steam Generator Supplier, Model No., Type: B & W, 177 FA, Once Through
Steam Generator (OTSG)
Number of tubes per Generator: 15,530
Tube Size, Material: Alloy 600; 0.625" OD; 0.557" ID

II. STEAM GENERATOR OPERATING CONDITIONS

Normal Operation

Inlet Temperature: 602.8°F
Primary Pressure: 2200 psi
Secondary Pressure: 925 psi
Allowed Leak Rate: 0.3 gpm
Primary Flow Rate: 65.66×10^6 lb/hr

Accidents

Design Basis LOCA; Maximum Delta-P: 925 psi
Main Steam Line Break; Maximum Delta-P: 2200 psi

III. STEAM GENERATOR SUPPORT PLATE INFORMATION

Material: SA 212 B Carbon Steel
Design Type: Broached
Design Code: ASME III (through 1967)
Dimensions: 58.7" R, thickness 1.5"
Steam Flow Rate: 5.3×10^6 lb/hr
Tube Dimensions: 5/8" D x .034" wall (nominal)

IV. STEAM GENERATOR BLOWDOWN INFORMATION

Oconee Nuclear Station's Once Through Steam Generators (OTSG) are not designed to perform normal blowdowns. There is no operational requirement to perform normal blowdowns. The steam generator sample line, however, can provide a limited blowdown capability of 1 GPM during power operation.

V. WATER CHEMISTRY SPECIFICATIONS

A. Feedwater (Normal Power Operation)

| | |
|--|------------------------|
| Total Solids | 10 ppb (max) |
| Cation Conductivity | 0.5 μ mho/cm (max) |
| Dissolved Oxygen as O ₂ | 7 ppb (max) |
| Hydrazine as N ₂ H ₄ | 1-25 ppb |
| Silica as SiO ₂ | 20 ppb (max) |
| Total Iron as Fe | 10 ppb (max) |
| Total Copper as Cu | 2 ppb (max) |
| pH @ 77°F | 9.3-9.6 |
| Lead as Pb | 1 ppb (max) |

Feedwater (Startup*)

| | |
|------------------------------------|---------------------------------------|
| Total Iron as Fe | 100 ppb (max) |
| Cation Conductivity | 1.0 μ mho/cm (max) |
| Dissolved Oxygen as O ₂ | 100 ppb (max) |
| Hydrazine | 300% of stoichiometric O ₂ |

* Established prior to feeding OTSGs.

B. OTSG Water (Less Than 10% Steaming)

| | |
|---------------------|-----------------------|
| pH | 9.0-10.5 |
| Cation Conductivity | 10 μ mho/cm (max) |
| Chloride | 1.0 ppm (max) |
| Sodium | 2.0 ppm (max) |

OTSG Water (Layup)

| | |
|----------------------------|--|
| Ammonia as NH ₃ | 10 ppm (nominal) 2 ppm-20 ppm range |
| ph @ 77°F | 9.5-10.5 |
| Hydrazine | 200 ppm initial 50 ppm (min) |
| Sodium | 1.0 ppm (max) |
| Cation Conductivity | 10 μ mho/cm (max) |

C. Condenser Cooling Water

Condenser Cooling Water is obtained from Lake Keowee. There are no demineralizers or cooling towers installed. The following is a table of representative chemistry values:

| | |
|------------------------|----------|
| Calcium | 2.2 ppm |
| Magnesium | 0.7 ppm |
| Sodium | 1.7 ppm |
| Potassium | 0.9 ppm |
| Bicarbonate Alkalinity | 13.6 ppm |
| Sulfates | 1.1 ppm |
| Chlorides | 0.6 ppm |
| Phosphates | <0.2 ppm |
| Nitrates | 0.1 ppm |
| Free Carbon Dioxide | 11.0 ppm |
| Silica | 6.1 ppm |
| Total Iron | 0.05 ppm |
| Manganese | 0.12 ppm |
| pH | 6.5-7.0 |

VI. TURBINE STOP VALVE TESTING

Turbine Stop Valve Testing had been performed on a daily basis from initial startup until February 1974, when weekly testing was initiated. In July 1975, the testing frequency was returned to a daily basis for stop valves and weekly for the control valves. In March 1977 when it appeared that stop valve testing might possibly contribute to steam generator tube failure, the frequency was changed back to monthly.

Frequency

Actual: Monthly (maximum time between tests is 6 weeks)
Recommended: Daily (turbine vendor)
Monthly (steam generator vendor)

Power Level

Actual: 65 percent full power, or
94 percent full power if power reduction not desirable
Recommended: 65 percent full power (steam generator vendor)
No recommendation (turbine vendor)

Testing Procedures

Actual: Stroke Length - full - 8.5 inches
- to trip - 8.0 inches
Stroke Rate - open to closed - 13 sec.
- closed to open - 27 sec.
Recommended: same as actual

VII. STEAM GENERATOR TUBE DEGRADATION HISTORY

A. November 1974 - Initial Refueling Inservice Inspection

OTSG 1A:

Number of tubes inspected: 573 (3.69%)

Number of tubes plugged prior to this ISI: 40 (.26%)

Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation in excess of 20%.

OTSG 1B:

Number of tubes inspected: 493 (3.17%)

Number of tubes plugged prior to this ISI: 33 (.21%)

Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation in excess of 20%.

B. March 1976 - 293 Effective Full Power Days (EFPD) since last refueling inspection

OTSG 1A:

Number of tubes inspected: 469 (3.02%)

Number of tubes plugged prior to this ISI: 40 (.26%)

Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation in excess of 20%.

OTSG 1B:

Number of tubes inspected: 495 (3.19%)

Number of tubes plugged prior to this ISI: 33 (.21%)

Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation in excess of 20%.

C. August 1977 - 308 EFPD since last refueling inspection

OTSG 1A:

Number of tubes inspected: 2500 (16.10%)

Number of tubes plugged prior to this ISI: 42 (.27%)

Number of tubes plugged this ISI: 5 (.03%)

Eddy-Current Exam Results: All 5 tubes were in periphery region and exceeded degradation limits. All five tubes showed corrosion/erosion type degradation with a maximum

wall thinning of 60%. The defect area was at the 14th support plate. The tubes were 7-4, 8-5, 117-107, 146-14, and 147-11.

OTSG 1B:

Number of tubes inspected: 5004 (32.22%)
Number of tubes plugged prior to this ISI: 53 (.34%)
Number of tubes plugged this ISI: 37 (.24%)

Eddy-Current Exam Results: All tubes were in periphery region. All tubes plugged showed localized OD degradation with a maximum wall thinning of 100%. The defect area was at the 14th support plate except as noted:

| | | |
|---------------|----------------|-----------------------------|
| 88-122 (9th) | 8-49 | 100-124 |
| 75-121 (12th) | 60-114 (12th) | 100-120 |
| 76-122 (12th) | 100-122 (13th) | 101-122 |
| 43-108 | 75-133 | 62-12 |
| 41-110 | 9-51 (12th) | 61-12 |
| 16-71 | 8-48 | 7-32 (between 12th-13th) |
| 60-127 | 83-117 | 133-56 (11th) |
| 61-123 | 99-125 | 51-123 |
| 17-79 (13th) | | |

Tubes 43-108 and 83-117 were removed for further study.

Tubes 69-128 and 69-132 were mistakenly plugged. Plugs should have been inserted in Tubes 68-127 and 68-131, respectively.

Tube 17-79 was correctly plugged at the UTS, but the LTS plug was mistakenly inserted in Tube 15-75. Tube 133-56 was correctly plugged at the LTS, but the UTS plug was mistakenly inserted in Tube 132-55.

Tubes 79-2, 133-57, 22-92, and 138-68 were plugged for reasons other than exceeding the degradation limit. The LTS plug for Tube 22-92 was mistakenly inserted in Tube 21-89.

D. August 1978 - 246 EFPD since last refueling inspection

OTSG 1A:

Number of tubes inspected: 1380 (8.89%)
Number of tubes plugged prior to this ISI: 47 (.30%)
Number of tubes plugged this ISI: 3 (.02%)

Eddy-Current Exam Results: All three tubes were in the periphery region and exceeded degradation limits. All three tubes showed localized OD degradation with a maximum wall thinning of 65%. The three tubes and their respective defect areas were: 75-9 at the 15th support plate, and 6-3 and 9-7 at the 14th support plate.

OTSG 1B:

Number of tubes inspected: 1121 (7.22%)
Number of tubes plugged prior to this ISI: 95 (.66%)
Number of tubes plugged this ISI: 36 (.23%)

Eddy-Current Exam Results: All tubes were in the periphery region. Twenty-four tubes showed localized OD degradation with a maximum wall thinning of 75%. The defect area is as noted:

| | | |
|------------------|------------------|-------------------|
| 6-32 (14th SP) | 55-125 (14th SP) | 90-129 (11th SP) |
| 6-51 (14th SP) | 64-125 (14th SP) | 93-119 (10th SP) |
| 7-1 (14th SP) | 69-2 (13th SP) | 98-125 (14th SP) |
| 8-45 (14th SP) | 85-126 (14th SP) | 101-121 (13th SP) |
| 12-68 (13th SP) | 85-127 (14th SP) | 112-6 (13th SP) |
| 53-125 (12th SP) | 86-127 (12th SP) | 113-112 (14th SP) |
| 54-2 (11th SP) | 89-125 (12th SP) | 143-6 (7th SP) |
| 55-124 (14th SP) | 90-124 (14th SP) | 150-16 (7th SP) |

Tubes 77-18 and 85-127 were removed for study.

Tubes 56-126, 66-127, 85-125, and 151-11 were mistakenly plugged.

Tubes 7-2, 72-68, 77-18, and 115-110 were plugged for reasons other than exceeding degradation limit.

Tubes 61-89, 68-127, 68-131, and 73-129 were plugged to correct errors made previously.

Plugging of Tubes 15-75, 17-79, 21-89, 22-92, 96-4, 101-4, 132-55, and 133-56, which were previously plugged at only one end, was completed.

E. November 1979 - 303 EFPD since last refueling inspection

OTSG 1A:

Number of tubes inspected: 3100 (24%)
Number of tubes plugged prior to this ISI: 50 (.39%)
Number of tubes plugged this ISI: 12 (.09%)

Eddy-Current Exam Results: The tubes were predominantly located in the periphery region. These tubes showed localized OD degradation with a maximum wall thinning of 65%. The defect area is as noted:

| | |
|------------------|---------------------|
| 4-14 (14th SP) | 8-16 (6th SP) |
| 5-17 (14th SP) | 75-7 (15th SP) |
| 78-7 (14th SP) | 75-8 (15th SP) |
| 78-22 (14th SP) | 79-8 (14th/15th SP) |
| 54-125 (14th SP) | 54-127 -- |
| 53-124 (14th SP) | 75-10 -- |

Tube 54-127 was mistakenly plugged for Tube 54-125, only the bottom of Tube 75-10 was plugged in error when Tube 75-9 was being removed from service previously.

OTSG 1B:

Number of tubes inspected: 7500 (51%)
 Number of tubes plugged prior to this ISI: 132 (.90%)
 Number of tubes plugged this ISI: 71 (.48%)

Eddy-Current Exam Results: The tubes were predominantly located in the periphery region. These tubes showed OD degradation, except for Tube 130-23 which showed ID, with a maximum wall thinning of 80%. The defect area is as noted:

| | | |
|-----------------------|-------------------|-------------------|
| 6-43 (14th SP) | 110-110 (12th SP) | 75-120 (14th SP) |
| 50-121 (14th SP) | 114-1 (12th SP) | 138-2 (7th SP) |
| 7-33 (14th SP) | 97-123 (14th SP) | 106-110 (14th SP) |
| 77-113 (14th SP) | 22-90 (14th SP) | 10-65 (14th SP) |
| 79-129 (13th SP) | 40-110 (14th SP) | 76-119 (14th SP) |
| 102-122 (14th SP) | 74-8 (14th SP) | 78-125 (12th SP) |
| 114-110 (14th SP) | 13-74 (14th SP) | 146-26 (6th SP) |
| 150-18 (12th SP) | 81-117 (14th SP) | 6-28 (10th SP) |
| 140-35 (11th/12th SP) | 83-130 (10th SP) | 9-61 (14th SP) |
| 19-55 (13th SP) | 150-14 (8th SP) | 9-62 (14th SP) |
| 5-41 (14th SP) | 35-101 (14th SP) | 18-73 (9th SP) |
| 8-55 (14th SP) | 66-131 (14th SP) | 12-71 (14th SP) |
| 14-69 (14th SP) | 124-21 (14th SP) | 124-22 (14th SP) |
| 35-92 (12th SP) | 98-4 (14th SP) | 34-7 (14th SP) |
| 51-105 (14th SP) | 91-4 (14th SP) | 72-8 (13th SP) |
| 41-109 (14th SP) | 87-6 (14th SP) | 65-125 (14th SP) |
| 50-122 (14th SP) | 11-6 (14th SP) | 52-108 (7th SP) |
| 73-127 (14th SP) | 31-13 (14th SP) | 116-7 (12th SP) |
| 74-113 (14th SP) | 61-11 (14th SP) | 3-10 (13th SP) |
| 130-23 (3rd-4th SP) | 61-110 (12th SP) | 122-91 (8th SP) |
| 10-4 (14th SP) | 46-119 (10th SP) | 23-90 -- |
| 44-10 (14th SP) | 82-130 (13th SP) | 151-14 -- |
| 72-127 (13th SP) | 129-90 (14th SP) | 97-120 -- |
| 61-10 (14th SP) | 70-123 (14th SP) | |

Tubes 23-90, 151-14, and 97-120 were mistakenly plugged for Tubes 22-90, 150-114, and 97-123 respectively.

F. July 1981 - EFPD since last refueling inspection

OTSG 1A:

Number of tubes inspected: 2872 (18.4%)
 Number of tubes plugged prior to this ISI: 62 (.39%)
 Number of tubes plugged this ISI: 5 (.032%)

Eddy-Current Exam Results: The tubes were predominately located in the periphery region. These tubes showed localized OD degradation with a maximum wall thinning of 70%. The defect area is as noted:

61-2 (14th/15th SP)
55-1 (13th SP)
67-2 (14th SP)
71-127 (11th SP)
75-10 (obstruction)

Tube 75-10 was removed due to obstruction.

OTSG 1B:

Number of tubes inspected: 8193 (52%)
Number of tubes plugged prior to this ISI: 203 (1.3%)
Number of tubes plugged this ISI: 40 (-25%)

Eddy-Current Exam Results: The tubes were predominately located in the periphery region. These tubes showed OD degradation with a maximum wall thinning of 80%. The defect area is as noted:

| | |
|---------------------|---------------------|
| 48-85 (LTS) | 73-120 (14th SP) |
| 87-126 (14th SP) | 75-114 (14th SP) |
| 105-121 (14th SP) | 77-11 (15th SP) |
| 117-105 (13th SP) | 78-1 (14th SP) |
| 114-111 (14th SP) | 76-112 (14th SP) |
| 143-5 (11th SP) | 99-124 (14th SP) |
| 130-20 (13th SP) | 123-13 (14th SP) |
| 122-3 (14th SP) | 121-14 (14th SP) |
| 121-4 (14th SP) | 86-18 (5th-6th SP) |
| 116-21 (10th SP) | 100-3 (14th SP) |
| 85-2 (14th SP) | 122-90 (8th SP) |
| 58-3 (14th SP) | 52-2 (14th-15th SP) |
| 70-3 (14th SP) | 50-2 (13th-14th SP) |
| 32-14 (14th SP) | 27-12 (14th SP) |
| 27-7 (12th-13th SP) | 17-8 (14th SP) |
| 11-5 (14th SP) | 6-10 (13th SP) |
| 28-39 (14th SP) | 26-89 (14th SP) |
| 35-91 (12th SP) | 77-6 (5th SP) |
| 44-109 (14th SP) | 123-1 (15th SP-UTS) |
| 52-117 (12th SP) | 44-110 --- |

Tube 123-1 was removed due to obstruction.

Tube 44-110 was mistakenly plugged.

REGION IDENTIFICATION

| <u>Region</u> | <u># Tubes Within Region</u> |
|-------------------------|------------------------------|
| Periphery of Bundle (1) | 6806 (43.82%) |
| Tube Lane (2) | 382 (2.46%) |
| Interior | 8342 (53.72%) |
| Total | 15,530 |

Allowed wall thinning before plugging 40%

- (1) Defined as tubes outside a 12 sided polygon connecting support rod positions (~20 rows)
- (2) Defined as tubes within 3 rows of open tube lane

VIII. ABNORMAL OPERATIONAL EVENTS

A. October 31, 1976 RO-269/76-17 OTSG 1A

Number of tubes leaking: 1
Number of additional tubes inspected: 15
Total number of tubes plugged/removed: 2

Summary

- a) Tube 77-17 plugged due to leakage at UTS.
- b) Tube 77-18 also plugged.

B. December 8, 1976 RO-269/76-19 OTSG 1B

Number of tubes leaking: 2
Number of additional tubes inspected: 139
Total number of tubes plugged/removed: 4

Summary

- a) 114-109 plugged due to leakage at 14th support plate (SP); 75-18 plugged due to leakage at UTS.
- b) Tubes 113-110 and 107-115 also plugged.

C. January 15, 1977 RO-269/77-2 OTSG 1B

Number of tubes leaking: 1
Number of additional tubes inspected: 140
Number of tubes plugged/removed: 2

Summary

- a) Tube 75-12 plugged due to crack at UTS.
- b) Tube 81-128 also plugged.

D. February 28, 1977 RO-269/77-8 OTSG 1B

Number of tubes leaking: 2
Number of additional tubes inspected: 490
Number of tubes plugged/removed: 7

Summary

- a) Tube 32-13 plugged due to leakage at 14th SP; Tube 77-25 plugged due to leakage at UTS, removed for further study.
- b) Tubes 33-14, 2-7, 2-8 also plugged.
- c) Tube 101-4 plugged at LTS only; UTS plug mistakenly placed in 96-4.

E. March 22, 1977 RO-269/77-11 OTSG 1B

Number of tubes leaking: 1
Number of additional tubes inspected: 100
Number of tubes plugged/removed: 5

Summary

- a) Tube 77-22 plugged due to crack at 15th SP.
- b) Tubes 77-3, 77-5, 77-8, and 77-29 also plugged.

F. May 7, 1977 RO-269/77-16 OTSG 1B

Number of tubes leaking: 1
Number of additional tubes inspected: 507
Number of tubes plugged/removed: 2

Summary

- a) Tube 77-15 identified as leaking at crack 1/4" below UTS.
- b) Tubes 77-5 also plugged.
- c) Tube 75-18 removed (plugged previously).

G. April 27, 1978 RO-269/78-13 OTSG 1B

Number of tubes leaking: 2
Number of additional tubes inspected: 481
Number of tubes plugged/removed: 5

Summary

- a) Tube 74-2 plugged due to leakage at UTS; Tube 69-1 plugged due to tube-to-tubesheet leakage at the LTS.
- b) Tubes 59-1 and 70-1 plugged as precautionary measure.
- c) Tube 77-27 plugged after unsuccessful extraction attempt.

H. October 3, 1978 RO-269/78-24 OTSG 1

Number of tubes leaking: 1

Reviewed previously plugged tubes.

Summary

- a) A large leak was observed in Tube 85-125; tube had been severed during the ISI at the 13th support plate for removal of a tube sample and had not been properly plugged.
- b) Investigation of previously plugged tubes revealed the following plugging errors existed prior to the outage:

| <u>Tube</u> | <u>Outage Plugged</u> | <u>Remarks*</u> |
|-------------|--------------------------------|--|
| 15-75 | 1977 ISI (September 1977) | LTS plug intened for 17-79 |
| **17-79 | 1977 ISI | LTS plug missing |
| 21-89 | 1977 ISI | LTS plug intended for 22-92 |
| **22-92 | 1977 ISI | LTS plug missing |
| 61-86 | OTSG Repairs (January 1973) | LTS and UTS plugged, intended for 61-89 |
| **61-89 | OTSG Repairs | Both plugs missing |
| 68-127 | 1977 ISI | LTS and UTS plugged, intended for 69-128 |
| **69-128 | 1977 ISI | Both plugs missing |
| **73-129 | OTSG Repairs | Not plugged following FOAK (First-of-a-kind) instrument removal as intended |
| 96-4 | 2/77 leak outage | UTS plug intended for 101-4 |
| **101-4 | 2/77 leak outage | UTS not plugged |
| 132-55 | 1977 ISI | LTS plug intended for 133-56 |
| **133-56 | 1977 ISI | LTS not plugged. |

* Both ends of tube generally plugged--UTS indicates upper tubesheet plug and LTS indicates lower tubesheet plug.

** Tubes not plugged which were to have been removed from service for indicated reasons.

The errors in which tubes were not removed from service (**) constitutes operation of the unit with a degraded RCS boundary.

I. July 23, 1979 R0-269/79-24 OTSG 1B

| | |
|---------------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | 330 |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 73-130 plugged and stablized due to leakage at the 14th support plate.

J. December 26, 1980 R0-269/80-40 OTSG 1A

| | |
|---------------------------------------|---|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 78-2 plugged and stablized due to leakage at the 15th support plate.
- b) Tubes 75-6, 75-21, 75-29, 77-32, 78-23 and 78-25 had indications of a maximum wall thinning of 30% at the 15th support plate. They were not plugged and stablized.

K. February 9, 1982 R0-269/82-03 OTSG 1A

Number of tubes leaking: 1
Number of additional tubes inspected: 372
Number of tubes plugged/removed: 1

Summary

- a) Tube 74-2 plugged and stablized due to leakage at the 15th support plate on the upper tube sheet.

L. March 6, 1982 R0-269/82-06 OTSG 1B

Number of tubes leaking: 1
Number of additional tubes inspected: 374
Number of tubes plugged/removed: 1

Summary

- a) Tube 78-2 plugged and stablized due to leakage at the 15th support plate on the upper tube sheet.

IX. CONDENSER INFORMATION

As stated earlier in Section V of this report, water from Lake Keowee is used to provide condenser cooling. Condenser tubes are made of 304 Stainless Steel. During operation, tube leakage is detected by secondary chemistry analysis for silica; a maximum of 20 ppb is allowed. A search for a tube leak occurs whenever the silica concentration in the secondary begins to increase.

Date

Remarks

November 1974
As of July 1981
July 1981

2 tubes plugged
Between 11/74 and 7/81 3 tubes were plugged
98 tubes plugged

X. RADIATION EXPOSURE WITH RESPECT TO STEAM GENERATORS

| <u>Date</u> | <u>OTSG</u> | <u>Dose (Exam & Repair) (1)</u> | <u>Comment:</u> |
|-------------|-------------|-------------------------------------|----------------------|
| 11/74 | 1A & 1B | 44 | First Refueling ISI |
| 3/76 | 1A & 1B | 28.3 | Second Refueling ISI |
| 10/76 | 1A | 22 | OTSG 1A leak |
| 12/76 | 1B | 25 | OTSG 1B leak |
| 1/77 | 1B | 18.7 | OTSG 1B leak |
| 2/77 | 1B | 25.4 | OTSG 1B leak |
| 5/77 | 1B | 18 | OTSG 1B leak |
| 8/77 | 1A & 1B | 25.7 (exam) 20.4 (repair) | Third Refueling ISI |
| 4/78 | 1B | 51.7 | OTSG 1B leak |
| 8/78 | 1A & 1B | 276.4 | Fourth Refueling ISI |
| 11/79 | 1A & 1B | 57.5 (exam) 86.9 (repair) | Fifth Refueling ISI |
| 12/80 | 1A & 1B | 59.5 | Sixth refueling ISI |
| 2/82 | 1A | 4.7 (exam) 4.6 (repair) | OTSG 1A Leak |
| 3/82 | 1B | 5 (exam) 10.3 (repair) | OTSG 1B Leak |
| Total | 1A & 1B | 784.1 | |

(1) Dose in man-rem (person-rem); testing and repair were not always separable.

XI. DEFECT GROWTH

OTSG 1A

% Through Wall Indication

| Tube Number | 9/77 ISI | 9/78 ISI | Growth |
|-------------|----------|----------|--------|
| 4-14 | 25 | 40 | 15 |
| 72-128 | 30 | 25 | -- |
| 75-21 | 20 | 20 | 0 |
| 75-26 | 20 | 20 | 0 |
| 78-22 | 20 | 30 | 10 |

Type of Degradation: Corrosion/erosion at 14th SP, Tube 4-14;
wear, Tube 78-22.

Two tubes which were inspected at the 9/77 ISI and which exceeded degradation limits at the 9/78 ISI were plugged. They exhibited an average degradation growth of approximately 30%.

OTSG 1B

% Through Wall Indication

| Tube Number | 9/77 ISI | 9/78 ISI | Growth |
|-------------|----------|----------|--------|
| 7-54 | 15 | 20 | 5 |
| 9-53 | 10 | 35 | 25 |
| 12-68 | 28 | 38 | 10 |
| 22-90 | 13 | 40 | 27 |
| 44-109 | 25 | 40 | 15 |
| 90-125 | 20 | 35 | 15 |
| 92-117 | 25 | 40 | 15 |
| 5-38 | 0 | 20 | 20 |
| 6-43 | 15 | 25 | 10 |
| 12-9 | 20 | 20 | 0 |
| 17-80 | 18 | 20 | 2 |
| 18-85 | 20 | 20 | 0 |
| 26-6 | 20 | 40 | 20 |
| 35-91 | 20 | 20 | 0 |
| 58-122 | 0 | 23 | 23 |
| 61-110 | 33 | 40 | 7 |
| 64-129 | 0 | 35 | 33 |
| 73-130 | 0 | 25 | 25 |
| 74-8 | 20 | 30 | 10 |
| 75-10 | 0 | 38 | 38 |
| 75-21 | 10 | 10 | 0 |
| 76-119 | 10 | 10 | 0 |
| 90-124 | 15 | 33 | 18 |
| 91-126 | 10 | 33 | 23 |
| 110-111 | 18 | 20 | 2 |
| 143-5 | 20 | 28 | 8 |

Average

13.5

The degradation data presented for OTSG 1B is the result of an independent review of the Eddy-Current Readings, and may not reflect the data presented in the ISI report in all cases. It is considered to be the best data available.

Twenty-two tubes which were inspected at the 9/77 ISI and which exceeded degradation limits at the 9/78 ISI, were plugged. They exhibited an average degradation growth of approximately 32%.

Type of Degradation: Corrosion/erosion at the 14th support plate EFP
Days between 9/77 ISI and 9/78 ISI: 246.

ATTACHMENT 2
OCONEE NUCLEAR STATION
UNIT 2
STEAM GENERATOR OPERATING HISTORY

OCONEE NUCLEAR STATION

UNIT 2

I. BASIC PLANT INFORMATION

Startup Date: September 9, 1974
Utility: Duke Power Company
Location: Seneca, South Carolina
Thermal Power Level: 2568 MWt
NSSS Supplier: Babcock and Wilcox (B & W)
Number of Loops: 2
Steam Generator Supplier, Model No., Type: B & W, 177 FA, Once Through
Steam Generator (OTSG)
Number of tubes per Generator: 15,530
Tube Size, Material: Alloy 600; 0.625" OD; 0.557" ID

II. STEAM GENERATOR OPERATING CONDITIONS

Normal Operation

Inlet Temperature: 602.8°F
Primary Flow Rate: 65.66×10^6 lb/hr
Primary Pressure: 2200 psi
Secondary Pressure: 925 psi
Allowed Leak Rate: 1 gpm

Accidents

Design Basis LOCA; Maximum Delta-P: 925 psi
Main Steam Line Break; Maximum Delta-P: 2200 psi

III. STEAM GENERATOR SUPPORT PLATE INFORMATION

Material: SA 212 B Carbon Steel
Design Type: Broached
Design Code: ASME III (through 1967)
Dimensions: 58.7"R, thickness 1.5"
Steam Flow Rate: 5.3×10^6 lb/hr
Tube Dimensions: 5/8" D x .034" wall (nominal)

IV. STEAM GENERATOR BLOWDOWN INFORMATION

Oconee Nuclear Station's Once Through Steam Generators (OTSG) are not designed to perform normal blowdowns. There is no operational requirement to perform normal blowdowns. The steam generator sample line, however, can provide a limited blowdown capability of 1 GPM during power operation.

V. WATER CHEMISTRY SPECIFICATIONS

Water chemistry specifications for Unit 2 are the same as Unit 1, and are contained in Attachment 1, Section V.

VI. TURBINE STOP VALVE TESTING

Turbine stop valve testing procedures for Unit 2 are the same as those for Unit 1 and are contained in Attachment 1, Section VI.

VII. STEAM GENERATOR DEGRADATION HISTORY

A. April 1976 - Initial Refueling Inspection

OTSG 2A

Number of tubes inspected: 479 (3.08%)
Number of tubes plugged prior to this ISI: 3 (.02%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation
in excess of 20%.

OTSG 2B

Number of tubes inspected: 476 (3.07%)
Number of tubes plugged prior to this ISI: 5 (.03%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation
in excess of 20%.

B. August 1977 - 277 EFPD since last refueling inspection

OTSG 2A

Number of tubes inspected: 506 (3.26%)
Number of tubes plugged prior to this ISI: 3 (.02%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: No evidence of degradation
in excess of 20%.

OTSG 2B

Number of tubes inspected: 987 (6.36%)
Number of tubes plugged prior to this ISI: 8 (.05%)
Number of tubes plugged this ISI: 4 (.03%)

Eddy-Current Exam Results: Three tubes plugged were in
the lane region and one in the interior. Maximum degrada-
tion was in excess of 40%. All were degraded at the 15th
SP except the interior tube, which was at the 12th SP.

The plugged tubes were: 75-5 Lane
75-9 Lane
78-2 Lane
112-29 Interior

C. October 1978 - 289 EFPD since last refueling inspection

OTSG 2A

Number of tubes inspected: 1336 (8.60%)
Number of tubes plugged prior to this ISI: 3 (.02%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: Eight tubes showed degradation in excess of 20%, with a maximum through wall indication of 35%.

OTSG 2B

Number of tubes inspected: 1310 (8.44%)
Number of tubes plugged prior to this ISI: 19 (0.05%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: Eight tubes showed degradation in excess of 20%, with a maximum through wall indication of 35%.

D. March 1980 - 354 EFPD since last refueling inspection

OTSG 2A

Number of tubes inspected: 1895 (12%)
Number of tubes plugged prior to this ISI: 3 (.02%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: Six tubes showed degradation equal to or in excess of 20%, with a maximum through wall indication of 35%.

OTSG 2B

Number of tubes inspected: 1855 (12%)
Number of tubes plugged prior to this ISI: 25 (.16%)
Number of tubes plugged this ISI: 1 (.01%)

Eddy-Current Exam Results: Eleven tubes showed degradation equal to or in excess of 20%. One of these tubes (97-33) was in excess of the 40% plugging limit at 65% of the wall thickness. This tube was degraded at the 12th SP.

E. January 1982 - 400 EFPD since last refueling inspection

OTSG 2A

Number of tubes inspected: 2886 (18.58%)
Number of tubes plugged prior to this ISI: 3 (.02%)
Number of tubes plugged this ISI: 2 (.01%)

Eddy-Current Exam results: The number of OD indications observed increased by 36% as compared to the 3/8 refueling outage ISI. Two of the tubes examined were in excess of the 40% plugging limit. These 2 tubes showed OD degradation with a maximum wall thinning of 43%. The defect area is as noted:

106-116 (13th SP)
107-118 (14th SP)

OTSG 2B

Number of tubes inspected: 3634 (23.4%)
Number of tubes plugged prior to this ISI: 27 (.17%)
Number of tubes plugged this ISI: 7 (.04%)

Eddy-Current Exam results: The number of OD indications observed increased by 115% as compared to the 3/80 refueling outage ISI. Seven of the tubes examined were in excess of the 40% plugging limit, with a maximum through wall indication of 68%. The defect area is as noted:

89-30 (12th SP)
97-32 (12th SP)
104-33 (12th SP)
110-52 (12th SP)
114-65 (12th SP)
119-42 (12th SP)
119-60 (12th SP)

REGION IDENTIFICATION

| <u>Region</u> | <u># Tubes Within Region</u> |
|-------------------------|------------------------------|
| Periphery of Bundle (1) | 6806 (43.82%) |
| Tube Lane (2) | 382 (2.46%) |
| Interior | 8342 (53.72%) |
| Total | 15,530 |

Allowed wall thinning before plugging 40%

- (1) Defined as tubes outside a 12 sided polygon connecting support rod positions (~20 rows)
- (2) Defined as tubes within 3 rows of open tube lane

VIII. ABNORMAL OPERATIONAL EVENTS

A. December 4, 1976 RO-270/76-15 OTSG 2B

| | |
|---------------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | 133 |
| Number of tubes plugged/removed: | 3 |

Summary

- a) Tube 77-23 plugged due to leakage at upper tube sheet.
- b) Tubes 77-27 and 124-42 also plugged.
- c) Tubes 77-23 and 77-27 were removed.

B. October 7, 1977 R0-270/77-12 OTSG 2B

Number of tubes leaking: 1
Number of tubes plugged/removed: 7

Summary

- a) Tube 77-25 plugged due to leakage at upper tube sheet
- b) Tubes also plugged: 75-21, 77-4, 77-18, 77-19
77-21, 78-4.
- c) All previously plugged tubes were replugged as an added precaution.

C. September 18, 1981 R0-270/81-16 OTSG 2B

| | |
|---------------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | 365 |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 77-2 plugged due to leakage at 15th support plate.
- b) No other inspected tubes showed unacceptable degradation.

IX. CONDENSER INFORMATION

As stated earlier in Section V of this report, water from Lake Keowee is used to provide condenser cooling. Condenser tubes are made of 304 Stainless Steel. During operation, tube leakage is detected by secondary chemistry analysis for silica; a maximum of 20 ppb is allowed. A search for a tube leak occurs whenever the silica concentration in the secondary begins to increase.

Condenser tube leakage: A total of 298 tubes have been plugged. The last inspection was performed February 1982. Information on when the 43 other tubes were plugged is not available.

| <u>Date</u> | <u>Remarks</u> |
|---------------------|--------------------------|
| January 1975 | 2 tubes plugged |
| As of June 2, 1980 | (Condenser-section) |
| | A-1 - 49 tubes plugged |
| | A-2 - 20 tubes plugged |
| | B-1 - 57 tubes plugged |
| | B-2 - 47 tubes plugged |
| | C-1 - 33 tubes plugged |
| | C-2 - 47 tubes plugged |
| | Total 253 tubes plugged |
| As of February 1982 | Between 6/80 and 2/82 43 |
| | tubes were plugged |

X. RADIATION EXPOSURE WITH RESPECT TO STEAM GENERATORS

| <u>Date</u> | <u>Generator</u> | <u>Dose (Exam & Repair)</u> ⁽¹⁾ | <u>Comments</u> |
|-------------|------------------|--|--|
| 4/76 | A & B | 2.1 | First Refueling ISI |
| 12/76 | B | 25 | OTSG B leak |
| 8/77 | A & B | 13.5 (exam) 36.5 (repair) | Second Refueling ISI SOAK (2) Instrumentation insertion and OTSG repair |
| 10/77 | B | 18 (exam) | OTSG B leak |
| 1/78 | B | 11.5 | OTSG B leak and SOAK removal |
| 10/78 | A & B | 23.0 | Third Refueling ISI |
| 3/80 | A & B | 25.4 | Fourth Refueling ISI |
| 9/81 | 2B | 27.8 (exam) 0.4 (repair) | OTSG B Leak |
| 1/82 | 2A | 14.5 (exam) 5.1 (repair) | Fifth refueling ISI |
| | 2B | 12.4 (exam) 11.9 (repair) | |
| Total | A & B | 232.1 | |

- (1) Dose in man-rem (person-rem); examination and repair dosages could not always be separated.
- (2) SOAK (Second-of-a-Kind) Flow-vibration instrumentation added for additional information on possible causes of OTSG leakage.

XI. DEFECT GROWTH

OTSG 2A

There are no tubes with a degradation history in Steam Generator 2A.
OTSG 2B

% Through Wall Indication

| <u>Tube Number</u> | <u>Location</u> | <u>8/77 ISI</u> | <u>10/78 ISI</u> |
|--------------------|-----------------|-----------------|------------------|
| 75-14 | 15th SP | 20 | 30 |
| 75-39 | 3rd - 4th SP | 30 | 30 |

Type of Degradation: Wear (for Tube 75-14)
EFP Days between 8/77 and 10/78 ISI: 289

ATTACHMENT 3
OCONEE NUCLEAR STATION
UNIT 3
STEAM GENERATOR OPERATING HISTORY

OCONEE NUCLEAR STATION

UNIT 3

I. BASIC PLANT INFORMATION

Startup Date: December 10, 1974
Utility: Duke Power Company
Location: Seneca, South Carolina
Thermal Power: 2568 MWt
NSSS Supplier: Babcock & Wilcox (B & W)
Number of Loops: 2
Steam Generator Supplier, Model No. Type: B & W, 177 FA, Once Through
Steam Generator
Number of tubes per Generator: 15,530
Tube Size, Material: Alloy 600; 0.625" OD; 0.557" ID

II. STEAM GENERATOR OPERATING CONDITIONS

Normal Operation

Inlet Temperature: 604°F
Primary Flow Rate: 65.66×10^6 lb/hr
Primary Pressure: 2200 psi
Secondary Pressure: 925 psi
Allowed Leak Rate: 1 gpm

Accidents

Design Basis LOCA; Maximum Delta-P: 925 psi
Main Steam Line Break; Maximum Delta-P: 2200 psi

III. STEAM GENERATOR SUPPORT PLATE INFORMATION

Material: SA 212 B Carbon Steel
Design Type: Broached
Design Code: ASME III (thru 1967)
Dimensions: 58.7"R, thickness 1.5"
Steam Flow Rate: 5.6×10^6 lb/hr
Tube Hole Dimensions: 5/8" D (nominal) x 0.034" wall

IV. STEAM GENERATOR BLOWDOWN INFORMATION

Oconee Nuclear Station's Once Through Steam Generators (OTSG) are not designed to perform normal blowdowns. There is no operational requirement to perform normal blowdowns. The steam generator sample line, however, can provide a limited blowdown capability of 1 GPM during power operation.

V. WATER CHEMISTRY SPECIFICATIONS

Water chemistry specifications for Unit 3 are the same as Unit 1 and are contained in Attachment 1, Section V.

VI. TURBINE STOP VALVE TESTING PROCEDURES

Turbine Stop Valve Testing Procedures for Unit 3 are the same as those for Unit 1 and are contained in Attachment 1, Section VI.

VII. STEAM GENERATOR DEGRADATION HISTORY

A. November 1976 - Initial Refueling Inspection

OTSG 3A

Number of tubes inspected: 586 (3.77%)
Number of tubes plugged prior to this ISI: 0
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: No evidence of degradation in excess of 20%.

OTSG 3B

Number of tubes inspected: 489 (3.15%)
Number of tubes plugged prior to this ISI: 3 (0.02%)
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: Four tubes had degradation between 20-30%. No other tubes showed evidence of degradation in excess of 20%.

B. October 1977 - 289 EFPD since last refueling inspection

OTSG 3A

Number of tubes inspected: 1090 (7.00%)
Number of tubes plugged prior to this ISI: 0
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: No evidence of degradation in excess of 20%.

OTSG 3B

Number of tubes inspected: 1090 (7.00%)
Number of tubes plugged prior to this ISI: 20 (0.13%)
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: Six tube tubes had evidence of degradation between 20%-40% at the 15th SP but were not plugged.

C. June 1978 - 160 EFPD since last refueling inspection

OTSG 3A

Number of tubes inspected: 882 (5.68%)
Number of tubes plugged prior to this ISI: 0
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: No evidence of degradation in excess of 20%.

OTSG 3B

Number of tubes inspected: 1107 (7.13%)
Number of tubes plugged prior to this ISI: 20 (0.13%)
Number of tubes plugged this ISI: 0
Metalurgical Exam Results: 7 lane tubes showed evidence of degradation of between 20%-40% at the 15th SP but were not plugged. Two other tubes in the bundle showed degradation of between 20%-40% (at the 9th SP and between the 12th and 13th SP respectively) but were not plugged.

D. May 1979 - 264 EFPD since last refueling inspection

OTSG 3A

Number of tubes inspected: 825 (5.31%)
Number of tubes plugged prior to this ISI: 0
Number of tubes plugged this ISI: 1 (0.01%)

Eddy-Current Exam Results: Six tubes exhibited degradation of 20%-30%, one each at the 9th and 10th SP, three at the 15th SP, and one between the 15th SP and the UTS Tube 75-3 was stabilized due to a through wall indication of approximately 60%.

OTSG 3B

Number of tubes inspected: 825 (5.31%)
Number of tubes plugged prior to this ISI: 20 (0.13%)
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: Thirteen tubes exhibited degradation of 20%-30%, ten at the 15th SP and three at the UTS. Tube 77-10, with a through wall indication of 30% at the UTS, was plugged.

E. December 1980 - 308 EFPD since last refueling inspection

OTSG 3A

Number of tubes inspected: 3800 (10%)
Number of tubes plugged prior to this ISI: 1
Number of tubes plugged this ISI: 0

Eddy-Current Exam Results: Four tubes exhibited degradation of 20%-30%, one each at the 11th, 12th, 14th, and 15th SP. No tube indications exceeded the 40% through wall plugging limitations.

OTSG 3B

Number of tubes inspected: 5230 (21%)
Number of tubes plugged prior to this ISI: 20 (0.13%)
Number of tubes plugged this ISI: 4

Eddy-Current Exam Results: Twenty-five tubes exhibited degradation equal to or greater than 20%, one between the LTS and 1st SP, two between the 2nd and 3rd SP, one between the 8th and 9th SP, one between the 9th and 10th SP, one at the 10th SP, one at the 13th SP, eight at the 14th SP, two between the 14th and 15th SP. Four tubes (150-14 at the 10th SP and 4-4, 58-2, 62-113 at the 14th SP) exceeded the 40% through wall indication level and had to be plugged.

F. June 1982 - 349 EFPD since last refueling outage

OTSG 3A

Number of tubes inspected: 2863 (18.44%), and 328 (2.11%) partial
Number of tubes plugged prior to this ISI: 15 (.1%)
Number of tubes plugged this ISI: 5 (.03%)

Eddy-Current Exam Results: Four tubes showed OD degradation with a maximum wall thinning of 86%. The defect area is as noted:

| | |
|-------|---------|
| 17-82 | (15 SP) |
| 47-6 | (15 SP) |
| 113-1 | (15 SP) |

Tube 85-1 would not be examined due to obstruction, and was removed from service by plugging.

OTSG 3B

Number of tubes inspected: 1915 (12.33%)
Number of tubes plugged prior to this ISI: 26 (.17%)
Number of tubes plugged this ISI: 1 (.01%)

Eddy-Current Exam Results: Tube 100-11 showed OD degradation with a maximum wall thinning of 50% at the 14th tube support plate. This tube was removed from service by plugging.

REGION IDENTIFICATION

| <u>Region</u> | <u># Tubes Within Region</u> |
|-------------------------|------------------------------|
| Periphery of Bundle (1) | 6806 (43.82%) |
| Tube Lane (2) | 382 (2.46%) |
| Interior | <u>8342</u> (53.72%) |
| Total | 15,530 |

Allowed wall thinning before plugging 40%

- (1) Defined as tubes outside a 12 sided polygon connecting support rod positions (~20 rows)
- (2) Defined as tubes within 3 rows of open tube lane

VIII.

ABNORMAL OPERATIONAL EVENTS

A. July 21, 1976 RO-287/76-10 OTSG 3B

| | |
|----------------------------------|---------------|
| Number of tubes leaking: | 1 |
| Number of other tubes inspected: | not available |
| Number of tubes plugged/removed: | 3 |

Summary

- a) Tube 77-11 was plugged due to leakage at the 15th SP.
- b) Tubes 81-63, 37-6 were also plugged.

B. February 14, 1977 RO-287/77-2 OTSG 3B

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of other tubes inspected: | 142 |
| Number of tubes plugged/removed: | 11 |

Summary

- a) Tube 77-19 was plugged due to leakage from crack at 15th SP.
- b) Tubes 75-2 and 77-12 thru -21 were also plugged.

C. June 10, 1977 RO-287/77-8 OTSG 3B

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of other tubes inspected: | 133 |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 78-1 was plugged due to leakage at 15th SP.

D. July 14, 1977 RO-287/77-10 OTSG 3B

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of other tubes inspected: | 120 |
| Number of tubes plugged/removed: | 2 |

Summary

- a) Tube 77-2 was plugged due to leakage at bottom of upper tube sheet.
- b) Tube 77-1 was also plugged.

E. June 14, 1980 RO-287/80-10 OTSG 3A

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of tubes inspected: | 360 |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 77-3 was plugged and stabilized due to leakage at the upper tube sheet.

F. February 11, 1982 RO-287/82-03 OTSG 3A

| | |
|---------------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | 174 |
| Number of tubes plugged/removed: | 2 |

Summary

- a) Tube 2-4 was plugged and stabilized due to leakage at the upper tube sheet
- b) Tube 75-118 was plugged because it was found to have a 52% through wall indication, no other tubes were removed from service.

G. October 9, 1982 OTSG 3A

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 0 |
| Number of tubes inspected: | 909 |
| Number of tubes plugged/removed: | 1 |

Summary

- a) Tube 97-106 was removed from service by plugging due to 60% OD degradation indication.
- b) No leakers could be located.

H. November 17, 1982 RO-287/82-12 OTSG 3A

| | |
|---------------------------------------|-------|
| Number of tubes leaking: | 5 |
| Number of additional tubes inspected: | 1,846 |
| Number of tubes plugged/removed: | 11 |

Summary

- a) Four tubes (68-4, 78-8, 78-4, and 83-5) were plugged and stabilized due to leakage at the 15th support plate.
- b) Tube 65-1 was plugged and stabilized due to leakage at the upper tube sheet.

- c) Tubes 46-6, 73-130 and 78-5 showed OD degradation with a maximum wall thinning of 90% at the 15th support plate. These tubes were removed from service by plugging.
- d) Tubes 78-8, 78-10 and 79-5 were pulled for laboratory analysis.

I. November 17, 1982 RO-287/82-12 OTSG 3B

| | |
|----------------------------------|-----|
| Number of tubes leaking: | 0 |
| Number of tubes inspected: | 432 |
| Number of tubes plugged/removed: | 0 |

Summary

- a) The OTSG 3B was inspected as well to ensure that a similar problem as found in OTSG 3A did not exist.
- b) No leakers could be located.

J. December 11, 1982 RO-287/82-14 OTSG 3B

| | |
|---------------------------------------|-----|
| Number of tubes leaking: | 1 |
| Number of additional tubes inspected: | 631 |
| Number of tubes plugged/removed: | 2 |

Summary

- a) Tube 77-9 was plugged and stablized due to leakage at the upper tube sheet.
- b) Tube 78-2 showed OD degradation with a maximum wall thinning of 62% at the 15th support plate. This tube was removed from service by plugging.

IX. CONDENSER INFORMATION

As stated earlier in Section V of this report, water from Lake Keowee is used to provide condenser cooling. Condenser tubes are made of 304 Stainless Steel. During operation, tube leakage is detected by secondary chemistry analysis for silica; a maximum of 20 ppb is allowed. A search for a tube leak occurs whenever the silica concentration in the secondary begins to increase.

Condenser tube leakage:

| <u>Date</u> | <u>Remarks</u> |
|---------------|---|
| August 1976 | Two tubes plugged. |
| October 1976 | Identified cause of previous leakage as a broken bypass line support member causing steam to impinge directly on condenser tubes. Plugged approximately 150 tubes that were bent. |
| February 1977 | One tube plugged. |
| April 1977 | One tube plugged. |
| May 1977 | Three tubes plugged. |
| December 1977 | One tube plugged. |
| June 1891 | 210 tubes plugged. |

X. RADIATION EXPOSURE WITH RESPECT TO STEAM GENERATORS

| <u>Date</u> | <u>Generator</u> | <u>Dose (Exam & Repair)</u> ⁽¹⁾ | <u>Comments:</u> |
|-------------|------------------|--|----------------------|
| 7/76 | B | 7 | OTSG B leak |
| 10/76 | A & B | 6.2 | First Refueling ISI |
| 2/77 | B | 10.7 | OTSG B leak |
| 6/77 | B | 3.7 | OTSG B leak |
| 7/77 | B | 6.9 | OTSG B leak |
| 10/77 | A & B | 39.3 | Second Refueling ISI |
| 6/78 | A & B | 14.3 | Third Refueling ISI |
| 5/79 | A & B | 15.9 | Fourth Refueling ISI |
| 6/80 | A | 7.5 | OTSG A leak |
| 12/80 | A & B | 17.9 | Fifth Refueling ISI |
| 2/82 | 3A | 5.8 (exam) | OTSG A Leak |
| | | 23.6 (repair) | |
| 6/82 | 3A | 4.7 (exam) | Sixth Refueling ISI |
| | and | 9.6 (repair) | |
| | 3B | 6.6 (exam) | |
| | | 1.0 (repair) | |
| 10/82 | 3A | 4.7 (exam) | OTSG A Leak |
| | | 0.4 (repair) | |
| 11/82 | 3A & 3B | 7.1 (exam) | OTSG A Leak |
| | | 24.6 (repair) | |
| 12/82 | 3B | 4.1 (exam) | OTSG B Leak |
| | | 3.3 (repair) | |
| Total | A & B | 224.9 | |

(1) Dose in person-rem: Testing and repair were not always separable.

XI. DEGRADATION GROWTH

OTSG 3B

| Tube Number | Location | 11/77 | 6/78 | 5/79 | 12/80 |
|-------------|----------|-------|------|-------|-------|
| 75-5 | 15th SP | 25 | 25 | 25 | 20-30 |
| 75-6 | 15th SP | 30 | 30 | 30 | 20-30 |
| 75-9 | 15th SP | 30 | 25 | 25 | 25 |
| 75-10 | 15th SP | 30 | 25 | 25 | 20-25 |
| 75-11 | 15th SP | 30 | 25 | 25 | <20 |
| 78-6 | 15th SP | 35 | 30 | 25-30 | 25 |

No evidence of significant degradation growth in tubes for which data is available.

Approximately 160 EFPD elapsed between 11/77 and 6/78; approximately 264 EFPD elapsed between 6/78 and 5/79.

There are no tubes in OTSG 3A for which degradation growth data is available.

X. RADIATION EXPOSURE WITH RESPECT TO STEAM GENERATORS

| <u>Date</u> | <u>Generator</u> | <u>Dose (Exam & Repair)</u> ⁽¹⁾ | <u>Comments:</u> |
|-------------|------------------|--|----------------------|
| 7/76 | B | 7 | OTSG B leak |
| 10/76 | A & B | 6.2 | First Refueling ISI |
| 2/77 | B | 10.7 | OTSG B leak |
| 6/77 | B | 3.7 | OTSG B leak |
| 7/77 | B | 6.9 | OTSG B leak |
| 10/77 | A & B | 39.3 | Second Refueling ISI |
| 6/78 | A & B | 14.3 | Third Refueling ISI |
| 5/79 | A & B | 15.9 | Fourth Refueling ISI |
| 6/80 | A | 7.5 | OTSG A leak |
| 12/80 | A & B | 17.9 | Fifth Refueling ISI |
| 2/82 | 3A | 5.8 (exam) | OTSG A Leak |
| | | 23.6 (repair) | |
| 6/82 | 3A | 4.7 (exam) | Sixth Refueling ISI |
| | and | 9.6 (repair) | |
| | 3B | 6.6 (exam) | |
| | | 1.0 (repair) | |
| 10/82 | 3A | 4.7 (exam) | OTSG A Leak |
| | | 0.4 (repair) | |
| 11/82 | 3A & 3B | 7.1 (exam) | OTSG A Leak |
| | | 24.6 (repair) | |
| 12/82 | 3B | 4.1 (exam) | OTSG B Leak |
| | | 3.3 (repair) | |
| Total | A & B | 224.9 | |

(1) Dose in person-rem: Testing and repair were not always separable.

XI. DEGRADATION GROWTH

OTSG 3B

| Tube Number | Location | 11/77 | 6/78 | 5/79 | 12/80 |
|-------------|----------|-------|------|-------|-------|
| 75-5 | 15th SP | 25 | 25 | 25 | 20-30 |
| 75-6 | 15th SP | 30 | 30 | 30 | 20-30 |
| 75-9 | 15th SP | 30 | 25 | 25 | 25 |
| 75-10 | 15th SP | 30 | 25 | 25 | 20-25 |
| 75-11 | 15th SP | 30 | 25 | 25 | <20 |
| 78-6 | 15th SP | 35 | 30 | 25-30 | 25 |

No evidence of significant degradation growth in tubes for which data is available.

Approximately 160 EFPD elapsed between 11/77 and 6/78; approximately 264 EFPD elapsed between 6/78 and 5/79.

There are no tubes in OTSG 3A for which degradation growth data is available.