RANCHO SECO UNIT 1
TECHNICAL SPECIFICATIONS

LIST OF TABLES

4.17 STEAM GENERATORS

Applicability

Applies to inservice inspection of the steam generator tubes.

Objective

To verify the operability of each steam generator and ensure the structural integrity of the tubes as part of the reactor coolant boundary.

Specification

Each steam generator shall be demonstrated OPERABLE by performance of the following augmented inservice inspection program and the requirements of Specification 1.3.

4.17.1 Steam Generator Sample Selection and Inspection

Each steam generator shall be determined OPERABLE during shutdown by selecting and inspecting steam generators as specified in Table 4.17-1.

4.17.2 Steam Generator Tube Sample Selection and Inspection

The steam generator tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 4.17-2A. The inspection result classification and the corresponding action required for inspection of "specific limited areas" (see Paragraph 4.17.2e) shall be as specifed in Table 4.17-2B. The inservice inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.17.3 and the inspected tubes shall be verified acceptable per Specification 4.17.4. The tubes selected for these inspections shall include at least 3% of the total number of tubes in both steam generators and be selected on a random basis except:

a. If experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least 50% of the tubes inspected shall be from these critical areas.

b. The first sample inspection during inservice inspection (subsequent to the first inservice inspection) of each steam generator shall include:

   1. All nonplugged tubes that previously had detectable wall penetrations (>20%), and

   2. Special area tubes pursuant to Specification 4.17.4a6

4.17.2 (continued)

c. The second and third sample inspections during each inservice inspection may be less than a full tube inspection by concentrating (selecting at least 50% of the tubes to be inspected) the inspection on those areas of the tube sheet array and on those portions of the tubes where tubes with imperfections were previously found.

d. A tube inspection (pursuant to Specification 4.17.4.5) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection. ("Adjacent" is interpreted to mean the nearest tube capable of being inspected.) Tubes which do not permit passage of the eddy current probe will be considered as degraded tubes when classifying inspection results.

e. Tubes in specific limited areas which are distinguished by unique operating conditions and/or physical construction (for example, tubes adjacent to the open inspection lane or tubes whose 15th tube support plate hole is not broached but drilled) may be excluded from random samples if all such tubes in the specific area of a steam generator are inspected. No credit will be taken for those tubes in meeting minimum sample size requirements.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

Note: In all inspections, previously degraded tubes must exhibit significant (>10%) further wall penetrations to be included in the above percentage calculations.

4.17.3 Inspection Frequencies

The above required inservice inspections of steam generator tubes shall be performed at the following frequencies:

4.17.3 Inspection Frequencies (Continued)

a. The first inservice inspection shall be performed during the first refueling outage. Subsequent inservice inspections shall be performed at intervals of not less than 12 nor more than 24 calendar months after the previous inspection. If two consecutive inspections following service result in all inspection results falling into the C-1 category or if two consecutive inspections demonstrate that previously observed degradation has not continued and no significant additional degradation has occurred, the inspection interval may be extended to a maximum of once per 40 months.

b. If the results of the inservice inspection of a steam generator conducted in accordance with Table 4.17-2A and/or Table 4.17-2B at 40-month intervals falls in Category C-3, the inspection frequency shall be increased to at least once per 20 months. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in 4.17.3a and the interval can be extended to a 40-month period.

c. Additional, unscheduled inservice inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Table 4.17-2A during the shutdown subsequent to any of the following conditions:

   1. A seismic occurrence greater than the Operating Basis Earthquake,

   2. A loss-of-coolant accident requiring automatic actuation of the engineered safeguards, or

   3. A main steam line or feedwater line break as defined in the USAR.

d. After primary-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Specification 3.1.6.9, an inspection of the affected steam generator will be performed in accordance with the following criteria.

   1. If the leaking tube falls within one of the Special Area groups designated in either Table 4.17-3 or Table 4-17-4, all of the tubes in this group in this steam generator will be inspected.

4.17.3 Inspection Frequencies (Continued)

2. If the leaking tube does not fall within one of the Special Area groups, an inspection will be performed on the affected steam generator in accordance with Table 4.17-2A with an initial inspection sample size of 6% of the tubes in the affected steam generator.

4.17.4 Definitions

a. As used in this Specification:

1. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications of less than 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections.

2. Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube.

3. Degraded Tube means a tube containing imperfections $\geq$20% of the nominal wall thickness caused by degradation.

4. Defective Tube means a tube containing an imperfection >40% of the nominal tube wall thickness unless higher limits are shown acceptable by analysis. Defective tubes shall be plugged.

5. Tube Inspection means an inspection of the steam generator tube from the point of entry completely to the point of exit (except as noted in 4.17.2c and 4.17.4a6).

6. Special Area Tubes include those tubes which have shown a significant amount of degradation throughout their operating history. These include peripheral tubes and lane region tubes designated in Tables 4-17-3. and 4-17-4.

b. The steam generator shall be determined OPERABLE after completing the corresponding actions required by Table 4.17-2A (and Table 4.17-2B if provisions of Paragraph 4.172e are utilized.)

4.17.5 Reports

a. Following each inservice inspection of steam generator tubes, the number of tubes plugged in each steam generator shall be reported to the Commission within 30 days.

4.17.5 Reports (Continued)

b. The results of the steam generator tube inservice inspection shall be included in the Annual Operating Report for the period in which this inspection was completed. This report shall include:

1. Number and extent of tubes inspected.

2. Location and percent of wall-thickness penetration for each indication of an imperfection.

3. Identification of tubes plugged.

c. Results of steam generator tube inspections which fall into Category C-3 and require notification of the Commission shall be reported pursuant to Specification 6.9.5P prior to resumption of plant operation. The written followup of this report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

Bases

The Surveillance Requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The surveillance requirements of steam generator tubes are based on a modification of B+W - Standard Technical Specifications dated June 1, 1976. Inservice inspection of steam generator tubing is essential in order to maintan surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken. For example, historical data has shown that certain areas of the steam generators are particularly susceptible to corrosion and degradation. Consequently, the inservice inspecton now includes provisions for a more indepth inspection of a Special area group of tubes specified in Table 4.17-3 and Table 4.17-4.

Bases (Continued)

Operational experience has shown that tube defects can be the result of unique operating conditions or physical arrangements in certain areas of the steam generators. A full inspection of all of the tubes in such limited areas will provide complete assurance that degraded or defective tubes in these areas are detected. Because no credit is taken for these distinctive tubes in the constitution of the first sample or its results, the requirements for the first sample are unchanged. This requirement is essentially equivalent to and meets the intent of the requirements set forth in NRC Regulatory Guide 1.83, Revision 1 and does not reduce the margin of safety provided by those requirements.

Wastage-type defects are unlikely with AVT chemistry treatment of the secondary coolant. However, even if a defect should develop in service, it will be found during scheduled inservice steam generator tube examinations. Plugging will be required for defective tubes. Steam generator tube inspections of operating plants have demonstrated the capability to reliably detect degradation that has penetrated 20 of the original tube wall thickness.

Whenever the results of any steam generator tubing inservice inspection fall into Category C-3, these results will be reported to the Commission pursuant to Specification 6.9.5P prior to resumption of plant operation. Such cases will be considered by the Commission on a case-by-case basis and may result in a requirement for analysis, laboratory examinations, tests, additional eddy-current inspection and revision of the Technical Specifications, if necessary.

TABLE 4.17-2A

STEAM GENERATOR TUBE INSPECTION

1ST SAMPLE INSPECTION			2ND SAMPLE INSPECTION		3RD SAMPLE INSPECTION	
Sample Size	Result	Action Required	Result	Action Required	Result	Action Required
A minimum of S of the Tubes per S.G.	C-1	None	N/A	N/A	N/A	N/A
	C-2	Plug defective tubes and inspect additional 2S of the tubes in this S.G.	C-1	None	N/A	N/A
			C-2	Plug defective tubes and inspect additional 4S of the tubes in this S.G.	C-1	None
					C-2	Plug defective tubes
					C-3	Plug defective tubes and perform action for C-3 result of first sample
			C-3	Plug defective tubes and perform action for C-3 result of first sample	N/A	N/A
	C-3	Inspect 6S tubes in this S.G., plug defective tubes and inspect 2S tubes in the other S.G. Perform follow-on inspections in the other S.G. in accordance with results of the above inspection as applied to Table 4.17-2A. Notification to NRC pursuant to specification 6.9.5P	The other S.G. is C-1	None	N/A	N/A
			The other S.G. is C-2	Perform action for C-2 result of second sample	N/A	N/A
			The other S.G. is C-3 (2)	(a) If defects can be localized to an affected area, inspect all tubes in affected area and plug defected tubes. (b) If defects cannot be localized to an affected area, inspect all tubes in this S.G. and plug defective tubes	N/A	N/A

(1) $S = \frac{6}{n}\%$ Where n is the number of steam generators inspected during an inspection

TABLE 4.17-2B

STEAM GENERATOR TUBE INSPECTION

1ST SAMPLE INSPECTION OF A "SPECIFIC LIMITED AREA"			2ND SAMPLE INSPECTION OF A "SPECIFIC LIMITED AREA"	
Sample Size	Result	Action Required	Result	Action Required
100% of Area in both OTSGs	C-1	None	N/A	N/A
	C-2	Plug defective tubes	N/A	N/A
	C-3	Plug defective tubes. Notification to NRC pursuant to specification 6.9.5P	N/A	N/A
100% of Area in one OTSG	C-1	None	N/A	N/A
	C-2	Plug defective tubes and inspect 100% of corresponding area in other OTSG.	C-1	None
			C-2	Plug defective tubes
			C-3	Plug defective tubes and notify NRC pursuant to specification 6.9.5P
	C-3	Plug defective tubes and inspect 100% of corresponding area in other OTSG. Notification to NRC pursuant to specification 6.9..5P	C-1	None
			C-2	Plug defective tubes
			C-3	Plug defective tubes

SPECIAL PERIPHERAL GROUP TUBES

(Above and including the 13th Tube Support Plate ONLY)

TABLE 4.17-3

Row	Tubes
1	1-16
2	1-27
3	1-34
4	1-41
5	1-17, 30-46
6	1-14, 38-51
7	1-12, 43-54
8	1-10, 48-57
9	1-10, 53-62
10	1-9, 57-65
11	1-9, 60-68
12	1-9, 63-71
13	1-8, 67-74
14	1-7, 69-75
15	1-7, 72-78
16	1-7, 75-81
17	1-6, 77-82
18	1-7, 79-85
19	1-6, 81-86
20	1-6, 80-85
21	1-6, 85-90
22	1-6, 88-93
23	1-6, 89-94
24	1-5, 91-95
25	1-6, 93-98
26	1-5, 95-99
27	1-5, 96-100
28	1-5, 97-101
29	1-5, 100-104
30	1-5, 101-105
31	1-5, 102-106
32	1-5, 103-107
33	1-4, 105-108
34	1-4, 104-107
35	1-4, 105-108
36	1-5, 109-113
37	1-5, 110-114
38	1-5, 111-115
39	1-5, 112-116
40	1-4, 114-117

SPECIAL PERIPHERAL GROUP TUBES

(Above and including the 13th Tube Support Plate ONLY)

TABLE 4.17-3 (Continued)

Row	Tubes
41	1-3, 114-116
42	1-3, 115-117
43	1-3, 116-118
44	1-3, 117-119
45	1-4, 117-120
46	1-4, 116-119
47	1-4, 119-122
48	1-4, 120-123
49	1-4, 121-124
50	1-3, 121-123
51	1-3, 122-124
52	1-3, 123-125
53	1-3, 124-126
54	1-4, 124-127
55	1-3, 124-126
56	1-3, 125-127
57	1-3, 126-128
58	1-3, 127-129
59	1-3, 122-124
60	1-3, 127-129
61	1-3, 124-126
62	1-2, 128-129
63	3, 126-128
64	124-126
65	123-124
66	125-127
67	127-128
68	126-127
69	128-130
70	128-129
71	127-129
72	127-128
73	126-128
74	122-123
75	123-124
76	58
77	122-124
78	122-124
79	126-128
80	128-129

SPECIAL PERIPHERAL GROUP TUBES

(Above and including the 13th Tube Support Plate ONLY)

TABLE 4.17-3 (Continued)

Row	Tubes
81	127-129
82	127-128
83	128-130
84	126-127
85	125-126
86	125-127
87	123-124
88	124-126
89	3, 126-128
90	1-2, 128-129
91	1-3, 124-126
92	1-3, 127-129
93	1-3, 122-124
94	1-3, 127-129
95	1-3, 126-128
96	1-3, 125-127
97	1-3, 124-126
98	1-4, 124-127
99	1-3, 124-126
100	1-3, 123-125
101	1-3, 122-124
102	1-3, 121-123
103	1-4, 121-124
104	1-4, 120-123
105	1-4, 119-122
106	1-4, 116-119
107	1-4, 117-120
108	1-3, 117-119
109	1-3, 116-118
110	1-3, 115-117
111	1-3, 114-116
112	1-4, 114-117
113	1-5, 112-116
114	1-5, 111-115
115	1-5, 110-114
116	1-5, 109-113
117	1-4, 105-108
118	1-4, 104-107
119	1-4, 105-108
120	1-5, 103-107

SPECIAL PERIPHERAL GROUP TUBES

(Above and including the 13th Tube Support Plate ONLY)

TABLE 4.17-3 (Continued)

Row	Tubes
121	1-5, 102-106
122	1-5, 101-105
123	1-5, 100-104
124	1-5, 97-101
125	1-5, 96-100
126	1-5, 95-99
127	1-6, 93-98
128	1-5, 91-95
129	1-6, 89-94
130	1-6, 88-93
131	1-6, 85-90
132	1-6, 80-85
133	1-6, 81-86
134	1-7, 79-85
135	1-6, 77-82
136	1-7, 75-81
137	1-7, 72-78
138	1-7, 69-75
139	1-8, 67-74
140	1-9, 63-71
141	1-9, 60-68
142	1-9, 57-65
143	1-10, 53-62
144	1-10, 48-57
145	1-12, 43-54
146	1-14, 38-51
147	1-17, 30-46
148	1-41
149	1-34
150	1-27
151	1-16

SPECIAL LANE REGION GROUP TUBES

(Above and including the 14th Tube Support Plate ONLY)

TABLE 4.17-4

Row	Tubes
63	1-2
64	1-4
65	1-6
66	1-9
67	1-13
68	1-20
69	1-20
70	1-23
71	1-27
72	1-30
73	1-60
74	1-60
75	1-60
77	1-60
78	1-60
79	1-60
80	1-30
81	1-28
82	1-23
83	1-20
84	1-20
85	1-13
86	1-9
87	1-6
88	1-4
89	1-2

Special Reports

6.9.5 Special reports shall be submitted to the Director of the Regulatory Operations Regional Office within the time period specified for each report. These reports shall be submitted covering the activities identified below pursuant to the requirements of the applicable reference specification:

A. A one-time only, "Narrative Summary of Operating Experience" will be submitted to cover the transition period (calendar year 1977).

B. A Reactor Building structural integrity report shall be submitted within ninety (90) days of completion of each of the following tests covered by Technical Specification 4.4.2 (the integrated leak rate test is covered in Technical Specification 4.4.1.1).

1. Annual Inspection
2. Tendon Stress Surveillance
3. End Anchorage Concrete Surveillance
4. Liner Plate Surveillance

C. Inservice Inspection Program

D. Reserved for Proposed Amendment No. 43

E. Reserved for Proposed Amendment No. 83 Supplement 1, Revision 2

F. Reserved for Proposed Amendment No. 125

G.	Radioactive Liquid Effluent Dose	30 days (3.17.2)
H.	Noble Gas Limits	30 days (3.18.2)
I.	Radioiodine and Particulates	30 days (3.18.3)
J.	Gaseous Radwaste Treatment	30 days (3.19)
K.	Radiological Monitoring Program	30 days (3.22)
L.	Monitoring Point Substitutions	30 days (3.22)
M.	Land Use Census	30 days (3.23)
N.	Fuel Cycle Dose	30 days (4.25)
O.	Liquid Holdup Tanks	30 days (3.17.3)
P.	Steam Generator Tube Inspection	30 days (4.17.5)

U.S. NUCLEAR REGULATORY COMMISSION

Revision 1
July 1975

REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

R. L. LLISCH

R. L. LLISC

AUG - 4 1975

CAT

cc: REN
R Slope

REGULATORY GUIDE 1.83

INSERVICE INSPECTION OF PRESSURIZED WATER REACTOR STEAM GENERATOR TUBES

A. INTRODUCTION

General Design Criteria 14, "Reactor Coolant Pressure Boundary," and 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," require that the reactor coolant pressure boundary have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. General Design Criterion 15, "Reactor Coolant System Design," requires that the reactor coolant system and associated auxiliary, control, and protection systems be designed with sufficient margin to ensure that the design conditions of the reactor coolant pressure boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences. Furthermore, General Design Criterion 32, "Inspection of Reactor Coolant Pressure Boundary," requires that components that are part of the reactor coolant pressure boundary be designed to permit periodic inspection and testing of critical areas to assess their structural and leaktight integrity.•

Failure[1] of steam generator tubes, which can be caused by cracking, wastage, and fretting, will release radioactive materials to the secondary coolant system. Furthermore, serious weakening of these tubes from similar causes could, in the event of a loss-of-coolant accident (LOCA), result in tube failures that would release the energy of the secondary system into the containment. This guide describes a method acceptable to the NRC staff for implementing these General Design Criteria by reducing the probability and consequences of steam generator tube failures through periodic inservice inspection for early detection of defects and deterioration. This guide applies only to pressurized water reactors (PWRs). The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

The heat transfer area of the steam generators in pressurized water reactors can comprise well over 50% of the area of the total primary system pressure-retaining boundary. The thin-walled steam generator tubing is an important part of a major barrier against fission product release to the environment. The steam generator tubing also acts as a barrier against steam release to the containment in the event of a LOCA. To act as an effective barrier, this tubing must be free of cracks, perforations, and general deterioration. The design criteria used to establish the structural integrity of the steam generator tubing should also define the minimum tube wall thickness required to sustain the pressure and thermal loading caused by the worst postulated LOCA in combination with a safe shutdown earthquake.[2]

Inadequate control of the secondary coolant chemistry has been identified as one of the principal sources

[1] Failure is defined as full penetration of the pressure boundary with subsequent leakage.

[2] As defined in Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, "Reactor Site Criteria."

of steam generator tube degradation and failure. There is evidence that excessive steam-side corrosion attack occurs in restricted flow areas that permit high local concentration of free caustic, phosphates, and impurities that may enter the steam generator through condenser inleakage. Therefore, secondary water chemistry specifications must reflect the limitation of the materials in the secondary system, and the supporting auxiliary chemical feed system must be designed to maintain desired feedwater quality to each steam generator. Effective monitoring of water chemistry with in-line continuous analytical instrumentation supplemented by plant laboratory sampling analysis of steam, condensate return, and feedwater is necessary at all times during operation to ensure that water quality is not degraded below acceptable limits by such events as condenser inleakage or chemical feed system maloperation.

Mechanical or flow-induced vibration can cause fretting or fatigue damage to steam generator tubes, which could also lead to tube failures.

A program of periodic inservice inspection of steam generators is essential to monitor the integrity of the tubing, particularly if there is evidence of mechanical damage or progressive deterioration caused by inadequate design, manufacturing errors, or chemical imbalance. Inservice inspection of steam generator tubing can also provide useful information regarding the nature and cause of any tube degradation, thereby assisting the operator in taking proper and timely corrective measures.

Inspection and repairs of steam generator tubing in operating plants cause some radiation exposure to personnel. Careful pre-job planning can assist in maintaining radiation exposures as low as is reasonably achievable. Temporary shielding, decontamination, special tooling, jigs and fixtures for remote inspection and repair, and other design and procedural considerations such as are outlined in Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposure as Low as Practicable (Nuclear Reactors)," should be used to the extent practical.

The recommendations in this guide are applicable to current "typical" once-through and U-bend steam generators that have Ni-Cr-Fe or stainless steel tubing. The steam generator tubing is usually seamless, cold drawn, and annealed and is manufactured and tested in accordance with specifications of the American Society of Mechanical Engineers and the American Society for Testing and Materials.

The initial quality of manufactured tubing is determined by hydrostatic, eddy current, and ultrasonic tests. The tube-to-tube-sheet welds are inspected visually and by dye penetrant, then finally leak tested.

During reactor operation, steam generator tube leaks are detected by monitoring the secondary system for radioactivity and the presence of boron through instrument analysis of steam and blowdown samples. If leaks are present, they can usually be located by eddy current examination of suspect tubing. Eddy current examination is effective because it detects the presence of defect-caused variations in effective electrical conductivity and/or magnetic permeability of the material being tested. Because the eddy current probing technique has excellent sensitivity in nonmagnetic materials, decreases in effective conductivity due to a discontinuity in a tube wall can be measured directly by increases in coil voltage in the probe. Special eddy current probes designed for scanning tubing from the inside have proved very effective in locating defect areas in steam generator tubes and for assessing the overall condition of the tubing in numerous operating PWRs.

Radiography is a supplemental method for inservice inspection of steam generator tubing. Although radiography does not provide the speed and flexibility of eddy current methods, it can supplement eddy current testing for defect characterization on a limited basis.

Leaking tubes, defective tubes, and tubes that exceed the plugging limit should be taken out of service by plugging both ends of the tube at the tube sheet with welded plugs. Various methods are used for plugging and welding. Plugs may be installed mechanically or explosively, and welding may be performed manually, automatically, or explosively.

Experience has indicated that each steam generator design has critical areas (e.g., crevices, low-flow areas, and regions that allow steam blanketing) where attack and degradation of the steam generator tubes may occur even if secondary water chemistry is properly maintained. Mechanical damage to steam generator tubes may also occur in areas subject to flow-induced vibrations. Typically, the number of tubes in these critical areas is less than 20% of the total.

The usual shop examination of tubing can be considered to serve as an adequate baseline examination. An onsite preservice inspection of the steam generator tubing should be performed in the absence of a documented shop or field examination. For plants now operating, the initial inspection should sample tubes on a random basis unless experience with similar designs and chemistry indicate critical areas. Subsequent inspections should concentrate on any critical areas identified so that most defective tubes will be found. This selection method can be expected to result in the ratio of tube defects found to total tubes inspected being considerably higher than the ratio of defective tubes to total tubes in the steam generator.

*Lines indicate substantive changes from previous issue.

C. REGULATORY POSITION

A program for inservice inspection of steam generator tubing should be established and should include the following:

1. Access for Inspection

a. Steam generators of pressurized water reactors should be designed to facilitate inspection of all tubes.

b. Sufficient access should be provided to perform these inspections and to plug tubes as required.

c. Pre-job planning should be undertaken to make provisions for inspections that ensure that personnel radiation exposure is maintained as low as is reasonably achievable.

2. Inspection Equipment and Procedures

a. Inservice inspection should include nondestructive examination by eddy current testing or equivalent techniques. The equipment should be capable of locating and identifying stress corrosion cracks and tube wall thinning by chemical wastage, mechanical damage, or other causes.

b. The inspection equipment should be sensitive enough to detect imperfections 20% or more through the tube wall.

c. A suitable eddy current inspection system could consist of (1) an internal sensing probe, (2) a two-channel eddy current tester, (3) a viewing oscilloscope, (4) a conventional two-channel strip chart recorder, and (5) a magnetic tape data recorder.

d. Examination results and reports should be stored and maintained for the operating life of the facility.

e. Standards consisting of similar as-manufactured steam generator tubing with known imperfections should be used to establish sensitivity and to calibrate the equipment. Where practical, these standards should include reference flaws that simulate the length, depth, and shape of actual imperfections that are characteristic of past experience.

f. The equipment should be capable of examining the entire length of the tubes.[3]

g. The equipment used for eddy current testing should be designed so that operators may be shielded or the equipment may be operated remotely to limit operator exposure to radiation.

h. Personnel engaged in data taking and interpreting the results of the eddy current inspection should be tested and qualified in accordance with American Society for Nondestructive Testing Standard SNT–TC–IA and supplements.[4]

i. The examinations should be performed according to written procedures.

3. Baseline Inspection

a. All tubes in the steam generators should be inspected by eddy current or alternative techniques prior to service to establish a baseline condition of the tubing.

b. For operating plants without an initial baseline inspection, the first inservice inspection performed according to regulatory positions C.4 and C.5 will define the baseline condition for subsequent inspections.

c. Operating plants instituting a major change in their secondary water chemistry (e.g., phosphate to volatile treatment) should conduct a baseline inspection before resumption of power operation.

4. Sample Selection and Testing

Selection and testing of steam generator tubes should be made on the following basis:

a. The preservice inspection should include all the tubes in the steam generators.

b. Tubes for the inspection of operating plants should be selected on a random basis except where experience in similar plants with similar secondary water chemistry indicates critical areas to be inspected.

c. At least 3% of the total number of tubes in each steam generator to be inspected should be tested during each inspection (see regulatory positions C.3 and C.6).

d. All of the steam generators in a given plant should be inspected at the first inservice inspection. Subsequent inspections may be limited to one steam generator on a rotating schedule encompassing 3% of the total tubes of the steam generators in the plant if the

[3] For U-bend designs, entry for the hot-leg side with examination from the point of entry completely around the U-bend to the top support of the cold leg is considered sufficient to constitute a tube inspection.

[4] SNT–TC–IA and Supplements, "Recommended Practice for Nondestructive Testing Personnel Qualification and Certification." Copies may be obtained from the American Society for Nondestructive Testing, 914 Chicago Avenue, Evanston, Illinois 60202.

results of the first inspection indicate that all steam generators are performing in a like manner. (Note: Under some circumstances, the operating conditions in one or more specific steam generators may be found to be more severe than those in the other generators. Under such circumstances, the sample sequence should be modified to inspect the steam generator with the most severe conditions.)

e. Every inspection subsequent to the preservice inspection should include all nonplugged tubes that previously had detectable wall penetrations (>20%) and should also include tubes in those areas where experience has indicated potential problems.

5. Supplementary Sampling Requirements

a. If the eddy current inspection pursuant to regulatory position C.4.d indicates any tubes with previously undetected imperfections of 20% or greater depth, additional steam generators, if any, should be inspected. If previously degraded tubes exhibit significant (>10%) further wall penetration, additional steam generators should be inspected.

b. If the eddy current inspection pursuant to regulatory position C.4.c indicates that more than 10%[5] of the inspected tubes have detectable wall penetration (>20%) or that one or more of the inspected tubes have an indication in excess of the plugging limit (see regulatory position C.7.a), an additional 3% of the tubes should be inspected, concentrating on tubes in those areas of the tube sheet array where tubes with imperfections were found. In addition, the rest of the steam generators should be inspected according to regulatory position C.4.c.

c. If this additional inspection indicates that more than 10% of these additionally inspected tubes have detectable wall penetration (>20%) or one or more of these additionally inspected tubes has an indication in excess of the plugging limit, additional tubes (no less than 6% of the total tubes in the steam generator) in the area of the tube sheet array where tubes with imperfections were found should be inspected.

6. Inspection Intervals

a. The first inservice inspection of steam generators should be performed after 6 effective full power months but before 24 calendar months.

b. Subsequent inservice inspections should be not less than 12 nor more than 24 calendar months after the previous inspection.

c. Inspections may be made coincident with refueling outages or any shutdown for plant repair and maintenance in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI.[6]

d. If two consecutive inspections, not including the preservice inspection, result in less than 10% of the tubes with detectable wall penetration (>20%) and no significant (>10%) further penetration of tubes with previous indications, the inspection frequency should be extended to 40-month intervals. If it can be demonstrated through two consecutive inspections that previously observed degradation has not continued and no additional degradation has occurred, a 40-month inspection interval may be initiated.

e. Unscheduled inspections should be conducted in the event of primary-to-secondary leaks exceeding technical specifications, a seismic occurrence greater than an operating basis earthquake,[2] a loss-of-coolant accident requiring actuation of engineered safeguards, or a major steam line or feedwater line break.

7. Acceptance Limits

a. As used in this regulatory guide:

(1) *Imperfection* means an exception to the dimensions, finish, or contour required by drawing or specification.

(2) *Defect* means an imperfection of such severity that the tube is unacceptable for continued service.

(3) *Plugging limit* means the imperfection depth at or beyond which plugging of the tube must be performed. (Note that the plugging limit is *not* a depth of penetration within the defect range but rather an imperfection depth with conservative allowances. These allowances include such considerations as general corrosion and measurement error.)

(4) *Plugging criteria* means those calculational and analytical procedures used to arrive at the plugging limit. These currently may be submitted by a licensee for approval by NRC.

b. If, in the inspection performed under regulatory position C.4, less than 10% of the tubes inspected have detectable wall pentration (>20%) and no tube has imperfections that exceed the plugging limit defect, plant operation may resume.

[5] In all inspections, previously degraded tubes that exhibit significant (>10%) further wall penetration must be included in the 10%.

[6] Copies may be obtained from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

c. If, in the inspections performed under regulatory position C.5, less than 10% of the total tubes inspected have detectable wall penetration (>20%) and no more than three tubes exceed the plugging limit, plant operation may resume after required corrective measures have been taken.

d. If, in the inspections performed under regulatory position C.5, more than 10% of the total tubes inspected have detectable wall penetration (>20%) or more than three of the tubes inspected exceed the plugging limit, the situation should be immediately reported to the Commission in accordance with the facility license for resolution and approval of the proposed remedial action. Additional sampling and more frequent inspections may be required.

8. Corrective Measures

All leaking tubes, defective tubes, and tubes with imperfections exceeding the plugging limit should be plugged.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for utilizing this regulatory guide.

This guide reflects current regulatory practice. Therefore, except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the methods described herein will be used by the NRC staff in evaluating an applicant's program for inspection of steam generator tubes.

Technical specifications for ensuring inspection as recommended in regulatory position C should be incorporated in operating licenses.

Nuclear Operating R.S. #1

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

March 14, 1985

Docket No. 50-312

LICENSEE: Sacramento Municipal Utility District

FACILITY: Rancho Seco Nuclear Generating Station

SUBJECT: SUMMARY OF MEETING HELD ON NOVEMBER 20, 1984 WITH SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD) TO DISCUSS STEAM GENERATOR TUBE FAILURE OF RANCHO SECO NUCLEAR GENERATING STATION

The Rancho Seco Nuclear Generating Station had experienced three shut downs in recent months due to steam generator failures. As a result of these failures the NRC staff requested a meeting with SMUD to discuss the cause of the failures and the licensees program for addressing the steam generator failures. The meeting was held on November 20, 1984 in Bethesda, Maryland. The attendees list (Enclosure 1) and copies of the viewgraph used at the meeting (Enclosure 2) are attached.

The tube failures have been occuring in the lane tube area of the steam generators from the 15th support plate to the upper tube sheet. The failure occurrs initially as a small leak probably due to micro cracks that grow slowly. On cool down the cracks open up as the tube goes from compression to tension. The licensee hypothesized that the micro cracks are formed by a combination of corrosion due to concentrated chemicals carried by the moisture and by normal tube loadings. The cracks are then propagated by high cycle fatigue at low alternating stresses. The licensee noted that of the 31,000 Rancho Seco Steam Generator tubes, to date 66 have been plugged and of these 6 were leaking.

The licensee described the approaches being considered to correct the problem of lane tube failures in B&W plants. Methods being considered include sleeving the lane tubes from the primary face of the upper tube sheet through the 15 tube support plate, and lane flow blockers.

The licensee then discussed the eddy current tube inspection program at Ranch Seco. The licensee noted that during the last outage caused by a steam generator leak they went to an improved eddy current inspection program. In addition a more conservative plugging criteria was used in establishing which tubes should be plugged. As a result more tubes were plugged on both steam generators. The licensee noted that during the refueling outage scheduled for early in 1985 two tubes would be removed for examination. Finally the licensee described their secondary water chemistry control program.

The staff noted that the current Technical Specification for additional unscheduled inservice inspections of the steam generator is based on I_{131} activity in the secondary side of the steam generators.

~~8503270695~~ 41pp

Copies:
Dieterich (3)
Heilman
Schwieger (2)
Oubre'
Moore
Andognini

The staff further stated that the secondary side I_{131} concentration depended on the primary side coolant activity as well as primary to secondary side tube leakage. Therefore primary to secondary side coolant leakage could be well in excess of the Technical Specification leakage limit for reactor operation before the Technical Specifications would require the additional unscheduled inservice inspection. The staff indicated that the current Technical Specification is not an adequate indication of tube degradation and noted that when plant shut down is required because the Technical Specification leakage limit is reached that the additional unscheduled inservice inspection should be conducted during the shut down. The licensee stated that when the plant is shut down because of tube leakage in the tube lane area, the lane tubes are inspected as well as some additional tubes on either side of the lane tubes (wedge tubes). The licensee committed to propose a revision the Technical Specifications to specify that if the leak occurs in the lane tube area, the lane tubes and wedge tubes will be inspected. If the leak occurs in other areas, inspection will be in accordance with table 4.17-2 in the Technical Specifications. We stated that this would be acceptable.

Sincerely,

Sydney Miner

Sydney Miner, Project Manager
Operating Reactors Branch #4
Division of Licensing

Enclosures

Meeting Attendees

cc: See next page

MEETING SUMMARY DISTRIBUTION

Licensee: Sacramento Municipal Utility District

*Copies also sent to those people on service (cc) list for subject plant(s).

Docket File
NRC PDR
L PDR
ORB#4 Rdg
Project Manager - Sydney Miner
JStolz
BGrimes (Emerg. Preparedness only)
OELD
NSIC
EJordan, IE
PMcKee, IE
ACRS-10

NRC Meeting Participants:

H. F. Conrad
B. D. Liaw
J. H. Eckhardt
Mary S. Wegner
C. Y. Cheng
Louis Frank
W. V. Johnston

cc w/enclosure(s):

David S. Kaplan, Secretary and
General Counsel
Sacramento Municipal Utility
District
6201 S Street
P. O. Box 15830
Sacramento, California 95813

Sacramento County
Board of Supervisors
827 7th Street, Room 424
Sacramento, California 95814

Mr. John B. Martin, Regional
Administrator
U.S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

Regional Radiation Representative
EPA Region IX
215 Fremont Street
San Francisco, California 94111

Mr. Robert B. Borsum
Babcock & Wilcox
Nuclear Power Generation Division
Suite 220, 7910 Woodmont Avenue
Bethesda, Maryland 20814

Thomas Baxter, Esq.
Shaw, Pittman, Potts & Trowbridge
1800 M Street, N.W.
Washington, D. C. 20036

Helen Hubbard
P. O. Box 63
Sunol, California 94586

Joseph O. Ward, Chief
Radiological Health Branch
State Department of Health Services
714 P Street, Office Building #8
Sacramento, California 95814

Ms. Eleanor Schwartz
California State Office
444 North Capitol Street, N.W., Suite 305
Washington, D.C. 20001

Docketing and Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Resident Inspector/Rancho Seco
c/o U. S. N. R. C.
14410 Twin Cities Road
Herald, CA 95638

Director
Energy Facilities Siting Division
Energy Resources Conservation &
Development Commission
1516 - 9th Street
Sacramento, California 95814

Enclosure 1

MEETING NOVEMBER 20, 1984

RANCHO SECO STEAM GENERATOR MEETING ATTENDEES

Sydney Miner	NRC
H. F. Conrad	NRC
B. D. Liaw	NRC
L. H. Whl	SMUD
R. E. Marlow	CONAM
Jim Field	SMUD
R. P. Wichert	SMUD
C. A. Creacy	B&W
F. W. Kellie	SMUD
Ron Colombo	SMUD
J. H. Eckhardt	NRC
J. H. Taylor	B&W
R. W. Ganthner	B&W
Paul Guill	Duke Power Co.
R. L. Gill	Duke Power Co.
C. W. Hendrix, Jr.	Duke Power Co.
Gary Abell	B&W
Mary S. Wegner	NRC
Lynn Connor	Doc-Search Associates
C. Y. Cheng	NRC
Louis Frank	NRC
Ron Rodriguez	SMUD
Jerry Delezenski	SMUD
W. V. Johnston	NRC

Enclosure 2

SMUD/NRC

RANCHO SECO STEAM GENERATOR STATUS MEETING

PRESENTED BY:
- SACRAMENTO MUNICIPAL UTILITY DISTRICT
- B&W
- B&W OWNERS GROUP
- CONAM

AT NRC--BETHESDA, MD
NOVEMBER 20, 1984

PURPOSE

ADDRESS NRC STAFF QUESTIONS ON:

- RECENT HISTORY OF THE RANCHO SECO OTSG'S
- SMUD MANAGEMENT POSITION TOWARDS
  - -INSPECTION
  - -REPAIR
  - -OPERATION

OF THE RANCHO SECO OTSG'S

SMUD/NRC MEETING
11-20-84
BETHESDA, MD

AGENDA

- INTRODUCTION — SMUD (10 MINUTES)
  - PURPOSE
  - OVERVIEW
  - PARTICIPANTS
- THE ONCE-THROUGH STEAM GENERATOR--OTSG — BWOG (20 MINUTES)
  - OTSG INDUSTRY OPERATING EXPERIENCE
  - DESIGN & OPERATING CHARACTERISTICS
  - AREAS OF SPECIAL INTEREST
- RANCHO SECO OTSG OPERATING EXPERIENCE — SMUD/CONAM (60 MINUTES)
  - MECHANICAL
  - NDE
  - CHEMISTRY
- DISTRICT SUMMARY AND ACTIONS — SMUD (30 MINUTES)
  - DISCUSSION

TUBE PLUGGING SUMMARY THROUGH NOVEMBER 15,1984
CATEGORIZED BY NDE

PLANT/GEN.	CATEGORY 1	2	3	TOTAL CAT. 1,2,&3	4	OVERALL TOTAL
"A"						
A-OTSG	3	31	1	35	42	77
B-OTSG	8	235	13	256	59	315
"B"						
A-OTSG	0	2	0	2	3	5
B-OTSG	3	20	2	25	17	42
"C"						
A-OTSG	9	14	5	28	79	107
B-OTSG	5	12	14	31	4	35
"D"						
A-OTSG	6	169	27	202	4	206
B-OTSG	0	82	3	85	7	92
RANCHO SECO						
A-OTSG	3	21	5	29	21	50
B-OTSG	3	10	13	26	8	34
"F"						
A-OTSG	1	0	1	2	4	6
B-OTSG	0	0	0	0	27	27
"G"						
A-OTSG	2	3	2	7	12	19
B-OTSG	0	2	1	3	6	9
	43	601	87	731	293	1024

CATEGORY	EXPLANATION
1	TUBE LEAK
2	EXCEEDED 40% TUBE PLUGGING CRITERIA (NDE)
3	CUSTOMER OPTION (0-40% THROUGH WALL)
4	OTHER (INSTRUMENTATION, ERROR, SHOP PLUGS, ETC.)

TUBE PLUGGING SUMMARY THROUGH NOVEMBER 15, 1984
CATEGORIZED BY DAMAGE MECHANISM

PLANT/GEN.	SECONDARY SULFUR IGA	LANE REGION		EROSION CORROSION	AFW HEADER	OTHER	TOTAL
		>40%	CUST. OPT.				
"A"							
A-OTSG	0	6	1	24	-	46	77
B-OTSG	0	11-	6	199	-	99	315
"B"							
A-OTSG	0	0	0	2	-	3	5
B-OTSG	0	5	2	17	-	18	42
"C"							
A-OTSG	0	7	1	6	2	91	107
B-OTSG	0	8	12	5	0	10	35
"D"							
A-OTSG	142	23	17	1	-	23	206
B-OTSG	70	1	0	0	-	21	92
RANCHO SECO							
A-OTSG	0	16	5	1	2	26	50
B-OTSG	0	8	12	0	6	8	34
"F"							
A-OTSG	0	0	0	0	-	6	6
B-OTSG	0	0	0	0	-	27	27
"G"							
A-OTSG	0	0	0	1	6	12	19
B-OTSG	0	0	0	0	3	6	9

DEFINITIONS

IGA - UPPER TUBESHEET MIDSPAN
LANE REGION - ROWS 73,74,75,77,78,79 & 15th TSP-UTS FACE
EROSION/CORROSION - 11th,12th,13th, or 14th TSP (PERIPHERY)
AFWH - 15th TSP-UTS FACE & OUTERMOST TUBES

LANE REGION FAILURES

FAILURE HYPOTHESIS

- Corrosion attack in the upper spans is due to concentrated chemical species carried by moisture

- Microcracks are formed by the combination of surface damage due to corrosion and by normal tube loadings

- Crack propagation is caused by high cycle fatigue at low alternating stress

LANE REGION FAILURES

FACTS

- Moisture is present along the lane at the upper span
- Tube samples reveal deposits and surface damage
- Surface damage has been reproduced in the laboratory by concentrated solutions of silicates and sulphates
- Micro cracking has been observed in the surface damage area
- Vibration measurements indicate low amplitude vibration
- A concentrated silicate environmnet has been shown to substantially lower the fatigue strength of inconel

O T S G
S L E E V E

OBJECTIVE: Provide a new pressure boundary from primary face of upper tubesheet through 15th TSP.

DESIGN FEATURES: 80 inch long sleeve

Mechanical Sleeve

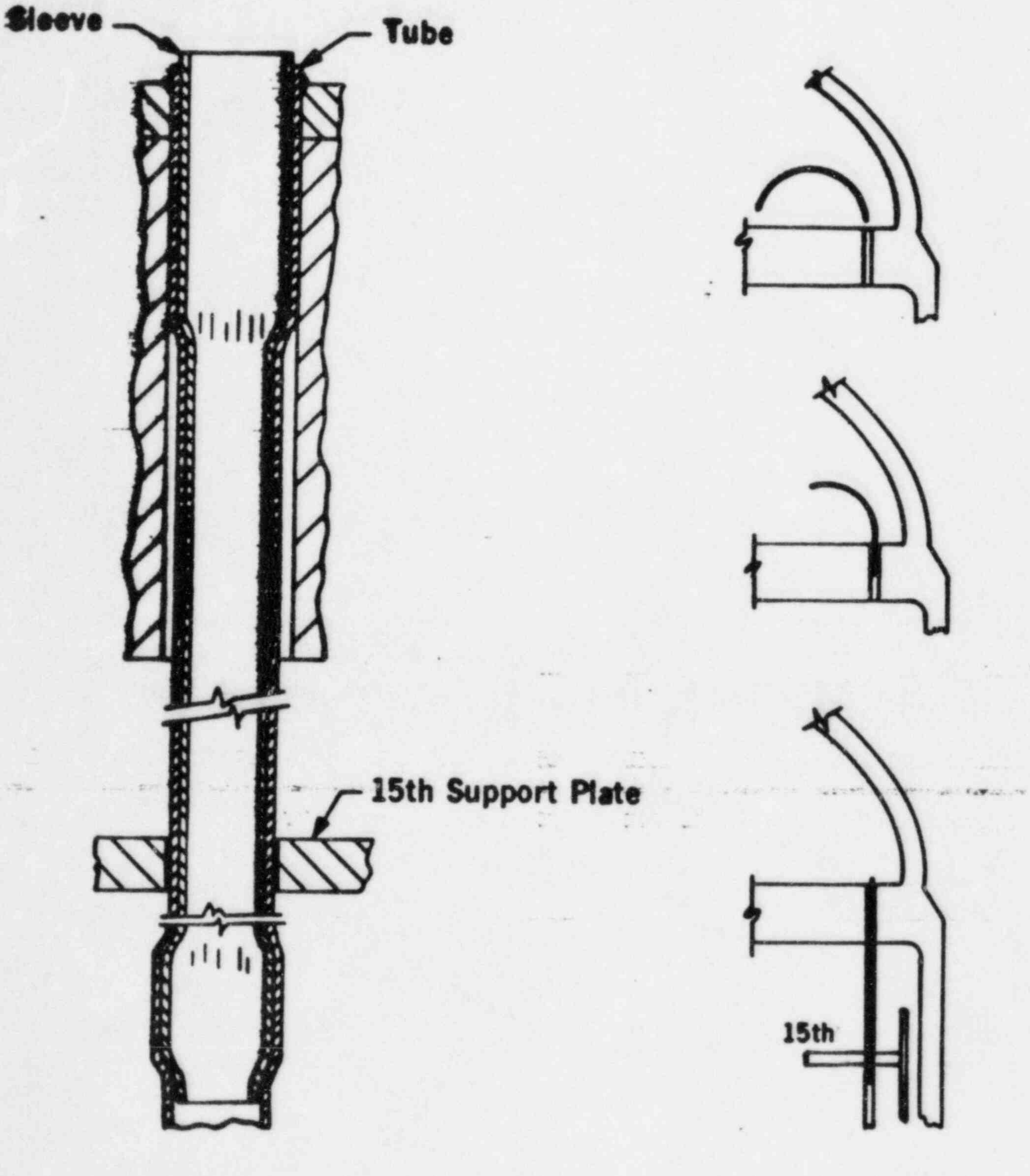
I600 - thermally treated

STATUS: Engineering Qualification Complete

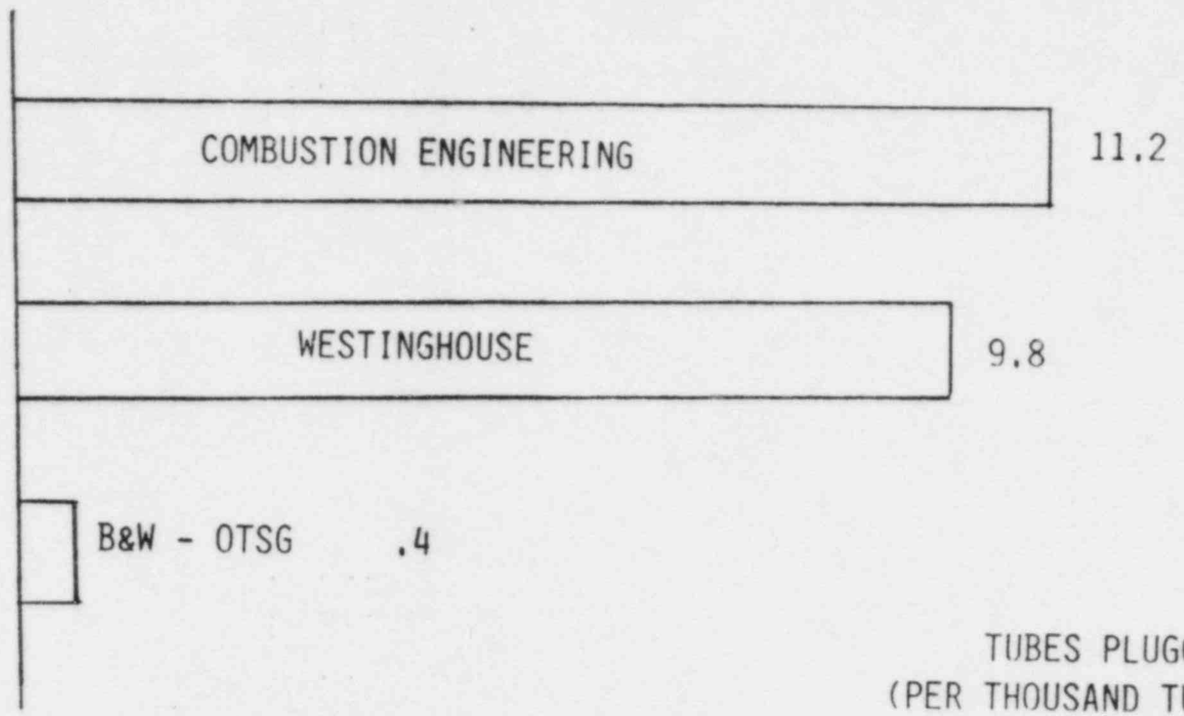
Prototype Tooling Developed

Demonstration Sleeving Program in early December

OTSG Sleeve



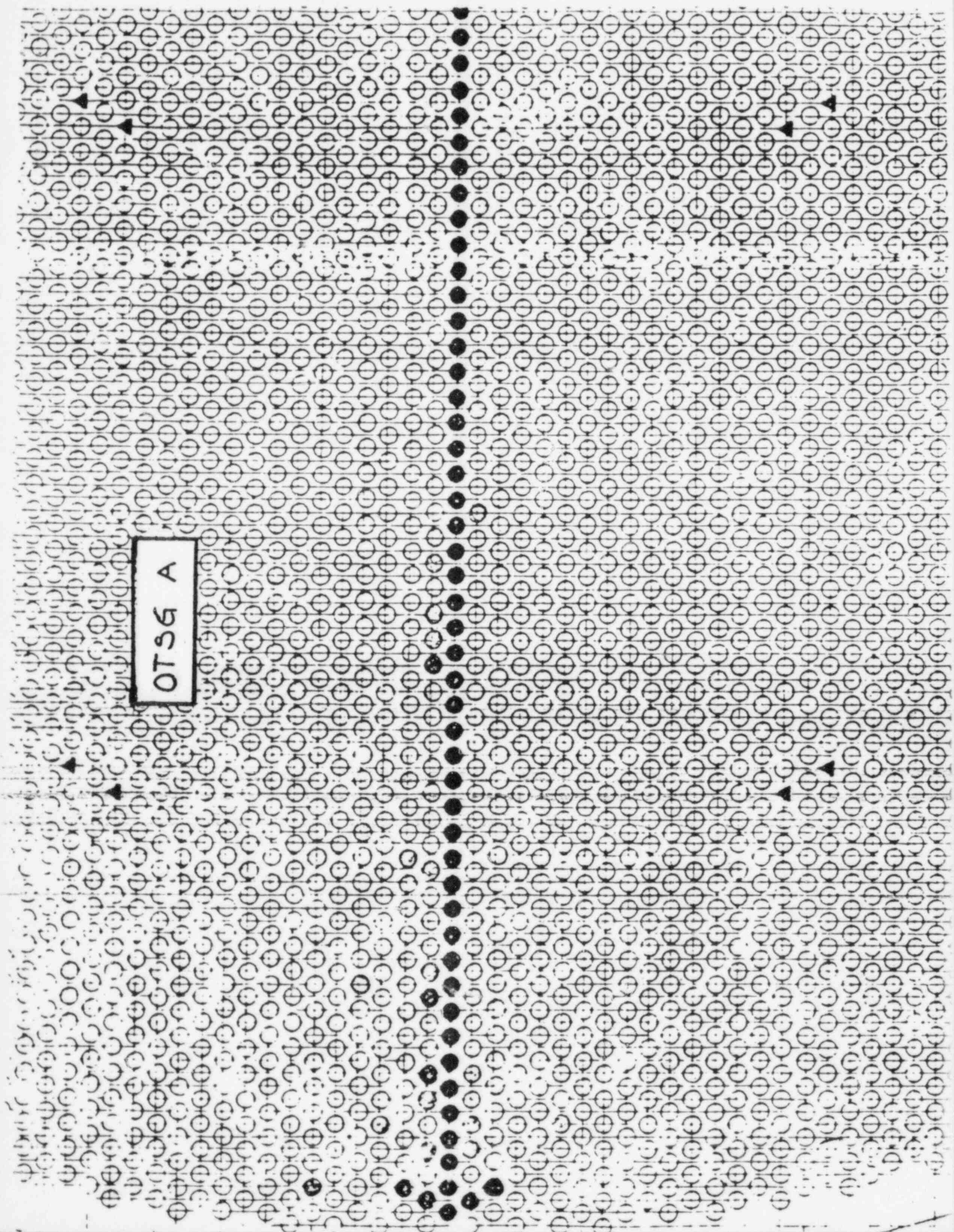
B & W: LEADERS IN STEAM GENERATOR INTEGRITY

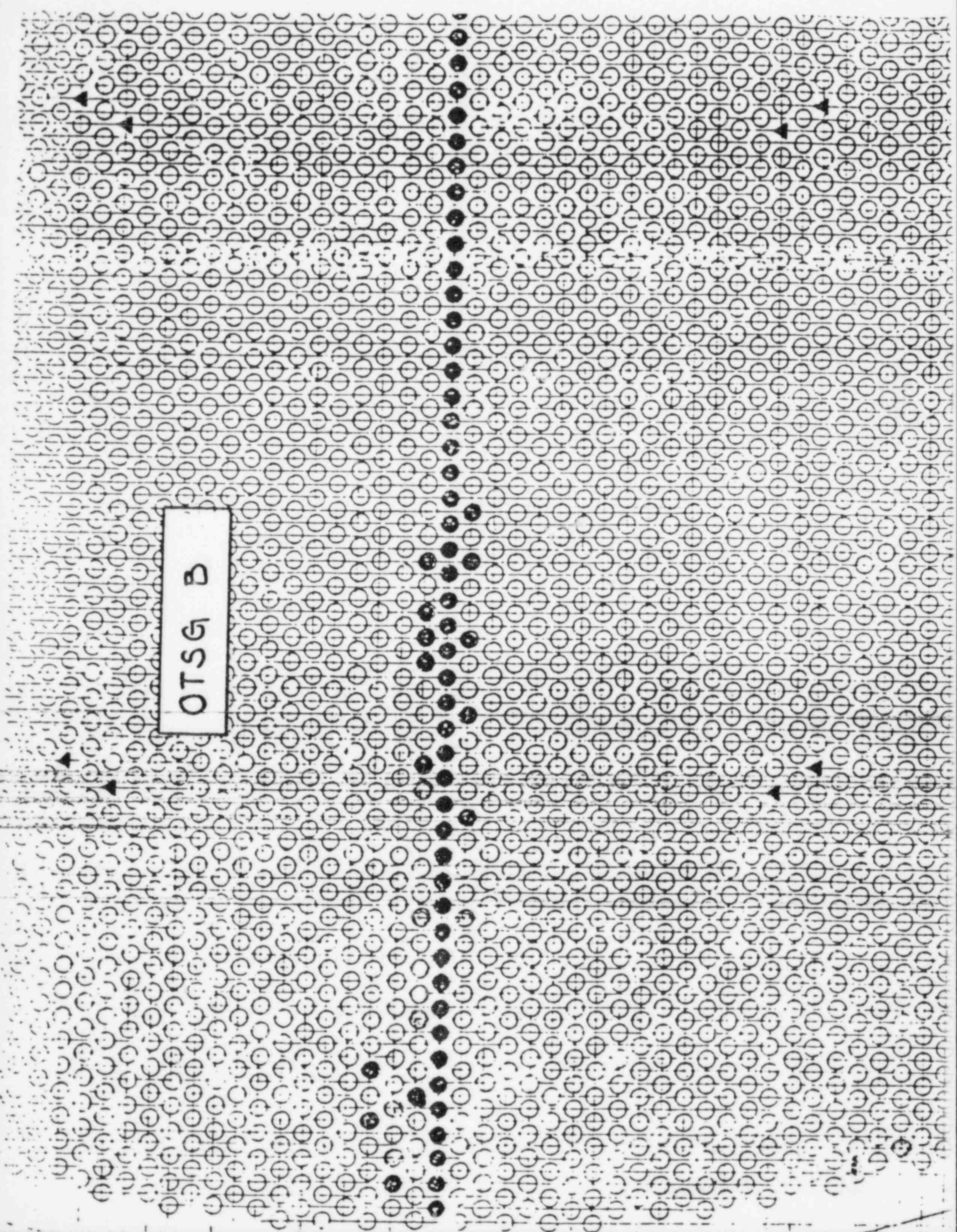


TUBES PLUGGED
(PER THOUSAND TUBE YEARS)
SOURCE: AECL 7689 1983

RANCHO SECO
OPERATIONAL TUBE INTEGRITY

	A OTSG	B OTSG
FIRST REFUELING 9-77	INSPECTED 8 TUBES PLUGGED	INSPECTED NO TUBES PLUGGED
SECOND REFUELING 12-78	INSPECTED NO TUBES PLUGGED	INSPECTED NO TUBES PLUGGED
THIRD REFUELING 2-80	INSPECTED 1 TUBE PLUGGED	INSPECTED 2 TUBES PLUGGED
FOURTH REFUELING 3-81	INSPECTED NO TUBES PLUGGED	NOT INSPECTED
TUBE LEAK 5-81	NOT INSPECTED	1 LEAKER PLUGGED 3 ADDITIONAL TUBES PLUGGED
AUX. FEEDWATER MODS 6-82	6 TUBES PLUGGED DUE TO PROXIMITY 4 ADDITIONAL TUBES PLUGGED	6 TUBES PLUGGED DUE TO PROXIMITY 3 ADDITIONAL TUBES PLUGGED
TUBE LEAK 11-82	1 LEAKER PLUGGED 1 ADDITIONAL TUBE PLUGGED	NOT INSPECTED
FIFTH REFUELING 4-83	INSPECTED NO TUBES PLUGGED	INSPECTED 2 TUBES PLUGGED
TUBE LEAK 9-83	1 LEAKER PLUGGED	NOT INSPECTED
TUBE LEAK 7-84	NOT INSPECTED	1 LEAKER PLUGGED
TUBE LEAK 8-84	NOT INSPECTED	1 LEAKER PLUGGED
TUBE LEAK 10-84	1 LEAKER PLUGGED 12 ADDITIONAL TUBES PLUGGED	INSPECTED 12 TUBES PLUGGED


OTSG A


OTSG B

- ~95% OF PLUGGABLE THROUGH WALL DEFECTS ARE IN AREA OF SPECIAL INTEREST

- ALL TUBE LEAKS HAVE BEEN IN AREA OF SPECIAL INTEREST

RANCHO SECO TUBE INTEGRITY SUMMARY

- 31,000 TUBES IN SERVICE
- ~ 300,000 TUBE-YEARS OF SERVICE
- 66 TUBES PLUGGED
- 6 LEAKS

EDDY CURRENT TESTING
AT RANCHO SECO

- 3% RANDOM SAMPLE REQUIRED BY TECHNICAL SPECIFICATIONS

- KNOWN PROBLEM AREAS
  - LANE
  - PERIPHERY
  - AFW HEADER PROXIMITY
  - WEDGE

EDDY CURRENT TESTING
AFTER TUBE LEAKS

- PREVIOUS PROBLEM AREAS
- LEAK LOCATION
- EXPERIENCE OF OTHER OTSG's

ECT TECHNIQUES USED AT RANCHO SECO

- SINGLE FREQUENCIES
  400 KHZ
  25 KHZ

- CECA

- MULTI FREQUENCIES

- CURRENT EQUIPMENT AND PROBES

EDDY CURRENT EXAMINATION

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR POWER PLANT

OCTOBER 1984

EXTENT OF EXAMINATION

S/G A 681 Tubes

S/G B 674 Tubes

EXAMINATION AREA

"LANE"

"WEDGE"

NUMBER OF TUBES PLUGGED

S/G A 13 Tubes

S/G B 12 Tubes

EXAMINATION METHOD

BOBBIN COIL

INSTRUMENT: MIZ-18 Digital Eddy Current Instrument

PROBE SIZE: .520" Diameter

EXAMINATION FREQUENCIES AND MODES

600 kHz Differential and Absolute

400 kHz Differential and Absolute

200 kHz Differential and Absolute

45 kHz Differential and Absolute

8 X 1 COILS

INSTRUMENT: MIZ- 18 Digital Eddy Current Instrument

PROBE SIZE: 8C-.520"

EXAMINATION FREQUENCIES AND MODES

400 kHz Absolute

100 kHz Absolute

PLUGGING CRITERIA

PLUGGING LISTS DEVELOPED FROM FOLLOWING :

1. Discontinuity signals in excess of 39% thru wall as measured by either bobbin coil or 8 x 1 coils examination.
2. Discontinuity signals at edge of support plate or upper tube sheet which were short and did not appear as wear and were crack like only in either bobbin coil or 8 x 1 coils examinations.

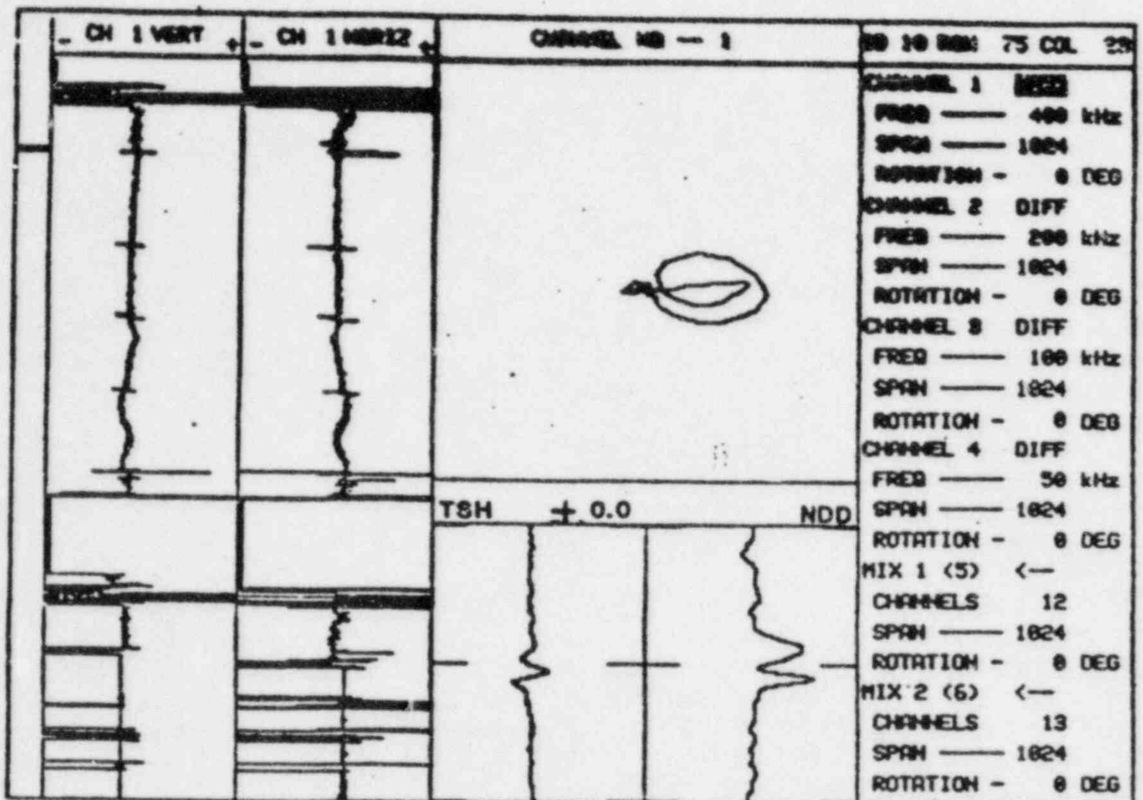
NOTE:

Plugging lists were developed with a conservative attitude to help prevent future leaks.

CONAM INSPECTION

Sacramento Municipal Utility District
Rancho Seco, Unit 1
Steam Generators A & B
October 1984

S/G A



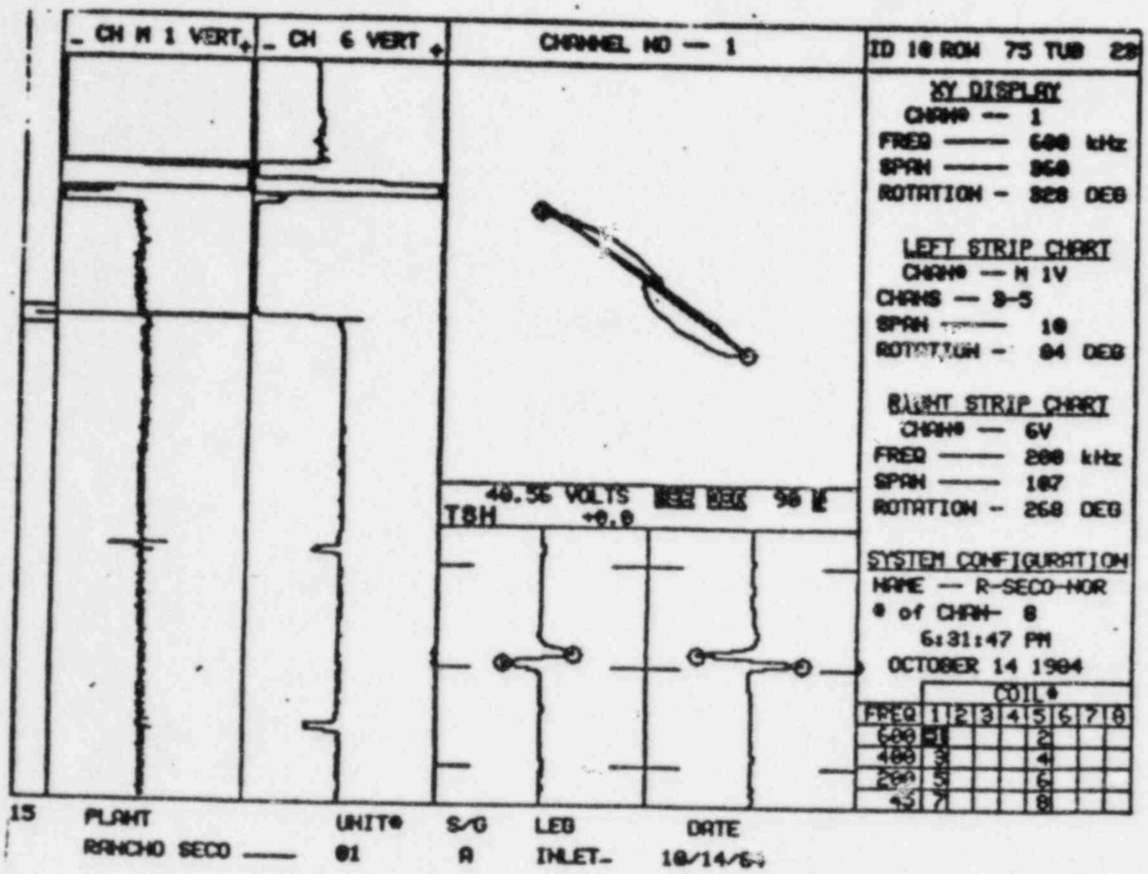
42
SEPT. 22, 1983

ZETEC Inc. - 1983
Edition 12.0 Rev 0

CONAM INSPECTION

Sacramento Municipal Utility District
Rancho Seco, Unit 1
Steam Generators A & B
October 1984

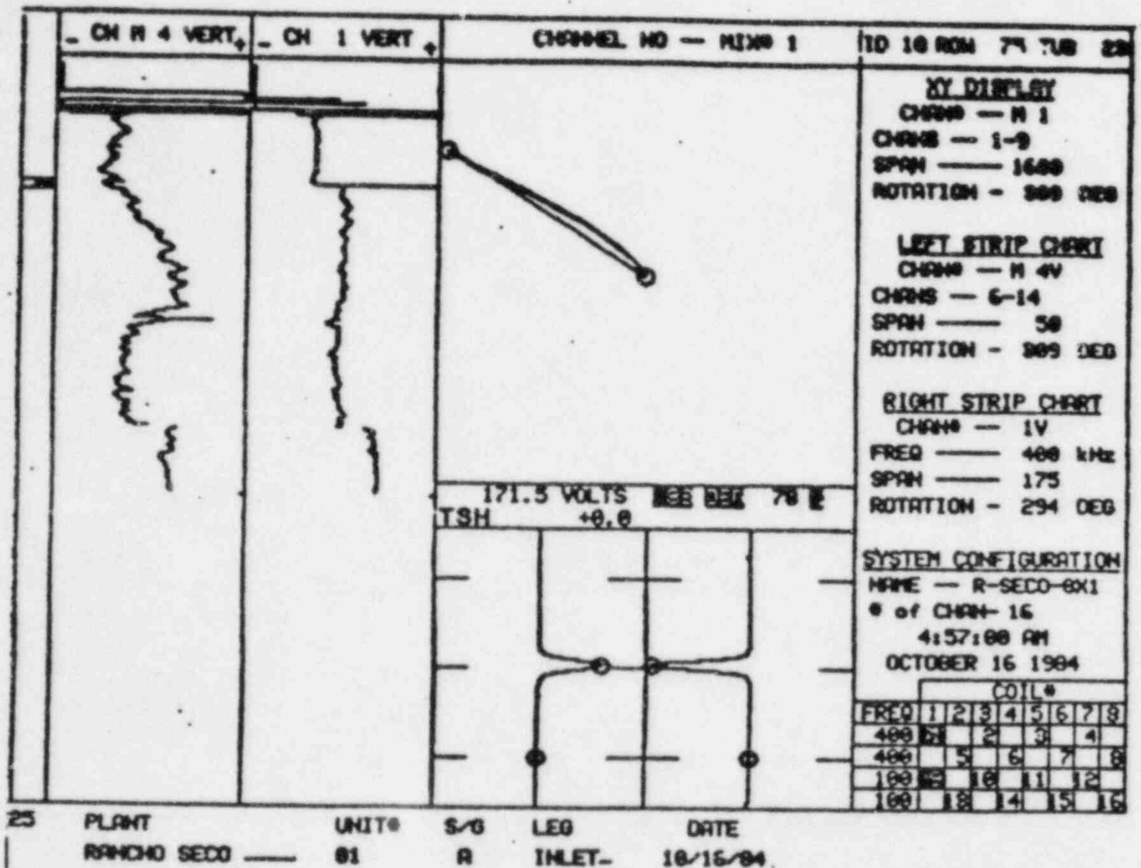
S/G A

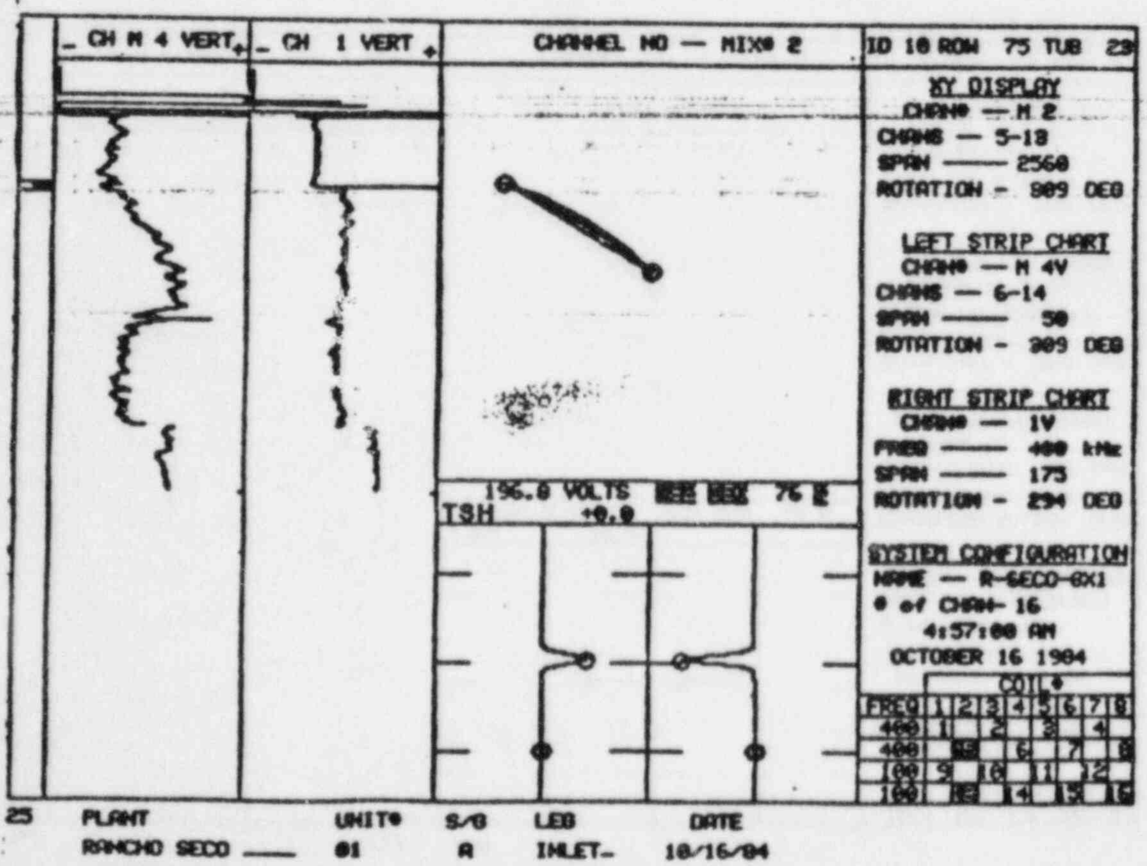


CONAM INSPECTION

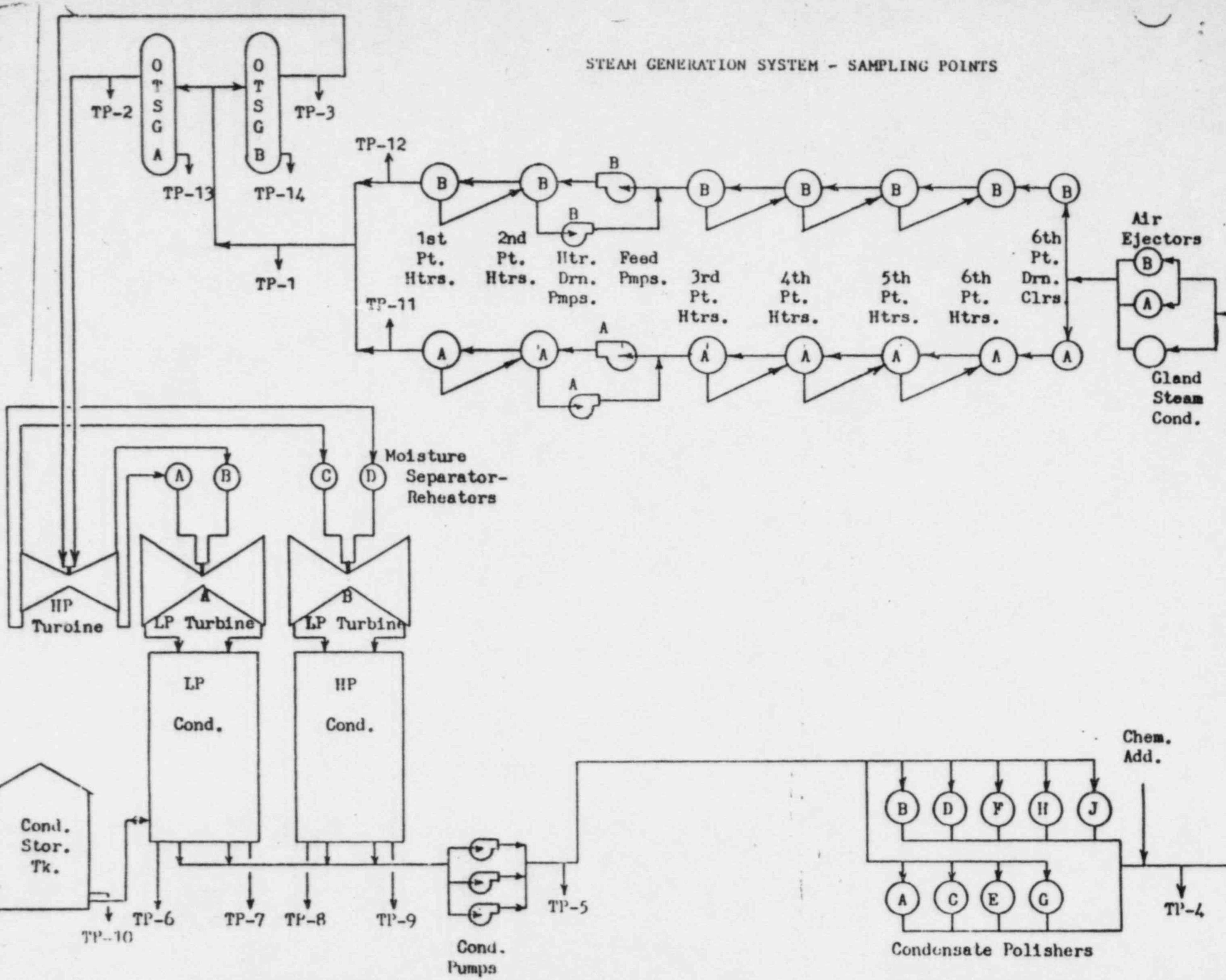
S/G A

Sacramento Municipal Utility District
Rancho Seco, Unit 1
Steam Generators A & B
October 1984

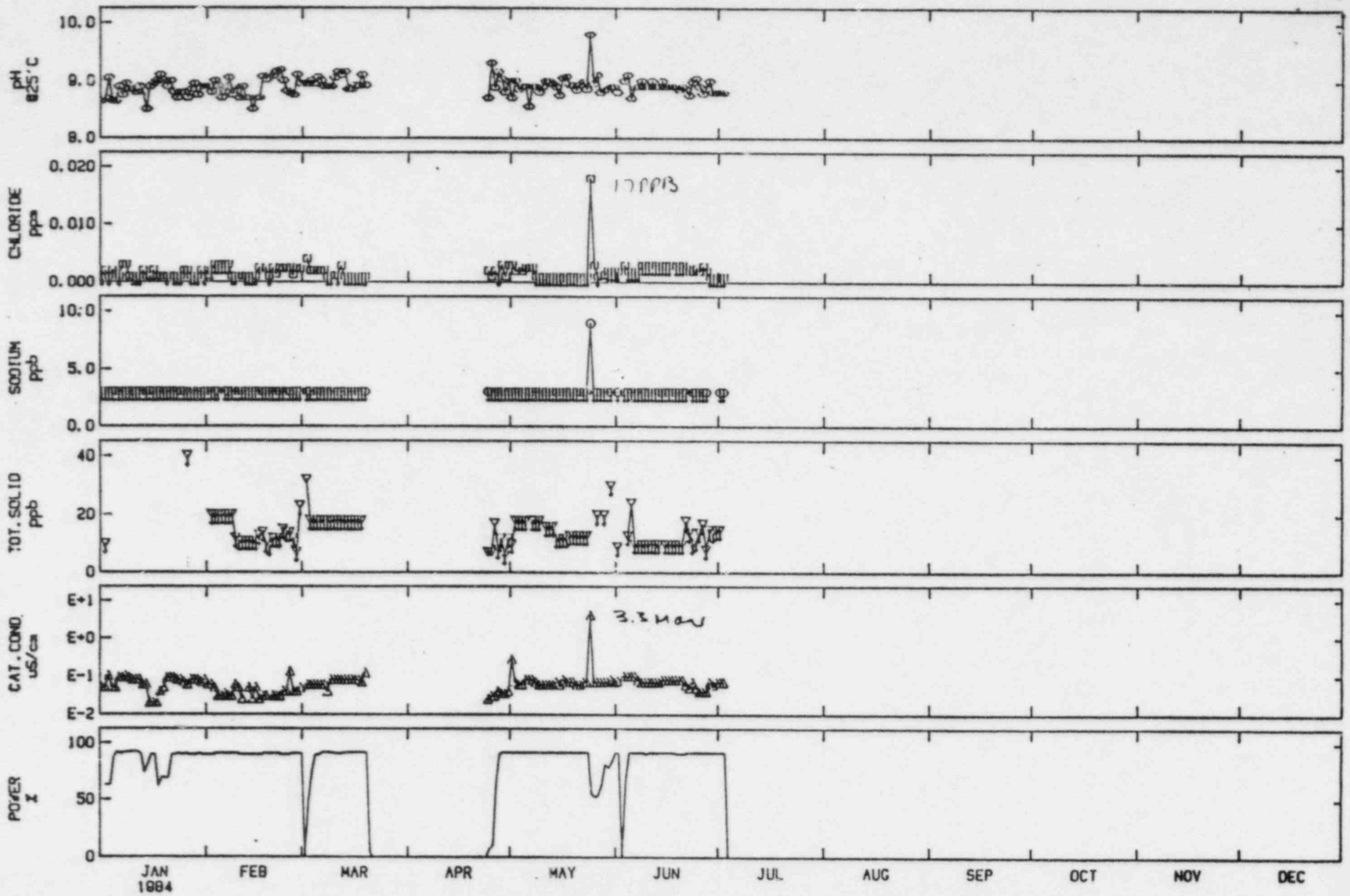




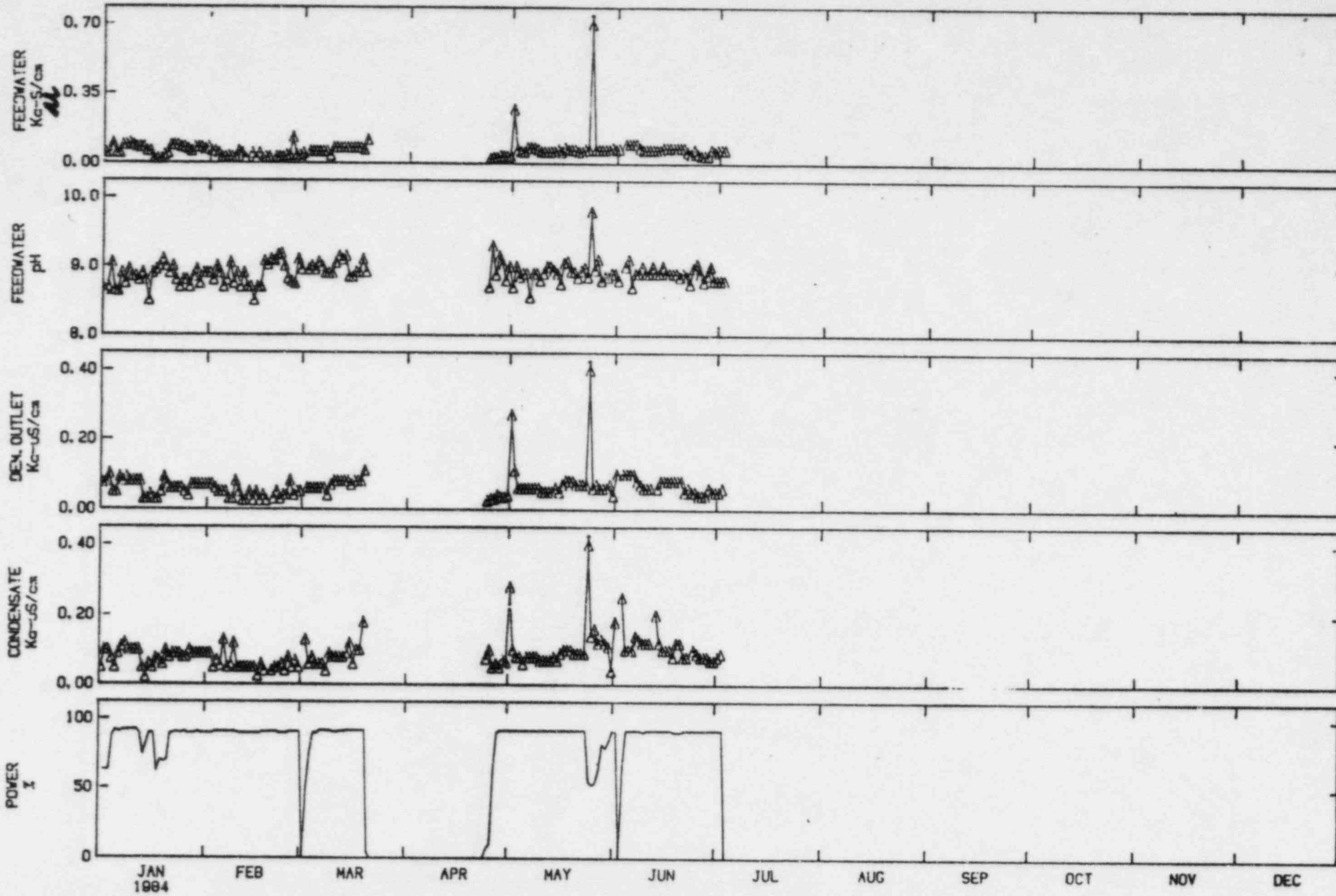
STEAM GENERATION SYSTEM - SAMPLING POINTS



Rev. 2
AP 306 III 844



FEEDWATER CHEMISTRY AT RANCHO SECO - 1984



SECONDARY SYSTEM CHEMISTRY AT RANCHO SECO -1984

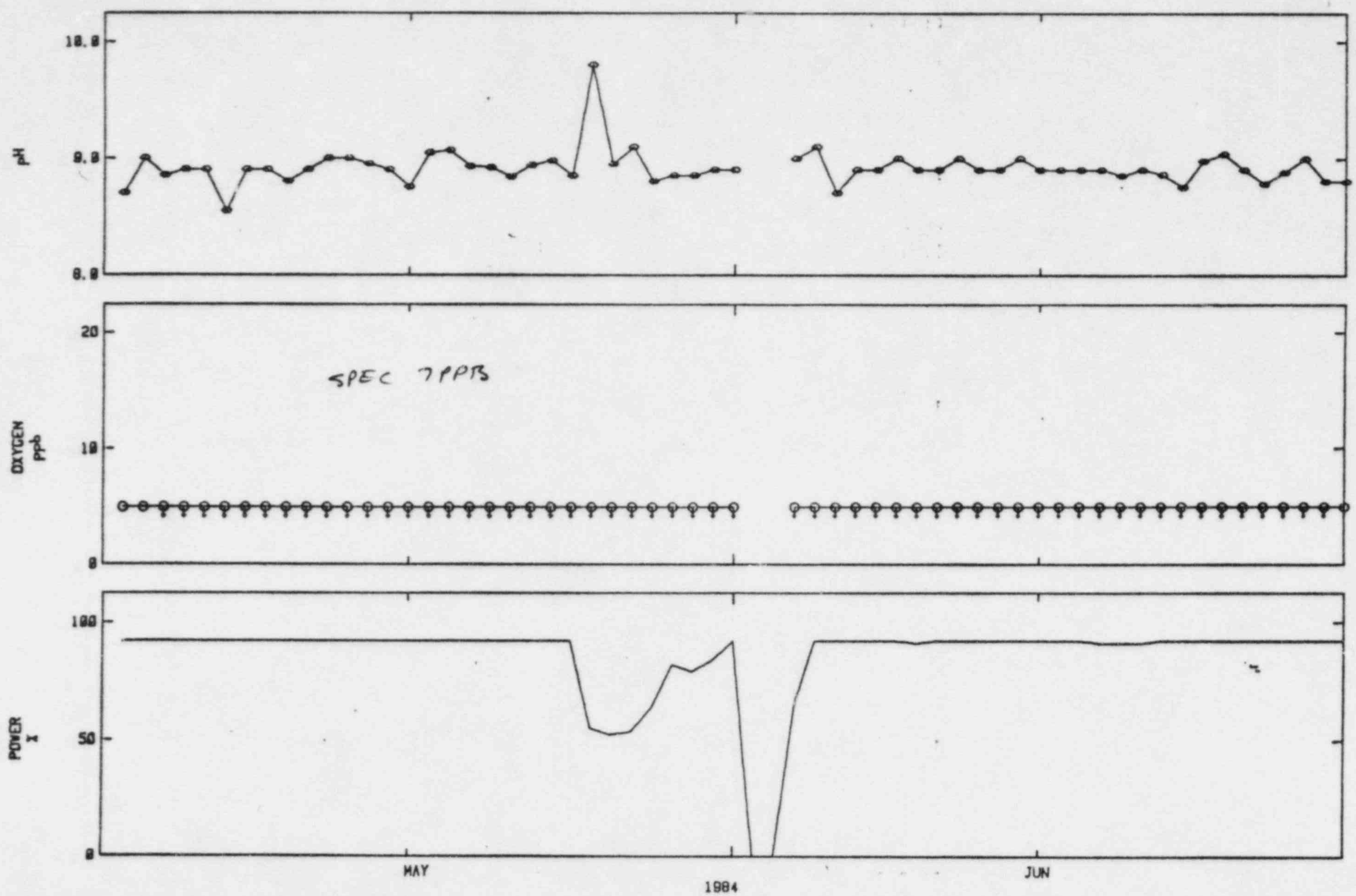


Figure 1 FEEDWATER CHEMISTRY AT RANCHO SECO DURING MAY AND JUNE 1984

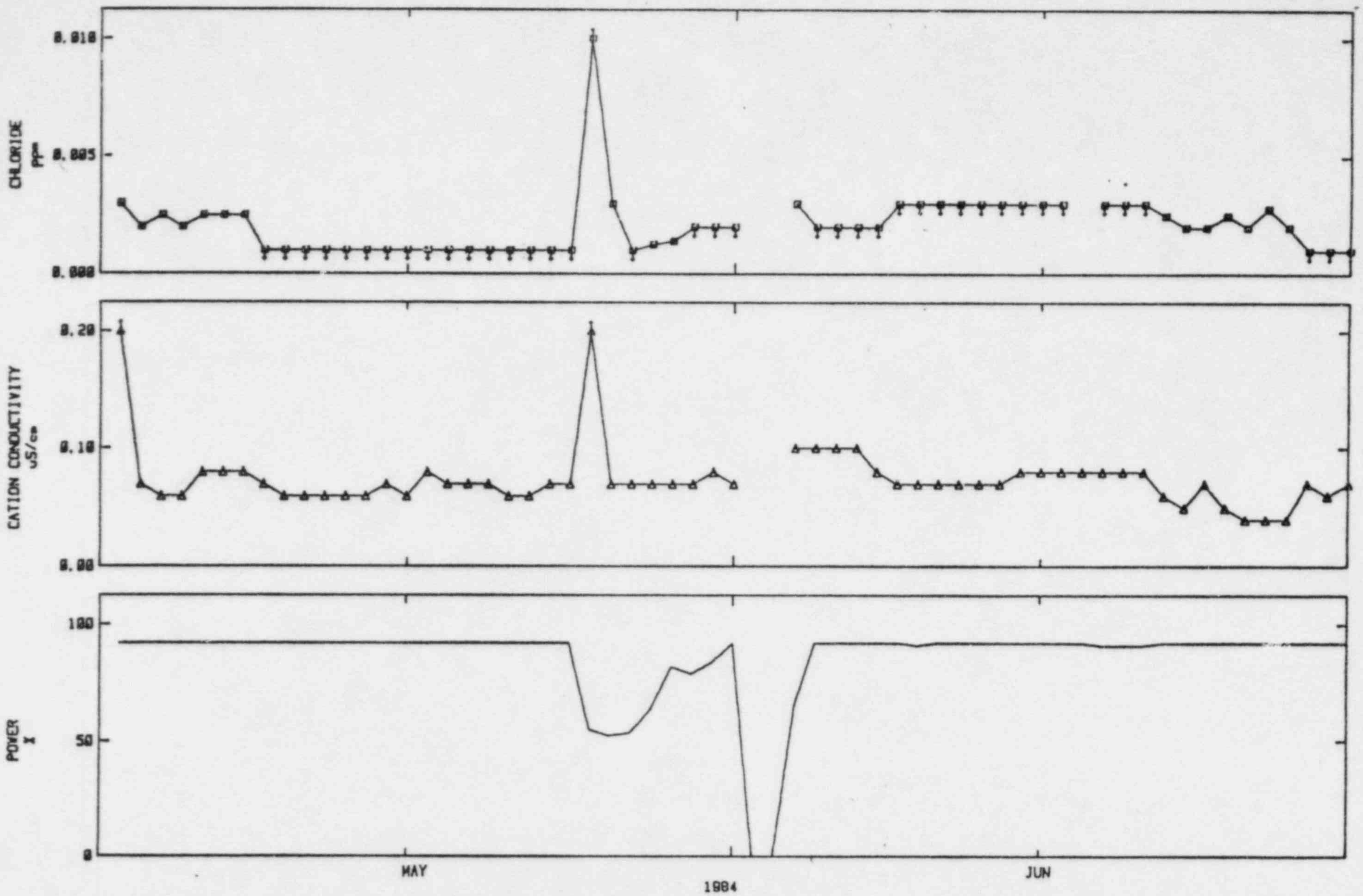


Figure 2 FEEDWATER CHEMISTRY AT RANCHO SECO DURING MAY AND JUNE 1984

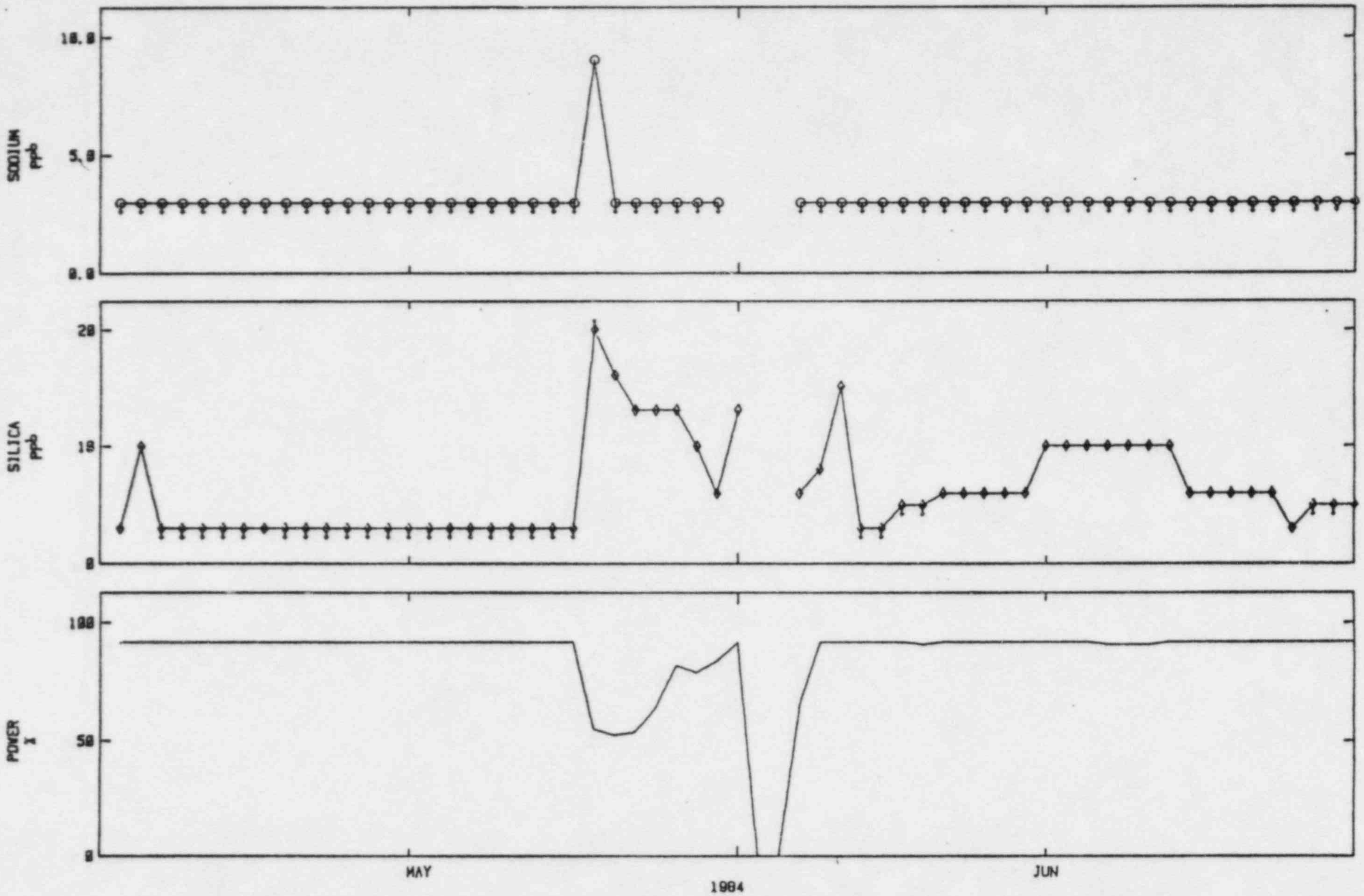


Figure 3 FEEDWATER CHEMISTRY AT RANCHO SECO DURING MAY AND JUNE 1984

OTSG SECONDARY SIDE INSPECTIONS

1. LAST INSPECTION 3-17-84.

2. OBSERVED LEVELS OF DEPOSITS ARE SIMILAR TO THOSE SEEN AT OTHER B&W OPERATING PLANTS WITH SIMILAR SERVICE LIFE.

3. THE GENERAL COMPOSITION OF DEPOSITS IS THE SAME AS OBSERVED AT ALL B&W PLANTS.

4. IRON IS THE MAJOR CONSTITUENT.

5. NICKEL WAS FOUND IN SOMEWHAT HIGHER LEVELS (1-12%). 1981 LEVELS, 0.5-4%. HIGHEST LEVEL AT AFW NOZZLE PENETRATION:

   A. NICKEL-CHROMIUM RATIO IS 2.25:3.4. RATIO IN INCONEL IS 5:1.

   B. THIS SUGGESTS INCONEL CORROSION IS NOT THE SOLE SOURCE OF NICKEL.

   C. MAY BE FROM THE FEEDWATER SYSTEM.

6. LEVELS OF MANGANESE AND MOLYBDENUM (~0.5% RESPECTIVELY) ARE CONSISTENT WITH VALUES FOUND IN 1981 INSPECTION.

OTSG SECONDARY SIDE INSPECTIONS

7. ~90% OF ALL SULFUR (SO_4^{-2}) LEVELS REPORTED FROM B&W OPERATING PLANTS ARE LESS THAN OR EQUAL TO 1.0 MILLIGRAMS PER SQUARE FOOT.

8. SULFUR VALUES REPORTED FOR RANCHO SECO (0.24 TO 1.32 MILLIGRAM PER SQUARE FOOT) ARE CONSISTENT WITH OTHER PLANTS. LEVEL OF SULFUR IN DEPOSITS HAS REMAINED CONSTANT.

9. THE AMOUNT OF DEPOSITS FOUND IN BOTH OTSG'S ARE APPROXIMATELY EQUIVALENT.

10. ALL PERIPHERAL (FLOW PATHS) BROACHED OPENINGS ARE 95% CLEAR AT THE 9TH, 10TH, AND 15TH TUBE SUPPORT PLATES. SUPPORT PLATES BELOW THE 9TH WERE NOT EXAMINED.

11. SILICON AS SIO_2 HAS DECREASED FROM 1977, 5.5%, TO 1981, 0.5%, FROM DEPOSIT SAMPLES IN THE LOWER PORTION OF THE OTSG.

OTSG SECONDARY SIDE INSPECTIONS

12. PRIMARY SIDE DEPOSITS, JULY 1982:

CHLORIDE	70-110	MICROGRAM PER FOOT SQUARE
SULFATE	<275	MICROGRAM PER FOOT SQUARE

OTHER B&W PLANTS RANGED FROM <70 TO 340 MICROGRAM PER FOOT SQUARE CHLORIDE AND <275 TO 5600 MICROGRAM PER FOOT SQUARE SULFATE.

DISTRICT ACTIONS/PROGRAMS TO MINIMIZE TUBE LEAKS

NEW ACTIONS

- INSPECTION UPGRADES
  - TECHNICAL SPECIFICATION CHANGES
  - STATE-OF-THE-ART TECHNIQUES
- CHEMISTRY UPGRADES
  - DISPOSABLE RESINS
  - ACTION TO MINIMIZE AIR INLEAKAGE
  - POSSIBLE WET LAYUP PROCEDURE CHANGES
- CONSERVATIVE PLUGGING CRITERIA
- PULL TUBE FOR EXAMINATION

ONGOING ACTIONS/PROGRAMS

- B&W OWNERS GROUP STEAM GENERATOR PROGRAM
- B&W OWNERS GROUP NDE COMMITTEE
- EPRI STEAM GENERATORS GROUP II
- SULFUR ANALYSIS AND MONITORING PROGRAM
- TUBE SLEEVING TRIAL PROGRAM
- SECOND PARTY CHEMISTRY PROGRAM OVERVIEW

SUMMARY

- B&W HAS THE BEST INTEGRITY RECORD OF THE THREE U.S. PWR MANUFACTURERS.
- PROBLEM AREAS IN THE OTSG HAVE BEEN IDENTIFIED AND DOCUMENTED.
- THE NUMBER OF TUBE LEAKS IS CONSISTENT WITH THE EXPERIENCE OF OTHER B&W UNITS.
- SECONDARY CHEMISTRY IS ROUTINELY KEPT WITHIN INDUSTRY GUIDELINE LIMITS.
- THE DISTRICT HAS DEVELOPED AND IMPLEMENTED A MULTIFACETED SOLUTION TO OTSG AVAILABILITY.