U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-483/89017(DRSS)

Docket No. 50-483 License No. NPF-30

Licensee: Union Electric Company
Post Office Box 149 - Mail Code 400
St. Louis, MO 63166

Facility Name: Callaway Plant, Unit 1

Inspection At: Callaway Site, Steedman, Missouri

Inspection Conducted: August 21-25, 1989 (Onsite)
August 31 and September 6, 1989
(Telephone discussions)

Inspector: R. B. Holtzman [signature: R. B. Holtzman] 9/22/89
Date

Approved By: M. C. Schumacher, Chief [signature: M. Schumacher]
Radiological Controls and
Chemistry Section
9/22/89
Date

Inspection Summary

Inspection on August 21-25 and 31 and September 6, 1989 (Report No. 50-89017(DRSS))
Areas Inspected: Routine, unannounced inspection of the chemistry program, including (1) procedures, organization, and training (IP 84750); (2) primary and secondary systems water quality control programs (IP 84750); (3) quality assurance/quality control program in the laboratory (IP 84750); and (4) nonradiological confirmatory measurements (IP 79701). Also reviewed were past Open Items and audits.
Results: The licensee has an extensive water quality control program that conforms to the EPRI Steam Generator Owners and Primary System Guidelines. The licensee's QA/QC chemical measurements program was improved over that of the previous inspection, but the initial results of the nonradiological confirmatory measurements were only fair and demonstrated some weaknesses in the QA/QC program. The licensee agreed to correct deficiencies in the program.

No violations or deviations were identified during this inspection.

DETAILS

1. Persons Contacted

[1] G. L. Randolph, General Manager, Nuclear Operations, UE
[1] J. R. Peevy, Assistant Manager, Technical Services, UENO
[1] J. R. Polchow, Superintendent, Chemistry and Radwaste, UENO
[1] C. A. Riggs, Supervisor, Chemistry, UENO
[1] R. R. Roselius, Superintendent, Health Physics, UENO
[1] W. R. Robinson, Assistant Manager, Operations and Maintenance, UE
[1] G. W. Hamilton, Supervisor, Radwaste, UENO
[1,2] D. J. Voeller, Rad/Chem Foreman, UENO
[1] J. Little, Engineer, UEQA
[1] N. Lombardi, Engineer, UEQA
[1] F. W. Eggers, Engineer, UEQA
K. R. Bryant, Reactor Engineer, UENO
D. Sievel, Radchem Technician (RCT), UENO
R. D. Kelley, RCT, UENO
R. L. Manning, Assistant RCT, UENO

[1] B. H. Little, Senior Resident Inspector, NRC

The inspector also interviewed other licensee personnel in various departments in the course of the inspection.

[1]Denotes those present at the plant exit interview on August 25, 1989.

[2]Telephone discussions held on August 31 and September 6, 1989.

2. Licensee Action on Previous Inspection Findings (IP 92701)

(Closed) Open Item (50-483/88017-02): Licensee to spike and split with BNL a sample of RCS and S/G water and analyze and submit the results to Region III for comparison with those from BNL. A comparison is given in Table 1 only for the metal ion results for the split samples; Brookhaven has no record of receiving the other sample. The comparison criteria are presented in Attachment 1. Although, the ratios appear to be large, the results are in agreement. Since a new split sample will be submitted in this inspection, this item is closed.

3. Management Controls, Organization and Training (IP 84750)

The organization of the Chemistry Department is similar to that in the previous inspection in this area (Inspection Report No. 50-483/88017). The Supervisor, Chemistry reports to the of Superintendent, Chemistry and Radwaste. A Chemist and Chemical Engineer, along with four laboratory foremen and 15 Radiation Chemical Technicians (RCT), operate the laboratory. All the RCTs are qualified under ANSI/ANS-3.1-1978.

The personnel have changed within the organization. The previous Chemist left and was replaced in an acting position by a Laboratory Foreman. He appears to be well-qualified; he has a degree in chemistry and is working on a Master's degree in Nuclear Engineering; his experience includes nine years at the plant and six years as a Navy ELT. Two foremen supervise the hot and cold laboratories, while the other two work on various other projects. The personnel complement and organization appear to be adequate for the chemistry program.

No violations or deviations were identified.

4. Water Chemistry Control Program (IP 84750)

The licensee's water chemistry control programs are essentially the same as those in the previous report in this area (Inspection Report No. 50-483/88017).

The Post Accident Sampling System was designed to limit the radiation exposure to workers under accident conditions by incorporating remotely-operated sampling and measurement systems operated from the counting room; RCS boron concentrations (by neutron absorption) and gamma activities by a Ge spectrometer are monitored inline.

The Chemistry Department stores most of the measurement results in a computerized data management system (CDMS) from which various reports are compiled regularly. Trend charts of the chemistry parameters for the various system are plotted on a monthly basis, including chloride, sulfate, fluoride, specific and cation conductivities, hydrogen, boron, lithium and dissolved oxygen. Relevant operational parameters are also plotted, including reactor power levels and steam generator blowdown rates. They also submit a monthly letter to the Assistant Plant Manager, Operations with information on significant trends and events.

The water quality of the secondary systems during normal operations was generally very good; the concentrations of the contaminant control and indicator parameters, including chloride, sulfate, sodium and silica were generally well below the licensee/EPRI secondary system guidelines. The primary system parameters appear to be maintained within their respective guidelines.

The inspector also reviewed some of the data on the chemistry parameters with T/S limits, including the boric acid storage tanks (BAST) A and B and the refueling water storage tanks (RWST). These all appeared to be within the specified concentrations, or were brought within specifications in the required times.

No violations or deviations were identified.

5. <u>Implementation of the Chemistry Program (IP 84750)</u>

The inspector reviewed the chemistry programs including physical facilities and laboratory operations. Both the hot and cold laboratories had sufficient room, good instrumentation, and good maintenance. The inspector noted that the temperature of the cold laboratory was high, over 80°F and variable. This could impact on the instrumentation, especially the ion chromatograph, and technician performances. The Chemist noted that management was investigating this problem. A check on the air conditioner showed it to be working at its specified capacity; they are now looking into modification to increase its output.

The inspector observed several technicians analyze the confirmatory measurements samples, including boron by an autotitrator, and metals by atomic absorption spectrophotometry (AAS). They appeared to be generally knowledgeable about the work and followed the procedures.

Overall, the housekeeping was good and the laboratories appeared to be adequate for the proper operation of the plant.

No violations or deviations were identified.

6. <u>Nonradiological Confirmatory Measurements (IP 79701)</u>

The inspectors submitted chemistry samples to the licensee for analysis as part of a program to evaluate the laboratory's capabilities to monitor nonradiological chemistry parameters in various plant systems with respect to various Technical Specification and other regulatory and administrative requirements. These samples had been prepared, standardized, and periodically reanalyzed (to check for stability) for the NRC by the Radiological Sciences Division of Brookhaven National Laboratory (BNL). The samples were analyzed by the licensee using routine methods and equipment.

A single dilution for each sample was made by licensee personnel as necessary to bring the concentrations within the ranges normally analyzed by the laboratory, and run in triplicate in a manner similar to that of routine samples. The results are presented in Table 2 and the criteria for agreement in Attachment 1. These criteria for agreement are based on comparisons of the mean values and estimates of the standard deviations (SD) of the measurements. Modifications made to these criteria (Attachment 1 Notes) are based on the consideration that the uncertainties (SD) of the licensee's results were not necessarily representative of the laboratory's because they were obtained by one analyst over a short period of time.

The licensee also prepared a sample of secondary system water spiked with the anion analytes fluoride, chloride and sulfate to be split with BNL.

The licensee determined the concentrations of the analytes and the results will be compared to those determined by BNL. This will be followed under Open Item No. 50-483/89017-01.

The licensee determined 11 analytes at three concentrations each. Of the initial 33 analyses, 19 were in agreement (58%). The disagreements were in the fluoride, and two of the three samples of chloride, sulfate, iron, copper and sodium. The fluoride results were low, indicating that the licensee's calibration standards were high, while those for chloride and sulfate appeared to be low. Reruns of the samples at higher concentrations and new standards, brought the results into agreement.

The problems with the metal analyses appeared to be due both to the use of the graphite furnace, which appears to be a generic problem with this type of analysis and to the sample matrix which contains copper, nickel and chromium. Additionally, the very small concentrations of the analytes (4 - 24 ppb) may have compounded the difficulties. Rerunning these with the flame and at higher concentrations brought them into good agreement and showed that the standards were good. Sodium presented similar problems; the precision of the sodium analysis in other laboratories has also been generally poor at the low concentrations used here.

Following adjustment of the concentrations and recalibration, the results of the reruns were then all in agreement. If one takes into account the possibility of matrix effects in the metal ion analyses and the initially low concentrations of the analytes, overall, the results of the analyses were good. Some particular problems were identified, mainly the large biases and wide control limits in the QC charts, as discussed in Section 7. The licensee is in the process of assessing and rectifying the problems. Progress in the improvements in the analyses and the control charts will be followed in subsequent inspections in this area.

No violations or deviations were identified.

7. Quality Assurance and Quality Control for Nonradiological Chemistry (IP 84750)

The inspector reviewed the nonradiolagical QA/QC program for both the primary and secondary systems laboratories. This program is controlled by Chemistry Departmental Procedures reviewed in the previous inspection (Region III Inspection Report No. 50-483/88017):

CDP-ZZ-00300 Control of Chemistry Instrumentation and Equipment, Revision 13, January 6, 1988, and

CDP-ZZ-00700 Laboratory Quality Control Program, Revision 9, August 22, 1988.

The related Chemistry Technical Procedures have been revised since the previous inspection:

CTP-ZZ-04701 Control Chart Construction and Use, Revision 6, June 29, 1989;

CTP-ZZ-04702 Quality Control Verification Program, Revision 3, November 29, 1988;

The second procedure above gives the key nonradiological parameters for analysis as boron, chloride, fluoride, sulfate, silica, iron, copper and sodium. Control charts were implemented for these analyses with warning limits of two standard deviations (SD) and control limits of three SD's.

Control charts have been revised to implement control limits of two standard deviations (SD). The procedures require that the results from the performance standards be within the control limits before the RCT may proceed with the analyses.

This program has been modified extensively to address the concerns expressed in the previous inspection in this area. The mean and SD values are calculated quarterly from the performance check standard data, and the previous QC chart remains in the book. The mean and control limit values, expressed as recovery (the ratio of the measured value to the expected value of the check standard) of the performance data are shown on the charts. All of the more significant analytical procedures now have control charts, and separate logsheets were implemented for the performance check data. The calibration and control standards are now from different sources, i.e. different manufacturers or different lots. The procedures also take into account the possible nonlinearity of calibration curves.

The inspector noted some concerns about the QA/QC program:

a. On many of the charts, the mean values had substantial biases with respect to the stated values of the standards, such as 5 % for chloride, 15 -25% for sulfate, 23% for total organic carbon (TOC), and 9% for copper. These varied from time to time. When this happens the problem should be checked.

b. The control limits should be recalculated when a substantial bias is seen. If this is not done it can lead to very wide control limits.

c. It appears that the check standard data need to be assessed more frequently than is done presently. Licensee representatives noted that the check standard data are calculated monthly, although the QC charts are revised only quarterly. They agreed to check and assess the parameters monthly for changes.

The laboratory also started in December 1988 under procedure CTP-ZZ-04704, "Equipment Trending Charts," Revision 0, June 5, 1989, a similar QC program for inline instrumentation, including conductivity, sodium, dissolved oxygen, and pH, in which instrument readout is periodically compared to laboratory or check standard values and plotted. This appears to improve the credibility of data from these sources.

The licensee has an extensive Interlaboratory Crosscheck program with a vendor (Analytics, Inc.) where they analyze sets of unknown samples quarterly. Each technician analyzes each of the samples, so that each is tested at least twice a year. The acceptance criteria are based on three sigma derived from the instrument QC control charts. The inspector noted two weaknesses in the program: the results are not used to assess the laboratory as a whole, and technician performance is not formally intercompared.

Licensee representatives acknowledged these concerns and agreed to consider them. Progress in this and the QA/QC program will be followed in subsequent inspections under Open Item 50-483/89017-02.

No violations or deviations were identified.

8. Audits and Surveillances (IP 84750)

The inspector reviewed some recent audits and surveillances of the Chemistry Department program. QA Audit AP 88-019, November 23, 1988 found that the procurement and receipt of chemicals used in safety-related systems, i.e. the RCS, were poorly documented, both for manufacturers specifications and of tests made on the materials by the licensee. The licensee has corrected this with a system that includes a checklist, document control and acceptance limits for materials.

No violations or deviations were identified.

9. Defective Fuel Rods in the Spent Fuel Pool (SFP) (IP 79701)

During the inspection, while the licensee was trying to remove defective fuel rods from the SFP two of the rods apparently broke. The inspector reviewed some of the chemistry records to note changes owing to placing the fuel bundles in the pool about October 1987. Of the parameters tabulated in the CDMS records only the chloride appeared to change; when the fuel was placed in the pool the chloride concentrations rose from below 5 ppb to above 25 ppb over a period of few months and then over about six months returned slowly to the present value of about 10 ppb. The licensee's administrative specification for this system is 100 ppb. The significance of the change is not clear; it could be due to defective fuel or to just adding additional material to the pool. Further, the water is cleaned by a demineralizer bed operated at irregular intervals. One set of gamma spectra was reviewed, one taken just before the second fuel rod was broken in the pool and one just after. The nuclide activities in the water were not much changed, except for Cs-134 activity which about doubled in the second sample. A licensee representative agreed to forward a trend chart showing concentrations of the cesium isotopes from 1987 to the present.

The licensee prepared a summary report to assess the fuel defect/leakage problem and has concluded, based on various factors in RCS, such as I-131/I-133 and Cs-134/Cs-137 ratios and I-131 spikes associated with power changes in the reactor, that several fuel leaks were present in the RCS. Radioactivity in the RCS was well within technical specification limits.

No violation or deviations were identified.

9. Open Items

Open items are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which involve some action on the part of the NRC or licensee, or both. Open items disclosed during the inspection are discussed in Sections 6 and 7.

10. Exit Interview

The scope and findings of the inspection were reviewed with licensee representatives (Section 1) at the conclusion of the inspection on August 25, 1989. The inspector discussed concerns about the quality control program and the confirmatory measurements addressed in Sections 6 and 7. Telephone conversations were held with licensee representatives on August 30 and September 6, 1989 relating to the confirmatory measurements results.

During the exit interview, the inspector discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspector during the inspection. Licensee representatives did not identify any such documents or processes as proprietary.

Attachments:
1. Table 1, Nonradiological Interlaboratory Split Sample Results, August 1988
2. Attachment 1, Criteria for Comparing Analytical Measurements (Nonradiological)
3. Table 2, Nonradiological Interlaboratory Test Results, August 21-30, 1989

TABLE 1

Non-Radiological Interlaboratory Split Sample Results
Callaway Plant
August 1988

Analyte	Analytical Method[b]	NRC Y ± SD	Licensee X ± SD	Ratio Z ± SD ± 2 SD	Comparison[a]
			Concentration, ppb		
Fe	AA/FL	238 ± 7	269 ± 26	1.130 ± 0.114	A
Cu	AA/FL	218 ± 12	257 ± 24	1.179 ± 0.128	A

a. A = Agreement
   D = Disagreement
b. AA/FL Atomic Absorption Analysis (Flame)

ATTACHMENT 1

Criteria for Comparing Analytical Measurements

This attachment provides criteria for comparing results of the capability tests. The acceptance limits are based on the uncertainty (standard deviation) of the ratio of the licensee's mean value (X) to the NRC mean value (Y), where

(1) $Z = X/Y$ is the ratio, and

(2) S_Z is the uncertainty of the ratio determined from the propagation of the uncertainties of licensee's mean value, S_x, and of the NRC's mean value, S_y.[1] Thus,

$$\frac{S_Z^2}{Z^2} = \frac{S_x^2}{X^2} + \frac{S_y^2}{Y^2}, \text{ so that}$$

$$S_Z = Z \bullet \left(\frac{S_x^2}{X^2} + \frac{S_y^2}{Y^2} \right)^{\frac{1}{2}}$$

The results are considered to be in agreement when the bias in the ratio (absolute value of difference between unity and the ratio) is less than or equal to twice the uncertainty in the ratio, i.e.

$$| 1-Z | \leq 2 \bullet S_Z \, .$$

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1. National Council on Radiation Protection and Measurements, A Handbook of Radioactivity Measurements Procedures, NCRP Report No. 58, Second Edition, 1985, Pages 322-326 (see Page 324).

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ATTACHMENT 1

NOTES

I. The uncertainties may be modified in cases of disagreement:

a. If the licensee's SD, S_x is smaller than that of the NRC, the NRC's relative standard deviation (RSD) (S_y/Y) will be substituted for that of the licensee (S_x/X), and the agreement criteria recalculated.

b. If a disagreement and the RSDs appear to be unreasonably low, RSDs of 3% will be substituted for those of both the NRC and the licensee. This will not be done for the boron analyses where the expected RSDs are 0.5-1%.

II. Due to some uncertainties in the values of the 1987 (87) boron standards, the mean values of the concentrations obtained by the plant laboratories in Region III are used as the NRC values. These results appear to have resolved the problem of the consistently negative biases between the licensees and BNL boron analyses. The licensees generally reported similar values of the 1000-ppm standard with a relatively small RSD of ±1.7%, although the analytical methods differed.

TABLE 2

Non-Radiological Interlaboratory Test Results
Callaway Plant
August 21-30, 1989

Analyte	Analytical Method[c]	NRC[a] Y ± SD	Licensee[a] X ± SD	Ratio Z ± SD ± 2 SD	Comparison[b]
		Concentration, ppb			
Fluoride	SIE	45.0 ± 4.0	33.0 ± 3.0	0.733 ± 0.092	D*
		63.4 ± 1.2	53.3 ± 0.6	0.840 ± 0.045	D+
		82.8 ± 1.7	70.7 ± 0.6	0.854 ± 0.025	D*
(rerun)		225 ± 20	220 ± 4	0.978 ± 0.089	A
		423 ± 8	426 ± 0	1.007 ± 0.019	A
		414 ± 9	437 ± 0	1.056 ± 0.031	A*
Chloride	IC	3.70 ± 0.02	5.6 ± 0.2	1.514 ± 0.068	D+
		5.59 ± 0.09	6.4 ± 0.8	1.144 ± 0.144	A
		7.65 ± 0.12	8.9 ± 0.3	1.163 ± 0.050	D+
(rerun)		18.5 ± 0.1	19.8 ± 0.1	1.070 ± 0.048	A+
		18.6 ± 0.3	20.1 ± 0.1	1.081 ± 0.048	A+
		19.1 ± 0.3	19.7 ± 0.2	1.030 ± 0.019	A
Sulfate	IC	3.90 ± 0.28	4.9 ± 0.2	1.256 ± 0.128	A*
		5.74 ± 0.40	6.8 ± 0.6	1.184 ± 0.134	A
		7.80 ± 0.23	9.1 ± 0.2	1.167 ± 0.042	D*
(rerun)		19.5 ± 1.4	19.5 ± 0.6	1.000 ± 0.078	A
		19.2 ± 1.4	20.6 ± 0.1	1.076 ± 0.076	A
		19.5 ± 0.6	19.9 ± 0.5	1.021 ± 0.040	A
Fe	AA/FU	8.0 ± 0.1	9.8 ± 0.2	1.225 ± 0.060	D+
		11.7 ± 0.3	13.3 ± 0.2	1.137 ± 0.045	D+
		22.3 ± 0.6	24.0 ± 0.1	1.075 ± 0.041	A*
(rerun)	AA/FL	111 ± 3	118 ± 3	1.059 ± 0.039	A
		1327 ± 17	1350 ± 23	1.018 ± 0.022	A
		1838 ± 49	1940 ± 42	1.056 ± 0.036	A
		1990 ± 25	1980 ± 35	0.995 ± 0.022	A
		1950 ± 50	1960 ± 35	1.005 ± 0.031	A
Cu	AA/FU	4.0 ± 0.2	4.6 ± 0.2	1.150 ± 0.078	A
		6.0 ± 0.2	6.8 ± 0.2	1.133 ± 0.051	D+
		12.0 ± 0.2	13.5 ± 0	1.125 ± 0.050	D+
(rerun)	AA/FL	120 ± 2	120 ± 2	1.002 ± 0.022	A
		1343 ± 50	1330 ± 10	0.990 ± 0.038	A
		1976 ± 30	2030 ± 10	1.027 ± 0.016	A
		2015 ± 75	2080 ± 23	1.032 ± 0.040	A
		2000 ± 50	2070 ± 25	1.035 ± 0.029	A
(rerun)	AA/FL	120 ± 2	120 ± 2	1.002 ± 0.022	A

Analyte	Analytical Method[c]	NRC[a] Y ± SD	Licensee[a] X ± SD	Ratio Z ± SD ± 2 SD	Comparison[b]
		Concentration, ppb			
Ni	AA/FU	8.34 ± 0.14	10.5 ± 0.3	1.259 ± 0.042	D
		12.1 ± 0.5	13.6 ± 0.5	1.124 ± 0.062	A
		24.4 ± 0.7	26.7 ± 0.6	1.094 ± 0.046	D+
(rerun)	AA/FL	122 ± 4	130 ± 3	1.069 ± 0.040	A
"		1390 ± 23	1400 ± 20	1.007 ± 0.022	A
"		2006 ± 59	2000 ± 12	0.997 ± 0.030	A
"		2085 ± 35	2010 ± 10	0.964 ± 0.023	A*
"		2017 ± 83	2040 ± 10	1.012 ± 0.042	A
Na	AA/FU	3.03 ± 0.35	3.1 ± 0.1	1.025 ± 0.123	A
		5.05 ± 0.29	6.2 ± 0.1	1.228 ± 0.098	D*
		7.90 ± 0.45	6.7 ± 0.1	0.848 ± 0.068	D*
(rerun)	AA/FL	297 ± 34	303 ± 6	1.022 ± 0.120	A
"		503 ± 28	543 ± 6	1.078 ± 0.062	A
"		765 ± 44	817 ± 12	1.068 ± 0.063	A
Li	AA/FL	985 ± 20	967 ± 12	0.982 ± 0.023	A
		1500 ± 35	1450 ± 18	0.967 ± 0.026	A
		2065 ± 50	1963 ± 21	0.951 ± 0.025	A
Hydrazine	Spec	19.9 ± 0.3	20.3 ± 0.6	1.020 ± 0.034	A
		49.9 ± 0.5	51.7 ± 0.6	1.036 ± 0.043	A+
		100 ± 1	99.3 ± 0.6	0.993 ± 0.012	A
Silica	Spec	52.8 ± 2.8	51.7 ± 5.8	0.979 ± 0.122	A
		106 ± 4	105 ± 7	0.990 ± 0.076	A
		157 ± 2	153 ± 11	0.975 ± 0.071	A
		Concentration, ppm			
Boron[d] 8/89	Titr	1002 ± 10	993 ± 4	0.991 ± 0.011	A
		2970 ± 23	2947 ± 10	0.992 ± 0.008	A
		4919 ± 47	4863 ± 22	0.989 ± 0.010	A

a. Value ± standard deviation (SD); the number of analyses is from 6 to 9 for BNL and three for the licensee.

b. A = Agreement
D = Disagreement

c. Analytical methods:
Titr - titration
IC - Ion chromatography
AA/FU - Atomic absorption Spectroscopy (furnace)
AA/FL - Atomic absorption Spectroscopy (flame)
SIE - Specific Ion Electrode
Spec - Uv/VIS Spectrophotometry

d. NRC (BNL) Values replaced by mean values of plants in Region III.

*Substituted the BNL uncertainty for licensee's uncertainty.

+Assumed a 3% Relative Standard Deviation (3% RSD).