

APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-285/88-18

Operating License: DPR-40

Docket: 50-285

Licensee: Omaha Public Power District (OPPD)
1623 Harney Street
Omaha, Nebraska 68102

Facility Name: Fort Calhoun Station (FCS)

Inspection At: FCS Site, Blair, Washington County, Nebraska

Inspection Conducted: June 6-10, 1988

Inspectors:

H. Ch...
for J. B. Nicholas, Senior Radiation Specialist
Facilities Radiological Protection Section

6/30/88
Date

H. Ch...
for R. Wise, Radiation Specialist, Facilities
Radiological Protection Section

6/30/88
Date

Approved:

R. E. Baer
for R. E. Baer, Chief, Facilities Radiological
Protection Section

6/30/88
Date

Inspection Summary

Inspection Conducted June 6-10, 1988 (Report 50-285/88-18)

Areas Inspected: Routine, unannounced inspection of the licensee's water chemistry and radiochemistry programs, postaccident sampling system (PASS), and water chemistry confirmatory measurements.

Results: Within the areas inspected, no violations or deviations were identified. One previously identified oper. item was closed.

DETAILS1. Persons ContactedOPPD

- *W. G. Gates, Manager, FCS
- R. J. Beck, Chemistry Technician
- C. J. Brunnert, Supervisor, Operations Quality Assurance (QA)
- *T. R. Dukarski, Chemistry Coordinator
- *J. J. Fisicaro, Supervisor, Nuclear Regulatory and Industry Affairs
- *J. K. Gasper, Manager, Administration and Training Services
- J. M. Glantz, Senior Chemistry Technician
- D. A. Jacobson, Supervisor, Chemistry and Radiation Protection Training
- *R. L. Jaworski, Manager, Station Engineering
- *K. J. Morris, Division Manager, QA
- *A. W. Richard, Manager, Corporate QA
- *G. L. Roach, Supervisor, Chemical and Radiation Protection
- *B. A. Schmidt, Chemist
- *C. F. Simmons, Licensing Engineer
- *F. K. Smith, Plant Chemist

NRC

- *R. E. Baer, Chief, Facilities Radiological Protection Section
- *P. H. Harrell, Senior Resident Inspector, FCS

*Denotes those present at the exit interview on June 10, 1988.

2. Followup on Previously Identified Inspection Finding (92701)

(Closed) Open Item 285/8721-03: Audit of Vendor Activities - This open item was identified in NRC Inspection Report 50-285/87-21 and involved the lack of an audit of the vendor selected to perform radiological analyses of samples of liquid effluents and waste stream characterization determinations. The licensee had performed an audit of the licensee's vendor laboratory in February 1988.

3. NRC Inspectors Observations

The following are observations the NRC inspectors discussed with the licensee during the exit interview on June 10, 1988. These observations are not violations, deviations, unresolved items, or open items. These observations were identified for licensee consideration, for program improvement, but the observations have no specific regulatory requirements. The licensee stated that these observations would be evaluated.

- a. Organizational Structure - The licensee's proposed organizational structure does not include specifically designated supervisory positions reporting to the plant chemist (see paragraph 4).
- b. Water Chemistry Calibration Standards Verification - The licensee was not using two independent standard stock solutions for instrument calibration and measurement quality control (see paragraph 6).
- c. Quality Control Charts - The licensee was not using quality control charts to trend and evaluate instrument quality control data. The licensee had not established criteria to identify and evaluate data biases in daily or periodic quality control analyses of water chemical parameters (see paragraph 6).
- d. PASS Operational Monitoring Program - The licensee had not developed a comprehensive PASS operational monitoring program (see paragraph 7).
- e. Contractor Laboratory Audit Team - The licensee's vendor audit team did not include a member or technical specialist trained in chemistry/radiochemistry activities at nuclear power facilities (see paragraph 9).
- f. Confirmatory Measurements - The licensee's contractor laboratory has not analyzed an NRC prepared spiked liquid sample for Sr-89 and Fe-55 content with satisfactory agreement to certified values (see paragraph 9).

4. Organization and Management Controls (83722/83522)

The NRC inspectors reviewed the licensee's organization, staffing, identification and correction of program weaknesses, audits and appraisals, communication to employees, and documentation and implementation of the water chemistry and radiochemistry programs to determine adherence to commitments in Chapter 12 of the Updated Safety Analysis Report (USAR) and the requirements in Section 5.2 of the Technical Specifications (TS).

The NRC inspectors verified that the organizational structure of the chemistry/radiochemistry section (C/RS) was as defined in the USAR and TS. The NRC inspectors reviewed the C/RS staff assignments and management controls for the assignment of responsibilities for management and implementation of the FCS water chemistry and radiochemistry programs. The NRC inspectors reviewed the proposed organizational changes for the C/RS which places the plant chemist at the level equivalent to a department manager reporting directly to the plant manager. The NRC inspectors noted the C/RS proposed organizational structure did not include specifically defined supervisory positions reporting to the plant chemist. This observation was discussed with the licensee during the exit interview on June 10, 1988. The licensee stated that the NRC inspectors' observation would be evaluated.

The NRC inspectors reviewed the staffing of the C/RS and noted that, since the previous NRC water chemistry/radiochemistry inspection in May 1987, the C/RS had replaced two chemistry technicians and added four new chemistry technicians. The four new technicians were currently undergoing shift qualification training. The C/RS personnel turnover had been approximately 20 percent in the past 12 months. This is a reduction in personnel turnover experienced in the C/RS over the past 3 years.

No violations or deviations were identified.

5. Training and Qualification (83523/83723)

The NRC inspectors reviewed the licensee's training and qualification program for C/RS personnel including education and experience, adequacy and quality of training, employee knowledge, qualification requirements, new employees, Institute of Nuclear Power Operations (INPO) accreditation, and audits and appraisals to determine adherence to commitments in Chapter 12 of the USAR and the requirements in Sections 5.3 and 5.4 of the TS.

The NRC inspectors reviewed the education and experience backgrounds of the six most recently hired chemistry technicians and determined that they met the qualifications specified in the USAR, TS, and ANSI N18.1-1971. A review of shift staffing indicated that all shifts had a shift chemistry technician meeting the qualification requirements of ANSI N18.1-1971. It was determined that the licensee had an adequately qualified staff to meet shift staffing requirements.

The NRC inspectors reviewed the licensee's program for training and qualification of C/RS personnel including a review of the chemistry training instructors' qualifications, the "Training Program Master Plan for Chemistry," the chemistry technician qualification guide, the chemistry technician continuing training program, selected course lesson plans and performance evaluation checklists, and selected C/RS personnel training records and qualification cards. It was determined that the chemistry training program had been recently INPO accredited.

The NRC inspectors reviewed selected C/RS individual staff training records and qualification cards and determined that the four most recently hired chemistry technicians were in the process of completing the required shift qualification training.

No violations or deviations were identified.

6. Light Water Reactor Chemistry Control and Chemical Analysis (79701/79501)

The NRC inspectors reviewed the licensee's water chemistry program including establishment and implementation of a water chemistry control program, sampling, facilities and equipment, establishment and implementation of a quality control program for chemical measurements, and

water chemistry confirmatory measurements to determine adherence to commitments in Chapter 4, 9, 11, and 14 of the USAR and the requirements in Section 2.20, 5.8, and 5.13 of the TS.

The NRC inspectors' review of the water chemistry program found that the licensee had revised and approved standing orders, surveillance procedures, chemical control procedures, instrument calibration and quality control procedures, and analytical procedures. A review of selected procedures revised and written since the previous NRC inspection in May 1987 indicated that the C/RS had established sufficient programmatic procedures to meet the requirements of the USAR and TS.

The NRC inspectors inspected the facilities and equipment used by the C/RS staff. The following facilities were inspected: secondary chemistry laboratory, radiochemistry laboratory, and radiochemistry counting room. The laboratories and counting room were equipped with the necessary chemicals, reagents, labware, and analytical instrumentation to perform the required analyses. The NRC inspectors reviewed the final plans for the proposed new chemistry laboratories and office facilities which are to be constructed adjacent to the existing auxiliary building. The new chemistry and radiochemistry laboratory facilities will provide the much needed additional space to perform routine chemistry and radiochemistry analyses to support plant operation.

The NRC inspectors reviewed selected C/RS procedures for operation, calibration, and quality control of the instrumentation used for analysis of the NRC water chemistry standards to determine the adequacy and effectiveness of the licensee's chemistry measurement quality control program. It was observed that the licensee was not using two independent standards for calibration and measurement of quality control of chemistry analytical instrumentation. The licensee could not verify the integrity of the standard solutions. The licensee had not initiated a program of two independent standard stock solutions prepared from independent sources, i.e., different vendors or different stock lots. This program would include one standard stock solution dedicated for instrument calibration and a second independent standard stock solution dedicated for quality control. The use of independent standards affords a crosscheck on the stability of the standards and identifies a degenerated standard solution. It was also observed that the licensee was not using quality control charts to trend quality control data collected from daily or periodic quality control analyses of chemical parameters. The licensee had also not established criteria to identify, evaluate, and correct data biases in instrument calibration and quality control data and changes or trends in instrument performance. These observations were discussed with the licensee during the inspection and at the exit interview on June 10, 1988. The licensee agreed to evaluate the NRC inspectors' observations and consider actions for program improvements.

The NRC inspectors reviewed secondary chemistry data sheets for the period January 1987 through May 1988 to determine compliance with TS requirements. The NRC inspectors verified that all TS required water chemistry sampling and analyses had been performed.

During the inspection, standard chemical solutions were provided to the licensee for confirmatory measurements analyses. The standards were analyzed by the licensee using routine methods and equipment. The results of the measurement comparisons are summarized in Attachments 1, 2, and 3 to this report.

No violations or deviations were identified.

7. Quality Assurance and Confirmatory Measurements for In-Plant Radiochemical Analysis (84725/84525)

The NRC inspectors reviewed the licensee's radiochemical analysis program including procedures, facilities and equipment, and implementation of chemistry control of the reactor coolant system and plant borated water sources to determine adherence to commitments in Chapters 4 and 9 in the USAR and the requirements in Sections 2.1, 3.2, 5.8, and 5.15 of the TS.

The NRC inspectors reviewed selected standing orders and radiochemistry laboratory analytical procedures revised and approved since the previous NRC inspection in May 1987 and determined that the licensee had established and implemented sufficient analytical procedures to meet USAR and TS requirements.

The NRC inspectors reviewed the licensee's records for the period January 1987 through May 1988 to determine compliance with TS requirements for sampling and analysis of the reactor coolant system, safety injection refueling water tank, boric acid storage tanks, safety injection tanks, and spent fuel pool. The E-Bar data for the period February 1985 through February 1988 was also inspected. The NRC inspectors verified that all TS required chemistry sampling and analyses of the above listed systems or components had been performed.

The NRC inspectors verified that the PASS equipment and operating procedures satisfied the requirements of NUREG-0737, Item II.B.3, and TS for representative sampling and analysis of reactor coolant and containment atmosphere following a reactor incident. The licensee had completed PASS operator training as part of shift qualification training for chemistry technicians and established a requalification training program on PASS which was being conducted annually. The licensee had implemented an in-line instrument calibration and preventative maintenance program in compliance with TS requirements. The NRC inspectors reviewed the in-line instrument preventative maintenance records. The licensee demonstrated PASS operability by collecting a sample of reactor coolant and performing analyses including gamma isotopic, boron, and dissolved hydrogen and comparing the results of these analyses with reactor coolant grab sample analyses results. The isotopic and boron results compared

were in agreement. The results of the dissolved hydrogen analysis appeared to have procedural calculation concerns. These calculational concerns were identified by the licensee and an evaluation of the calculational method was initiated during the inspection. The licensee also collected and analyzed a containment atmosphere sample for isotopic content. The isotopic results compared were in agreement. The NRC inspectors provided the licensee with a PASS boron standard for confirmatory measurement. The PASS instrumentation analyzed the boron standard giving a satisfactory result. It was determined that the licensee's equipment, procedures, analytical sensitivities, and analytical results of chemistry and radiochemistry parameters were consistent with PASS requirements. The licensee had established and implemented a PASS operational monitoring program. However, the results of this monitoring program were not well documented and a more structured program to demonstrate complete operability of the PASS upon demand needs to be developed and implemented. This observation was discussed with the licensee during the inspection and at the exit interview on June 10, 1988. The licensee agreed to develop and implement an operational monitoring program of the PASS which would check the operability of all PASS functions on a routine frequency, i.e., quarterly.

During the inspection, radiological confirmatory measurements were attempted. However, due to instrument malfunctions experienced in the Region IV mobile laboratory this portion of the inspection has been postponed and will be rescheduled and completed at a later date.

No violations or deviations were identified.

8. Quality Assurance Program (79701/79501; 84725/84525)

The NRC inspectors reviewed the licensee's QA surveillance and audit programs regarding water chemistry and radiochemistry activities to determine adherence to commitments in Chapter 12 of the USAR and the requirements in Section 5.5 of the TS.

The NRC inspectors reviewed the surveillance and audit schedules for 1988, QA surveillance and audit plans and checklists, selected QA department procedures, and the qualifications of QA auditors. Surveillance reports of QA activities performed during the period January 1987 through May 1988 in the areas of water chemistry and radiochemistry were reviewed for scope to ensure thoroughness of program evaluation. It was determined that the QA surveillances were designed to ensure compliance with the USAR, TS, and FCS procedures. The NRC inspectors determined that the QA surveillances were performed by qualified personnel. The NRC inspectors verified that no QA audits of the water chemistry and radiochemistry programs had been performed since the previous NRC inspection of these areas in May 1987.

No violations or deviations were identified.

9. Contractor Activities (84725/84525)

The licensee uses a contractor laboratory to perform TS required radiochemistry analyses on radioactive effluent composite samples. The licensee's program for oversight of contractor laboratory activities and the quality control of analytical measurements by the contractor laboratory were reviewed to verify adherence to the requirements in Section 3.12 and 5.9.4 of the TS and agreement with the recommendations of Regulatory Guide 4.15.

The licensee performs vendor audits triannually with annual evaluations to retain current status on OPPD's routine supplier's list. The NRC inspectors reviewed the audit performed on the licensee's contractor laboratory in February 1988 and verified that the contractor had been approved for the required TS analyses and placed on the current routine supplier's list. However, it was noted that the audit team did not include a member or technical specialist trained in chemistry/radiochemistry activities at nuclear power facilities.

Confirmatory measurements were performed by the licensee's contractor laboratory on a liquid radiochemistry sample prepared by the Radiological Environmental Sciences Laboratory (RESL) in Idaho Falls, Idaho. The analytical results were compared to the known sample activities and the results of the comparisons are presented in Attachment 4 of this report. The laboratory's results were in agreement with the certified activities for Sr-90 and in disagreement with the activities for H-3, Sr-89, and Fe-55. Further review of FCS's contractor laboratory's performance on RESL samples indicated that FCS Sr-89 and Fe-55 results have been in disagreement on both the 1986 and 1987 RESL samples. The disagreements were discussed with the licensee during the exit interview on June 10, 1988, and the licensee agreed to evaluate the performance of their contractor laboratory on analyzing samples for Sr-89 and Fe-55.

No violations or deviations were identified.

10. Exit Interview

The NRC inspectors met with the NRC senior resident inspector and the licensee representatives denoted in paragraph 1 at the conclusion of the inspection on June 10, 1988. The NRC inspectors summarized the scope of the inspection and discussed the inspection findings, inspector observations, and the results of the water chemistry confirmatory measurements as presented in this report.

ATTACHMENT 1

Analytical Measurements

1. Water Chemistry Confirmatory Measurements

During the inspection, standard chemical solutions were provided to the licensee for analysis. The standard solutions were prepared by the Brookhaven National Laboratory (BNL), Safety and Environmental Protection Division, for the NRC. The standards were analyzed by the licensee using routine methods and equipment. The analysis of chemical standards is used to verify the licensee's capability to monitor chemical parameters in various plant systems with respect to Technical Specification requirements and other industry standards. In addition, the analyses of standards are used to evaluate the licensee's analytical procedures with respect to accuracy and precision.

The results of the measurements comparison are listed in Attachment 2. Attachment 3 contains the criteria used to compare results. All standards were analyzed in triplicate. The licensee's original analytical results indicated that 25 of the 34 results were in agreement. The licensee's original chloride results analyzed by ion chromatography were all in disagreement. The fluoride midrange concentration result analyzed by ion chromatography was in disagreement. The licensee's chloride and fluoride quality control standards did not indicate a significant data bias. The licensee recalibrated the ion chromatograph, prepared new BNL standard dilutions, and reran the chloride and fluoride standards. The rerun results for the low chloride concentration and the midrange fluoride concentration remained in disagreement. The licensee's original hydrazine results were all in disagreement and systematically biased low. The licensee prepared new hydrazine reagent and reran the BNL hydrazine standards. The rerun results for hydrazine were all in agreement. The licensee's original silica result for the high concentration was in disagreement and biased low. The licensee's silica quality control standards indicated a high data bias. The licensee reran the high concentration silica standard and the result remained in disagreement. The licensee's final analytical results after retests showed 88 percent agreement with the BNL results based on 30 agreement results out of 34 total results compared. The unresolved disagreements are not considered to indicate any significant programmatic problems.

As part of the previous water chemistry confirmatory measurements inspection, an actual inplant condensate water sample was spiked with anions and split between the licensee and the NRC. This sample was analyzed for fluoride, chloride, and sulfate by the licensee using their normal analytical methods and instrumentation and by BNL for the NRC. The comparison of the analytical results is presented as sample 12, Attachment 2. All analytical results were in agreement.

2. Radiological Confirmatory Measurements

Confirmatory measurements were performed by the licensee and their contractor laboratory on two liquid radiochemistry samples prepared by the Radiological Environmental Sciences Laboratory (RESL) in Idaho Falls, Idaho. The samples were provided to the licensee for analysis in July 1987. The licensee's analytical results were compared to the known sample activities and the results of the comparisons are presented in Attachment 4. Attachment 5 contains the criteria used to compare the results. The licensee's results for the 1987 RESL samples were in 43 percent agreement with the certified activities.

ATTACHMENT 2

Water Chemistry Confirmatory Measurements Results

Fort Calhoun Nuclear Station

NRC Inspection Report: 50-285/88-18

1. Chloride Analysis (5-100 ppb) Ion Chromatograph

<u>Sample</u>	<u>FCS Results (ppb)</u>	<u>NRC Results (ppb)</u>	<u>FCS/NRC Ratio</u>	<u>Comparison Decision</u>
B7A	22.3±0.6	18.5±0.1	1.21±0.03	Disagreement
B7B	40.3±0.6	37.3±0.3	1.08±0.02	Disagreement
B7C	83.0±1.0	76.5±1.2	1.08±0.02	Disagreement

Retest - after recalibration and new standard dilutions prepared

B7A	20.3±0.6	18.5±0.1	1.10±0.03	Disagreement
B7B	40.0±1.0	37.3±0.3	1.07±0.04	Agreement
B7C	79.0±1.0	76.5±1.2	1.03±0.02	Agreement

2. Fluoride Analysis (5-100 ppb) Ion Chromatograph

<u>Sample</u>	<u>FCS Results (ppb)</u>	<u>NRC Results (ppb)</u>	<u>FCS/NRC Ratio</u>	<u>Comparison Decision</u>
B7A	20.7±1.2	22.5±2.0	0.92±0.10	Agreement
B7B	44.3±0.6	42.3±0.4	1.05±0.02	Disagreement
B7C	85.3±2.3	82.8±1.7	1.03±0.03	Agreement

Retest - after recalibration and new standard dilutions prepared

B7A	18.7±0.6	22.5±2.0	0.83±0.09	Agreement
B7B	40.0±0.4	42.3±0.4	0.95±0.01	Disagreement
B7C	80.7±2.1	82.8±1.7	0.97±0.03	Agreement

3. Chloride Analysis (10-1000 ppb) Selective Ion Electrode

<u>Sample</u>	<u>FCS Results (ppb)</u>	<u>NRC Results (ppb)</u>	<u>FCS/NRC Ratio</u>	<u>Comparison Decision</u>
B7A	40.0±3.0	37.0±0.2	1.08±0.08	Agreement
B7B	151.3±3.2	149.2±1.2	1.01±0.02	Agreement
B7C	340.0±9.2	306.0±4.8	1.11±0.03	Disagreement

4. Fluoride Analysis (20-450 ppb) Selective Ion Electrode

<u>Sample</u>	<u>FCS Results</u> (ppb)	<u>NRC Results</u> (ppb)	<u>FCS/NRC</u> <u>Ratio</u>	<u>Comparison</u> <u>Decision</u>
87A	39.3±0.6	45.0±4.0	0.87±0.08	Agreement
87B	162.7±3.1	169.2±1.6	0.96±0.02	Agreement
87C	318.3±10.0	331.2±6.8	0.96±0.04	Agreement

5. Sulfate Analysis (5-100 ppb) Ion Chromatograph

<u>Sample</u>	<u>FCS Results</u> (ppt)	<u>NRC Results</u> (ppb)	<u>FCS/NRC</u> <u>Ratio</u>	<u>Comparison</u> <u>Decision</u>
87A	20.7±1.2	19.5±1.4	1.06±0.10	Agreement
87B	41.7±0.6	38.3±2.7	1.09±0.08	Agreement
87C	83.7±1.2	78.0±2.3	1.07±0.04	Agreement

6. Boron Analysis (100-2000 ppm) Manitol Titration

<u>Sample</u>	<u>FCS Results</u> (ppm)	<u>NRC Results</u> (ppm)	<u>FCS/NRC</u> <u>Ratio</u>	<u>Comparison</u> <u>Decision</u>
87D	203±2	208±2	0.98±0.01	Agreement
87E	590±5	620±20	0.95±0.03	Agreement
87F	987±18	1000±18	0.99±0.03	Agreement
PASS Boron Analysis				
87F	2480	2500	0.99	Agreement

7. Sodium Analysis (5-50 ppb) Flame Atomic Absorption

<u>Sample</u>	<u>FCS Results</u> (ppb)	<u>NRC Results</u> (ppb)	<u>FCS/NRC</u> <u>Ratio</u>	<u>Comparison</u> <u>Decision</u>
87J	10.3±0.6	12.1±1.4	0.85±0.11	Agreement
87K	22.0±1.0	21.2±1.2	1.04±0.08	Agreement
87L	35.3±1.2	31.6±1.8	1.12±0.07	Agreement

8. Lithium Analysis (1-2 ppm) Flame Atomic Absorption

<u>Sample</u>	<u>FCS Results</u> (ppb)	<u>NRC Results</u> (ppb)	<u>FCS/NRC</u> <u>Ratio</u>	<u>Comparison</u> <u>Decision</u>
87J	1.94±0.02	1.97±0.04	0.98±0.02	Agreement
87K	1.50±0.01	1.50±0.04	1.00±0.03	Agreement
87L	1.00±0.01	1.03±0.03	0.97±0.03	Agreement

9. Ammonia Analysis (20-1000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	FCS/NRC Ratio	Comparison Decision
B7M	53.0±6.9	52.0±2.5	1.02±0.14	Agreement
B7N	150.7±14.4	150.5±1.5	1.00±0.10	Agreement
B7D	537.0±20.8	492.0±23.0	1.09±0.07	Agreement

10. Hydrazine Analysis (5-600 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	FCS/N Ratio	Comparison Decision
B7P	17.7±0.6	19.9±0.3	0.89±0.03	Disagreement
B7Q	42.7±0.6	49.9±0.5	0.86±0.01	Disagreement
B7R	86.7±1.2	100.0±1.0	0.87±0.01	Disagreement

Retest - using new reagent and analyzing the same standards

B7P	19.7±1.5	19.9±0.3	0.99±0.08	Agreement
B7Q	48.7±0.6	49.9±0.5	0.98±0.02	Agreement
B7R	97.0±2.0	100.0±1.0	0.97±0.02	Agreement

11. Silica Analysis (10-2000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	FCS/NRC Ratio	Comparison Decision
B7S	50.3±4.0	52.8±2.8	0.95±0.09	Agreement
B7T	97.7±1.2	104.0±4.0	0.94±0.04	Agreement
B7T	190.3±1.2	208.0±8.0	0.91±0.04	Disagreement

Retest - new analysis on the same standards

B7T	188.0±2.3	208.0±8.0	0.90±0.04	Disagreement
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12. Spiked Condensate Water Sample

Analysis	FCS Results (ppb)	BNL Results (ppb)	FCS/BNL Ratio	Comparison Decision
Fluoride	25.7±1.2	24.0±0.2	1.07±0.05	Agreement
Chloride	36.3±1.5	34.9±0.2	1.04±0.04	Agreement
Sulfate	32.7±1.2	32.6±4.3	1.00±0.14	Agreement

ATTACHMENT 3

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This attachment provides criteria for comparing results of capability tests. In these criteria the judgement limits are based on the uncertainty of the ratio of the licensee's value to the NRC value. The following steps are performed:

- (1) The ratio of the licensee's value to the NRC value is computed

$$\left(\text{ratio} = \frac{\text{Licensee's Value}}{\text{NRC VALUE}}\right); \text{ and}$$

- (2) the uncertainty of the ratio is propagated.¹

If the absolute value of one minus the ratio is less than or equal to twice the ratio uncertainty, the results are in agreement.

$$\left(|1 - \text{ratio}| \leq 2 \times \text{uncertainty}\right)$$

$$Z = \frac{x}{y}, \text{ then } \frac{S_z^2}{Z^2} = \frac{S_x^2}{x^2} + \frac{S_y^2}{y^2}$$

¹(From: Bevington, P. R., Data Reduction and Error Analysis for the Physical Sciences, McGraw-Hill, New York, 1969)

ATTACHMENT 4

Radiological Confirmatory Measurement Results

Fort Calhoun Nuclear Station

NRC Inspection Report: 50-285/88-18

RESL Unknown Liquid Sample

(Standardized: 12:00, MST, January 11, 1987)

<u>Nuclide</u>	<u>FCS Results (uCi/ml)</u>	<u>NRC Results (uCi/ml)</u>	<u>FCS/NRC Ratio</u>	<u>Comparison Decision</u>
Mn-54	1.78±0.10E-5	1.98±0.04E-5	0.90	Agreement
Co-60	1.99±0.10E-5	1.91±0.04E-5	1.04	Agreement
Cs-137	3.85±0.11E-5	2.80±0.08E-5	1.38	Disagreement
Fe-55	<6.16E-9	6.19±0.12E-5	----	Disagreement
Sr-89	3.54±0.35E-4	1.39±0.04E-4	2.55	Disagreement
Sr-90	1.44±0.06E-5	1.26±0.05E-5	1.14	Agreement
H-3	6.19±0.11E-5	1.01±0.02E-4	0.61	Disagreement
Fe-59	Not Reported	4.75±0.19E-6		
Cs-134	3.18±0.48E-6	Not Present		

NRC results were taken from the standard certification supplied to the NRC Region IV office as prepared by RESL and traceable to the National Bureau of Standards.

ATTACHMENT 5

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

The following are the criteria used in comparing the results of capability tests and verification measurements. The criteria are based on an empirical relationship established through prior experience and this program's analytical requirements.

In these criteria, the judgement limits vary in relation to the comparison of the resolution.

$$\text{Resolution} = \frac{\text{NRC VALUE}}{\text{NRC UNCERTAINTY}}$$

$$\text{Ratio} = \frac{\text{LICENSEE VALUE}}{\text{NRC VALUE}}$$

Comparisons are made by first determining the resolution and then reading across the same line to the corresponding ratio. The following table shows the acceptance values.

RESOLUTION	AGREEMENT RATIO
<4	0.40 - 2.50
4 - 7	0.50 - 2.00
8 - 15	0.60 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

The above criteria are applied to the following analyses:

- (1) Gamma Spectrometry
- (2) Tritium in liquid samples
- (3) Iodine on adsorbers
- (4) ⁸⁹Sr and ⁹⁰Sr determinations
- (5) Gross Beta where samples are counted on the same date using the same reference nuclide.