APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-285/91-07 Operating License: DPR-40

Docket: 50-285

Licensee: Omaha Public Power District (OPPD)
444 South 16th Street Mall
Mail Stop 8E/EP4
Omaha, Nebraska 68102-2247

Facility Name: Fort Calhoun Station (FCS)

Inspection At: FCS Site, Blair, Nebraska

Inspection Conducted: April 15-19, 1991

Inspectors: for Lorenzo Wilborn 5/20/91
J. B. Nicholas, Senior Radiation Specialist Date
Radiological Protection and Emergency
Preparedness Section

Lorenzo Wilborn 5/20/91
L. Wilborn, Radiation Specialist, Radiological Date
Protection and Emergency Preparedness Section

Arthur D. Gaines 5/20/91
A. D. Gaines, Radiation Specialist Date
Radiological Protection and Emergency
Preparedness Section

Approved: Blaine Murray 5/20/91
Blaine Murray, Chief, Radiological Protection Date
and Emergency Preparedness Section

Inspection Summary

Inspection Conducted April 15-19, 1991 (Report 50-285/91-07)

Areas Inspected: Routine, announced inspection of the licensee's water chemistry and radiochemistry programs including water chemistry and radiochemistry confirmatory measurements.

Results: The inspectors determined that the licensee had developed and implemented a water chemistry program and radiochemistry program based on regulatory and industry guidelines. The water chemistry and radiochemistry programs were being conducted in accordance with Technical Specification (TS) requirements. The licensee's chemistry staff had experienced a personnel turnover of approximately 30 percent over the past 22 months. Quality Assurance (QA) surveillances and audit had been performed as required and were technically comprehensive. The results of the water chemistry confirmatory measurements from the secondary chemistry laboratory indicated 90 percent agreement with the NRC's results and the radiochemistry laboratory results were in 83 percent agreement. The licensee's performance showed approximately the same performance as the 92 percent agreement and 80 percent agreement as reported for the two laboratories, respectively, during the previous NRC inspection of this area conducted in June 1989. The licensee's radiological confirmatory measurements results were in 98 percent agreement with the NRC's results. This showed a performance equivalent to the 98 percent agreement achieved during the NRC inspection of this area in June 1989.

Within the areas inspected, no violations or deviations were identified. One unresolved item and three open items which were previously identified were closed.

DETAILS

1. Persons Contacted

OPPD

*W. C. Jones, Senior Vice President, OPPD
*T. L. Patterson, Manager, FCS
R. C. Beck, Chemistry Laboratory Specialist
A. D. Bilau, Supervisor, Radwaste
J. B. Biggs, Chemist
*F. F. Franco, Manager, Radiological Services
A. F. Friebe, Chemistry, Technician
*J. K. Gasper, Manager, Training
J. M. Glantz, Chemist, Radiological Services
*R. L. Jaworski, Manager, Station Engineering
J. G. Krist, Environmental Scientist, Radiological Services
*L. T. Kusek, Manager, Nuclear Safety Review
*W. W. Orr, Manager, QA/Quality Control (QC)
B. A. Schmidt, Supervisor, Secondary Chemistry
*L. D. Sills, QA Auditor
*C. F. Simmons, Station Licensing Engineer
*F. K. Smith, Supervisor, Chemistry
*D. E. Spires, QA Auditor
*T. G. Therkildsen, Acting Manager, Licensing and Industry Affairs

NRC

*R. P. Mullikin, Senior Resident Inspector, FCS

*Denotes those present during the exit interview on April 19, 1991.

2. Followup on Previously Identified Inspection Findings (92701)

(Closed) Unresolved Item (285/9011-01): Failure to Complete All Identified Training for the Radwaste Staff - This unresolved item was identified in NRC Inspection Report 50-285/90-11 and involved radwaste personnel who had not completed training covering all the objectives in Lesson Plans 19-23-18, "Shipment and Receipt of Radioactive Material," and 19-24-35, "Shipment/Receipt Surveys." During this inspection, the inspectors verified that the licensee had provided formal training commensurate with radwaste personnel job assignments. The licensee provided radiation protection fundamentals training for junior radwaste technicians starting in July 1990. A radioactive material shipping and packing workshop course and site-specific training were provided in December 1990 for the senior radiation protection technicians, as well as the radwaste operations coordinator, contamination control coordinator, and the radioactive waste operations supervisor. The junior radwaste technicians attended the site-specific training. The inspectors verified that no licensee personnel had performed activities in this area without the appropriate training. The licensee's actions were adequate to close this unresolved item.

(Closed) Open Item (285/9041-01): Radioactive Waste Material Shipment Dose Rates - This open item was identified in NRC Inspection Report 50-285/90-41 and involved revising radwaste procedures to include the corrective actions outlined in the licensee's response to a violation of the state of Washington's Administrative Code and U.S. Ecology, Inc.'s Radioactive Materials License WN-I019-2. The violation resulted from a discrepancy between the licensee's external radiation reading on Drum 90-CT-0383 in a radwaste shipment on April 5, 1990, and the burial site's external radiation reading on that drum during a receipt inspection of the shipment on April 9, 1990. The inspectors verified that the changes to Procedures RP-401 and RW-312 and Forms FC-RW-201-1 and FC-RW-304-2 incorporated those corrective actions committed to by the licensee in its response to the state of Washington. The licensee's procedural changes were adequate to close this open item.

(Closed) Open Item (285/9041-02): QA Radiological Effluent Surveillance Program - This open item was identified in NRC Inspection Report 50-285/90-41 and involved the lack of semiannual QA surveillances of liquid and gaseous radiological effluent releases performed in years previous to 1989. The inspectors reviewed the licensee's QA surveillance schedules for 1990 and 1991 and noted that Surveillance B-1, "Radioactive Effluent Release Summary Report," was scheduled semiannually for June and December. The licensee's actions were adequate to close this open item.

(Closed) Open Item (285/9041-03): Chemistry Section Radioactive Effluent Dose Calculations - This open item was identified in NRC Inspection Report 50-285/90-41 and involved the licensee altering the monitor tank radionuclide input listing and not changing the data input table to correspond to the radionuclide input listing for the licensee's computer code written by the licensee to determine compliance with the TS requirements. The results of this computer software modification caused the input data for several radionuclides to be out-of-order and not correspond with the correct radionuclide listed in the computer code, thus causing erroneous dose results. The inspectors determined that the licensee had modified the data input table to properly correspond to the radionuclide input listing. The inspectors verified that the chemistry section software computed doses for radioactive liquid effluents were in accordance with the Offsite Dose Calculation Manual equations and table values and were in agreement with the NRC's computed doses for the adult total body and the adult critical organ (liver). The licensee's actions were adequate to close this open item.

(Open) Open Item (285/9041-04): Radiological Services Group Radioactive Dose Calculations - This open item was identified in NRC Inspection Report 50-285/90-41 and involved differences in the calculated dose results between the licensee's radiological services group and the NRC for the various age groups and critical organs resulting from radioactive liquid and gaseous effluents. The inspectors determined that the licensee had completed their study and research of the computer code, LADTAP, and had made the necessary corrections to the dose factor library so that it conformed with the dose factor tables in Regulatory Guide 1.109, Revision 1. The inspectors performed additional confirmatory dose

calculations with the licensee and verified that all calculated doses resulting from radioactive liquid effluents compared exactly between the licensee and the NRC for all age groups (adult, teen, child, and infant) and for all critical organs (liver, thyroid, kidney, lung, gastro-intestine, and total body). The licensee's actions were satisfactory to close the radioactive liquid effluent dose calculation portion of the open item.

The licensee was continuing their study, research, and investigations into the computer code, GASPAR, for calculating doses resulting from radioactive effluent airborne iodine and particulates. The licensee's original calculated doses for ingestion pathways including cow meat, cow milk, and vegetation indicated that the licensee's dose results were nonconservative when compared to the NRC's calculated doses. The licensee had established an action plan and schedule for researching and correcting their GASPAR computer code so that their calculated dose results from airborne iodine and particulates will compare with the NRC's calculated doses. The licensee indicated that their action plan was on schedule and would be completed by their proposed completion date of July 31, 1991. The gaseous effluent portion of this open item will remain open pending further review by the inspectors.

3. Organization and Management Controls (84750)

The inspectors reviewed the licensee's organization and staffing of the FCS chemistry section to determine agreement with commitments in Chapter 12 of the Updated Safety Analysis Report (USAR) and compliance with the requirements of TS 5.2.

The inspectors reviewed the organization structure of the FCS chemistry section and verified it to be as described in the USAR and TS. Since the previous NRC inspection of the licensee's chemistry program conducted in June 1989, the licensee had made one supervisory organizational change and had added six new chemistry technicians. A supervisory position responsible for hazardous materials had been established. At the time of the inspection, the FCS chemistry staff was composed of a chemistry supervisor, four assistant chemistry supervisors, seven chemists and laboratory assistants, six shift-qualified chemistry technicians, four contractor staff chemists, and five chemistry technicians in training. There were two vacancies in the chemistry technical staff which were not presently filled. The four assistant chemistry supervisors report directly to the chemistry supervisor. Each of these assistant chemistry supervisors were responsible for a specific chemistry area (i.e., secondary chemistry, radiochemistry, laboratories, and hazardous materials). The chemistry technical staff personnel were assigned to work in the various chemistry areas and reported to their respective assistant chemistry supervisor. The inspectors were informed that as the five new chemistry technicians complete their shift-qualification training, they will replace three of the contractor chemistry technical staff and fill the two technician vacancies. The fourth contractor position will not

remain authorized. This will completely fill the 19 authorized chemistry section technical staff positions with OPPD personnel.

Since the previous NRC chemistry inspection in June 1989, the FCS chemistry section had experienced a personnel turnover of approximately 30 percent. This personnel turnover was identical to the chemistry section personnel turnover experienced during the 12 months prior to June 1989 which indicated a reduction in chemistry staff turnover at that time. This is a positive indication of chemistry staff stability.

No violations or deviations were identified.

4. Training and Qualifications (84750)

The inspectors reviewed the licensee's continuing training and qualification program for FCS chemistry section personnel to determine agreement with commitments in Chapter 12 of the USAR and compliance with the requirements in TS 5.3 and 5.4.

The inspectors reviewed the experience, educational backgrounds, and qualifications of the present chemistry staff and determined that all met the ANSI 18.1-1971 qualification requirements and qualifications specified in the USAR and TS except for the five new staff members, who were currently in training. It was determined that the licensee had an adequately qualified chemistry staff.

The inspectors reviewed: (1) the chemistry staff training records for shift qualification, (2) the requalification and continuing training program, (3) the postaccident sampling system operator requalification training, (4) the initial chemistry training program including the use of performance evaluation checklists for documentation of on-the-job training (OJT) leading to shift qualification, and (5) the chemistry instructors' training and certifications. The initial and continuing chemistry training programs and training calendar for 1991 appeared satisfactory. The inspectors determined that the licensee's training program for the FCS chemistry staff was being implemented in accordance with the FCS chemistry training procedures. The chemistry OJT for the new chemistry technicians was being completed as rapidly as time and routine chemistry activities would permit.

No violations or deviations were identified.

5. QA Program (84750)

The inspectors reviewed the licensee's QA surveillance and audit programs regarding water chemistry and radiochemistry activities to determine agreement with commitments in Chapter 12 of the USAR and compliance with the requirements in TS 5.5.2.8.

The inspectors reviewed the licensee's audit and surveillance schedules for 1990 and 1991 and the qualifications of the QA auditors. Audit and

surveillance reports generated from QA activities during the period January 1989 through April 1991 in the area of chemistry were reviewed for scope and depth to ensure thoroughness of the chemistry program evaluation and timely followup of identified deficiencies. The inspectors determined that the surveillances, audit plan, and audit checklist were comprehensive. The inspectors determined that the QA surveillances and audit of the chemistry program were performed in accordance with FCS procedures and schedules and by qualified auditors who were experienced in nuclear power facility chemistry activities.

No violations or deviations were identified.

6. Confirmatory Measurements for Chemistry Analysis (84750)

The inspectors reviewed the licensee's water chemistry analysis program by performing water chemistry confirmatory measurements to determine agreement with the commitments in Chapter 4 of the USAR and compliance with TS 2.1.5, 2.2, 5.8, and 5.13.

The inspectors reviewed selected water chemistry procedures revised since the previous NRC chemistry inspection conducted in June 1989 and determined that the licensee had implemented sufficient programmatic procedures to meet the commitments of the USAR and TS requirements.

During the inspection, the inspectors provided standard chemical solutions to the licensee for confirmatory measurement analyses. The standards were analyzed by the licensee in both the secondary chemistry laboratory and the radiochemistry laboratory using routine analytical methods and equipment. The results of the measurement comparisons are summarized in Attachments 1, 2, and 3 of this report. The licensee's analytical results from the secondary chemistry laboratory indicated 90 percent agreement with the Brookhaven National Laboratory (BNL) results. This was approximately the same performance in the secondary chemistry laboratory as the 92 percent agreement reported during the previous NRC inspection conducted in June 1989. The licensee's analytical results from the radiochemistry laboratory indicated 83 percent agreement with the BNL results. The licensee's performance in the radiochemistry laboratory showed a slight improvement over the 80 percent agreement reported in the previous NRC inspection conducted in June 1989.

No violations or deviations were identified.

7. Confirmatory Measurements for Radiochemistry Analysis (84750)

The inspectors reviewed the licensee's radiochemical analysis program by performing radiochemistry confirmatory measurements to determine agreement with the commitments in Chapter 4 of the USAR and compliance with TS 2.1, 2.9.1, 2.20, 3.2, 3.12, 5.8, and 5.15.

The inspectors reviewed selected radiochemistry procedures revised since the previous NRC chemistry inspection conducted in June 1989 and

determined that the licensee had implemented sufficient radioanalytical procedures to meet the commitments of the USAR and TS requirements.

During the inspection, radiochemistry confirmatory measurements were performed on standards and split samples by the licensee and the inspectors in the Region IV mobile laboratory on site. The standards and samples were analyzed by the licensee using routine methods and equipment. The results of the measurements comparisons are summarized in Attachments 1 and 5 of this report. The licensee's analytical results from the radiochemistry counting room indicated 98 percent agreement with the NRC's mobile laboratory analytical results. These radiochemistry confirmatory measurement results were equivalent to the high quality performance of 98 percent agreement reported during the previous NRC chemistry confirmatory measurements inspection conducted in June 1989.

No violations or deviations were identified.

8. Exit Meeting (30703)

The inspectors met with the NRC senior resident inspector and the licensee representatives identified in paragraph 1 of this report at the conclusion of the inspection on April 19, 1991. The inspectors summarized the scope and findings of the inspection and discussed the results of the water chemistry and radiochemistry confirmatory measurements as presented in the report. The licensee did not identify as proprietary any of the materials provided to, or reviewed by, the inspectors during the inspection.

ATTACHMENT 1

Analytical Measurements

Fort Calhoun Station

NRC Inspection Report: 50-285/91-07

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 (TS) 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 water chemistry confirmatory measurement comparisons are listed in Attachment 2 for the secondary chemistry laboratory and in Attachment 3 for the radiochemistry laboratory. Attachment 4 contains the criteria used to evaluate the analytical results.

The licensee's original analytical results from the secondary chemistry laboratory indicated slight problems with the analyses for sulfate, iron, nickel, and silica. The original analytical results showed that 22 of the 30 results were in agreement. Four of the original analytical results were in disagreement, and four were in the qualified agreement criteria.

(a) The licensee's original high concentration sulfate analysis result was in qualified agreement and biased high. The licensee prepared new sulfate calibration standards, recalibrated the ion chromatograph in the secondary chemistry laboratory over the range of 50 - 100 ppb rather than 20 - 100 ppb, and reanalyzed the original BNL sulfate standard dilution. The retest analysis result was in agreement.

(b) The licensee's original low and mid-range concentration iron analyses results were in qualified agreement and biased high, and the original high concentration iron analysis result was in disagreement and biased high. The licensee prepared new iron calibration standards, recalibrated the atomic absorption spectrometer in the secondary chemistry laboratory, and reanalyzed the three original BNL iron standard dilutions. The retest analyses results were all in agreement.

(c) The licensee's original nickel results were all in disagreement and biased high. The licensee prepared new nickel calibration standards, recalibrated the atomic absorption spectrometer in the secondary chemistry laboratory, and reanalyzed the three original BNL nickel standard dilutions. The retest analyses results for the low and mid-range concentrations were still in disagreement. The high concentration nickel analysis result was in agreement.

The licensee did not routinely perform the nickel analysis.

(d) The silica analysis result which was in qualified agreement was not retested.

The licensee's final analytical results from the secondary chemistry laboratory, after the licensee had performed retests in an attempt to resolve the original qualified agreements and disagreements, indicated 90 percent agreement with the BNL results based on 27 agreement results out of 30 results compared. The licensee's performance showed approximately the same performance in the secondary chemistry laboratory of 93 percent agreement reported in the previous NRC inspection of this area conducted in June 1989.

The licensee's original analytical results from the radiochemistry laboratory indicated problems with the fluoride, sulfate, boron, nickel, and silica analyses. The original results showed that 28 of the 36 results were in agreement. Two of the original analytical results were in disagreement, and six were in the qualified agreement criteria.

(a) The fluoride analyses results which were in qualified agreement were not retested.

(b) The licensee's original mid-range concentration sulfate analysis result was in disagreement and biased high, and the original high concentration sulfate result was in qualified agreement and biased high. The licensee prepared new sulfate calibration standards, recalibrated the ion chromatograph in the radiochemistry laboratory over the range of 5 - 40 ppb rather than 5 - 100 ppb, and reanalyzed the original mid-range concentration BNL sulfate standard dilution. The retest analysis result was in agreement. The sulfate analysis result which was in qualified agreement was not retested.

(c) The licensee's original low concentration boron analysis result was in qualified agreement and biased low. The licensee prepared a new BNL boron standard dilution, recalibrated the boron titrator, and reanalyzed the new BNL boron standard dilution. The retest analysis result was in agreement.

(d) The licensee's original high concentration nickel analysis result was in disagreement and biased low, and the original mid-range concentration nickel analysis result was in qualified agreement and biased low. The nickel analyses results which were in disagreement or qualified agreement were not repeated.

The licensee did not routinely perform the nickel analysis.

(e) The silica analysis result which was in qualified agreement was not retested.

The licensee's final results from the radiochemistry laboratory, after the retests in an attempt to resolve the original disagreements and qualified agreements, indicated 83 percent agreement with the BNL results based on 30 agreement results out of 36 results compared. The licensee's performance showed a slight improvement in the radiochemistry laboratory over the 80 percent agreement reported in the previous NRC inspection of this area conducted in June 1989.

2. Radiological Confirmatory Measurements

Confirmatory measurements were performed on the following standards and samples in the NRC Region IV mobile laboratory at Fort Calhoun Station during the inspection:

(1) NRC Air Particulate Filter Standard (34118-109)

(2) FCS Air Particulate Filter Standard (38210-22)

(3) NRC CESCO Charcoal Cartridge Standard (34119-109)

(4) FCS TEDA 2 Charcoal Cartridge Standard (38207A-22)

(5) Waste Liquid Holdup Tank "C" Sample

(6) Reactor Coolant Gas Sample

(7) Reactor Coolant Liquid Sample

(8) Containment Atmosphere Sample (RM-050)

The radiological confirmatory measurement tests consisted of comparing the analysis results of the licensee and the NRC Region IV mobile laboratory. The NRC's mobile laboratory measurements are referenced to the National Institute of Standards and Technology by laboratory intercomparisons. Confirmatory measurements are made only for those nuclides identified by the NRC as being present in concentrations greater than 10 percent of the respective isotopic values for liquid and gas concentrations as stated in 10 CFR Part 20, Appendix B, Table II.

At the time of the inspection, the licensee was utilizing two germanium-lithium detector systems in the radiochemistry counting room. The analytical results from these two detector systems were compared with the NRC's analytical results. The individual sample analyses and comparison of analytical results of the radiological confirmatory measurements are tabulated in Attachment 5. Attachment 6 describes the criteria used to compare the analytical results.

The licensee's gamma isotopic results from the listed standards and samples in Attachment 5 showed 98 percent agreement with the NRC's analytical results based on 108 agreement results out of 110 total results compared. The licensee's performance in the area of radiological confirmatory measurements was identical to the 98 percent agreement achieved during the previous NRC inspection of this area in June 1983.

ATTACHMENT 2

Water Chemistry Confirmatory Measurements Results (Secondary Chem. Lab.)

Fort Calhoun Station

NRC Inspection Report: 50-285/91-07

1. Chloride Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	31.06	30.00	Agreement
88B	65.27	62.00	Agreement
88C	100.17	95.00	Agreement

2. Fluoride Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	25.08	24.00	Agreement
88B	51.87	48.00	Agreement
88C	81.15	74.00	Agreement

3. Sulfate Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	20.15	19.00	Agreement
88B	41.69	38.00	Agreement
88C	66.84	60.00	Qual. Agree.

Retest - prepared new sulfate calibration standards, restandardized the ion chromatograph over the range 50 - 100 ppb rather than 20 - 100 ppb, and performed the retest analysis

88C	64.50	60.00	Agreement

4. Iron Analysis (2-500 ppb) Graphite Furnace Atomic Absorption

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88G	11.15	9.90	Qual. Agree.
88H	21.68	19.60	Qual. Agree.
88I	33.47	29.00	Disagreement

Retest - prepared new iron calibration standards, restandardized the atomic absorption system, and performed the retest analyses

88G	9.08	9.90	Agreement
88H	19.32	19.60	Agreement
88I	30.97	29.00	Agreement

5. Copper Analysis (1-50 ppb) Graphite Furnace Atomic Absorption

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88G	10.43	9.95	Agreement
88H	20.82	20.25	Agreement
88I	30.79	29.75	Agreement

6. Nickel Analysis (3-50 ppb) Graphite Furnace Atomic Absorption

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88G	13.42	10.15	Disagreement
88H	25.66	20.15	Disagreement
88I	35.59	30.50	Disagreement

Retest - prepared new nickel calibration standards, restandardized the atomic absorption system, and performed the retest analyses

88G	11.40	10.15	Disagreement
88H	23.10	20.15	Disagreement
88I	32.10	30.50	Agreement

7. Chromium Analysis (1-50 ppb) Graphite Furnace Atomic Absorption

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88G	10.03	10.00	Agreement
88H	20.11	20.20	Agreement
88I	30.50	30.00	Agreement

8. Ammonia Analysis (20-3000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88M	47.00	51.00	Agreement
88N	155.00	155.00	Agreement
88O	536.00	500.00	Agreement

9. Hydrazine Analysis (10-600 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88P	20.60	20.40	Agreement
88Q	41.30	42.30	Agreement
88R	166.30	168.80	Agreement

10. Silica Analysis (10-2000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
87S	46.00	52.00	Agreement
86T	100.00	109.00	Agreement
87U	285.00	314.00	Qual. Agree.

ATTACHMENT 3

Water Chemistry Confirmatory Measurements Results (Radiochem. Lab.)

Fort Calhoun Station

NRC Inspection Report: 50-285/91-07

1. Chloride Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	31.76	30.00	Agreement
88B	64.72	62.00	Agreement
88C	94.96	95.00	Agreement

2. Fluoride Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	26.12	24.00	Agreement
88B	54.16	48.00	Qual. Agree.
88C	85.82	74.00	Qual. Agree.

3. Sulfate Analysis (10-1000 ppb) Ion Chromatograph

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88A	20.12	19.00	Agreement
88B	43.82	38.00	Disagreement
88C	66.87	60.00	Qual. Agree.

Retest - prepared new sulfate calibration standards, restandardized the ion chromatograph over the range 5 - 40 ppb rather than 5 - 100 ppb, and performed the retest analysis

88B	40.50	38.00	Agreement

4. Boron Analysis (400-2500 ppm) Manitol Titration

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
88D	502	513	Qual. Agree.
88K	751	748	Agreement
88F	2499	2550	Agreement

Retest - prepared new BNL boron standard dilution, prepared new boron calibration standard, recalibrated the titrator, and performed retest analysis

88D	505	513	Agreement

5. Iron Analysis (3-50 ppm) Flame Atomic Absorption

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
88G	3.81	3.96	Agreement
88H	17.80	19.60	Agreement
88I	26.30	29.00	Agreement

6. Copper Analysis (3-50 ppm) Flame Atomic Absorption

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
88G	3.86	3.98	Agreement
88H	20.21	20.25	Agreement
88I	30.80	29.75	Agreement

7. Nickel Analysis (3-50 ppm) Flame Atomic Absorption

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
88G	4.10	4.06	Agreement
88H	18.50	20.15	Qual. Agree.
88I	26.30	30.50	Disagreement

8. Chromium Analysis (3-50 ppm) Flame Atomic Absorption

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
88G	3.94	4.00	Agreement
88H	18.65	20.20	Agreement
88I	27.10	30.00	Agreement

9. Lithium Analysis (2-50 ppm) Flame Atomic Absorption

Sample	FCS Results (ppm)	NRC Results (ppm)	Comparison Decision
87J	2.03	1.97	Agreement
87K	3.17	3.00	Agreement
88L	4.25	3.95	Agreement

10. Ammonia Analysis (20-3000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88M	49.00	51.00	Agreement
88N	144.00	155.00	Agreement
88O	513.00	500.00	Agreement

11. Hydrazine Analysis (10-600 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
88P	19.30	20.40	Agreement
88Q	39.90	42.30	Agreement
88R	159.30	166.80	Agreement

12. Silica Analysis (10-2000 ppb) Spectroscopy

Sample	FCS Results (ppb)	NRC Results (ppb)	Comparison Decision
87S	49.00	52.00	Agreement
86T	101.00	109.00	Agreement
87U	285.00	314.00	Qual. Agree.

ATTACHMENT 3

13. Postaccident Sample Matrix Analysis Ion Chromatograph

Analysis	FCS Results (ppm)	NRC Results (ppm)	Comparison Deviation
Chloride	12.40	11.30	Agreement
Boron	2020.00	2060.00	Agreement

ATTACHMENT 4

CRITERIA FOR COMPARING WATER CHEMISTRY ANALYTICAL MEASUREMENTS

The following are the criteria used in comparing the results of the capability tests and verification measurements. The criteria for the judgement limits are based on the data from Table 2.1 of NUREG/CR-5244, "Evaluation of Non-Radiological Water Chemistry at Power Reactors." Licensee values within the plus or minus two standard deviations range of the BNL known values are considered to be in agreement. Licensee values outside the plus or minus two standard deviations range but within the plus or minus three standard deviations range of the BNL known values are considered to be in qualified agreement. Retest results which are in qualified agreement will receive additional attention. Licensee values greater than the plus or minus three standard deviations range of the BNL known values are in disagreement. The standard deviations were computed using the average percent standard deviation values of each analyte in Table 2.1.

The ranges for the data in Attachment 2 is as follows:

Ampule	Analyte	Agreement Range	Qualified Agreement Range
88A	F	21.00 - 27.00	20.00 - 28.00
	Cl	28.00 - 32.00	27.00 - 33.00
	SO_4	17.00 - 21.00	16.00 - 22.00
88B	F	42.00 - 54.00	40.00 - 56.00
	Cl	57.00 - 67.00	55.00 - 69.00
	SO_4	34.00 - 42.00	33.00 - 43.00
88C	F	85.00 - 83.00	81.00 - 87.00
	Cl	88.00 - 102.00	85.00 - 105.00
	SO_4	54.00 - 66.00	52.00 - 68.00
88G	Fe	8.95 - 10.85	8.45 - 11.35
	Cu	9.00 - 10.90	8.55 - 11.35
	Ni	9.50 - 10.80	9.20 - 11.10
	Cr	9.05 - 10.95	8.55 - 11.45
88H	Fe	17.70 - 21.50	16.80 - 22.40
	Cu	18.30 - 22.20	17.35 - 23.15
	Ni	18.90 - 21.40	18.30 - 22.00
	Cr	18.35 - 22.15	17.25 - 23.15
88I	Fe	26.20 - 31.80	24.80 - 33.20
	Cu	26.90 - 32.60	25.50 - 34.00
	Ni	28.60 - 32.40	27.60 - 33.40
	Cr	27.10 - 32.90	25.60 - 34.40

ATTACHMENT 4

2

Ampule	Analyte	Agreement Range	Qualified Agreement Range
88M	NH_3	46.00 - 56.00	44.00 - 59.00
88N	NH_3	140.00 - 170.00	132.00 - 178.00
88O	NH_3	452.00 - 548.00	428.00 - 572.00
88P	N_2H_4	18.80 - 22.00	18.00 - 22.80
88Q	N_2H_4	39.00 - 45.60	37.40 - 47.20
88R	N_2H_4	155.80 - 181.80	149.20 - 188.40
87S	SiO_2	47.40 - 56.60	45.10 - 58.90
86T	SiO_2	100.00 - 120.00	95.00 - 125.00
87U	SiO_2	300.00 - 360.00	284.00 - 376.00

The ranges for the data in Attachment 3 is as follows:

Ampule	Analyte	Agreement Range	Qualified Agreement Range
88A	F	21.00 - 27.00	20.00 - 28.00
	Cl	28.00 - 32.00	27.00 - 33.00
	SO_4	17.00 - 21.00	16.00 - 22.00
88B	F	42.00 - 54.00	40.00 - 56.00
	Cl	57.00 - 67.00	55.00 - 69.00
	SO_4	34.00 - 42.00	33.00 - 43.00
88C	F	65.00 - 83.00	61.00 - 87.00
	Cl	88.00 - 102.00	85.00 - 105.00
	SO_4	54.00 - 66.00	52.00 - 68.00
88D	B	504 - 526	490 - 532
88E	B	732 - 764	724 - 772
88F	B	2495 - 2605	2469 - 2632

Ampule	Analyte	Agreement Range	Qualified Agreement Range
88G	Fe	3.58 - 4.34	3.38 - 4.54
	Cu	3.60 - 4.36	3.42 - 4.54
	Ni	3.80 - 4.36	3.42 - 4.54
	Cr	3.62 - 4.38	3.42 - 4.58
88H	Fe	17.70 - 21.50	16.80 - 22.40
	Cu	18.30 - 22.20	17.35 - 23.15
	Ni	18.90 - 21.40	18.30 - 22.00
	Cr	18.25 - 22.15	17.25 - 23.15
88I	Fe	26.20 - 31.80	24.80 - 33.20
	Cu	26.90 - 32.60	25.50 - 34.00
	Ni	28.60 - 32.40	27.60 - 33.40
	Cr	27.10 - 32.90	25.60 - 34.40
87J	Li	1.70 - 2.26	1.57 - 2.39
87K	Li	2.52 - 3.34	2.30 - 3.56
88L	Li	3.40 - 4.50	3.12 - 4.78
88M	NH_3	46.00 - 56.00	44.00 - 59.00
88N	NH_3	140.00 - 170.00	132.00 - 178.00
88O	NH_3	452.00 - 548.00	428.00 - 572.00
88P	N_2H_4	18.80 - 22.00	18.00 - 22.80
88Q	N_2H_4	39.00 - 45.60	37.40 - 47.20
88R	N_2H_4	155.80 - 181.80	149.20 - 188.40
87S	SiO_2	47.40 - 56.60	45.10 - 58.90
86T	SiO_2	100.00 - 120.00	95.00 - 125.00
87U	SiO_2	300.00 - 360.00	284.00 - 376.00

ATTACHMENT 5

Radiological Confirmatory Measurement Results

Fort Calhoun Station

NRC Inspection Report: 50-285/91-07

1. NRC Air Particulate Filter Standard (34118-109)
(Standardized: 08:00, CDT, April 15, 1991)

The standard was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/sample)	NRC Results (uCi/sample)	FCS/NRC Ratio	Comparison Decision
Co-57	8.110±0.280E-3	7.717±0.081E-3	1.05	Agreement
	8.630±0.400E-3		1.12	Agreement
Ce-139	3.750±0.190E-3	3.330±0.073E-3	1.13	Agreement
	3.830±0.200E-3		1.15	Agreement
Sn-113	4.960±0.260E-3	4.720±0.148E-3	1.05	Agreement
	4.940±0.200E-3		1.05	Agreement
Cs-137	7.320±0.200E-2	6.852±0.032E-2	1.07	Agreement
	7.370±0.260E-2		1.08	Agreement
Y-88	6.850±0.290E-3	6.325±0.212E-3	1.08	Agreement
	6.660±0.250E-3		1.05	Agreement
Co-60	7.160±0.190E-2	6.671±0.039E-2	1.07	Agreement
	7.070±0.210E-2		1.06	Agreement

2. FCS Air Particulate Filter Standard (38210-22)
(Standardized: 11:00, CT, January 1, 1991)

The standard was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/sample)	NRC Results (uCi/sample)	FCS/NRC Ratio	Comparison Decision
Co-57	2.600±0.090E-2	2.355±0.016E-2	1.10	Agreement
	2.740±0.120E-2		1.16	Agreement
Ce-139	4.170±0.190E-2	3.638±0.023E-2	1.15	Agreement
	4.050±0.200E-2		1.11	Agreement
Hg-203	6.560±0.310E-2	5.716±0.066E-2	1.15	Agreement
	6.400±0.280E-2		1.12	Agreement
Sn-113	8.360±0.350E-2	7.623±0.050E-2	1.07	Agreement
	8.550±0.280E-2		1.09	Agreement
Cs-137	6.420±0.170E-2	5.865±0.033E-2	1.09	Agreement
	6.480±0.230E-2		1.10	Agreement
Y-88	1.380±0.040E-1	1.287±0.008E-1	1.07	Agreement
	1.380±0.040E-1		1.07	Agreement
Co-60	7.000±0.180E-2	6.472±0.066E-2	1.08	Agreement
	6.930±0.210E-2		1.07	Agreement

3. NRC CESCO Charcoal Cartridge Standard (34119-109)
(Standardized: 08:00, CDT, April 15, 1991)

The standard was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/sample)	NRC Results (uCi/sample)	FCS/NRC Ratio	Comparison Decision
Co-57	1.160±0.038E-2	1.045±0.010E-2	1.10	Agreement
	1.160±0.054E-2		1.11	Agreement
Ce-139	5.350±0.253E-3	4.529±0.088E-3	1.18	Agreement
	4.910±0.256E-3		1.08	Agreement
Sn-113	6.630±0.312E-3	6.213±0.168E-3	1.07	Agreement
	6.170±0.294E-3		0.99	Agreement
Cs-137	10.10±0.265E-2	8.720±0.030E-2	1.16	Agreement
	9.450±0.272E-2		1.08	Agreement
Y-88	9.060±0.326E-3	8.213±0.231E-3	1.10	Agreement
	8.760±0.299E-3		1.07	Agreement
Co-60	9.480±0.244E-2	8.338±0.043E-2	1.14	Agreement
	9.180±0.251E-2		1.10	Agreement

4. FCS TKDA 2 Charcoal Cartridge Standard (38207A-22)
(Standardized: 11:00, CST, January 1, 1991)

The standard was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/sample)	NRC Results (uCi/sample)	FCS/NRC Ratio	Comparison Decision
Co-57	2.790±0.090E-2	2.591±0.019E-2	1.08	Agreement
	2.800±0.130E-2		1.08	Agreement
Ce-139	4.460±0.200E-2	3.972±0.027E-2	1.12	Agreement
	4.190±0.220E-2		1.05	Agreement
Hg-203	6.960±0.320E-2	5.813±0.071E-2	1.20	Agreement
	6.550±0.330E-2		1.13	Agreement
Sn-113	8.950±0.370E-2	8.250±0.058E-2	1.08	Agreement
	8.230±0.370E-2		1.00	Agreement
Cs-137	6.930±0.180E-2	6.240±0.037E-2	1.11	Agreement
	6.480±0.190E-2		1.04	Agreement
Y-88	1.470±0.040E-1	1.354±0.008E-1	1.09	Agreement
	1.400±0.040E-1		1.03	Agreement
Co-60	7.440±0.190E-2	6.768±0.041E-2	1.10	Agreement
	7.130±0.200E-2		1.05	Agreement

5. Waste Liquid Holding Tank "C" Sample
(Sampled: 13:53, CDT, April 10, 1989)

The sample was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/ml)	NRC Results (uCi/ml)	FCS/NRC Ratio	Comparison Decision
Mn-54	3.140±0.110E-5	3.161±0.058E-5	0.99	Agreement
	3.110±0.110E-5		0.98	Agreement
Co-58	2.100±0.060E-4	2.102±0.011E-4	1.00	Agreement
	2.080±0.060E-4		0.99	Agreement
Co-60	1.740±0.070E-5	1.905±0.045E-5	0.91	Agreement
	1.770±0.080E-5		0.93	Agreement
Sb-125	1.550±0.320E-5	2.026±0.019E-5	0.76	Disagreement
	1.750±0.220E-5		0.86	Agreement
I-131	2.230±1.020E-6	3.654±0.635E-6	0.61	Agreement
	3.350±0.690E-6		0.92	Agreement
Cs-134	4.280±0.110E-4	4.155±0.016E-4	1.03	Agreement
	4.270±0.130E-4		1.03	Agreement
Cs-137	7.190±0.190E-4	7.207±0.020E-4	1.00	Agreement
	7.200±0.260E-4		1.00	Agreement

6. Reactor Coolant Gas Sample
(Sampled: 17:15, CDT, April 16, 1991)

The sample was analyzed by the licensee using their Canberra Series-80 and Series-80 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/cc)	NRC Results (uCi/cc)	FCS/NRC Ratio	Comparison Decision
Ar-41	4.020±0.280E-3	4.142±0.137E-3	0.97	Agreement
	4.280±0.260E-3		1.03	Agreement
Kr-85m	1.360±0.050E-2	1.445±0.013E-2	0.94	Agreement
	1.350±0.050E-2		0.93	Agreement
Kr-87	2.600±0.110E-2	[illegible]±0.020E-2	0.92	Agreement
	2.490±0.110E-2		0.89	Agreement
Kr-88	3.300±0.240E-2	[illegible]±0.035E-2	1.00	Agreement
	3.130±0.230E-2		0.94	Agreement
Xe-133m	4.760±0.800E-3	5.467±0.570E-3	0.87	Agreement
	4.190±0.660E-3		0.77	Agreement
Xe-133	1.880±0.070E-1	1.674±0.005E-1	1.12	Agreement
	1.690±0.060E-1		1.01	Agreement
Xe-135m	8.260±0.310E-2	9.414±0.197E-2	0.88	Agreement
	7.920±0.350E-2		0.84	Agreement
Xe-135	1.120±0.100E-1	1.141±0.002E-1	0.98	Agreement
	1.050±0.090E-1		1.05	Agreement
Xe-138	1.140±0.070E-1	1.137±0.073E-1	1.00	Agreement
	0.980±0.080E-1		0.86	Agreement

7. Reactor Coolant Liquid Sample
(Sampled: 17:15, CDT, April 16, 1991)

The sample was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems' analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/ml)	NRC Results (uCi/ml)	FCS/NRC Ratio	Comparison Decision
I-131	4.360±0.340E-3	3.675±0.105E-3	1.19	Agreement
	3.640±0.220E-3		0.99	Agreement
I-132	3.970±0.290E-2	5.826±0.029E-2	0.68	Disagreement
	5.320±0.250E-2		0.91	Agreement
I-133	3.820±0.130E-2	3.685±0.015E-2	1.04	Agreement
	3.910±0.150E-2		1.06	Agreement
I-134	9.470±0.280E-2	1.936±0.092E-2	0.95	Agreement
	9.900±0.310E-2		1.00	Agreement
I-135	6.770±0.240E-2	6.579±0.056E-2	1.03	Agreement
	6.550±0.240E-2		1.00	Agreement
Cs-134	3.650±0.360E-3	3.909±0.098E-3	0.93	Agreement
	3.580±0.260E-3		0.92	Agreement
Cs-137	5.110±0.280E-3	4.604±0.102E-3	1.11	Agreement
	4.910±0.450E-3		1.07	Agreement
Cs-138	1.260±0.050E-1	1.300±0.015E-1	0.97	Agreement
	1.240±0.050E-1		0.95	Agreement

ATTACHMENT 5

8.

8. Containment Atmosphere Sample (RM-050)
(Sampled: 12:42, CST, April 16, 1991)

The sample was analyzed by the licensee using their Canberra Series-80 and Series-90 analytical systems in their radiochemistry counting room and the isotopic results from the two systems's analyses are reported in that order in the following table.

Nuclide	FCS Results (uCi/cc)	NRC Results (uCi/cc)	FCS/NRC Ratio	Comparison Decision
Ar-41	3.330±0.160E-6	3.250±0.104E-6	1.02	Agreement
	3.380±0.190E-6		1.04	Agreement
Xe-131m	2.700±0.600E-6	2.451±0.409E-6	1.10	Agreement
	1.890±0.440E-6		0.77	Agreement
Xe-133m	1.280±0.230E-6	1.546±0.141E-6	0.83	Agreement
	1.260±0.150E-6		0.82	Agreement
Xe-133	1.420±0.050E-4	1.259±0.004E-4	1.13	Agreement
	1.300±0.050E-4		1.03	Agreement
Xe-135	2.980±0.270E-6	2.726±0.041E-6	1.09	Agreement
	2.720±0.140E-6		1.00	Agreement

ATTACHMEMENT G

CRITERIA FOR COMPARING RADIOCHEMISTRY 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 or adsorbers

(4) ^{89}Sr and ^{90}Sr determinations

(5) Gross Beta where samples are counted on the same date using the same reference nuclide.