APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-313/87-33
50-368/87-33

Operating Licenses: DPR-51
NPF-6

Dockets: 50-313
50-368

Licensee: Arkansas Power & Light Company (AP&L)
P.O. Box 551
Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One (ANO)

Inspection At: ANO Site, Russellville, Pope County, Arkansas

Inspection Conducted: November 16-20, 1987

Inspectors: Russell Wise 12/18/87
for J. B. Nicholas, Senior Radiation Specialist — Date
Facilities Radiological Protection Section

Russell Wise 12/18/87
R. Wise, Radiation Specialist, Facilities — Date
Radiological Protection Section

H. Chaney 12/18/87
H. D. Chaney, Radiation Specialist, Facilities — Date
Radiological Protection Section

Approved: Blaine Murray 12/22/87
B. Murray, Chief, Facilities Radiological — Date
Protection Section

Inspection Summary

Inspection Conducted November 16-20, 1987 (Report 50-313/87-33; 50-368/87-33)

Areas Inspected: Routine, unannounced inspection of the licensee's chemistry/radiochemistry program and water chemistry and radiochemistry confirmatory measurements.

Results: Within the areas inspected, no violations or deviations were identified. Three previously identified violations were closed.

DETAILS

1. Persons Contacted

AP&L

J. M. Levine, Executive Director, ANO Site Operations
*E. C. Ewing, General Manager, Plant Support
L. W. Humphrey, General Manager, Nuclear Quality
*S. M. Quennoe, General Manager, Plant Operations
*T. C. Baker, Technical Support Manager
*B. L. Bata, Quality Assurance Engineer
*E. E. Bickel, Health Physics Superintendent
A. J. Bryant, Chemist
*R. Carroll, Health Physics Specialist, AP&L General Office
D. R. Coker, Assistant Chemistry Supervisor
R. K. Duvall, Chemist
*M. E. Frala, Assistant Radiochemistry Supervisor
*R. D. Gillespie, Technical Analysis Superintendent
C. D. Harris, Lead Trainer, Chemistry/Radiochemistry
*L. G. Hodges, Training Instructor, Chemistry/Radiochemistry
*D. R. Howard, Special Projects Manager
*R. L. Jones, Assistant Chemistry Supervisor
*D. B. Lomax, Plant Licensing Supervisor
R. D. McCormick, Senior Radiochemist
W. C. McKelvy, Assistant Radiochemistry Supervisor
D. J. Meatheany, Chemist
*P. L. Michalk, Plant Licensing Engineer
W. R. Pool, Assistant Radiochemistry Supervisor
P. C. Robins, Assistant Chemistry Supervisor
T. C. Spalding, Radiochemist
J. F. Strother, Senior Chemist
D. J. Wagner, Quality Assurance Engineer
D. W. Williams, Radiochemist
G. W. Williams, Chemist

*Denotes those present during the exit interview on November 20, 1987.

2. Followup on Previous Inspection Findings

(Closed) Violation (50-313/8701-01; 50-368/8701-01): Failure to Meet Health Physics Personnel Qualifications - This violation was identified in NRC Inspection Report 50-313/87-01; 50-368/87-01 and involved the promotion of a contract junior health physics technician to a senior health physics technician prior to acquiring the minimum of 4000 hours of radiological protection experience. The NRC inspectors reviewed the licensee's response and corrective actions to the violation. The licensee had implemented a change to Procedure 1612.013, "Contract Health Physics Technician Selection," which defines the qualifications for contractor

junior and senior health physics technicians. The NRC inspectors also reviewed the licensee's promotion of a contract junior health physics technician to a senior health physics technician on October 12, 1987, and verified that all required qualifications were met. This violation is considered closed.

(Closed) Violation (50-313/8701-02; 50-368/8701-02): Failure to Perform Laboratory Analyses - This violation was identified in NRC Inspection Report 50-313/87-01; 50-368/87-01 and involved the failure to perform monthly gross alpha analyses of unit vent air particulate samples. The NRC inspectors reviewed the licensee's response and corrective actions to the violation. The licensee had made the appropriate changes to Procedures 1604.015 and 1042.003 and Data Forms 1042.001GG and 1042.001L. The NRC inspectors reviewed the procedure changes and monthly gross alpha analysis data of unit vent air particulate samples for the period January through October 1987 and verified that the Technical Specification requirements were met. This violation is considered closed.

(Closed) Violation (50-313/8701-03; 50-368/8701-03): Failure to Report Radwaste Effluent Radiation Doses - This violation was identified in NRC Inspection Report 50-313/87-01; 50-368/87-01 and involved the licensee not including in the first semiannual effluent release report filed in 1986, a summary of radiation doses due to radiological effluents released to the environment during the previous calendar year (1985) nor did the report contain the radiation dose to members of the public due to their activities inside the site boundary. The NRC inspectors reviewed the licensee's response and corrective actions to the violation. The licensee had submitted a revised report for 1985 which included the required radiation dose data. The NRC inspectors reviewed the revised semiannual effluent release report for 1985 and the first semiannual effluent release report for 1986 and verified that the Technical Specification reporting requirements were met. This violation is considered closed.

3. Inspector Observations

The following are observations the NRC inspectors discussed with the licensee during the exit interview on November 20, 1987. 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 following observations are identified in paragraphs 6 and 8 of this report. The licensee stated that these observations would be evaluated.

a. Quality Control Charts - The licensee was not using quality control charts to trend and evaluate data biases identified in daily or periodic quality control analyses of chemical parameters (see paragraph 6).

b. Calibration Standards Verification - The licensee was not using two independent standards for calibration and measurement quality control (see paragraph 6).

c. Quality Control Procedures - The licensee's secondary chemistry instrument quality control procedures did not contain sufficient detail to describe the exact sequence of events which are performed in conducting the instrument quality control checks (see paragraph 6).

d. Spectrometer Calibration - The licensee was not using a 100 mm cell path for routine analysis of hydrazine which would provide a more sensitive method of analysis than the 50 mm cell path currently used (see paragraph 6).

e. Postaccident Sampling System (PASS) Boron Analysis - The PASS boron analysis is performed by a manual titration of an undiluted grab sample of reactor coolant (see paragraph 8).

f. PASS Area - The areas where the boron samples are obtained for Units 1 and 2 are not radiologically isolatable from the cubicle in which the PASS system piping and valve gallery are located (see paragraph 8).

g. Confirmatory Measurements - The percent agreement between the licensee's and NRC's results were below the expected value for these kinds of measurements (see paragraph 8).

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 chemistry section (CS) and radiochemistry section (RS) to determine adherence to commitments in Chapter 12 of the Unit 1 Updated Safety Analysis Report (USAR) and Chapter 13 of the Unit 2 USAR and the requirements in Section 6.2 of Units 1 and 2 Technical Specifications (TS).

The NRC inspectors verified that the organization structure of the CS and RS were as defined in the USAR and TS. The NRC inspectors reviewed the ANO staff assignments and management controls for the assignment of responsibilities for the management and implementation of the ANO chemistry and radiochemistry programs. The NRC inspectors verified that the administrative control responsibilities specified by the ANO procedures were being implemented.

The NRC inspectors reviewed the staffing of the CS and RS. The ANO CS and RS organizational structures and staffing were determined to be in accordance with licensee commitments.

No violations or deviations were identified.

5. Training and Qualifications (83723/83523)

The NRC inspectors reviewed the licensee's training and qualification program for chemistry and radiochemistry 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 Unit 1 USAR, Chapter 13 of the Unit 2 USAR, and the requirements in Sections 6.3 and 6.4 of the Units 1 and 2 TS.

The NRC inspectors reviewed the education and experience backgrounds of the present chemistry and radiochemistry staffs and determined that all but one staff member met the experience qualification requirements of ANSI N18.1-1971. A review of shift staffing for both chemistry and radiochemistry indicated that all five chemistry and radiochemistry shifts had a lead chemist meeting the qualification requirements of ANSI N18.1-1971. It was determined that the licensee had an adequate qualified staff to meet shift staffing requirements.

The NRC inspectors reviewed the licensee's training program for chemistry and radiochemistry personnel. It was determined that the chemistry training program was INPO accredited.

No violations or deviations were identified.

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

The NRC inspectors reviewed the licensee's chemistry and radiochemistry programs including establishment and implementation of a water chemistry control program, water sampling, water chemistry confirmatory measurements, facilities and equipment, establishment and implementation of a quality assurance program for chemical measurements, and audits and appraisals to determine adherence to commitments in Chapters 4, 9, 11, and 13 of the Unit 1 USAR and Chapters 5, 9, 11, and 13 of the Unit 2 USAR and the requirements in Sections 3.1, 3.10, 6.5, and 6.8 of the Unit 1 TS and Sections 3/4.4.7, 3/4.4.8, 6.5, and 6.8 of the Unit 2 TS.

The NRC inspectors' review of the chemistry and radiochemistry programs found that the licensee had revised and approved administrative procedures, surveillance procedures, chemical control procedures, instrument calibration and quality control procedures, and analytical procedures. A review of analytical data and of selected procedures revised and written since the previous NRC inspection in July 1986

indicated that the CS and RS had established sufficient programmatic procedures to meet the requirements of the USAR and TS. A list of procedures reviewed is provided in Attachment 6.

The NRC inspectors reviewed chemistry logs and records of completed chemical and radiochemical analyses and determined that the required analyses were being performed in accordance with appropriate procedures. The review also included discussions of the recorded trends of the water quality data with the chemistry personnel and reactor coolant chemistry parameters with the radiochemistry personnel. The NRC inspectors reviewed the records of out-of-specification chemical and radiochemical parameters and the licensee's corrective actions taken when chemical parameters did not meet established limits. The NRC inspectors reviewed the effectiveness of the water chemistry program to measure and prevent the introduction of chemical contaminants into secondary water systems and found the licensee's limits established according to the Electric Power Research Institute owner's group guidelines for pressurized water reactor secondary water chemistry. The NRC inspectors held interviews with CS and RS personnel and determined that staff at all levels understood the importance and need for water chemistry control.

The NRC inspectors inspected the facilities and equipment used by the CS and RS staff. The following facilities were inspected: secondary chemistry laboratory, radiochemistry laboratories for Units 1 and 2, radiochemistry counting room, PASS area, and chemistry and radiochemistry personnel work areas. The laboratories were equipped with the necessary chemicals, reagents, labware, and analytical instrumentation to perform the required analytical procedures.

The NRC inspectors reviewed selected quality assurance (QA) audit procedures, audit reports, and surveillance reports. A list of the reviewed documents is provided in Attachment 6. The QA program was reviewed to determine scope and thoroughness of chemistry and radiochemistry program evaluation. The NRC inspectors found the QA audit and surveillance program for chemistry and radiochemistry adequate and corrective actions and responses to audit findings and observations timely.

The NRC inspectors reviewed the licensee's records, for the period July 1986 through October 1987, involving instrument calibration and quality control procedures, instrument calibration and performance check data, and other documentation of instrument performance. It was verified that the chemistry and radiochemistry laboratory instruments had been calibrated according to procedures and an instrument quality control program had been implemented. The NRC inspectors reviewed the licensee's procedures listed in Attachment 6.

The NRC inspectors reviewed selected chemistry 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 control program. It

was noted that the licensee was not using quality control charts to trend and evaluate data biases identified in daily or periodic quality control analyses of chemical parameters. The licensee had not established in the quality control program for water chemistry criteria to identify and evaluate data biases in calibration data and changes or trends in instrument performance.

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 standards which would include one standard stock solution dedicated for instrument calibration and a second independent standard stock solution dedicated for quality control.

The NRC inspectors' review of chemistry analytical instrument quality control procedures indicated that these procedures contained insufficient detail to describe the exact sequence of events which are performed in conducting the instrument quality control checks. The procedures did not contain quality control acceptance criteria in all cases.

The licensee was observed using a 50 mm cell for the routine analysis of hydrazine. The short spectrometer cell path was reducing the sensitivity of the hydrazine analysis at concentrations greater than 20 parts per billion and giving results which were biased low. The licensee performed additional analyses on the hydrazine standards using a 100 mm spectrometer cell path and the results were within the acceptance criteria.

The above observations were discussed with the licensee at the exit interview. The licensee agreed to evaluate the observations and consider actions for program improvements.

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.

No violations or deviations were identified.

7. Plant Systems Affecting Plant Water Chemistry (79502)

The NRC inspectors did not devote much time to evaluating plant water chemistry systems during this inspection due to the emphasis placed on performing the water chemistry confirmatory measurements. The NRC inspectors verified the operation of in-line chemistry process instrumentation in both Units 1 and 2 secondary chemistry sampling areas.

No violations or deviations were identified.

8. 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, equipment, and supplies; implementation of a quality assurance program; audits and appraisals; contractor activities; PASS sample analyses; confirmatory measurements to determine adherence to commitments in Chapters 4, 9, 11, and 13 of the Unit 1 USAR and Chapters 5, 9, 11, and 13 of the Unit 2 USAR, and the requirements in Section 6.8 of the Units 1 and 2 TS and NUREG-0737, Item II.B.3.

The NRC inspectors inspected the PASS building and installed hardware. The NRC inspectors verified that the equipment and associated procedures satisfied the requirements of NUREG-0737, Item II.B.3, for representative sampling and analysis of reactor coolant and containment atmosphere following a reactor incident. The licensee had completed PASS operator training for all radiochemistry technicians as part of their shift qualification. Requalification training on PASS was being conducted every 6 months.

The NRC inspectors verified that the licensee had established and implemented a routine surveillance and preventative maintenance program for Units 1 and 2 PASS. The NRC inspectors reviewed weekly surveillance reports for the period July 1986 through October 1987 for Units 1 and 2 and found the licensee in compliance with their surveillance requirements. The licensee demonstrated PASS operability on Unit 1 by collecting an undiluted sample of reactor coolant and performing a boron analysis, dissolved hydrogen analysis, dissolved oxygen analysis, and isotopic analysis. The analytical results from the PASS sample were compared with results from a reactor coolant grab sample. The results comparison was satisfactory. The licensee also performed a Unit 1 PASS isotopic analysis of containment atmosphere and compared the analysis results with the results obtained on a grab sample of Unit 1 containment atmosphere. The results comparison was satisfactory. The licensee could not demonstrate PASS operability on Unit 2 during the inspection due to the system being tagged out-of-service because the hydrogen analyzer was being replaced following repairs. In conjunction with the PASS demonstration, the NRC inspectors reviewed the PASS procedures listed in Attachment 6. The NRC inspectors determined that the licensee's procedures and analytical sensitivities were consistent with PASS requirements.

The NRC inspectors observed during the performance of the manual titration for boron analysis of the reactor coolant grab sample that the exposure to the technicians might be excessive and that an alternate remote method of performing a PASS boron analysis be evaluated to reduce exposure. It was also observed that the PASS areas for Units 1 and 2 where the reactor coolant grab samples are collected and the boron analysis performed were not isolated to prevent inleakage of airborne contamination from the adjacent cubicles where the PASS system piping and valve galleries are located for the respective units. If a system leak developed in the PASS piping cubicles during a reactor incident, the PASS grab sampling area

would be uninhabitable. These observations were discussed with the licensee during the exit interview. The licensee agreed to evaluate the NRC inspectors' concerns and observations.

During the inspection, radiological confirmatory measurements were performed on standards and split samples by the licensee and the NRC inspectors in the Region IV mobile laboratory. 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, 4, and 5.

No violations or deviations were identified.

9. Radiological Controls

The NRC inspectors reviewed the events concerning a radiological incident. On October 28, 1987, at approximately 2 a.m., upon exiting the Unit 1 reactor containment following reinstallation of insulation on the bottom of Steam Generator-A (SG-A), three contract workers (Daniel) were found contaminated. One of the workers had received approximately 1250 millirem of gamma exposure which was more than twice his authorized weekly administrative limit of 600 millirem. Also, one of the workers had received during the course of the work, a puncture wound to the right lower leg.

Based on discussions with the Daniel workers, the licensee inspected the work site and found there had been a loss of radiological control over the work activities. The problems noted were:

- Quick disconnect fittings on the ends of the breathing air lines were laying uncontained in a highly contaminated area.
- Temporary lead shielding was not replaced over the entrance to the SG skirt.
- The majority of the personal dosimetry used by the worker was contaminated.
- One worker received approximately twice the allowed weekly radiation dose.
- All of the crew, including the Health Physics Technician (HPT) covering the job, incurred a minor amount of skin contamination.
- Gross inconsistencies existed in the airborne contamination results obtained from the contract health physics technician's (C-HPT) grab air sample and the results from analysis of the breathing zone air sampler used by one of the Daniel workers.

The reinstallation of insulation was being radiologically controlled by continuous on-the-job coverage by a C-HPT and the instructions contained

in Radiological Work Permit (RWP) No. 871533. The RWP was issued on October 23, 1987, for removal of the inspection port on SG-A, which also required removal of interfering insulation. The C-HPT had been on site since October 12, 1987. The insulation work had commenced about 12:30 a.m. the morning of October 28, 1987. The C-HPT had been briefed on the contents of the RWP and area conditions by the shift C-HPT supervisor (Combustion Engineering - CE) at approximately 10:30 p.m. on the night of October 27, 1987. The C-HPT supervisor had been employed at ANO for the last 18 months and had personally worked with the C-HPT at other nuclear plants in job situations involving high levels of contamination and radiation. A licensee HPT supervisor was also on shift at the time of the briefing and the C-HPT was assigned to the job, but was not directly supervising this particular job.

The licensee's investigations revealed the following causes for the loss of radiological controls during the job:

- A pre-job briefing between the workers and HP personnel was not performed as required by the RWP and ANO procedures.

- Previous radiation surveys of the work area were not reviewed by the worker or the C-HPT.

- The C-HPT performed an inadequate radiation survey of the work area prior to allowing the workers to enter under SG-A. The licensee also believes the C-HPT's job-related air sample during the SG-A work operations was improperly accomplished.

- The C-HPT did not establish a suitable location from which the work activities could be adequately observed.

- The C-HPT did not require the workers to periodically read their self-reading dosimeters.

- The C-HPT evidently lacked sufficient ability and knowledge for a job involving high radiation and contamination hazards.

The licensee documented this incident in accordance with ANO procedures (1622.014 and 1000.025) and issued: (a) a Report of Abnormal Condition (1-87-206), and (b) a Radiological Safety Infraction/Condition Report regarding the incident.

The licensee recognized the seriousness of this incident and has initiated the following corrective actions:

- The C-HPT's employment at ANO was terminated.

- All HPTs should ensure that pre-job briefing requirements are discussed with HP Supervisors and any ambiguities and inconsistencies in understanding of the radiological control requirements should be clarified.

- Errors made by the C-HPT will be discussed with all HPTs on site and factored into general employee refresher training.

- The C-HPT screening process will be reviewed for flaws.

The ANO Corporate Health Physics staff had also conducted a review of the incident and had provided a report to ANO management on November 17, 1987, which included several recommended corrective actions that would increase the licensee's control over C-HPTs.

The NRC inspector determined that the licensee had adequately identified the root cause of the incident and had initiated satisfactory corrective actions to prevent a similar recurrence of this incident.

No violations or deviations were identified.

10. Exit Interview

The NRC inspectors met with the licensee representatives denoted in paragraph 1 at the conclusion of the inspection on November 20, 1987. The NRC inspectors summarized the scope of the inspection and discussed the inspection findings, inspector observations, and the results of the confirmatory measurements.

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 26 of the 30 results were in agreement. Two hydrazine results were originally found in disagreement and biased low. The licensee reran the hydrazine standards and the rerun results were all in agreement. The two other disagreements with the fluoride and iron analyses results were due to a high analytical precision in the results and based on a statistical analysis of the results. The disagreements are not considered to indicate any significant programmatic problem. The licensee's final analytical results showed 93 percent agreement with the BNL results based on 28 agreement results out of 30 total results compared.

As part of the inspection, actual inplant samples were split between the licensee and the NRC in order to verify the licensee's measurement capabilities on actual plant water samples. The analyses will be performed by the licensee using their normal analytical methods and instrumentation and by BNL. Upon completion of the analyses by both laboratories, the results will be documented in a subsequent NRC inspection report.

2. Radiological Confirmatory Measurements

Confirmatory measurements were performed on the following standards and samples in the Region IV mobile laboratory at Arkansas Nuclear One during the inspection:

(1) Reactor Coolant Liquid (20 cc Scintillation Vial)

(2) Reactor Coolant Gas Sample (15 cc Serum Vial)

(3) Particulate Filter Standard (24838-109)

(4) Charcoal Cartridge Standard (24841-109)

(5) Liquid Waste Sample (1 liter Marinelli Beaker)

(6) Containment Gas (33 cc Gas Bulb)

(7) Reactor Coolant Tritium Sample

The confirmatory measurements tests consisted of comparing measurements made by the licensee and the NRC mobile laboratory. The NRC's mobile laboratory measurements are referenced to the National Bureau of Standards (NBS) 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. Attachment 5 contains the criteria used to compare results.

At the time of the inspection, the licensee utilized two detectors in radiochemistry for comparison with the NRC results. The licensee performed the tritium analysis on their liquid scintillation counting system. The individual sample analyses and comparison of analytical results of the confirmatory measurements are tabulated in Attachment 4, as caves 1 and 2.

The licensee's gamma isotopic results from the listed samples in Attachment 4 showed 98 percent agreement with the NRC analysis results. The licensee's tritium result was in agreement with the NRC analysis result.

Confirmatory measurements were performed by the licensee and a 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 in July 1987. The analytical results were compared to the known sample activities and the results of the comparisons are presented in Attachment 4, sample 8. The licensee's results were in agreement with the certified activities for Mn-54, Co-60, and Cs-137 and in disagreement with the certified activities for H-3, Sr-89, and Sr-90. The contractor laboratory's Fe-55 result was in disagreement. Therefore, the licensee's overall results for the 1987 RESL samples were in 43 percent agreement. Further review of ANO's performance on RESL samples indicated that ANO tritium results 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 November 20, 1987, and the licensee agreed to evaluate their performance and the performance of their contractor laboratory on analyzing samples for tritium, Fe-55, Sr-89, and Sr-90.

ATTACHMENT 2

Water Chemistry Confirmatory Measurements Results

Arkansas Nuclear One

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1. Chloride Analysis (2-40 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86A	IC	10.27±0.12	12.05±1.60	0.85±0.11	Agreement
86B		20.33±0.12	18.70±0.60	1.09±0.04	Agreement
86C		41.33±0.23	40.30±1.10	1.03±0.03	Agreement

2. Fluoride Analysis (15-100 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86A	SIE	19.00±0.90	23.10±0.50	0.82±0.04	Disagreement
86B		48.30±2.50	43.50±1.90	1.11±0.08	Agreement
86C		90.00±4.00	83.50±2.80	1.0[illegible]±0.06	Agreement

3. Sulfate Analysis (5-40 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86A	IC	10.33±0.21	10.00±0.50	1.03±0.06	Agreement
86B		20.33±0.12	20.50±1.20	0.99±0.06	Agreement
86C		40.80±1.00	40.40±1.50	1.01±0.04	Agreement

4. Boron Analysis (100-2000 ppb)

Sample	Method	ANO Results (ppm)	NRC Results (ppm)	ANO/NRC Ratio	Comparison Decision
86D	MT	501±6	500±5	1.00±0.02	Agreement
86E		1495±8	1512±23	0.99±0.02	Agreement
86F		2494±8	2473±31	1.01±0.01	Agreement

5. Iron Analysis (5-20 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86G	AAGF	5.70±0.30	4.90±0.40	1.16±0.11	Agreement
86H		10.50±0.25	9.60±0.30	1.09±0.04	Agreement
86I		17.00±0.50	14.70±0.42	1.16±0.05	Disagreement

6. Copper Analysis (1-10 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86G	AAGF	4.60±0.20	4.70±0.20	0.98±0.06	Agreement
86H		9.90±0.06	9.70±0.50	1.02±0.05	Agreement
86I		2.30±0.06	2.90±0.10	0.79±0.03	Agreement

7. Sodium Analysis (5-100 ppm)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86J	AAF	28.20±1.00	22.90±2.50	1.23±0.14	Agreement
86K		10.07±0.06	9.23±0.80	1.09±0.09	Agreement
86L		65.60±1.00	57.60±3.20	1.14±0.07	Agreement

8. Ammonia Analysis (350-1000 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86M	SPEC	604.3±9.10	583.4±35.3	1.04±0.06	Agreement
86N		295.0±3.00	314.0±26.0	0.94.0.08	Agreement
86O		971.0±2.00	938.0±85.0	1.04±0.09	Agreement

9. Hydrazine Analysis (20-100 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86P	SPEC	20.60±0.70	22.30±1.40	0.92±0.07	Agreement
86Q		49.80±0.20	56.90±0.70	0.87±0.01	Disagreement
86R		98.30±0.30	104.0±1.00	0.95±0.01	Disagreement
Rerun					
86P	SPEC	21.00±1.00	22.30±1.40	0.94±0.07	Agreement
86Q		53.30±0.60	56.90±0.70	0.94±0.03	Agreement
86R		107.3±1.20	104.0±1.00	1.03±0.02	Agreement

10. Silica Analysis (5-100 ppb)

Sample	Method	ANO Results (ppb)	NRC Results (ppb)	ANO/NRC Ratio	Comparison Decision
86S	SPEC	17.30±0.06	18.10±1.90	0.96±0.10	Agreement
86T		26.30±0.06	27.30±1.80	0.96±0.06	Agreement
86U		79.40±0.06	80.00±2.50	0.99±0.03	Agreement

Analysis Method Definitions:

Ion Chromatograph - IC
Atomic Absorption Graphite Furnace - AAGF
Atomic Absorption Flame - AAF
Selective Ion Electrode - SIE
Manitol Titration - MT
Spectroscopy - SPEC

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.

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

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

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

ATTACHMENT 4

Radiological Confirmatory Measuresment Results

Arkansas Nuclear One

NRC Inspection Report: 50-313 & 368/87-33

1. Reactor Coolant Liquid (20cc Scintillation Vial)
(Sampled: 10:46, CST, November 17, 1987)

Nuclide	ANO Results (uCi/ml)	NRC Results (uCi/ml)	ANO/NRC Ratio	Comparison Decision
Na-24	3.271±0.035E-2	3.265±0.020E-2	1.00	Agreement
	3.181±0.030E-2		0.97	Agreement
Co-58	1.599±0.148E-3	1.601±0.090E-3	0.99	Agreement
	1.610±0.152E-3		1.01	Agreement
Sb-122	4.016±1.224E-4	4.816±0.648E-4	0.83	Agreement
	2.42E-4		0.50	Agreement
Sr-91	1.353±0.364E-3	1.215±0.228E-3	1.11	Agreement
	8.784±3.125E-4		0.72	Agreement
Nb-95	6.381±1.007E-4	3.221±0.657E-4	1.98	Agreement
	6.655±0.994E-4		2.07	Disagreement
I-131	2.599±0.124E-3	2.632±0.065E-3	0.99	Agreement
	2.842±0.132E-3		1.08	Agreement
I-132	1.665±0.026E-2	1.564±0.022E-2	1.06	Agreement
	1.601±0.229E-2		1.02	Agreement
I-133	2.476±0.020E-2	2.498±0.011E-2	0.99	Agreement
	2.402±0.019E-2		0.96	Agreement
I-134	7.062±0.143E-2	6.406±0.175E-2	1.10	Agreement
	6.685±0.094E-2		1.04	Agreement
I-135	4.355±0.091E-2	4.495±0.054E-2	0.96	Agreement
	4.055±0.075E-2		0.90	Agreement

Reactor Coolant Cont'd

Nuclide	ANO Results (uCi/ml)	NRC Results (uCi/ml)	ANO/NRC Ratio	Comparison Decision
Cs-134	4.880±0.156E-3	5.081±0.103E-3	0.96	Agreement
	4.972±0.174E-3		0.98	Agreement
Cs-137	8.688±0.173E-3	8.737±0.081E-3	0.99	Agreement
	8.482±0.156E-3		0.97	Agreement
Cs-138	1.022±0.050E-1	1.006±0.056E-1	1.02	Agreement
	9.481±0.319E-2		0.94	Agreement
Ba-139	8.374±1.313E-3	1.112±0.058E-2	0.75	Agreement
	1.179±0.098E-2		1.06	Agreement

2. Reactor Coolant Gas Sample (15cc Serum Vial)
(Sampled: 10:28, CST, November 17, 1987)

Nuclide	ANO Results (uCi/cc)	NRC Results (uCi/cc)	ANO/NRC Ratio	Comparison Decision
Ar-41	2.618±0.013E0	2.740±0.008E0	0.96	Agreement
	2.610±0.011E0		0.95	Agreement
Xe-133	1.469±0.005E0	1.463±0.004E0	1.00	Agreement
	1.616±0.006E0		1.10	Agreement
Xe-133m	6.723±0.893E-2	7.323±0.661E-2	0.92	Agreement
	7.567±1.279E-2		1.03	Agreement
Xe-135	2.346±0.004E0	2.355±0.003E0	1.00	Agreement
	2.284±0.005E0		0.97	Agreement
Xe-135m	1.904±0.404E-1	1.900±0.056E-1	1.00	Agreement
	2.179±0.052E-1		1.15	Agreement
Xe-138	5.998±1.847E-1	4.552±0.216E-1	1.32	Agreement
	4.848±0.203E-1		1.07	Agreement
Kr-85m	5.477±0.029E-1	5.622±0.014E-1	0.97	Agreement
	5.258±0.029E-1		0.94	Agreement
Kr-87	6.380±0.072E-1	5.995±0.038E-1	1.06	Agreement
	6.296±0.057E-1		1.05	Agreement
Kr-88	1.006±0.008E0	1.058±0.005E0	0.95	Agreement
	1.035±0.008E0		0.98	Agreement

3. Particulate Filter Standard (47 mm Filter 24838-109)
(Standardized: 12:00, CST, November 17, 1987)

Nuclide	ANO Results (uCi/Sample)	NRC Results (uCi/Sample)	ANO/NRC Ratio	Comparison Decision
Cd-109	1.263±0.005E0	1.195±0.003E0	1.06	Agreement
	1.493±0.008E0		1.25	Disagreement
Co-57	3.187±0.016E-2	3.108±0.011E-2	1.03	Agreement
	3.630±0.029E-2		1.17	Agreement
Ce-139	2.646±0.017E-2	2.637±0.012E-2	1.00	Agreement
	2.947±0.026E-2		1.12	Agreement
Hg-203	4.384±0.025E-2	4.247±0.019E-2	1.03	Agreement
	4.845±0.038E-2		1.14	Agreement
Sn-113	4.361±0.035E-2	4.386±0.027E-2	0.99	Agreement
	5.092±0.052E-2		1.16	Agreement
Cs-137	4.621±0.042E-2	4.592±0.033E-2	1.01	Agreement
	5.200±0.056E-2		1.13	Agreement
Y-88	5.782±0.049E-2	5.814±0.040E-2	0.99	Agreement
	6.546±0.072E-2		1.13	Agreement
Co-60	4.157±0.046E-2	4.134±0.036E-2	1.01	Agreement
	4.739±0.062E-2		1.15	Agreement

4. Charcoal Cartridge Standard (Cartridge 24841-109)
(Standardized: 12:00, CST, November 17, 1987)

Nuclide	ANO Results (uCi/Sample)	NRC Results (uCi/Sample)	ANO/NRC Ratio	Comparison Decision
Cd-109	1.351±0.004E0	1.246±0.004E0	1.08	Agreement
	1.411±0.007E0		1.13	Agreement
Co-57	3.343±0.015E-2	3.248±0.014E-2	1.03	Agreement
	3.411±0.025E-2		1.05	Agreement
Ce-139	2.814±0.016E-2	2.694±0.015E-2	1.04	Agreement
	2.818±0.023E-2		1.05	Agreement

Charcoal Cartridge Standard Cont'd

Nuclide	ANO Results (uCi/Sample)	NRC Results (uCi/Sample)	ANO/NRC Ratio	Comparison Decision
Hg-203	4.652±0.023E-2	4.371±0.022E-2	1.06	Agreement
	4.762±0.033E-2		1.09	Agreement
Sn-113	4.661±0.031E-2	4.522±0.031E-2	1.03	Agreement
	4.825±0.045E-2		1.07	Agreement
Cs-137	4.866±0.034E-2	4.807±0.038E-2	1.01	Agreement
	5.098±0.045E-2		1.06	Agreement
Y-88	6.020±0.046E-2	5.986±0.046E-2	1.01	Agreement
	6.357±0.061E-2		1.06	Agreement
Co-60	4.394±0.040E-2	4.244±0.041E-2	1.04	Agreement
	4.576±0.055E-2		1.08	Agreement

5. Liquid Waste Sample (1 liter Marinelli)
(Sampled: 16:30, CST, November 16, 1987)

Nuclide	ANO Results (uCi/ml)	NRC Results (uCi/ml)	ANO/NRC Ratio	Comparison Decision
Cr-51	1.719±0.046E-4	1.433±0.038E-4	1.20	Agreement
	1.641±0.063E-4		1.15	Agreement
Co-58	1.103±0.002E-3	9.344±0.016E-4	1.18	Agreement
	1.080±0.002E-3		1.16	Agreement
Fe-59	3.678±0.081E-5	3.157±0.074E-5	1.17	Agreement
	3.638±0.086E-5		1.15	Agreement
Co-60	5.413±0.048E-5	4.646±0.046E-5	1.17	Agreement
	5.200±0.053E-5		1.12	Agreement
Zr-95	1.610±0.076E-5	1.481±0.067E-5	1.09	Agreement
	1.588±0.094E-5		1.07	Agreement
Ag-110m	3.297±0.060E-5	2.522±0.057E-5	1.31	Agreement
	3.206±0.071E-5		1.27	Agreement

Liquid Waste Sample Cont'd

Nuclide	ANO Results (uCi/ml)	NRC Results (uCi/ml)	ANO/NRC Ratio	Comparison Decision
Sb-122	6.273±0.695E-6	4.944±0.643E-6	1.27	Agreement
	5.121±0.073E-6		1.04	Agreement
Sb-125	2.260±0.157E-5	1.835±0.122E-5	1.23	Agreement
	2.602±0.208E-5		1.42	Agreement
Cd-113m	1.501±0.494E-2	2.020±0.405E-2	0.74	Agreement
	1.181E-2		0.90	Agreement
I-131	1.998±0.062E-5	1.629±0.047E-5	1.23	Agreement
	1.924±0.081E-5		1.18	Agreement
Cs-134	5.744±0.067E-5	4.530±0.062E-5	1.27	Disagreement
	5.525±0.077E-5		1.22	Agreemont
Cs-137	1.009±0.007E-4	8.374±0.060E-5	1.20	Agreement
	9.740±0.081E-5		1.16	Agreement

6. Containment Atmosphere Gas Sample (33cc Gas Bulb)
(Sampled: 13:13, CST, November 18, 1987)

Nuclide	ANO Results (uCi/cc)	NRC Results (uCi/cc)	ANO/NRC Ratio	Comparison Decision
Xe-133	2.095±0.015E-4	1.987±0.035E-4	1.05	Agreement
	2.257±0.024E-4		1.14	Agreement
Xe-135	2.944±0.119E-6	3.811±0.450E-6	0.77	Agreement
	3.161±0.200E-6		0.83	Agreement

7. Reactor Coolant Tritium Sample (20 ml Scintillation Vial)
(Sampled: 10:46, CST, November 17, 1987)

Nuclide	ANO Results (uCi/ml)	NRC Results (uCi/ml)	ANO/NRC Ratio	Comparison Decision
H-3	1.03±0.01E-2	1.34±0.10E-2	0.77	Agreement

8. RESL Unknown Liquid Sample
(Standardized: 12:00, MST, January 11, 1987)

Nuclide	ANO Results (uCi/cc)	NRC Results (uCi/cc)	ANO/NRC Ratio	Comparison Decision
Mn-54	1.97±0.16E-5	1.83±0.04E-5	1.08	Agreement
Co-60	1.88±0.17E-5	1.76±0.04E-5	1.07	Agreement
Cs-137	2.91±0.16E-5	2.59±0.08E-5	1.12	Agreement
Fe-55	1.18±0.10E-4	7.12±0.14E-5	1.66	Disagreement
Sr-89	<1.09E-4	1.59±0.05E-4	---	Disagreement
Sr-90	1.01±0.49E-5	1.44±0.06E-5	0.70	Disagreement
H-3	8.53±0.16E-5	1.17±0.02E-4	0.73	Disagreement
Fe-59		4.39±0.18E-6		

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

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

ATTACHMENT 6

Documents Reviewed

Arkansas Nuclear One

NRC Inspection Report: 50-313 & 368/87-33

	Title	Revision	Date
1.	Chemistry Procedures		
1604.027,	Determination of Fluoride-Specific Ion Electrode Method	5	12/23/86
1604.030,	Determination of Boron-High Range	2	2/10/83
1604.043,	Chemical Analysis Using the Ion Chromatograph	1	9/25/87
1605.003,	Determination of Ammonia (Photometric Method)	4	8/29/85
1605.011A	Determination of Copper (AA Method)	3	8/31/84
1605.015,	Determination of Hydrazine-Low Range (Photometric Method)	4	8/29/85
1605.016B	Determination of Iron (AA Method)	3	8/31/84
1605.025,	Determination of Silica (Photometric Method)	4	8/22/85
1605.26A,	Determination of Sodium (AE Method)	4	8/31/84
1605.032,	Determination of Sulfate by Ion Chromatography	4	7/16/86
1605.033,	Determination of Chloride by Ion Chromatography	3	7/16/86
1606.08,	Operation of the IL-551 in Emission Mode	3	8/28/86
1606.09,	Operation of the IL-551 Using the Graphite Furnace	2	9/11/84
1606.12,	Ion Chromatograph Startup, Shutdown, and Calibration of the Dionex 2010i	4	7/16/86
1606.30,	Startup, Shutdown, and Calibration of the Perkin-Elmer Lambda 1 Spec.	1	7/2/86

2. Postaccident Sampling System Procedures

1617.002,	Use of the Unit I ND/APT Grab Sampler	2	10/22/87
1617.003,	Use of the ND6620 for On-line Chemical and Radiochemical Analysis	4	9/11/87
1617.004,	Use of the Unit II ND/APT Grab Sampler	3	7/9/87
1617.005,	On-line Oxygen Analysis for Unit I	3	10/22/87
1617.006,	On-line Oxygen Analysis for Unit II	3	10/22/87
1617.007,	On-line Reactor Coolant Hydrogen Analysis for Unit I	3	7/9/87
1617.008,	On-line Reactor Coolant Hydrogen Analysis for Unit II	2	7/9/87
1617.009,	Panel 2C357 Valve Alignment	9	10/22/87
1617.012,	Post Accident Grab Sample Boron Analysis	2	10/22/87
1617.014,	Energy Calibration of PASS/AIMS Detector	1	7/9/87

3. Quality Assurance Audits and Surveillances

QA Audit QAP-22-86, "Chemistry/Radiochemistry/Environmental Monitoring," performed September 29, 1986 through December 18, 1986

QA Audit Surveillance Report 87-026, "Radiochemistry Determination of the Boron Concentration of Reactor Coolant," dated March 27, 1987

QA Observation Program results for chemistry and radiochemistry for the period January 1987 - November 1987

QA Audit Checklist for QAP-22-87