UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

JAN 31 1986

Report Nos.: 50-413/85-50 and 50-414/85-60

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-413 and 50-414 License Nos.: NPF-35 and CPPR-117

Facility Name: Catawba 1 and 2

Inspection Conducted: December 9-13, 1985

Inspectors: G. B. Kuzo — 16 January 1986 (Date Signed)

W. Groersen — January 16, 1986 (Date Signed)

J. D. Harris — 1-16-86 (Date Signed)

Accompanying Personnel: G. Froemsdorf

Approved by: W. E. Cline, Section Chief — 1/16/86 (Date Signed)
Emergency Preparedness and Radiological
Protection Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope: This routine, unannounced inspection involved 115 inspector-hours onsite in the areas of quality control and confirmatory measurements including review of the laboratory quality control program; review of procedures and instructions; review of quality control records and logs; review of counting room and chemistry laboratory facilities; results of split samples analyzed by the licensee and the NRC Region II Mobile Laboratory; and whole-body counter measurements using a fission product phantom.

Results: One violation was identified - failure to have adequate procedures to implement the Quality Assurance Program for effluent measurements.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*H. B. Barron, Superintendent of Operations
W. P. Deal, Station Health Physicist
*G. T. Mode, Health Physics Coordinator
*C. V. Wray, Health Physics Coordinator
G. L. Courtney, Staff Health Physicist
*M. J. Geer, Assistant Engineer, Corporate
*B. Chundrlik, Health Physics Supervisor
*C. L. Hartzell, Licensing and Project Engineer
*P. G. LeRoy, Licensing Engineer

Other licensee employees contacted included engineers, technicians, and office personnel.

NRC Resident Inspector

*P. K. VanDoorn

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on December 13, 1985, with those persons indicated in Paragraph 1 above. The inspector noted that the temporary power supply provided by the licensee for the NRC Region II Mobile was inadequate and discussed the need for a permanent power supply to be established in a timely manner. The inspector discussed the following inspector followup items: updating of counting room procedures (Paragraph 6.b); evaluation of alpha/beta and beta/gamma analysis instrumentation performance biases (Paragraph 7.b); resolution of Fe-55 analysis methodology and verification analyses (Paragraph 8.b); and review of calibration and quality control data for the whole-body counting instrumentation (Paragraph 9.b). One violation concerning inadequate QA procedures (Paragraph 6.c) for effluent measurement instrumentation was discussed. Licensee representatives acknowledged the inspectors' comments and committed to completing resolution of Fe-55 analysis concerns and requesting an additional spiked sample from the NRC Region II Office by March 31, 1986, to demonstrate Fe-55 analysis capability. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during this inspection.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Laboratory Quality Control Program (84725)

The inspectors noted that the licensee's Quality Assurance (QA) program for effluent measurements had not changed since previous inspections (50-413/84-42, 50-413/84-64, 50-413/84-76). The inspectors reviewed and discussed with cognizant licensee representatives concerns regarding quality control (QC) procedures and records, and results of interlaboratory comparisons for radiological effluent measurements conducted by the Catawba Nuclear Station (Paragraphs 6 and 7). The inspectors further noted that results of the split sample analyses between the licensee and the NRC Region II Mobile Laboratory gamma spectroscopy systems (Paragraph 8.a) identified concerns regarding the adequacy of the effluent measurements QA program to ensure accurate effluent measurement capability. Details of these concerns are discussed in Paragraphs 6.b, 6.c, and 8.

No violations or deviations were identified.

5. Audits and Reviews (84725)

a. Technical Specification (TS) 6.5.2.9 states that audits of unit activities shall be performed under the cognizance of the Nuclear Safety Review Board (NSRB) encompassing: the conformance of unit operation to provisions contained within the Technical Specifications and applicable license conditions at least once per 12 months; the radiological environmental monitoring program and the results thereof at least once per 12 months; the Offsite Dose Calculation Manual and implementing procedures at least once per 12 months; and the performance of activities required by the Quality Assurance Program to meet the criteria of Regulatory Guide 4.15, December 1977 at least once per 12 months. The inspectors reviewed the following audit report:

QA Audit NP-85-89(CN) Technical Services and Operations Activities, April 15 - May 1, 1985.

The inspectors noted that the counting room and body burden analysis programs were audited against Technical Specifications, Regulatory Guide 4.15, and Catawba Station Health Physics Manual. One concern regarding the inability to verify algorithms used in the Ortec ADCM Analysis Systems was identified. The inspectors discussed and reviewed licensee action regarding this item. Cognizant licensee personnel presently are developing computer software which will allow review and verification of algorithms utilized for each separate system.

b. The inspectors discussed the following technical reviews completed by licensee personnel:

(1) Quality Assurance, Teledyne Isotopes Technical Review, GS-750.00, 110.70, 10/24/85.

(2) Catawba Nuclear Station Radioanalysis Program Review, GS-750-05, 768, 11/26/85.

The inspectors noted that several technical items concerning radiological measurement capability and QA were identified in the reviews. Identified items included inaccurate Fe-55 measurements, improvement of instrument performance acceptance criteria, initiation of intralaboratory crosscheck program, Lower Limit of Detection (LLD) capabilities, updating of procedures, improvement in gamma spectroscopy efficiency graphs, and quality control performance analyses. The inspectors noted that licensee action regarding Fe-55 analysis concerns was being finalized (Paragraph 8.b) and responses to and/or action concerning the other identified items were in progress.

No violations or deviations were identified.

6. Procedures (84725)

a. Technical Specification (TS) 6.8.1 states written procedures shall be established, implemented and maintained covering the applicable procedures recommended in Appendix A of Regulatory Guide 1.33, Revision 2, February 1978, Offsite Dose Calculation Manual implementation, and the Quality Assurance Program for effluent and environmental monitoring. The following selected procedures were reviewed by the inspector.

(1) HP/O/B/1001/07 Operation and Calibration of Liquid Scintillation Counters, Rev. 6, 11/21/84.

(2) HP/O/B/1001/09 Operating/Calibration Procedure for Body Burden Analyzer, Rev. 4, 3.16.84.

(3) HP/O/B/1001/12 Technical Specifications Gaseous Waste Sampling and Analysis, Rev. 11, 12/3/85.

(4) HP/O/B/1001/15 Preparation of Sources, Rev. 2, 8/24/84.

(5) HP/O/B/1001/16 Operation and Calibration: ORTEC ADCAM GAMMA ANALYSIS System, Rev. 2, 7/5/84.

(6) HP/O/B/1001/21 Operation and Calibration: Canberra Fastscan - Body Burden Analysis, Rev. 0, 10/22/85.

The inspector discussed results of the procedure review with cognizant licensee representatives as detailed in Paragraphs 6.b. - .c.

b. The inspectors discussed the need for improved review and update of radiochemical analytical procedures. For example, selected procedures (HP/O/B/1001/12, HP/O/B/1001/15) detailed a volume of 4400 cc for the marinelli beaker geometry utilized to monitor gaseous effluents whereas the actual volume is 4600 cc. The inspectors verified that the correct volume was used for effluent sample measurements. The inspectors noted that all procedures should be periodically reviewed and updated by cognizant licensee personnel as part of the QA program. The inspectors

informed licensee representatives that a review of radiological analytical procedures for effluent measurement methodology and changes in QA procedures to ensure adequate analytical nuclide measurement capabilities would be considered an open item to be reviewed during a subsequent inspection (50-413/85-50-01, 50-414/85-60-01).

c. The inspectors noted that QC procedures for the gamma spectroscopy systems required review of daily background, performance checks, energy calibration, and Full Width Half-Maximum (FWHM) results by cognizant count room personnel. Procedures required only performance checks to be graphed using trend charts. The inspectors discussed with cognizant licensee representatives the need for improved review and trending of the QC data collected. Furthermore, the inspectors noted that QA procedures to maintain consistency and accuracy of analytical measurements and minimize differences observed between detectors, i.e., standardization of plotted efficiency graphs for all geometries for each detector system, verification of efficiency calibration algorithms for all detectors, and the implementation of intralaboratory and interlaboratory crosscheck programs were not adequate. The inspectors informed licensee representatives that the inaccurate licensee measurements noted for the confirmatory measurements split sample analyses (Paragraph 8.a) may have been identified by the licensee with an adequate QA program. An adequate program should include a thorough review and evaluation of all analytical QC trend data, and proper technical review of intralaboratory and interlaboratory crosscheck results for trends and anomalous data. Furthermore, criteria for initiating action regarding trends and anomalous data should be established. The inspectors informed licensee representatives that 10 CFR 20.201(b) requires the licensee to make surveys that are reasonable under the circumstance to evaluate radiation hazards that may be present and TS 6.8.1.g requires procedures to be established, implemented and maintained for QA Program implementation for effluent and environmental monitoring. The inspectors informed licensee representatives that failure to have adequate procedures for QA Program implementation to ensure accurate effluent measurements as demonstrated by the inaccuracies noted in the licensee's gamma spectroscopy measurements (Paragraph 8.a) was considered a violation (50-413/85-50-02), 50-414/85-60-02).

Open Item (50-413/85-50-01, 50-414/85-60-01) - review of effluent measurement procedures for inconsistencies, improved methodology, and improvement in QA Programs to ensure adequate effluent measurements.

Violation (50-413/85-50-02, 50-414/85-60-02) - failure to have adequate QA procedures to implement QA programs for effluent measurements.

7. Review of Records and Logs (84725)

a. The inspector reviewed selected portions of the following records and logs:

(1) LS 1800 Liquid Scintillation Counter Nos. CHP 1127-CE and CHP 1128-CE Instrument Quality Control Logs for August - December 1985 including:

(a) Daily Background & Performance (H-3, Gross Beta) Log Sheets
(b) Monthly Performance Data & Charts
(c) Weekly H-3 Alignment Log Sheet
(d) Monthly Background Log Sheet
(e) Monthly Performance Data Sheet
(f) Quarterly Quenched H-3 Standard Preparation Data

(2) Alpha/Beta Proportional Counter Nos. CHP-1131-CE and CHP1133-CE Quality Control Logs for January - December 1985 including:

(a) Daily Background and Alpha/Beta Performance Check
(b) Alpha/Beta Check Source Data Sheet
(c) Efficiency & Monthly Performance Worksheet
(d) Efficiency & Monthly Performance Value Determination

(3) Manual APC Beta/Gamma Counter Nos. CHP-1116, CHP-1117 CHP-1118 and CHP-1119 Quality Control Logs for January - December 1985 including:

(a) Daily Performance and Background Data Sheets and Graphs
(b) Check Source Data Sheets
(c) Efficiency and Monthly Performance Worksheet

(4) Ge(Li) Detector System Nos. 24-N-1096, 24-P-94VC, 24-P-92-VA and 24-P-04TC Quality Control Logs for August - December 1985 including:

(a) Daily Performance Checks
(b) Performance Graphs
(c) Daily Background Data
(d) Daily Energy Calibration & FWHM Data

(5) Annual (1985) Gamma Spectroscopy Efficiency Calibration data for Detector Nos. 24-N-1096, 24-P-94VC, 24-P-92VA, and 24-P-04TC including the following geometries: 50 ml bottle, 1000 & 3500 ml liquid marinelli beaker, 2" filter paper, face-loaded charcoal cartridge, 12 cc gas vial, 100 cc gas bomb, and 4600 gas marinelli beaker.

(6) Interlaboratory Crosscheck Results, December 1984 - September 1985.

(7) Daily Quality Control Checks and Performance Plots for the Canberra Fastscan Whole-body Counter, October - December 1985.

(8) Annual (1985) Efficiency Checks and Performance Plots for Canberra Fastscan Whole-body Counter, August - September 1985 for the following geometries: lungs, GI tract, and thyroid.

Results of the record review are discussed in Paragraphs 7.b - .c.

b. The inspectors discussed systematic biases noted for performance checks of all alpha/beta and beta/gamma counting systems. The inspectors noted that the observed biases were not correlated with the following: changeout of counting gas, contamination problems, location (systems are located in different rooms), and technician errors. The inspectors noted that biases for background counts were not observed. Cognizant licensee representatives presently are investigating the performance data and have detailed their concerns to an approved vendor. The inspectors informed licensee representatives that resolution of this problem would be considered an inspector followup item and would be reviewed during a subsequent inspection (50-413/85-50-03, 50-414/85-60-03).

c. The results of the 1985 interlaboratory crosscheck program were discussed with cognizant licensee representatives. The inspectors noted that gamma spectroscopy results for liquid samples met established licensee acceptance criteria and were consistent among the station's gamma spectroscopy systems. However, the inspectors noted that results for a July 1985, charcoal cartridge crosscheck met the licensee's acceptance criteria but showed a maximum difference of 26% between detectors. The inspectors noted that this large difference was not observed for a January 1985 charcoal cartridge crosscheck sample and informed licensee representatives that the July 1985 difference among detectors indicated improper efficiency calibrations. The inspectors informed licensee representatives that the failure to identify and resolve the noted differences was indicative of poor Quality Control (QC) review for effluent measurement instrumentation. Furthermore resolution of these differences may have identified licensee measurement problems noted for the confirmatory measurement samples (Paragraph 8.a). Licensee representatives informed the inspectors that procedures for an improved QA program for effluent measurements capability, including an intraloboratory crosscheck program were in progress. The inspector informed licensee representatives that these procedures would be reviewed as part of the inspector followup item regarding procedure review discussed in Paragraph 6.b.

Open Item (50-413/85-50-03, 50-414/85-60-03) - review of licensee's evaluation of alpha/beta and beta/gamma performance check biases.

No violations or deviations were identified.

8. Confirmatory Measurements (84725)

a. During the inspection, reactor coolant and selected liquid and gaseous plant effluent process streams were sampled and the resultant sample matrices analyzed for radionuclide concentrations using licensee and NRC Region II Laboratory gamma-ray spectroscopy systems. The purpose of these comparative measurements was to verify the licensee's capability to measure radionuclides accurately in various plant systems. Analyses were conducted utilizing as many of the licensee's gamma spectroscopy systems as practicable. Sample types and counting geometries included the following: Reactor Coolant System (RCS) sample - 50 ml polybottle; Liquid Waste - 3500 ml marinelli beaker; RCS Gas sample - 12 cc vial; Waste Gas Decay Tank Sample - 100 cc bomb; and Effluent Gas Grab Sample 4600 cc marinelli beaker. Spiked particulate filter and charcoal cartridge sample types were provided for analyses in lieu of licensee samples which did not have sufficient levels of activity for analysis. Comparison of licensee and NRC results are listed in Table 1 with the acceptance criteria listed in Attachment 1. Results were in agreement and no significant trends in comparisons were noted in liquid waste, particulate filter and the 100 cc gas bomb geometries. Concerns regarding the RCS, charcoal filter; and selected gas sample geometries were discussed with licensee representatives as noted below.

(1) For the reactor coolant sample, Co-58, a major plant contaminant, was in disagreement for all detectors, with concentrations underestimated by 27 to 39%. Also, I-131 was in disagreement (29% underestimate) for Detector No. 24-P-94VC. The inspectors noted that these differences were not identified for the liquid waste geometry which also contained these isotopes, thus the observed differences most likely resulted from inaccurate efficiency calibration of this geometry. Furthermore, the inspectors noted that the 36% difference between the licensee's detectors for RCS I-131 analyses was considered inadequate for the quantitative measurements conducted with these detector systems.

(2) For the charcoal cartridge sample geometry, Ba-133 results were in disagreement for Detector No. 24-P-92-VA and overall results were biased high, approximately 5 to 26%. A reanalysis of an additional NRC spiked sample (multiple isotopes) and the licensee's original calibration source confirmed that the noted bias resulted from inaccurate calibrations.

(3) Xe-135 analysis for the 12 cc gas vial geometry was in disagreement. All other gas results for this geometry were biased low. For this geometry, efficiency calibrations were suspect in that the 100 cc gas bomb analyzed using this detector were in agreement, thus eliminating software nuclide identification and quantification problems.

(4) For the 4600 cc gas marinelli geometry analyzed using Detector No. 24-P-04TC5 results were biased low for all nuclides and in disagreement for Xe-133. Because results for this geometry on Detector 24-N-1096 were in agreement, the inspectors again suspected inaccurate calibration resulted in the observed differences.

The inspectors noted that the above detailed differences demonstrated and supported the violation regarding inadequacy of the QA Program procedures for effluent measurements detailed in Paragraph 6.c. Furthermore, the inspectors informed cognizant licensee representatives that large inconsistencies for nuclide identification and quantification among detectors were identified in a previous inspection (50-413/84-64-02) and thus, initial licensee actions regarding that item are now considered inadequate. Licensee representatives acknowledged the concerns and stated that an evaluation of all geometries to ensure accurate effluent measurements would be implemented in a timely manner.

b. The inspectors noted that the licensee was provided with a simulated liquid waste sample by the NRC Contract Laboratory, July 1985, and was requested to complete radiochemical analyses for H-3, Fe-55, Sr-89, and Sr-90. Results of these comparisons were issued to the licensee in a letter from Roger D. Walker, Director, Division of Reactor Projects, NRC Region II, dated November 29, 1985. Results were in agreement for all nuclides. However, the inspectors noted that a significant bias, overestimation of Fe-55 concentrations by 24 to 45%, has been identified in three NRC samples analyzed since June 1984. The inspectors discussed licensee actions regarding this systematic bias with cognizant licensee representatives. Licensee actions have included a technical audit of the vendor laboratory, suggested technical changes to established procedures, and providing the vendor with spiked liquid samples for Fe-55 analysis capability verification. Licensee representatives committed to completing verification of Fe-55 analysis methodology and stated that they would request by March 31, 1986, additional spiked samples from the Region II Office to demonstrate Fe-55 analysis capability. The inspectors informed licensee representatives that review of the licensee's Fe-55 results for the NRC spiked sample would be considered an open item and would be reviewed during a subsequent inspection (50-413/85-50-04, 50-414/85-60-04).

No violations or deviations were identified.

Open Item (50-413/85-50-04, 50-414/85-60-04) - Review of licensee's Fe-55 analysis of NRC spiked samples.

9. Use of Fission Product Phantom for Checking Whole-body Counter Measurements (84725)

During the inspection, the inspectors verified the licensee's capability to perform radiological bioassays using their whole-body counter system. A fission product phantom containing radioactive sources was provided to the licensee. The phantom duplicated nuclide and organ burdens that the licensee might encounter during normal operations. The phantom was analyzed using the licensee's normal methods and equipment.

The licensee had one whole-body counting system which had recently been placed into service. This system was a "stand-up" linear geometry counter referred to as "FASTSCAN" manufactured by Canberra. The FASTSCAN incorporated two large NaI(TL) detectors, configured in a linear array on a common vertical axis. The dimensions of the crystals were 4" x 4" x 16" and each was viewed by a single photomultiplier tube. The subject stands inside the shield on an axis parallel with the detectors. The inspectors reviewed the licensee's procedures for operating and calibrating the whole-body counting system. In addition, the Quality Assurance program was reviewed. Calibrations were conducted using a vendor supplied block phantom containing an NBS traceable mixed gamma source. The mixed gamma source was contained in a cylindrical solid matrix and consisted of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Sr-85, Cs-137, Y-88, and Co-60. The licensee calibrated the whole body counting system for three geometries: lung, thyroid, and gastrointestinal (GI) tract. The inspectors noted that the licensee's calibration phantom was a Radiation Management Corporation (RMC) REMCAL Transfer phantom which was designed as an analog to the Alderson REMCAL Phantom. The REMCAL phantom assembly consisted of the following separate cavities: GI, lung, and thyroid. The calibration source was placed approximately in the center of the air space in each cavity. The inspectors questioned whether or not the GI cavity should be filled with water and the lung cavity with a lung tissue equivalent matrix. The inspectors reviewed QA records including daily source checks. Daily source checks were plotted and tracked on control charts. The inspectors noted that daily background checks were performed and the analytical results compared to previous background analysis results. The computer system prints the "minimum detectable activity" (MDA) amounts as the background. The inspectors and the licensee discussed plotting the gross background counts from each detector to note any significant change in detector background characteristics.

Subsequent to discussions with NRC inspectors, cognizant licensee representatives agreed to evaluate the following areas as related to review of HP/O/B/1001/21:

- Trend gross background counts from each detector to note any significant change in background or detector characteristics.

- Provide methodology to plot and tabularize efficiency versus energy data for each geometry used on the FASTSCAN.

- Evaluate the use of the REMCAL Transfer Phantom with air-filled cavities and a point calibration source.

The inspectors informed licensee representatives that these items will be considered an open item and will be reviewed during a future inspection (50-413/85-50-05, 50-414/85-60-05).

Results of the intercomparisons are presented in Table 2. The results were based on an average of five measurements, each measurement counted for 60 seconds. All licensee results were higher than the know values, with measurements ranging from 23 to 54% above the know values. The inspectors noted that longer counting times, approximately 180 seconds, did not improve comparison results.

No violations or deviations were identified.

Open Item (50-413/85-50-05, 50-414/85-60-05) - Review of Calibration and QA Data Required for Operation of Whole-body "Fastscan" BBA System.

10. Review of Counting Room Procedures for Unit 2 (84525)

The inspectors reviewed procedures and discussed with cognizant licensee representatives radiological analytical capabilities for Unit 2 effluent measurements. The inspectors noted that the counting room is a shared facility between Units 1 and 2 and thus all analytical procedures are identical.

TABLE 1

RESULTS OF CONFIRMATORY MEASUREMENTS AT CATAWBA NUCLEAR PLANT - DECEMBER 9-13, 1985

SAMPLE (Geometry)	ISOTOPE	CONCENTRATION (uCi/Unit) LICENSEE	NRC	RESOLUTION	RATIO LICENSEE/NRC	COMPARISON
(1) Reactor Coolant (50 ml Bottle)	Co-58	7.23 E-3	1.18 0.03 E-2	39	0.61	Disagreement
	I-131	7.13 E-3	8.23 0.27 E-3	30	0.87	Agreement
	I-133	1.28 E-2	1.48 0.04 E-2	37	0.86	Agreement
	I-135	1.13 E-2	1.18 0.11 E-2	11	0.96	Agreement
(2) Reactor Coolant (50 ml Bottle)	Co-58	6.89 E-3	1.18 0.03 E-2	39	0.58	Disagreement
	I-131	5.84 E-3	8.23 0.27 E-3	30	0.71	Disagreement
	I-133	1.27 E-2	1.48 0.04 E-2	37	0.86	Agreement
	I-135	1.10 E-2	1.18 0.11 E-2	11	0.93	Agreement
(3) Reactor Coolant (50 ml Bottle)	Co-58	8.09 E-3	1.18 0.03 E-2	39	0.68	Disagreement
	I-131	8.81 E-3	8.23 0.27 E-3	30	1.07	Agreement
	I-133	1.48 E-3	1.48 0.04 E-2	37	1.00	Agreement
	I-135	1.40 E-2	1.18 0.11 E-2	11	1.19	Agreement
(4) Reactor Coolant (50 ml Bottle)	Co-58	8.67 E-3	1.18 0.03 E-2	39	0.73	Disagreement
	I-131	7.67 E-3	8.23 0.27 E-3	30	0.93	Agreement
	I-133	1.36 E-2	1.48 0.04 E-2	37	0.92	Agreement
	I-135	1.36 E-2	1.18 0.11 E-2	11	1.15	Agreement
(1) Liquid Waste (3500 ml Marinelli)	Mn-54	9.10 E-7	1.28 0.18 E-6	7	0.71	Agreement
	Co-58	3.04 E-5	2.96 0.06 E-5	49	1.03	Agreement
	Fe-59	2.13 E-6	2.06 0.27 E-6	8	1.03	Agreement
	Co-60	2.28 E-6	1.82 0.24 E-6	8	1.25	Agreement
	I-131	2.58 E-6	2.48 0.24 E-6	10	1.04	Agreement
	I-133	9.97 E-7	1.02 0.37 E-6	3	0.98	Agreement
	Cs-134	4.04 E-6	3.27 0.29 E-6	11	1.24	Agreement
	Cs-137	7.42 E-6	6.82 0.39 E-6	17	1.09	Agreement
(2) Liquid Waste (3500 ml Marinelli)	Mn-54	9.28 E-7	1.28 0.18 E-6	7	0.72	Agreement
	Co-58	3.03 E-5	2.96 0.06 E-5	49	1.02	Agreement
	Fe-59	1.76 E-6	2.06 0.27 E-6	8	0.85	Agreement
	Co-60	1.93 E-6	1.82 0.24 E-6	8	1.06	Agreement
	I-131	2.67 E-6	2.48 0.24 E-6	10	1.08	Agreement
	I-133	7.88 E-7	1.02 0.37 E-6	3	0.77	Agreement
	Cs-134	3.79 E-6	3.27 0.29 E-6	11	1.16	Agreement
	Cs-137	7.64 E-6	6.82 0.39 E-6	17	1.12	Agreement
(3) Liquid Waste (3500 ml Marinelli)	Mn-54	9.86 E-7	1.28 0.18 E-6	7	0.77	Agreement
	Co-58	3.08 E-5	2.96 0.06 E-5	49	1.04	Agreement
	Fe-59	1.86 E-6	2.06 0.27 E-6	8	0.90	Agreement
	Co-60	2.13 E-6	1.82 0.24 E-6	8	1.17	Agreement
	I-131	2.72 E-6	2.48 0.24 E-6	10	1.10	Agreement
	I-133	1.12 E-6	1.02 0.37 E-6	3	1.10	Agreement
	Cs-134	3.68 E-6	3.27 0.29 E-6	11	1.12	Agreement
	Cs-137	7.59 E-6	6.82 0.39 E-6	17	1.11	Agreement

TABLE 1 (Cont'd)

SAMPLE	ISOTOPE	CONCENTRATION (uCi/Unit) LICENSEE	NRC	RESOLUTION	RATIO LICENSEE/NRC	COMPARISON
(4) Liquid Waste (3500 ml Marinelli)	Mn-54	9.40 E-7	1.28 0.18 E-6	7	0.73	Agreement
	Co-58	3.07 E-5	2.96 0.06 E-5	49	1.04	Agreement
	Fe-59	2.20 E-6	2.06 0.27 E-6	8	1.07	Agreement
	Co-60	2.17 E-6	1.82 0.24 E-6	8	1.19	Agreement
	I-131	2.86 E-6	2.48 0.24 E-6	10	1.15	Agreement
	I-133	1.21 E-6	1.02 0.37 E-6	3	1.19	Agreement
	Cs-134	3.83 E-6	3.27 0.29 E-6	11	1.17	Agreement
	Cs-137	7.56 E-6	6.82 0.39 E-6	17	1.11	Agreement
(1) Particulate Filter (47 mm Filter Paper)	Co-60	8.23 E-3	9.40 0.28 E-3	34	0.88	Agreement
	Cs-137	1.13 E-2	1.32 0.03 E-2	44	0.86	Agreement
(2) Particulate Filter (47 mm Filter Paper)	Mn-54	3.32 E-3	3.62 0.21 E-3	17	0.92	Agreement
	Co-60	1.82 E-2	2.02 0.04 E-2	50	0.90	Agreement
	Cs-137	1.36 E-2	1.34 0.03 E-2	45	1.01	Agreement
	Ce-144	5.92 E-3	6.64 0.42 E-3	16	0.89	Agreement
(3) Particulate Filter (47 mm Filter Paper)	Mn-54	3.34 E-3	3.62 0.21 E-3	17	0.92	Agreement
	Co-60	1.84 E-2	2.02 0.04 E-2	50	0.91	Agreement
	Cs-137	1.38 E-2	1.34 0.03 E-2	45	1.03	Agreement
	Ce-144	6.53 E-3	6.64 0.42 E-3	16	0.98	Agreement
(4) Particulate Filter (47 mm Filter Paper)	Co-60	9.55 E-3	9.40 0.28 E-3	34	1.02	Agreement
	Cs-137	1.38 E-2	1.32 0.03 E-2	44	1.04	Agreement
(2) Charcoal Cartridge (Face Loaded)	Ba-133	5.01 E-2	4.08 0.03 E-2	136	1.23	Agreement
(3) Charcoal Cartridge (Face Loaded)	Ba-133	5.16 E-2	4.08 0.03 E-2	136	1.26	Disagreement
(4) Charcoal Cartridge (Face Loaded)	Ba-133	4.60 E-2	4.08 0.03 E-2	136	1.13	Agreement
(1) Charcoal Cartridge (Face Loaded)	Ba-133	4.30 E-2	4.08 0.03 E-2	136	1.05	Agreement
(1) Gas (12cc Vial)	Kr-85m	4.94 E-3	6.21 0.11 E-3	56	0.80	Agreement
	Kr-88	1.20 E-2	1.40 0.05 E-2	28	0.86	Agreement
	Xe-133	3.70 E-2	4.02 0.02 E-2	201	0.92	Agreement
	Xe-135	2.18 E-2	2.81 0.02 E-2	140	0.78	Disagreement
(3) Gas (4600cc Marinelli)	Xe-133m	1.11 E-5	1.00 0.06 E-5	17	1.11	Agreement
	Xe-133	6.88 E-4	6.30 0.02 E-4	315	1.09	Agreement
	Xe-135	1.09 E-5	9.86 0.15 E-6	66	1.10	Agreement
(4) Gas (4600cc Marinelli)	Xe-133m	9.24 E-6	1.00 0.06 E-5	17	0.92	Agreement
	Xe-133	4.47 E-4	6.30 0.02 E-4	315	0.71	Disagreement
	Xe-135	8.52 E-6	9.86 0.02 E-6	66	0.86	Agreement

TABLE 1 (Cont'd)

SAMPLE	ISOTOPE	CONCENTRATION (uCi/Unit) LICENSEE	NRC	RESOLUTION	RATIO LICENSEE/NRC	COMPARISON
(1) Gas (100cc Gas Bomb)	Xe-131m	1.48 E-3	1.38 0.12 E-3	12	1.07	Agreement
	Xe-133m	1.04 E-3	1.10 0.03 E-3	37	0.94	Agreement
	Xe-133	7.77 E-2	7.82 0.01 E-2	782	0.99	Agreement
	Xe-135	4.69 E-4	4.78 0.07 E-4	68	0.98	Agreement
(2) Gas (100cc Gas Bomb)	Xe-131m	1.26 E-3	1.38 0.12 E-3	12	0.91	Agreement
	Xe-133m	9.78 E-4	1.10 0.03 E-3	37	0.89	Agreement
	Xe-133	7.29 E-2	7.82 0.01 E-2	782	0.93	Agreement
	Xe-135	4.26 E-4	4.78 0.07 E-4	68	0.89	Agreement

ND Not Detected
NC Not Compared
(1) Analyzed Using Gamma Spectroscopy System No. SN 24-N-1096
(2) Analyzed Using Gamma Spectroscopy System No. SN 24-P-94VC
(3) Analyzed Using Gamma Spectroscopy System No. SN 24-P-92VA
(4) Analyzed Using Gamma Spectroscopy System No. SN 24-P-04TC

TABLE 2

RESULTS OF WHOLE BODY COUNTER MEASUREMENTS
USING A COMMERCIALLY AVAILABLE FISSION PRODUCT PHANTOM AT
CATAWBA NUCLEAR PLANT, DECEMBER 11, 1985

Nuclide	Organ	Licensee(1) (nCi)	NRC (nCi)	Ratio (Licensee/NRC)
MN-54	Lungs	30.9	20.1	1.54
Co-57	Lungs	51.9	33.7	1.54
Co-60	Lungs	211.5	172.4	1.23
Cs-137	Lungs	120.3	87.8	1.37

1. Licensee value represents the arithmetic mean of five measurements, each measurement was counted for 60 seconds.

NOTE: Licensee's calibration procedure used a point source.

ATTACHMENT 1

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This enclosure provides criteria for comparing results of capability tests and verification measurements. The criteria are based on an empirical relationship which combines prior experience and the accuracy needs of this program.

In these criteria, the judgement limits denoting agreement or disagreement between licensee and NRC results are variable. This variability is a function of the NRC's value relative to its associated uncertainty. As the ratio of the NRC value to its associated uncertainty, referred to in this program as "Resolution"[1] increases, the range of acceptable differences between the NRC and licensee values should be more restrictive. Conversely, poorer agreement between NRC and licensee values must be considered acceptable as the resolution decreases.

For comparison purposes, a ratio[2] of the licensee value to the NRC value for each individual nuclide is computed. This ratio is then evaluated for agreement based on the calculated resolution. The corresponding resolution and calculated ratios which denote agreement are listed in Table 1 below. Values outside of the agreement ratios for a selected nuclides are considered in disagreement.

[1] Resolution = $\frac{\text{NRC Reference Value for a Particular Nuclide}}{\text{Associated Uncertainty for the Value}}$

[2] Comparison Ratio = $\frac{\text{Licensee Value}}{\text{NRC Reference Value}}$

TABLE 1 - Confirmatory Measurements Acceptance Criteria
Resolutions vs. Comparison Ratio

Resolution	Comparison Ratio for Agreement
<4	0.4. - 2.5
4 - 7	0.5. - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18