



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

AUG 08 1985

Report Nos.: 50-325/85-21 and 50-324/85-21

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket Nos.: 50-325 and 50-324

License Nos.: DPR-71 and DPR-62

Facility Name: Brunswick 1 and 2

Inspection Conducted: July 22-26, 1985

Inspectors:

George B. Kuzo
G. B. Kuzo

William B. Gloersen
W. B. Gloersen

6 August 1985

Date Signed

8/6/85

Date Signed

Accompanying Personnel: J. D. Harris

Approved by:

P. G. Stoddart
P. G. Stoddart, Acting Section Chief
Division of Radiation Safety and Safeguards

8/7/85

Date Signed

SUMMARY

Scope: This routine, unannounced inspection entailed 150 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 the 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: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

*J. W. Chase, Manager, Operations
 *B. E. Hinkley, Manager, Technical Support
 *R. M. Poulk, Jr., Senior Regulatory Specialist
 *A. G. Cheatham, Manager, Environmental and Radiation Control
 *C. E. Robertson, Supervisor, Environmental and Radiation Control
 *M. L. Milliner, Foreman, Environmental and Radiation Control
 *J. W. Davis, Project Engineer, Environmental and Radiation Control
 B. Nurnberger, Foreman, Environmental and Radiation Control
 J. W. Gurganious, Foreman, Environmental and Radiation Control
 S. Watson, Environmental and Chemistry Specialist
 C. Barnhill, Dosimetry Specialist
 R. Andrews, Senior Specialist, Health Physics (Corporate)
 S. Brown, Project Specialist, Health Physics (Corporate)
 J. Henderson, Supervisor, Radiation Control

Other licensee employees contacted included technicians and office personnel.

NRC Resident Inspectors

*L. W. Garner

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on July 26, 1985, with those persons indicated in Paragraph 1. Licensee management representatives acknowledged the inspectors' comments and expressed no contrary opinions. 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

(Closed) 50-324/84-14-01, 50-325/84-14-01: Failure to follow procedures for calibration of Ge(Li) detector system. From review of the appropriate procedures and records and acceptable confirmatory measurement results (Paragraph 8.a.), the inspectors noted that the gamma spectroscopy systems were calibrated properly.

4. Laboratory Quality Control Program (84725)

The inspectors reviewed selected portions of the Quality Assurance program with cognizant licensee representatives and determined that organizational structure and program management had not changed since the previous inspection (IE 50-324/84-14, 50-325/84-14). The inspectors noted that program implementation met the general guidance of Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs," with respect to the radioactive effluent monitoring program.

No violations or deviations were identified.

5. Audits (84725)

Technical Specification (TS) 6.5.5.2 states audits of facility activities shall be performed by the Performance Evaluation Unit (PEU) encompassing performance of facility operation to provisions contained within the TSs and applicable license conditions at least once per 12 months and the performance of activities required by the Quality Assurance Program to meet provisions of Regulatory Guide 1.21, Revision 1, June 1974 and Regulatory Guide 4.1, Revision 1, April 1975 at least once per 12 months. The inspectors reviewed the following audit reports:

- a. QAA/21-34, Quality Assurance Audit of BSEP Operations Units 1 and 2, August 13-17, 1984
- b. QAA/XX21-85-02, Quality Assurance Audit of BSEP Operations Units 1 and 2, April 8-12, 1985

The inspectors discussed the audits with licensee personnel and reviewed the corrective actions taken by the licensee. The inspectors noted that, in general, all corrective action had been taken promptly to resolve items of concern.

No violations or deviations were identified.

6. Procedures (84725)

- a. Technical Specification 6.8.1 requires written procedures to be established, implemented, and maintained covering the applicable procedures recommended in Appendix A of Regulatory Guide 1.33, November 1972 and the Quality Assurance Program for effluent and environmental monitoring. The inspectors reviewed selected portions of the following Environmental and Radiation Control (E&RC) procedures:
 - (1) E&RC-1000, Sampling and Analysis Schedule for Technical Specifications Related Radioactive and Nonradioactive Chemistry, Rev. 14, 6/10/85
 - (2) E&RC-0160, Calibration/Operation of ND 6685 Multichannel Analyzers, Rev. 0, 3/22/85

- (3) E&RC-0420, Personnel Bioassay Methods, Rev. 16, 7/17/85
- (4) E&RC-0421, Calibration of the ND 6600 Series Chair Direct Bioassay Counter, Rev. 5, 2/27/85
- (5) E&RC-0423, Trend Analysis of In-Vivo Monitoring Results, Rev. 0, 11/2/84
- (6) E&RC-0490, Updating Whole Body Counting Records, Rev. 5, 6/10/85
- (7) E&RC-1036, Standardization of Storm Drain Basin pH Analyzer/Controller and Setting of the Control and Alarm Points, Rev. 0, 6/27/85
- (8) E&RC-1040, Metal Analysis by Atomic Absorption Spectrophotometer (IL-35), Rev. 2, 4/25/84
- (9) E&RC-1041, Sample Collection and Preparation for Metals Analysis, Rev. 4, 5/13/85
- (10) E&RC-1070, Anion Resin Capacity Determination, Rev. 2, 7/8/85
- (11) E&RC-1110, Chloride Determination by Color, Rev. 2, 7/3/84
- (12) E&RC-1111, Chloride Ion by Mercuric Nitrate Titration, Rev. 3, 4/25/84
- (13) E&RC-1115, Silica Analysis, Rev. 3, 3/22/85
- (14) E&RC-1130, Monthly Determination of Sodium Pentaborate Solution in Standby Liquid Control Tank, Rev. 5, 4/3/85
- (15) E&RC-1341, Determination and Regulation of Exhaust Hood Flow Rates, Rev. 2, 7/10/85
- (16) E&RC-1700, Verification of Analytical Performance, Rev. 3, 10/30/84
- (17) E&RC-2015, Procedure for Preparation of the Semiannual Environmental Effluent Release Report, Rev. 2, 1/31/85
- (18) E&RC-1270, Minimum Detectable Activity, Rev. 2, 11/9/83
- (19) E&RC-1271, Determination of Lower Limit for Detection Counting Systems, Rev. 3, 5/12/85
- (20) E&RC-4000, Format, Approvals, and Revisions for E&RC Procedures, Rev. 4, 10/31/84
- (21) E&RC-4200, Determination of Compliance to 49 CFR 190, Rev. 3, 5/15/85

- (22) E&RC-1210, Determination of Radioiodine (RCS), Rev. 9, 5/23/84
- (23) E&RC-1221, Sampling and Analysis Procedure for Routine SJAE Off-Gas Analysis, Rev. 5, 6/19/85
- (24) E&RC-1222, Operation of Gas Chromatograph, Rev. 3, 10/31/84
- (25) E&RC-1198, Operation of the Dionex Model 2010i Ion Chromatograph, Rev. 0, 8/17/84
- (26) E&RC-1199, Cation and Anion Analysis by Ion Chromatography, Rev. 4, 5/23/84
- (27) E&RC-1310, Calibration of Spectrophotometer, Rev. 3, 10/30/84
- (28) E&RC-1500, Analysis of PASS Samples in the Laboratory, Rev. 7, 12/27/84
- (29) E&RC-1504, Post-Accident Analysis by Ion Chromatography (C1 & B), Rev. 1, 2/3/84

The inspectors noted that the above procedures were being reviewed and approved in accordance with administrative control directives. Results of the procedure review were discussed with cognizant licensee representatives as noted in Paragraph 6.b.

- b. The inspectors discussed with cognizant licensee representatives effluent sampling and analysis procedure limits required by Technical Specifications. The inspectors noted that TS Lower Limits of Detection (LLD) calculations were based on set time intervals between sample collection and analyses. In contrast, the appropriate sampling and analyses procedures did not establish time limits between sampling and analyses. From a review of LLD determinations and selected gaseous analyses records (Paragraph 7), the inspectors noted that effluent analyses met Technical Specification requirements. However, cognizant licensee personnel informed the inspectors that the establishment of procedural controls to ensure TS LLD requirements would be evaluated.

No violations or deviations were identified.

7. Records (84725)

- a. The inspectors reviewed selected portions of the following records:
 - (1) Gamma Spectroscopy System Detector Nos. 1216, 1267, HP1 and HP2 Quality Control Logs for June - July 1985 including:

- (a) Energy Calibration & Efficiency Checks
 - (b) Resolution Check Results
 - (c) FWHM Determinations
 - (d) Background Checks
 - (e) Separate Source Verification Worksheet
- (2) Annual (1984 - 1985) Gamma Spectroscopy Detector System Nos. 1216, 1267, HP1 and HP2 Energy Calibrations for the following geometries: 14 cc Gas Vial, 1.26 L Gas Marinelli, 43 mm Filter Paper, Face-Loaded Charcoal Cartridge, 14 cc Liquid Vial, Wide Range Gas Monitor Charcoal, 4 L Marinelli.
- (3) Liquid Scintillation System TriCarb 2002 and 4530 QC Records for January - July 1985 including:
- (a) Daily Quality Control Sheets
 - (b) Background Determinations
 - (c) Reliability Records and Trend Charts
 - (d) Chi-Square Determinations
 - (e) Efficiency Determination
 - (f) Batch Standard Results
- (4) LB-5100, Baird Atomic Nos. 139, 142, 146, and NMC 7234 and NMC 7235 Proportional Counter QC Records for Jun - July 1985 including:
- (a) Daily Reliability Results and Trend Charts
 - (b) Chi-Square Determination
 - (c) Background Results
 - (d) Efficiency Determinations
 - (e) Resolving Time Determinations
 - (f) Voltage Plateaus
- (5) Standard Radionuclide Source Certificates 1984 - 1985
- (6) Reactor Coolant Log January - June 1985, Units 1 and 2, for the following analyses: Chloride; Conductivity; Silica; Total Organic Carbon; Gross Activity; Dose Equivalent Iodine; and Gamma Isotopic.
- (7) Main Condenser Off-Gas Explosive Gas Monitoring System for Hydrogen and Oxygen, Unit 2, January - June 1985
- (8) Dionex IC 16 Chloride Control Chart and Calibration Check Log, June 1984, July 1985
- (9) Gas Chromatograph Hydrogen Control Chart Calibration Checks, November 1984 - July 1985
- (10) Radiochemistry Cross Check Program Results (1984 - July 1985)

- (11) Chemistry Round-Robin Water Chemistry Analyses and Chemistry Cross Check Results (1984 - July 1985)
- (12) Stack Gas Gamma Spectroscopy Sample Analyses, May - July 1985
- (13) Health Physics Memorandum Concerning Sources and Test Methods for the Health Physics Count Room Gas-Flow Proportional Counters, dated May 8, 1985

Results of the record review were discussed with cognizant licensee representatives as noted in Paragraph 7.b.

- b. The inspectors reviewed stack gas release analyses and calculated selected nuclide Lower Limit of Detection (LLD) for licensee gamma spectroscopy systems. The inspectors noted that stack gas analyses required analyses to be completed within approximately 2.0 hours of sampling to meet TS LLDs for Xe-138 measurements. For all analyses, TS LLD requirements were within compliance limits.

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 were analyzed for radionuclide concentrations using licensee and NRC Region II Mobile 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 - 14 cc vial, liquid waste - 1 L Marinelli; and gaseous waste - 14 cc off-gas vial, 1.26 L gas Marinelli. 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 for all sample types analyzed.
- b. The inspectors noted that the licensee was provided with a simulated liquid waste sample by the NRC contract laboratory and was requested to complete radiochemical analyses for H-3, Sr-89, Sr-90, and Fe-55 concentrations. Comparison of licensee and NRC results are listed in Table 2 with the acceptance criteria listed in Attachment 1. Results were in agreement for all analyses.

No violations or deviations were identified.

9. Tour of the Chemistry and Counting Room Facilities (84725)

The inspectors toured the counting room facilities. The inspectors noted adequate cleanliness and organization in the laboratory.

No violations or deviations were identified.

10. Use of Fission Product Phantom for Checking Whole-Body Counter Measurements (84725)

During this inspection, the inspectors verified the licensee's capability to perform radiological bioassays using their whole-body counting 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 two whole-body counting systems. The first counter was a "stand-up" model which was out of service at the time of this inspection. The second counter, which recently had been placed in service, was a standard chair geometry system consisting of Nuclear Data electronic equipment and three NaI detectors for the thyroid, lungs, and lower torso. The inspectors reviewed the licensee's procedures for operating and calibrating the whole-body counting system. In addition, procedures describing the quality assurance program were reviewed. Calibrations were conducted using vendor supplied block phantoms for the thyroid, lungs, and lower torso. The licensee used individual Ce-139, Sn-113, Y-88, and Co-60 sources for calibration. The inspectors reviewed QA records including calibration checks conducted from March 18 through July 24, 1985. The inspectors noted that the licensee had not plotted daily source check results on a control chart. The licensee agreed that plotting daily check source results on a control chart with the appropriate control limits provided would allow whole-body counter operators to better monitor system responses.

The results of the intercomparison are presented in Table 3. The results were based on an average of five measurements, except as indicated by footnote in the Table. All licensee measurements were higher than the known values except for Co-57 which was 2% below the known value. The other nuclide measurements ranged from 14% to 69% above the known values. The inspectors noted that in two out of five cases, system software identified both Mn-54 and Co-58 for the photopeak corresponding to Mn-54. The inspectors noted that the licensee had set the system's energy tolerance to 30 keV. Licensee representatives agreed to evaluate this area and readjust the energy tolerance accordingly. The inspectors also noted that in one survey, the counting system split the Cs-137 photopeak into two peaks at the 632.6 and 673.5 keV energy levels. This photopeak split resulted in the system software underestimating the amount of Cs-137. Summation of counts in these two peaks and manual calculations resulted in the correct nanocurie amount. Licensee representatives also agreed to evaluate this area.

No violations or deviations were identified.

TABLE 1

RESULTS OF GAMMA SPECTROSCOPY CONFIRMATORY MEASUREMENTS AT BRUNSWICK STEAM ELECTRIC PLANT - JULY 22-26, 1985

SAMPLE TYPE (Licensee Geometry)	ISOTOPE	CONCENTRATION ($\mu\text{Ci}/\text{Unit}$)		RESOLUTION Licensee/NRC	RATIO	COMPARISON
		Licensee	NRC			
(1) REACTOR COOLANT (14 cc Liquid Vial)	Cr-51	1.31 E-2	1.27 \pm 0.18 E-2	7	1.03	Agreement
	Tc-99m	3.79 E-2	3.54 \pm 0.03 E-2	118	1.07	Agreement
	I-131	7.36 E-4	7.46 \pm 1.87 E-4	4	0.97	Agreement
	I-132	1.04 E-2	9.17 \pm 0.48 E-3	19	1.13	Agreement
	I-133	9.67 E-3	1.05 \pm 0.04 E-2	26	0.92	Agreement
	I-134	1.28 E-2	9.09 \pm 0.67 E-3	14	1.41	Agreement
	I-135	2.26 E-2	1.94 \pm 0.13 E-2	15	1.16	Agreement
(2) REACTOR COOLANT (14 cc Liquid Vial)	Cr-51	1.32 E-2	1.27 \pm 0.18 E-2	7	1.04	Agreement
	Tc-99m	3.68 E-2	3.54 \pm 0.03 E-2	118	1.04	Agreement
	I-131	6.70 E-4	7.46 \pm 1.87 E-4	4	0.90	Agreement
	I-132	1.02 E-2	9.17 \pm 0.48 E-3	19	1.11	Agreement
	I-133	9.85 E-3	1.05 \pm 0.04 E-2	26	0.94	Agreement
	I-134	1.24 E-2	9.09 \pm 0.67 E-3	14	1.36	Agreement
	I-135	1.87 E-2	1.94 \pm 0.13 E-2	15	0.96	Agreement
(1) SIMULATED LIQUID WASTE (1L Marinelli)	Cr-51	8.97 E-5	8.62 \pm 0.43 E-5	20	1.04	Agreement
	Sr-92	1.19 E-5	1.12 \pm 0.09 E-5	12	1.06	Agreement
	Tc-99m	1.53 E-4	1.44 \pm 0.01 E-4	144	1.06	Agreement
	I-131	4.26 E-6	4.06 \pm 0.44 E-6	9	1.05	Agreement
	I-132	1.48 E-5	1.60 \pm 0.09 E-5	18	0.92	Agreement
	I-133	5.10 E-5	5.25 \pm 0.08 E-5	65	0.97	Agreement
	I-135	7.82 E-5	7.83 \pm 0.32 E-5	24	1.00	Agreement
(2) SIMULATED LIQUID WASTE (1L Marinelli)	Cr-51	8.95 E-5	8.62 \pm 0.43 E-5	20	1.04	Agreement
	Sr-92	1.14 E-5	1.12 \pm 0.09 E-5	12	1.02	Agreement
	Tc-99m	1.50 E-4	1.44 \pm 0.01 E-4	144	1.04	Agreement
	I-131	4.11 E-6	4.06 \pm 0.44 E-6	9	1.01	Agreement
	I-132	1.56 E-5	1.60 \pm 0.09 E-5	18	0.98	Agreement
	I-133	5.07 E-5	5.25 \pm 0.08 E-5	65	0.96	Agreement
	I-135	7.77 E-5	7.83 \pm 0.32 E-5	24	0.99	Agreement
(1) PARTICULATE FILTER SPIKE (47 mm Filter)	Co-60	9.05 E-3	1.03 \pm 0.03 E-2	34	0.88	Agreement
	Cs-137	1.18 E-2	1.29 \pm 0.03 E-2	43	0.91	Agreement
(2) PARTICULATE FILTER SPIKE (47 mm Filter)	Co-60	9.85 E-3	1.29 \pm 0.30 E-2	34	0.96	Agreement
	Cs-137	1.20 E-2	1.29 \pm 0.03 E-2	43	0.93	Agreement
(3) PARTICULATE FILTER SPIKE (47 mm Filter)	Mn-54	4.61 E-3	5.07 \pm 0.21 E-3	24	0.91	Agreement
	Co-60	1.91 E-2	2.02 \pm 0.04 E-2	50	0.94	Agreement
	Cs-137	1.26 E-2	1.34 \pm 0.03 E-2	45	0.94	Agreement
	Ce-144	9.36 E-3	9.33 \pm 0.41 E-3	23		
(4) PARTICULATE FILTER SPIKE (47 mm Filter)	Mn-54	4.61 E-3	5.07 \pm 0.21 E-3	24	0.91	Agreement
	Co-60	1.92 E-2	2.02 \pm 0.04 E-2	50	0.95	Agreement
	Cs-137	1.26 E-2	1.34 \pm 0.03 E-2	45	0.94	Agreement
	Ce-144	9.07 E-3	9.33 \pm 0.41 E-3	23	0.97	Agreement

TABLE 1 (cont'd)

SAMPLE TYPE (Licensee Geometry)	ISOTOPE	CONCENTRATION ($\mu\text{Ci}/\text{Unit}$)		RESOLUTION Licensee/NRC	RATIO	COMPARISON
		Licensee	NRC			
(1) CHARCOAL CARTRIDGE SPIKE (Face-Loaded Cartridge)	Co-57	1.01 E-3	8.93 \pm 0.53 E-4	17	1.13	Agreement
	Co-60	1.97 E-2	1.90 \pm 0.04 E-2	48	1.04	Agreement
	Cd-109	4.99 E-2	4.97 \pm 0.19 E-2	26	1.00	Agreement
	Cs-137	2.17 E-2	1.97 \pm 0.04 E-2	49	1.10	Agreement
(2) CHARCOAL CARTRIDGE SPIKE (Face-Loaded Cartridge)	Co-57	9.20 E-4	8.93 \pm 0.53 E-4	17	1.03	Agreement
	Co-60	1.90 E-2	1.90 \pm 0.04 E-2	48	1.00	Agreement
	Cd-109	4.47 E-2	4.97 \pm 0.19 E-2	26	0.90	Agreement
	Cs-137	2.03 E-2	1.97 \pm 0.04 E-2	49	1.03	Agreement
(3) CHARCOAL CARTRIDGE SPIKE (Face-Loaded Cartridge)	Co-57	8.81 E-4	7.99 \pm 0.49 E-4	16	1.10	Agreement
	Co-60	1.92 E-2	1.74 \pm 0.04 E-2	44	1.10	Agreement
	Cd-109	4.42 E-2	4.30 \pm 0.16 E-2	27	1.03	Agreement
	Cs-137	1.96 E-2	1.80 \pm 0.04 E-2	45	1.09	Agreement
(2) CHARCOAL CARTRIDGE SPIKE (Face-Loaded Cartridge)	Co-57	9.01 E-4	7.99 \pm 0.49 E-4	16	1.13	Agreement
	Co-60	1.85 E-2	1.74 \pm 0.04 E-2	44	1.06	Agreement
	Cd-109	4.72 E-2	4.30 \pm 0.16 E-2	27	1.10	Agreement
	Cs-137	1.99 E-2	1.80 \pm 0.04 E-2	45	1.10	Agreement
(1) OFF-GAS (14 cc Vial)	Kr-85m	4.10 E-2	4.27 \pm 0.05 E-2	85	0.96	Agreement
	Kr-87	1.56 E-1	1.43 \pm 0.02 E-1	72	1.09	Agreement
	Kr-88	1.22 E-1	1.32 \pm 0.02 E-1	66	0.92	Agreement
	Xe-133	4.59 E-2	4.32 \pm 0.08 E-2	54	1.06	Agreement
	Xe-135	2.03 E-1	2.09 \pm 0.01 E-1	209	0.97	Agreement
(2) OFF-GAS (14 cc Vial)	Kr-85m	4.14 E-2	4.27 \pm 0.05 E-2	85	0.97	Agreement
	Kr-87	1.66 E-1	1.43 \pm 0.02 E-1	72	1.16	Agreement
	Kr-88	1.26 E-1	1.32 \pm 0.02 E-1	66	0.95	Agreement
	Xe-133	4.68 E-2	4.32 \pm 0.08 E-2	54	1.08	Agreement
	Xe-135	2.03 E-1	2.09 \pm 0.01 E-1	209	0.97	Agreement
(2) STACK GAS (1L Marinella)	Xe-135	7.41 E-8	8.64 \pm 1.84 E-8	5	0.86	Agreement
	Xe-138	7.82 E-7	4.70 \pm 1.14 E-7	4	1.66	Agreement

ND - Not Deleted

NC - Not Compared

(1) - Analyzed Using Gamma Spectroscopy System No. 1216

(2) - Analyzed Using Gamma Spectroscopy System No. 1267

(3) - Analyzed Using Gamma Spectroscopy System No. HP1

(4) - Analyzed Using Gamma Spectroscopy System No. HP2

TABLE 2

RESULTS OF H-3, Fe-55, Sr-89, AND Sr-90 CONFIRMATORY MEASUREMENTS AT BRUNSWICK STEAM ELECTRIC PLANT - JULY 22-26*, 1985

SAMPLE TYPE (Licensee Geometry)	ISOTOPE	CONCENTRATION ($\mu\text{Ci}/\text{Unit}$)		RESOLUTION Licensee/NRC	RATIO	COMPARISON
		Licensee	NRC			
Spiked Liquid Sample from NRC Contract Laboratory	H-3	7.02 E-5	7.01 \pm 0.21 E-5	33	1.00	Agreement
	Sr-89	2.02 E-4	1.93 \pm 0.04 E-4	48	1.05	Agreement
	Sr-90	3.35 E-5	3.16 \pm 0.09 E-5	35	1.06	Agreement
	Fe-55	3.07 E-5	2.46 \pm 0.11 E-5	22	1.25	Agreement

*Sample Provided to Brunswick Steam Electric Plant - April 1984

TABLE 3: RESULTS OF WHOLE BODY COUNTER MEASUREMENTS
USING A COMMERCIALLY AVAILABLE FISSION PRODUCT PHANTOM AT
BRUNSWICK NUCLEAR PLANT, JULY 24, 1985

Nuclide	Organ	Licensee ⁽¹⁾ (nCi)	NRC (nCi)	Ratio (Licensee/NRC)
Mn-54	Lungs	44	26	1.69
Co-57	Lungs	43 ⁽²⁾	44	0.98
Co-60	Lungs	190	160	1.19
Cs-137	Lungs	96 ⁽³⁾	84	1.14

1. Licensee value represents the arithmetic mean of five measurements, each measurement was counted for 300 seconds.
2. Licensee's whole-body counting system nuclide library did not identify Co-57. This value was hand-calculated.
3. Licensee value represents the arithmetic mean of only four measurements, the counting system split the 662 KeV photopeak into a doublet for one of the measurements.

Attachment 1

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This attachment 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 are variable in relation to the comparison of the NRC's value to its associated uncertainty. As that ratio, referred to in this program as "Resolution", increases, the acceptability of a licensee's measurement should be more selective. Conversely, poorer agreement must be considered acceptable as the resolution decreases.

$$\text{RATIO} = \frac{\text{LICENSEE VALUE}}{\text{NRC REFERENCE VALUE}}$$

<u>Resolution</u>	<u>Agreement</u>
<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