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

APR 24 1992

Report No. 50-302/92-08

Licensee: Florida Power Corporation
3201 34th Street, South
St. Petersburg, FL 33733

Docket No. 50-302 License No. DPR-72

Facility Name : Crystal River 3

Inspection Conducted: March 23-27, 1992

Inspector: _____ 4.22.92
D. A. Seymour Date Signed

Accompanying Personnel: B. Nicholas, Senior Radiation Specialist, Region IV
A. Massey, Nuclear Engineer, Headquarters

Approved by: Thomas R Decker 4/23/92
T. R. Decker, Chief Date Signed
Radiological Effluents and Chemistry Section
Radiological Protection and Emergency Preparedness Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope:

This routine, announced inspection was conducted in the a as of confirmatory measurements, count room quality control, and dose assessment.

Results:

The licensee was in agreement for all sample streams analyzed as part of the confirmatory measurements inspection (Paragraph 2).

Based on a review of the quality control measures implemented in the radiochemistry count room, it was determined that the overall operability of the gamma spectroscopy detectors and other instrumentation was satisfactory (Paragraph 2).

The licensee's computer calculations of offsite doses resulting from radioactive liquid and gaseous effluent discharged to the environment were confirmed to be accurate and in accordance with the methods, assumptions, bioaccumulation and dose factors, and equations described and defined in the ODCM (Paragraph 3).

The licensee's program for determining the proficiency of their chemistry technicians at performing specified chemical analyses was adequate for its designated purposes. The implementation of a computerized Laboratory Information Management System was considered to be a chemistry program strength (Paragraph 4).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*M. Adams, Nuclear Chemistry Technician
*J. Alberdi, Manager, Nuclear Plant Operations
*A. Boettcher, Jr., Chief Chemistry Technician
*G. Boldt, Vice President, Nuclear Production
*J. Buckner, Nuclear Regulatory Specialist
*P. Ezzell, Radiochemistry and Environmental Specialist
*E. Froats, Manager, Nuclear Compliance
*R. Fuller, Senior Nuclear Licensing Engineer
*P. Geradin, Senior Quality Auditor
*B. Hickle, Director, Quality Programs
*W. Mauney, Chemistry Technician
*P. McKee, Director Nuclear Plant Operations
*J. Roberts, Assistant Chemistry Radiation Superintendent
*R. Pinner, Supervisor, Nuclear Chemistry
*S. Robinson, Superintendent, Nuclear Chemistry and Radiation Protection
*W. Rossfield, Manager, Site Nuclear Services
*R. Widell, Director, Nuclear Operations Site Support
*K. Wilson, Manager, Nuclear Licensing
*R. Yost, Supervisor, Quality Audits

Other licensee employees contacted during this inspection included engineers, technicians, and administrative staff.

Nuclear Regulatory Commission

*P. Holmes-Ray, Senior Resident Inspector
*E. Merschoff, Deputy, Division of Reactor Safety

*Attended Exit Interview

2. Confirmatory Measurements (84750)

10 CFR 20.201(b) requires the licensee to perform surveys as necessary to evaluate the extent of radiation hazards.

The licensee uses their measurements of effluent streams to assess doses to the public resulting from the operation of the plant. In order for the licensee to assess the doses to the public accurately, it is imperative that the measurements of the different effluent streams be representative and accurate.

Pursuant to these requirements, the inspector evaluated the licensee's analytical capabilities to make accurate radioactivity measurements. During this inspection, samples of reactor coolant and selected liquid and gaseous process streams were collected and the resultant sample matrices were analyzed for radionuclide concentrations using the licensee's counting laboratory and the NRC Region II mobile laboratory gamma spectroscopy system. The purpose of these comparative measurements was to verify the licensee's capability to measure quantities of radionuclides accurately in various plant systems.

Analyses were conducted using the licensee's three intrinsic germanium gamma spectroscopy systems, and the intrinsic germanium gamma spectroscopy system used by the Health Physics Organization. Sample types and counting geometries included the following:

a. reactor coolant: a one milliliter sample, diluted to a known volume;

b. liquid waste (Evaporator Condensate Storage Tank B): one liter marinelli;

c. gaseous waste (Waste Gas Decay Tank): 34 cubic centimeter gas sphere;

d. simulated airborne particulate (filtered reactor coolant);

e. a spiked charcoal cartridge (provided by the NRC);

f. one liter spiked simulated gas marinelli (provided by the NRC).

A comparison of licensee and NRC results are listed in Attachment 1, Table 1 with the acceptance criteria listed in Attachment 2. The results were in agreement for all sample streams analyzed.

As part of the confirmatory measurements inspection, the inspector also reviewed the licensee's Quality Assurance Program for count room instrumentation. This review was performed to ensure compliance with selected and applicable portions of Regulatory Guide 4.15, Quality Assurance for Radiochemistry Monitoring Programs (normal operations) - Effluent Streams and the Environment, Rev. 1, February 1978.

The inspector toured the radiochemistry counting laboratory. Instrumentation included three high purity germanium detectors with two software packages for gamma spectroscopy, a proportional counter for alpha and beta counting, and one

liquid scintillation counting unit for tritium (H-3) determination.

The inspector reviewed the licensee's quality control/ quality assurance program records for the above instrumentation. Review of the licensee's procedures indicate that the program was operating within the established criteria. Specifically, daily background checks, energy calibration and full width half max (resolution) determinations were performed on the gamma spectroscopy systems using a mixed gamma source to indicate detector stability and operability. The obtained values were automatically charted via computer. Control charts were constructed on a quarterly basis.

Daily checks for background and source accuracy were also performed on the liquid scintillation and proportional counter; performance information for these detectors is documented onto control charts by hand with new charts being constructed on a quarterly basis. At the end of the quarter, all control charts and accompanying information is sent to records control where they are stored onto microfiche. The control chart warning limits were set at two (2) standard deviations and control limits were set at three (3) standard deviations. The control charts indicated that prompt corrective action was taken whenever points fell outside specified limits. The supervisor kept a master log on all instrumentation calibration and all discrepancies.

The inspector reviewed Procedure CH405 - Laboratory Instrumentation and Analytical Quality Control Scheduling Program. The calibrations reviewed by the inspector were conducted on a timely basis in accordance with this procedure.

The inspector also reviewed the results of the licensee's quarterly cross-check program for 1990 and the quarters for which information was available for 1991. With the exception of a problem with a gross beta analysis, which was noted and in the process of correction, the vendor and licensee were in agreement for all analysis conducted.

Based on this review, the inspector concluded that overall operability of the detectors and program was satisfactory.

No violations or deviations were identified.

3. Radioactive Liquid and Gaseous Effluent Dose Calculations (84750)

The Offsite Dose Calculation Manual (ODCM) establishes the requirements for the Radioactive Effluent and Radiological Environmental Monitoring Programs. This manual includes the methods and parameters for the calculation of offsite doses resulting from radioactive gaseous and liquid effluents. These calculations are performed to verify that the concentrations of effluents to the unrestricted area, and the resultant doses at the site boundary or to the maximum exposed member of the public, will not exceed the applicable regulatory limits.

The inspector reviewed the licensee's radioactive waste effluent dose calculations to determine compliance with requirements in the Offsite Dose Calculation Manual (ODCM) and Technical Specifications 3/4.11.1 and 3/4.11.2.

The inspector conducted initial confirmatory calculations of the offsite doses resulting from the plant's liquid and gaseous radioactive effluent released to the environment. Radioactive waste effluent dose calculations were performed by the inspectors for liquids; noble gases; and airborne tritium, iodines, and particulates using the NRC computer code, PC-DOSE, which was developed to verify the dose calculations described in the licensee's ODCM.

The licensee performed effluent dose calculations using methodologies, assumptions, and equations described in the ODCM and implemented by a computer code supplied by a vendor. The inspector, in cooperation with the licensee's chemistry staff, developed realistic test cases based on typical effluent radionuclide concentrations and release rates for radioactive liquid and gaseous effluent. The inspector and the licensee's chemistry staff performed dose calculations using the same radionuclide concentrations and release rates for two liquid radwaste effluent test cases. The calculated dose results for the liquid radwaste effluents were all in agreement between the licensee and the NRC for the adult total body and adult critical organs for all radionuclides tested. The inspector noted that the licensee's computer code for calculating offsite doses included a dose factor for tritium in the bone which was not included in the dose factor tables for all age groups in Regulatory Guide 1.109. This one aspect of the licensee's computer code was different from the tritium dose factor table used by the NRC. Therefore, this caused the licensee's calculated doses from the liquid radwaste effluent which contained tritium to be slightly greater (conservative) relative to the specific tritium contribution to the radionuclide mixture in the liquid radwaste effluent.

In addition to the radioactive liquid radwaste effluent test cases, a test case for noble gas dose calculations and a test case for airborne tritium, iodines, and particulates dose calculations were performed. The licensee's dose results for the total body gamma-air dose and the total body beta-air dose from exposure to radioactive noble gases were in agreement with the NRC's calculated doses. The inspector observed that the dose results from the total skin and the gamma total body were slightly greater and more conservative than the comparable NRC's calculated dose results. These differences in the dose results between the licensee's results and the NRC's results were determined to be caused by the licensee using calculation equations from NUREG-0133 which did not include the shielding factor (0.7) for residential structures. The comparable NRC dose results were calculated using equations from Regulatory Guide 1.109 which incorporated the residential shielding factor therefore reducing the resulting calculated doses.

The licensee's dose data from the radioactive airborne tritium, iodines, and particulates test case was greater (conservative) when compared to the NRC's dose results. For example, the dose data comparisons between the licensee's and the NRC's calculated doses for the infant age group organs indicated that the licensee's calculated doses were greater than the NRC's calculated doses except for the total body dose which was identical to the NRC's calculated dose. The differences in the calculated dose results were due to the licensee adding the ground plane dose to each of the calculated organ doses resulting from ingestion. The NRC's computer code, PC-DOSE, adds the ground plane dose contribution to only the total body dose. Therefore, if the ground plane dose was added to the NRC's calculated organ doses, the licensee's and the NRC's calculated dose results were identical for all test cases calculated. It was noted that the licensee used NUREG-0133 calculational methodologies to calculate doses resulting from airborne radionuclides. The calculated dose results were compared between the licensee and the NRC for the infant age group (most conservative) using the dose contributions from the ground plane, inhalation, and cow milk ingestion pathways. The licensee used site specific calculation factors of the elemental iodine fraction of iodine (FT) as 1.0 in accordance with the NUREG-0133 default value rather than 0.5 used as the default value in Regulatory Guide 1.109, and the "cow feed fresh pasture grass fraction" (f) was set to 1.0 rather than 0.5 for calculating the dose resulting from the grass-cow-milk ingestion pathway.

The inspector concluded that the licensee's computer calculations of offsite doses resulting from radioactive liquid and gaseous effluent discharged to the environment

were confirmed to be accurate and in accordance with the methods, assumptions, bioaccumulation and dose factors, and equations described and defined in the ODCM.

4. Chemistry (84750)

This area was inspected to determine whether the licensee was adequately controlling the quality of the reactor coolant to ensure long-term integrity of the reactor pressure boundaries and minimize out-of-core radiation field buildup.

Pursuant to this, the inspector reviewed the results of the licensee's program to test the proficiency of the technicians with different types of required analyses. Based on conversations with the licensee the inspector determined that the licensee's program included having every technician analyze a set of solutions spiked with nonradioactive chemical species (boron, fluorides, chlorides, sodium, lithium, iron, copper, sulfates, ammonia, morpholine, silicon, etc.). The inspector reviewed the results for January 1991 to June 1991.

These solutions were prepared in-house. The concentrations of the samples were not revealed to the technicians prior to the analyses; which were performed over several weeks. For the 280 results (approximately) reported, six of the results were greater than the ± two sigma control limit. The technicians who "missed" these results were required to demonstrate proficiency in the required analyses prior to resuming testing of routine samples. The technicians were also randomly selected to participate in a quarterly cross check program with samples provided by an outside vendor. In addition, the technicians were also involved in a daily cross check program were standards with a known concentration were analyzed with each set of samples. The licensee tracked and trended these results on a spread sheet.

The inspector determined, based on this selective review, that the licensee's program for determining the proficiency of their chemistry technicians at performing specified chemical analyses was adequate for its designated purposes. For the areas reviewed, no problems or concerns were identified by the inspector.

The inspector also discussed the licensee's "Laboratory Information Management System," (LIMS). This system was a computer program which appeared to be a very powerful tool for tracking and trending chemistry results. At the time of the inspection, reactor coolant system data was being manually entered into this system. Information from the

count room (radioisotopic analysis results) were automatically entered into this system. This program allowed the trending of the last 30 data points and enhanced tracking and trending of chemistry data. The licensee planned implementing automatic entry of primary system chemistry data early in 1992; and by 1993, the licensee expected to have automatic entry of secondary system chemistry data. The program had protective devices installed that would impede changing or falsifying data. The program also flagged and tracked out-of-specification data, and allowed "electronic mail" to be sent between terminals. The licensee was planning to maintain back-up and "manual" capabilities in this area in the event of a program failure.

The inspector considered the implementation of the LIMS to be a chemistry program strength.

No violations or deviations were identified.

5. Exit

The inspection scope and results were summarized on March 27, 1992 with those persons indicated in Paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results as listed in the summary. No violations or deviations were identified. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

ATTACHMENT 1

TABLE 1

CRYSTAL RIVER - MARCH 24, 1992
NRC-LICENSEE SAMPLE COMPARISON DATA

Reactor Coolant Sample

Detector # 1

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CS-134 | 4.38E-03 | 4.82E-03 +- 4.03E-04 | 12 | 1.20 | Agreement |
| CS-137 | 6.63E-03 | 6.39E-03 +- 4.14E-04 | 16 | 1.04 | Agreement |
| I-131 | 2.80E-02 | 2.47E-02 +- 1.91E-03 | 13 | 1.13 | Agreement |
| I-132 | 1.54E-01 | 1.68E-01 +- 8.38E-03 | 20 | 0.92 | Agreement |
| I-133 | 1.54E-01 | 1.52E-01 +- 7.23E-03 | 22 | 1.01 | Agreement |
| I-135 | 2.27E-01 | 2.14E-01 +- 8.15E-03 | 27 | 1.06 | Agreement |
| TC-99M | 2.40E-03 | 1.50E-03 +- 3.16E-04 | 5 | 1.60 | Agreement |

Detector # 2

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CS-134 | 5.07E-03 | 4.82E-03 +- 4.03E-04 | 12 | 1.05 | Agreement |
| CS-137 | 6.48E-03 | 6.39E-03 +- 4.14E-04 | 16 | 1.01 | Agreement |
| I-131 | 2.59E-02 | 2.47E-02 +- 1.91E-03 | 13 | 1.05 | Agreement |
| I-132 | 1.46E-01 | 1.68E-01 +- 8.38E-03 | 20 | 0.87 | Agreement |
| I-133 | 1.47E-01 | 1.52E-01 +- 7.23E-03 | 22 | 0.97 | Agreement |
| I-135 | 2.23E-01 | 2.14E-01 +- 8.15E-03 | 27 | 1.04 | Agreement |
| TC-99M | 2.54E-03 | 1.50E-03 +- 3.16E-04 | 5 | 1.70 | Agreement |

Detector # 3

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CS-134 | 4.95E-03 | 4.82E-03 +- 4.03E-04 | 12 | 1.03 | Agreement |
| CS-137 | 6.29E-03 | 6.39E-03 +- 4.14E-04 | 16 | 0.98 | Agreement |
| I-131 | 2.67E-02 | 2.47E-02 +- 1.91E-03 | 13 | 1.08 | Agreement |
| I-132 | 1.49E-01 | 1.68E-01 +- 8.38E-03 | 20 | 0.89 | Agreement |
| I-133 | 1.53E-01 | 1.52E-01 +- 7.23E-03 | 22 | 1.01 | Agreement |
| I-135 | 2.32E-01 | 2.14E-01 +- 8.15E-03 | 27 | 1.08 | Agreement |
| TC-99M | 1.64E-03 | 1.50E-03 +- 3.16E-04 | 5 | 1.09 | Agreement |

Evaporator Condensate Storage Tank

Detector # 1

| Isotope | Concentration (uCi/unit) Licensee | NRC | Reso-lution | Ratio | Comparison |
|---|---|---|---|---|---|
| CO-58 | 7.01E-06 | 7.55E-06 +- 5.04E-07 | 15 | 0.93 | Agreement |
| CS-134 | 1.38E-06 | 1.36E-06 +- 2.43E-07 | 6 | 1.01 | Agreement |
| CS-137 | 1.82E-06 | 1.93E-06 +- 2.64E-07 | 7 | 0.94 | Agreement |
| TC-99M | 1.37E-06 | 1.31E-06 +- 1.50E-07 | 9 | 1.04 | Agreement |

Detector # 2

| Isotope | Concentration (uCi/unit) Licensee | NRC | Reso-lution | Ratio | Comparison |
|---|---|---|---|---|---|
| CO-58 | 7.10E-06 | 7.55E-06 +- 5.04E-07 | 15 | 0.94 | Agreement |
| CS-134 | 1.46E-06 | 1.36E-06 +- 2.43E-07 | 6 | 1.07 | Agreement |
| CS-137 | 2.08E-06 | 1.93E-06 +- 2.64E-07 | 7 | 1.08 | Agreement |
| TC-99M | 1.62E-06 | 1.31E-06 +- 1.50E-07 | 9 | 1.24 | Agreement |

Detector # 3

| Isotope | Concentration (uCi/unit) Licensee | NRC | Reso-lution | Ratio | Comparison |
|---|---|---|---|---|---|
| CO-58 | 6.78E-06 | 7.55E-06 +- 5.04E-07 | 15 | 0.90 | Agreement |
| CS-134 | 1.43E-06 | 1.36E-06 +- 2.43E-07 | 6 | 1.05 | Agreement |
| CS-137 | 1.73E-06 | 1.93E-06 +- 2.64E-07 | 7 | 0.90 | Agreement |
| TC-99M | 1.42E-06 | 1.31E-06 +- 1.50E-07 | 9 | 1.08 | Agreement |

Waste Gas Decay Tank
Results of licensee's second sample

Detector # 1

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| KR-85 | 5.89E-03 | 5.80E-03 +- 5.08E-04 | 11 | 1.02 | Agreement |
| XE-131M | 4.61E-04 | 4.08E-04 +- 4.49E-05 | 9 | 1.13 | Agreement |
| XE-133 | 2.73E-02 | 3.09E-02 +- 8.89E-04 | 34 | 0.88 | Agreement |
| XE-133M | 1.88E-04 | 1.85E-04 +- 1.26E-05 | 14 | 1.02 | Agreement |
| XE-135 | 1.20E-04 | 1.02E-04 +- 4.57E-06 | 20 | 1.18 | Agreement |

Detector # 2

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| KR-85 | 4.76E-03 | 5.80E-03 +- 5.08E-04 | 11 | 0.82 | Agreement |
| XE-131M | 5.36E-04 | 4.08E-04 +- 4.49E-05 | 9 | 1.31 | Agreement |
| XE-133 | 2.77E-02 | 3.09E-02 +- 8.89E-04 | 34 | 0.90 | Agreement |
| XE-133M | 1.82E-04 | 1.85E-04 +- 1.26E-05 | 14 | 0.98 | Agreement |
| XE-135 | 1.20E-04 | 1.02E-04 +- 4.57E-06 | 20 | 1.18 | Agreement |

Detector # 3

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| KR-85 | 5.37E-03 | 5.80E-03 +- 5.08E-04 | 11 | 0.92 | Agreement |
| XE-131M | 4.25E-04 | 4.08E-04 +- 4.49E-05 | 9 | 1.04 | Agreement |
| XE-133 | 2.84E-02 | 3.09E-02 +- 8.89E-04 | 34 | 0.92 | Agreement |
| XE-133M | 2.06E-04 | 1.85E-04 +- 1.26E-05 | 14 | 1.13 | Agreement |
| XE-135 | 1.21E-04 | 1.02E-04 +- 4.57E-06 | 20 | 1.19 | Agreement |

Reactor Coolant Crud

Detector: Health Physics

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| BA-140 | 1.80E-05 | 1.75E-05 +- 4.10E-06 | 4 | 1.03 | Agreement |
| CE-141 | 2.16E-06 | 1.94E-06 +- 3.25E-07 | 6 | 1.11 | Agreement |
| CO-58 | 2.99E-04 | 2.53E-04 +- 9.03E-06 | 28 | 1.18 | Agreement |
| CO-60 | 1.62E-05 | 1.16E-05 +- 1.10E-06 | 10 | 1.40 | Agreement |
| CR-51 | 1.48E-04 | 1.37E-04 +- 2.36E-05 | 6 | 1.08 | Agreement |
| CS-134 | 1.84E-05 | 1.57E-05 +- 1.46E-06 | 10 | 1.17 | Agreement |
| CS-137 | 2.44E-05 | 2.03E-05 +- 1.93E-06 | 11 | 1.20 | Agreement |
| I-131 | 4.75E-05 | 4.06E-05 +- 3.29E-06 | 12 | 1.17 | Agreement |
| I-133 | 2.73E-04 | 2.34E-04 +- 1.18E-05 | 20 | 1.17 | Agreement |
| I-135 | 3.50E-04 | 2.81E-04 +- 2.80E-05 | 10 | 1.25 | Agreement |
| MN-54 | 9.14E-06 | 1.06E-05 +- 9.15E-07 | 12 | 0.86 | Agreement |
| NB-95 | 1.66E-05 | 1.39E-05 +- 1.34E-06 | 11 | 1.19 | Agreement |
| TC-99M | 1.09E-05 | 7.10E-05 +- 6.45E-06 | 11 | 0.15 | Agreement |
| TE-132 | 7.58E-06 | 6.61E-06 +- 6.42E-07 | 10 | 1.15 | Agreement |
| ZR-95 | 1.71E-05 | 1.76E-05 +- 1.48E-06 | 12 | 0.97 | Agreement |
| ZR-97 | | 2.10E-05 +- 2.33E-06 | 9 | | No Comparison |

Detector # 1

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| BA-140 | 1.32E-05 | 1.75E-05 +- 4.10E-06 | 4 | 0.75 | Agreement |
| CE-141 | 2.64E-06 | 1.94E-06 +- 3.25E-07 | 6 | 1.36 | Agreement |
| CO-58 | 3.01E-04 | 2.53E-04 +- 9.03E-06 | 28 | 1.19 | Agreement |
| CO-60 | 1.40E-05 | 1.16E-05 +- 1.10E-06 | 10 | 1.21 | Agreement |
| CR-51 | 1.32E-04 | 1.37E-04 +- 2.36E-05 | 6 | 0.96 | Agreement |
| CS-134 | 1.46E-05 | 1.57E-05 +- 1.46E-06 | 10 | 0.93 | Agreement |
| CS-137 | 1.83E-05 | 2.03E-05 +- 1.93E-06 | 11 | 0.90 | Agreement |
| I-131 | 4.52E-05 | 4.06E-05 +- 3.29E-06 | 12 | 1.11 | Agreement |
| I-133 | 2.60E-04 | 2.34E-04 +- 1.18E-05 | 20 | 1.11 | Agreement |
| I-135 | 3.53E-04 | 2.81E-04 +- 2.80E-05 | 10 | 1.26 | Agreement |
| MN-54 | 1.18E-05 | 1.06E-05 +- 9.15E-07 | 12 | 1.11 | Agreement |
| NB-95 | 1.59E-05 | 1.39E-05 +- 1.34E-06 | 11 | 1.14 | Agreement |
| TC-99M | 1.02E-04 | 7.10E-05 +- 6.45E-06 | 11 | 1.44 | Agreement |
| TE-132 | 8.05E-06 | 6.61E-06 +- 6.42E-07 | 10 | 1.22 | Agreement |
| ZR-95 | 1.70E-05 | 1.76E-05 +- 1.48E-06 | 12 | 0.97 | Agreement |
| ZR-97 | 2.56E-05 | 2.10E-05 +- 2.33E-06 | 9 | 1.22 | Agreement |

Detector # 2

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| BA-140 | 1.52E-05 | 1.75E-05 +- 4.1JE-06 | 4 | 0.87 | Agreement |
| CE-141 | 2.97E-06 | 1.94E-06 +- 3.25E-07 | 6 | 1.53 | Agreement |
| CO-58 | 2.96E-04 | 2.53E-04 +- 9.03E-06 | 28 | 1.17 | Agreement |
| CO-60 | 1.46E-05 | 1.16E-05 +- 1.10E-06 | 10 | 1.26 | Agreement |
| CR-51 | 1.46E-04 | 1.37E-04 +- 2.36E-05 | 6 | 1.07 | Agreement |
| CS-134 | 1.30E-05 | 1.57E-05 +- 1.46E-06 | 10 | 0.83 | Agreement |
| CS-137 | 1.64E-05 | 2.03E-05 +- 1.93E-06 | 11 | 0.81 | Agreement |
| I-131 | 4.48E-05 | 4.06E-05 +- 3.29E-06 | 12 | 1.10 | Agreement |
| I-133 | 2.56E-04 | 2.34E-04 +- 1.18E-05 | 20 | 1.09 | Agreement |
| I-135 | 4.30E-04 | 2.81E-04 +- 2.80E-05 | 10 | 1.53 | Agreement |
| MN-54 | 1.23E-05 | 1.06E-05 +- 9.15E-07 | 12 | 1.16 | Agreement |
| NB-95 | 1.59E-05 | 1.39E-05 +- 1.34E-06 | 11 | 1.14 | Agreement |
| TC-99M | 7.92E-05 | 7.10E-05 +- 6.45E-06 | 11 | 1.12 | Agreement |
| TE-132 | 7.87E-06 | 6.61E-06 +- 6.42E-07 | 10 | 1.19 | Agreement |
| ZR-95 | 1.63E-05 | 1.76E-05 +- 1.48E-06 | 12 | 0.93 | Agreement |
| ZR-97 | 1.94E-05 | 2.10E-05 +- 2.33E-06 | 9 | 0.92 | Agreement |

Detector # 3

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| BA-140 | 1.86E-05 | 1.75E-05 +- 4.10E-06 | 4 | 1.06 | Agreement |
| CE-141 | 2.58E-06 | 1.94E-06 +- 3.25E-07 | 6 | 1.33 | Agreement |
| CO-58 | 2.92E-04 | 2.53E-04 +- 9.03E-06 | 28 | 1.15 | Agreement |
| CO-60 | 1.52E-05 | 1.16E-05 +- 1.10E-06 | 10 | 1.31 | Agreement |
| CR-51 | 1.41E-04 | 1.37E-04 +- 2.36E-05 | 6 | 1.03 | Agreement |
| CS-134 | 1.38E-05 | 1.57E-05 +- 1.46E-06 | 10 | 0.88 | Agreement |
| CS-137 | 1.62E-05 | 2.03E-05 +- 1.93E-06 | 11 | 0.80 | Agreement |
| I-131 | 4.42E-05 | 4.06E-05 +- 3.29E-06 | 12 | 1.09 | Agreement |
| I-133 | 2.57E-04 | 2.34E-04 +- 1.18E-05 | 20 | 1.10 | Agreement |
| I-135 | 3.85E-04 | 2.81E-04 +- 2.80E-05 | 10 | 1.37 | Agreement |
| MN-54 | 9.91E-06 | 1.06E-05 +- 9.15E-07 | 12 | 0.93 | Agreement |
| NB-95 | 1.61E-05 | 1.39E-05 +- 1.34E-06 | 11 | 1.16 | Agreement |
| TC-99M | 1.07E-04 | 7.10E-05 +- 6.45E-06 | 11 | 1.51 | Agreement |
| TE-132 | 7.30E-06 | 6.61E-06 +- 6.42E-07 | 10 | 1.10 | Agreement |
| ZR-95 | 1.67E-05 | 1.76E-05 +- 1.48E-06 | 12 | 0.95 | Agreement |
| ZR-97 | 2.08E-05 | 2.10E-05 +- 2.33E-06 | 9 | 0.99 | Agreement |

Charcoal Cartridge (NRC spike, CP100)

Detector: Health Physics

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CD-109 | 3.62E-01 | 4.57E-01 +- 1.29E-02 | 35 | 0.79 | Agreement |
| CE-139 | 3.15E-03 | 3.04E-03 +- 1.59E-04 | 19 | 1.04 | Agreement |
| CO-57 | 6.47E-03 | 6.78E-03 +- 2.26E-04 | 29 | 0.95 | Agreement |
| CO-60 | 4.45E-02 | 4.45E-02 +- 1.55E-03 | 28 | 1.00 | Agreement |
| CS-137 | 4.72E-02 | 4.61E-02 +- 2.04E-03 | 23 | 1.02 | Agreement |
| SN-113 | 4.17E-03 | 4.36E-03 +- 3.04E-04 | 15 | 0.96 | Agreement |
| Y-88 | 5.58E-03 | 5.49E-03 +- 3.07E-04 | 18 | 1.02 | Agreement |

Detector #1

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CD-109 | 3.65E-01 | 4.57E-01 +- 1.29E-02 | 35 | 0.80 | Agreement |
| CE-139 | 3.04E-03 | 3.04E-03 +- 1.59E-04 | 19 | 1.00 | Agreement |
| CO-57 | 6.36E-03 | 6.78E-03 +- 2.26E-04 | 29 | 0.94 | Agreement |
| CO-60 | 4.34E-02 | 4.45E-02 +- 1.55E-03 | 28 | 0.98 | Agreement |
| CS-137 | 4.57E-02 | 4.61E-02 +- 2.04E-03 | 23 | 0.99 | Agreement |
| SN-113 | 4.00E-03 | 4.36E-03 +- 3.04E-04 | 15 | 0.92 | Agreement |
| Y-88 | 5.40E-03 | 5.49E-03 +- 3.07E-04 | 18 | 0.98 | Agreement |

Detector #2

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CD-109 | 3.77E-01 | 4.57E-01 +- 1.29E-02 | 35 | 0.82 | Agreement |
| CE-139 | 3.16E-03 | 3.04E-03 +- 1.59E-04 | 19 | 1.04 | Agreement |
| CO-57 | 6.46E-03 | 6.78E-03 +- 2.26E-04 | 29 | 0.95 | Agreement |
| CO-60 | 4.33E-02 | 4.45E-02 +- 1.55E-03 | 28 | 0.97 | Agreement |
| CS-137 | 4.61E-02 | 4.61E-02 +- 2.04E-03 | 23 | 1.00 | Agreement |
| SN-113 | 4.16E-03 | 4.36E-03 +- 3.04E-04 | 15 | 0.95 | Agreement |
| Y-88 | 5.75E-03 | 5.49E-03 +- 3.07E-04 | 18 | 1.05 | Agreement |

Detector #3

| Isotope | Concentration (uCi/unit) Licensee | NRC | Resolution | Ratio | Comparison |
|---|---|---|---|---|---|
| CD-109 | 3.63E-01 | 4.57E-01 +- 1.29E-02 | 35 | 0.79 | Agreement |
| CE-139 | 3.09E-03 | 3.04E-03 +- 1.59E-04 | 19 | 1.02 | Agreement |
| CO-57 | 6.44E-03 | 6.78E-03 +- 2.26E-04 | 29 | 0.95 | Agreement |
| CO-60 | 4.39E-02 | 4.45E-02 +- 1.55E-03 | 28 | 0.99 | Agreement |
| CS-137 | 4.57E-02 | 4.61E-02 +- 2.04E-03 | 23 | 0.99 | Agreement |
| SN-113 | 4.08E-03 | 4.36E-03 +- 3.04E-04 | 15 | 0.94 | Agreement |
| Y-88 | 5.62E-03 | 5.49E-03 +- 3.07E-04 | 18 | 1.02 | Agreement |

Gas Marinelli (NRC spike)

Detector: Health Physics

| Isotope | Concentration (uCi/unit) Licensee | NRC | Reso-lution | Ratio | Comparison |
|---|---|---|---|---|---|
| CD-109 | 1.68E+00 | 1.98E+00 +- 5.33E-02 | 40 | 0.85 | Agreement |
| CE-139 | 1.44E-02 | 1.29E-02 +- 4.65E-04 | 26 | 1.12 | Agreement |
| CO-57 | 3.00E-02 | 3.00E-02 +- 9.12E-04 | 33 | 1.00 | Agreement |
| CO-60 | 2.08E-01 | 1.99E-01 +- 6.19E-03 | 33 | 1.04 | Agreement |
| CS-137 | 2.20E-01 | 2.04E-01 +- 7.80E-03 | 26 | 1.08 | Agreement |
| SN-113 | 1.95E-02 | 1.77E-02 +- 9.75E-04 | 18 | 1.10 | Agreement |
| SR-85 | 2.23E-03 | 2.63E-03 +- 3.07E-04 | 8 | 0.85 | Agreement |

ATTACHMENT 2

CRITERIA FOR COMPARISONS OF ANALYTICAL MEASUREMENTS

This attachment provides criteria for the comparison of results of analytical radioactivity measurements. These criteria are based on empirical relationships which combine prior experience in comparing radioactivity analyses, the measurement of the statistically random process of radioactive emission, and the accuracy needs of this program.

In these criteria, the "Comparison Ratio Limits"[1] denoting agreement or disagreement between licensee and NRC results are variable. This variability is a function of the ratio of the NRC's analytical value relative to its associated statistical and analytical uncertainty, referred to in this program as "Resolution"[2].

For comparison purposes, a ratio between the licensee's analytical value and the NRC's analytical value is computed for each radionuclide present in a given sample. The computed ratios are then evaluated for agreement or disagreement based on "Resolution." The corresponding values for "Resolution" and the "Comparison Ratio Limits" are listed in the Table below. Ratio values which are either above or below the "Comparison Ratio Limits" are considered to be in disagreement, while ratio values within or encompassed by the "Comparison Ratio Limits" are considered to be in agreement.

TABLE

NRC Confirmatory Measurements Acceptance Criteria
Resolution vs. Comparison Ratio Limits

| Resolution | Comparison Ratio Limits 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 |

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

[2]Resolution = $\frac{\text{NRC Reference Value}}{\text{Associated Uncertainty}}$