



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W., SUITE 3100
ATLANTA, GEORGIA 30303

Report Nos: 50-259/83-11, 50-260/83-11, and 50-296/83-11

Licensee: Tennessee Valley Authority
500A Chestnut Street
Chattanooga, TN 37401

Docket Nos: 50-259, 50-260 and 50-296

License Nos: DPR-33, DPR-52, and DPR-68

Facility Name: Browns Ferry 1, 2, and 3

Inspection at Browns Ferry site near Decatur, Alabama

Inspectors: D. M. Montgomery for 5-20-83
G. B. Kuzo Date Signed

D. M. Montgomery 5-20-83
D. M. Montgomery Date Signed

Accompanying Personnel: P. C. McPhail

Approved by: A. F. Gibson 5/23/83
A. F. Gibson, Chief Date Signed
Operational Programs Branch
Division of Engineering and Operational Programs

SUMMARY

Inspection on April 11 - 15, 1983

Areas Inspected

This routine, unannounced inspection involved 112 inspector-hours on site in the areas of quality control and confirmatory measurements including: review of the laboratory quality control program; review of chemistry and radiochemistry procedures; review of quality control records and logs; and comparison of the results of split samples analyzed by the licensee and NRC RII Mobile Laboratory.

Results

Of the four areas inspected, one apparent violation was found in one area (inadequate surveys and failure to have a calibration procedure for efficiency calibration of gamma spectroscopy systems).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *J. A. Coffey, Plant Superintendent
- *J. E. Swindell, Assistant Plant Manager
- *J. R. Pittman, Assistant Plant Manager
- *D. C. Mims, Engineering Supervisor
- *A. Clement, Chemical Unit Supervisor
- *T. L. Chinn, Compliance Supervisor
- *T. S. Sharpe, Nuclear Chemist
- *L. Turner, Nuclear Chemist

NRC Resident Inspector

- *R. C. Butcher (Acting)

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on April 15, 1983, with those persons indicated in paragraph 1 above. Licensee representatives acknowledged the violation. The licensee representatives agreed to provide a detailed evaluation of the radiochemistry laboratory gamma spectroscopy systems to the NRC Region II Office by May 23, 1983, and agreed to discontinue use of the Ge(Li) associated with Select Code 3 until a recalibration of the system is conducted. The inspector noted that implementation of an improved laboratory quality assurance program should be expedited. Licensee representatives agreed to perform H-3, Sr-89, and Sr-90 analyses on a spiked sample to be provided by the NRC and report the results to the NRC RII Office.

3. Licensee Action on Previous Enforcement Matters

(Closed) Unresolved (259/81-30-20, 260/81-30-02, 296/81-30-02) Failure to implement a quality assurance program using the guidance in Regulatory Guide 4.15. A review of this issue by NRC management determined that the audit requirement was not an implicit requirement to meet the criteria of Regulatory Guide 4.15.

4. Laboratory Quality Assurance Program

- a. The inspector discussed with cognizant licensee representatives the changes in the laboratory quality assurance program since the previous inspection (IE Inspection Report 50-259/81-30). The position of nuclear chemist had been created in response to the need for a person

to be responsible for operation of the counting room and implementation of a quality control program including daily performance checks, instrument calibration, and interlaboratory crosschecks. During the previous inspection the need to improve the quality assurance program using guidance of Regulatory Guide 4.15 was identified. The TVA Office of Nuclear Power issued a Division Procedure Manual (DPM) N79E2 which includes requirements for the Laboratory Quality Control Program. This DPM provides program requirements for TVA facilities to meet the general criteria of Regulatory Guide 4.15. Licensee representatives stated that the laboratory quality assurance program is being revised to implement DPM N79E2, Section III and should be operational by July 1983. Implementation of the revised quality assurance program in accordance with DPM N79E2 will be reviewed during a subsequent inspection (259/83-11-01, 260/83-11-01, 296/83-11-01).

- b. The inspector discussed with licensee representatives the qualifications and duties of the nuclear chemist. The major duties of the nuclear chemist position includes responsibility for development and implementation of quality control procedures associated with the radiochemistry counting room. The inspector determined from discussion with cognizant licensee representatives that additional technical training in radiological measurements has been provided for the nuclear chemists at BFNP. This closes a previously identified inspector followup item (50-259/81-30-01, 260/81-30-01, 296/81-30-01).
- c. The inspector reviewed the most recent audit performed by the Office of Power Quality and Audit Staff (OPQAA), Audit No. CH-8200-12, dated September 1 - 24, 1982. This audit reviewed activities related to the radiological effluent monitoring program against DPM N79E2 Section III, "Laboratory Quality Control Program," Rev. 6/29/82. Audit recommendations included the following: review of conformance of BFNP laboratory QC program to requirements of DPM N79E2; incorporation and implementation of subject program elements into the laboratory QC procedures: review of the laboratory QC program against Regulatory Guide 4.15 and incorporation of subject elements in the laboratory QC procedures. As noted in paragraph 4.a the quality assurance program is being revised to meet the criteria established in DPM N79E2, and should be in operation by July 1983. The inspector had no further questions regarding the audits.

5. Review of Radiochemistry Procedures

The inspector reviewed selected portions of the following procedures:

| | | |
|-------------|---|----------|
| BF RLM 500 | Radiochemical Laboratory Quality Control | 5/05/76 |
| BF TLM 700 | Sampling and Data Reduction | 6/03/76 |
| BF RLM 900 | Methods of Analysis - Analytical Procedures | 6/07/76 |
| BF RLM 1200 | Operation of Counting Room Equipment | 10/15/76 |

RLM 1202.26 Chi Square Test, 8/12/82 was modified to include the Chi-Square confidence limits, i.e. 99% level that must be met for daily checks of the low background gas flow proportional counter. This closes a previously identified inspector followup item (259/81-30-04, 260/81-30-04, 296/81-30-04).

6. Review of Records and Logs

a. The inspector reviewed the following records and logs:

- (1) Low Background Gas Proportional Daily Quality Control Records January 1981 - April 12, 1983
- (2) Low Background Gas Proportional Counter Quality Control Records for Individual and Service Samples January 1981 - April 12, 1983
- (3) Ge(Li) and Canberra Analyzer Quality Control Records, SC2 and SC3 January 1982 - April 12, 1983 and SCI January 1982 - October 19, 1982.
- (4) Ge(Li) Efficiency Calibration Data for 1982
- (5) Browns Ferry Nuclear Plant - Laboratory QC Program - Radiochemical Cross Check Results for June - December 1982

Review of the records and logs were discussed with cognizant licensee representatives as noted in paragraph 6b-c.

- b. During the review the inspector noted that efficiency calibration and daily quality control documentation were not readily available. The inspector noted that appropriate records to document counting room quality assurance activities should be maintained for a minimum of one year in the counting room laboratory for review by the nuclear chemist and appropriate management. The inspector noted that the lack of adequate calibration records and management review contributed to problems identified in paragraph 7b. Licensee representatives stated that record retention is being reviewed as part of the quality assurance program revision.
- c. The inspector reviewed the analytical results of crosscheck samples provided by the TVA Power Operations Training Center POTC. The inspector noted problems associated with selected gamma isotopic and also for Sr-89 and Sr-90 results. Licensee representatives reported that problems associated with gamma isotopic data were attributed to failure of the computer system to resolve doublets. Implementation of the new gamma spectroscopy systems should correct this problem. Licensee representatives stated that Sr-89 and Sr-90 analyses are now conducted by outside laboratories due to the problems identified by the crosscheck program. The inspector had no further questions regarding this item.

7. Confirmatory Measurements

- a. During the inspection liquid and gaseous samples were collected and split with the licensee for analysis by gamma ray spectroscopy. Samples included the following: floor drain sample tank; millipore, and anion filters from a reactor coolant sample; spiked particulate filter sample; pretreatment offgas samples; main stack gaseous sample; and plant vent charcoal cartridges. Comparison of licensee and NRC gamma spectroscopy results are listed in Table 1 with the acceptance criteria in Attachment 1. For filter and liquid samples the licensee results were in agreement or possible agreement for all radionuclides. Disagreements for Kr-85m were noted for pretreatment gas samples. Kr-85m and Kr-88 results for analyses of a gas sample from the main stack were in disagreement for Kr-85m and Kr-88 for Select Code 2. The disagreements were partially attributable to the failure of the licensee's system to resolve doublets or photopeaks with similar energies. This problem will be resolved with new equipment as discussed in paragraph 7e. All radionuclides except Xe-133, were in disagreement using Select Code 3. Charcoal plant vent analyses for I-131 were in disagreement for Select Code 2. A detailed review of the licensee's calibration of the gamma spectroscopy systems is discussed in paragraph 7.c - 7.d.
- b. The inspector reviewed the efficiency records for the gamma spectroscopy systems that were being used for measuring radioactivity in effluent samples. The inspector noted that the efficiency factors for charcoal cartridges associated with the gamma spectroscopy system designated as Select Code 2 did not agree with the efficiency calibration data supplied by the TVA Power Operations Training Center (POTC). The detector associated with Select Code 2 had been calibrated as part of the POTC detector exchange program. The efficiency calibration records were incomplete with no documentation as to the actual data entered into Select Code 2. No current efficiency calibration records for Select Code 3 could be located. In addition, the analyses of split samples discussed in paragraph 7a showed significant differences for a charcoal cartridge and a stack gas sample counted with Select Code 2 and Select Code 3. Since no efficiency calibration records could be located for Select Code 3, the system was taken out of service. During the inspection licensee representatives reviewed the calibration data for the GeLi detector associate with Select Code 2 and updated the system with the correct efficiency data.

The inspector noted that measurements of liquid and airborne effluents being conducted with Select Code 3 and previous measurements with Select Code 2 would be in error, however, an accurate evaluation of the errors associated with survey could not be determined during the inspection. Licensee representatives agreed to perform an evaluation of the status of the gamma spectroscopy efficiency calibrations between

October, 1981 and the present, and provide the results of this evaluation to the NRC by May 23, 1983. This evaluation will include:

- (1) Summary of calibration history for all gamma spectroscopy systems used during the referenced evaluation period including details of how and when they were calibrated.
- (2) Comparison of efficiency calibration data for Select Code 2 and Select Code 3 in the "as found" condition on April 14, 1983, with the appropriate efficiency calibration data.
- (3) Errors associated with all measurements made by gamma spectroscopy and their effect on effluent accountability and regulatory limits including health physics applications.

The inspector determined from discussions with licensee representatives that there was no approved procedure for efficiency calibrations of the gamma spectroscopy systems. The detector associated with Select Code 2 controls had been in service since July 1982 but there were no procedural controls or instructions for transferring and verifying the detector calibration data for the system. In addition there were no provisions for documenting and retaining the data associated with the efficiency calibrations. The need for improved operating procedures for operation and calibration of the gamma spectroscopy systems had been previously identified by the NRC (259/81-30-03, 260/81-30-03, 296/81-30-03). The failure of the licensee to initiate corrective action contributed to current problems.

The inspector informed licensee representatives that failure to properly calibrate the gamma spectroscopy systems in accordance with approved procedures and the use of improperly calibrated instruments to perform radiation surveys of effluents was a violation of Technical Specification 6.9.3.A that requires approved radiation control procedures and 10 CFR 20.211 that requires surveys as necessary to demonstrate compliance with 10 CFR 20.106 which limits the release of radioactivity (259/83-11-02, 260/83-11-02, 296/83-11-02).

- c. The inspector reviewed the efficiency calibration procedures for gas Marinelli samples and noted that liquid standards were used for efficiency calibrations of gas geometries. The inspector noted that this would result in reporting higher concentrations than actually present. Licensee representatives agreed to improve gas calibration techniques. This item will be reviewed in a subsequent inspection (259/83-11-03, 260/83-11-03, 296/83-11-03).
- d. The inspector discussed the plate out and efficiency correction factors utilized in analyses of plant vent charcoal cartridges for radioiodine and noted that they should be consistent with the efficiency calibration techniques used. Since the POTC is now calibrating the detectors,

this area needs to be reviewed to ensure the validity of current correction factors. In addition the calibration techniques should utilize charcoal standards that are representative of plant samples. This closes out a previously identified inspector followup item. (259/81-30-05, 260/81-30-05, 296/81-30-05). Licensee representatives agreed to perform plant specific studies to determine appropriate detector calibrations for charcoal cartridges. This will be carried as an inspector followup item (259/83-11-04, 260/83-11-04, 296/83-11-04).

- e. The inspector discussed with licensee representatives the progress in upgrading the computer-based gamma spectroscopy system. The equipment has been received and personnel are presently undergoing training on the new system prior to installation in the BFNP radiochemistry laboratory. This area will be reviewed during a subsequent inspection.

TABLE I

RESULTS OF CONFIRMATORY MEASUREMENTS AT BFNP, 4/11-15/83

| SAMPLE | NUCLIDE | CONCENTRATION, MICROCURIES/CC | | RATIO BFNP/NRC | RESOLUTION | COMPARISON |
|------------|---------|----------------------------------|--------------|-------------------|------------|----------------|
| | | LICENSEE | NRC | | | |
| Floor | I-131 | 2.34 E-5 | 2.52±.03 E-5 | .93 | 84 | Agreement |
| Drain | I-132 | NI | 8.0±.3 E-6 | - | - | - |
| Tank | I-133 | 7.02 E-5 | 7.04±.05 E-5 | 1.0 | 104 | Agreement |
| 4-13-83 at | I-135 | 3.6 E-5 | 4.7±0.3 E-5 | .77 | 14 | Agreement |
| 11:30 | Na-24 | 4.4 E-5 | 4.9±0.2 E-5 | .90 | 25 | Agreement |
| | Tc-99m | 1.48 E-6 | 1.3±0.1 E-6 | 1.14 | 13 | Agreement |
| | La-140 | 1.44 E-6 | 1.6±0.1 E-6 | .88 | 16 | Agreement |
| | Np-239 | NI* | 8.8±1.0 E-6 | - | - | - |
| U-3 | Cr 51 | 2.0 E-3 | 1.89±.03 E-3 | 1.05 | 63 | Agreement |
| Reactor | I-131 | 3.7 E-5 | 3.81±.3 E-5 | .97 | 13 | Agreement |
| Coolant | I-132 | 1.21 E-3 | 1.02±.01 E-3 | 1.18 | 102 | Agreement |
| Anion | I-133 | 3.91 E-4 | 4.34±.06 E-4 | .90 | 72 | Agreement |
| Filter | I-134 | 3.51 E-3 | 2.80±.1 E-3 | 1.26 | 28 | Agreement |
| | I-135 | 8.41 E-4 | 8.51±.6 E-4 | .99 | 14 | Agreement |
| Reactor | Na-24 | 5.13 E-3 | 4.52±.03 E-3 | 1.13 | 150 | Agreement |
| Coolant | Mn-54 | 5.1 E-5 | 4.0±0.4 E-5 | 1.27 | 10 | Agreement |
| Cation | Mn-56 | 5.8 E-3 | 5.0±.04 E-3 | 1.15 | 125 | Agreement |
| Filter | Co-58 | 9.1 E-5 | 9.1±.06 E-5 | 1.0 | 15 | Agreement |
| 4-12-83 | Co-60 | 1.1 E-5 | 8.6±.6 E-5 | 1.28 | 14 | Agreement |
| | Co-64 | 6.0 E-3 | 7.1± 1 E-3 | .86 | 7 | Agreement |
| | Zn-65 | 2.9 E-4 | 2.3±0.2 E-4 | 1.26 | 11 | Agreement |
| | Zn-69m | 2.3 E-5 | 2.6±0.4 E-5 | .88 | 6 | Agreement |
| | Np-239 | 1.2 E-4 | 7.3±1.9 E-5 | 1.64 | 4 | Agreement |
| | Sr-92 | 3.5 E-4 | 3.1±.2 E-4 | 1.13 | 15 | Agreement |
| | Tc-99m | 2.44E-4 | 2.25±.04 E-4 | 1.08 | 55 | Agreement |
| | Ba-139 | 1.4 E-4 | 3.0±0.6 E-4 | .47 | 5 | Pos. Agreement |

*NI Not Identified

TABLE I (Continued)

| SAMPLE | ISOTOPE | CONCENTRATION, MICROCURIES/CC | | RATIO BFNP/NRC | RESOLUTION | COMPARISON |
|--|----------|----------------------------------|---------------|-------------------|------------|----------------|
| | | LICENSEE | NRC | | | |
| Millipore Filter Reactor Coolant Unit 3 4-12-83 at 11:15 | Cr-51 | 1.1 E-4 | 1.1±0.2 E-4 | 1.0 | 5 | Agreement |
| | Mn-54 | 1.8 E-5 | 1.2±0.2 E-5 | 1.5 | 6 | Agreement |
| | Mn-56 | 1.4 E-3 | 1.26±0.0±E-3 | 1.11 | 126 | Agreement |
| | Co-58 | 2.3 E-5 | 1.80±0.1 E-5 | 1.27 | 18 | Agreement |
| | Co-60 | 2.6 E-5 | 2.4±0.2 E-5 | 1.08 | 12 | Agreement |
| | Cu-64 | 5.3 E-3 | 6.8±0.5 E-3 | .78 | 14 | Agreement |
| | Zn-65 | 7.8 E-5 | 7.4±0.4 E-5 | 1.05 | 20 | Agreement |
| | Zn-69m | 8.8 E-6 | 8.8±1.6 E-6 | 1.0 | 5 | Agreement |
| | Nb-95 | 1.5 E-5 | 1.2±0.2 E-5 | 1.25 | 6 | Agreement |
| | Nb-97 | 5.0 E-5 | 1.1±0.1 E-4 | .45 | 11 | Pos. Agreement |
| | Tc-99M | 4.3 E-5 | 4.1±0.1 E-5 | 1.05 | 41 | Agreement |
| Ba-139 | 3.0 E-4 | 3.4±0.2 E-4 | .88 | 17 | Agreement | |
| Spiked Particulate Filter 4-13-83 | Co-60 | 2.07 E-2* | 1.97±.04 E-2 | 1.05 | 50 | Agreement |
| | Cs-137 | 2.04 E-2* | 1.90±.03 E-2 | 1.07 | 63 | Agreement |
| U-3 Pretreatment gas 4-12-83 | Kr-85m | 5.18 E-3 | 2.46±.03 E-3 | 2.10 | 135 | Disagreement |
| | Kr-87 | 1.22 E-2 | 1.01±0.01 E-2 | 1.21 | 112 | Agreement |
| | Kr-88 | 2.48 E-3 | .86±.09 E-3 | 2.88 | 103 | Disagreement |
| | Xe-133 | 2.87 E-3 | 2.83±.06 E-3 | 1.01 | 55 | Agreement |
| | Xe-135m | 2.81 E-2 | 2.34±.04 E-2 | 1.20 | 71 | Agreement |
| | Xe-135 | 1.13 E-2 | 1.04±.006 E-2 | 1.09 | 203 | Agreement |
| U-2 Pretreatment gas 4-12-83 | Xe-138 | 9.52 E-2 | 7.81±.09 E-2 | 1.04 | 101 | Agreement |
| | Kr-85m | 1.08 E-3 | 2.9±.01 E-4 | 3.7 | 32 | Disagreement |
| | Kr-87 | 1.76 E-3 | 1.49±.04 E-3 | 1.18 | 4 | Agreement |
| | Kr-88 | 7.46 E-4 | 9.2±0.6 E-4 | .81 | 18 | Pos. Agreement |
| | Xe-133 | 5.5 E-4 | 5.6±0.3 E-4 | .98 | 21 | Agreement |
| | Xe-135m | 1.04 E-3 | 8.4±0.2 E-2 | 1.24 | 108 | Agreement |
| Xe-135 | 2.35 E-3 | 2.04±.03 E-3 | 1.15 | 80 | Agreement | |
| Xe-138 | 2.67 E-2 | 2.03±.03 E-2 | 1.31 | 59 | Agreement | |

*Licensee concentration corrected to delete plateout and filter collection efficiency factors.

TABLE I (Continued)

| SAMPLE | ISOTOPE | CONCENTRATION, MICROCURIES/CC | | RATIO BFNP/NRC | RESOLUTION | COMPARISON |
|--|---------------|----------------------------------|---------------|-------------------|------------|--------------|
| | | LICENSEE | NRC | | | |
| | Select Code 2 | | | | | |
| Main Stack | Kr-85 | 1.48 E-4 | 3.53±.02 E-5 | 4.2 | 173 | Disagreement |
| | Kr-87 | 1.32 E-5 | 1.29±.03 E-5 | 1.0 | 43 | Agreement |
| | Kr-88 | 4.10 E-5 | 5.90±.06 E-5 | .70 | 98 | Disagreement |
| | Xe-133m | 2.18 E-6 | 3.2±.05 E-6 | .70 | 6 | Agreement |
| | Xe-133 | 1.48 E-4 | 1.18±.06 E-4 | 1.25 | 19 | Agreement |
| | Xe-135m | 4.0 E-5 | 3.0±0.4 E-6 | 13.3 | 8 | Disagreement |
| | Xe-135 | 2.24 E-6 | 2.13±.07 E-6 | 1.05 | 30 | Agreement |
| | Select Code 3 | | | | | |
| | Kr-85m | 2.07 E-5 | 3.53±.02 E-5 | .58 | 170 | Disagreement |
| | Kr-87 | 6.22 E-6 | 1.29±.03 E-5 | .48 | 43 | Disagreement |
| | Kr-88 | 2.34 E-5 | 5.90±.06 E-5 | .40 | 98 | Disagreement |
| | Xe-133m | 1.20 E-6 | 3.2±.05 E-6 | .37 | 6 | Disagreement |
| | Xe-133 | 9.55 E-5 | 1.18±.06 E-4 | .80 | 19 | Agreement |
| | Xe-135 | 1.03 E-6 | 2.13±.07 E-6 | .48 | 30 | Disagreement |
| | Select Code 3 | | | | | |
| Charcoal Cartridge Plant Vent 4/9 - 12/83 | I-131 | 2.15 E-10* | 1.90±.01 E-10 | 1.13 | 190 | Agreement |
| | Select Code 2 | | | | | |
| | I-131 | 3.68 E-10* | 1.90±.01 E-10 | 1.93 | 190 | Disagreement |

*Note: Licensee concentrations corrected to delete
plateout and collection efficiency factors

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 judgment limits are variable in relation to the comparison of the NRC 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.

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

| <u>Resolution</u> | <u>Agreement</u> | <u>Possible Agreement A</u> | <u>Agreement B</u> |
|-------------------|------------------|-----------------------------|--------------------|
| <3 | 0.4 - 2.5 | 0.3 - 3.0 | No Comparison |
| 4 - 7 | 0.5 - 2.0 | 0.4 - 2.5 | 0.3 - 3.0 |
| 8 - 15 | 0.6 - 1.66 | 0.5 - 2.0 | 0.4 - 2.5 |
| 16 - 50 | 0.75 - 1.33 | 0.6 - 1.66 | 0.5 - 2.0 |
| 51 - 200 | 0.80 - 1.25 | 0.75 - 1.33 | 0.6 - 1.66 |
| >200 | 0.85 - 1.18 | 0.80 - 1.25 | 0.75 - 1.33 |

"A" criteria are applied to the following analyses

Gamma spectrometry where principal gamma energy used for identification is greater than 250 Kev.

Tritium analyses of liquid samples.

"B" criteria are applied to the following analyses:

Gamma spectrometry where principal gamma energy used for identification is less than 250 Kev.

⁸⁷Sr and ⁹⁰Sr Determinations.

Gross beta where samples are counted on the same date using the same reference nuclide.