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

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Report Nos.: 50-259/91-28, 50-260/91-28, and 50-296/91-28

Licensee: Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

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 Conducted: August 6-9, 1991

Inspector: S. S. Adamovitz 8/26/91 Date Signed

Approved by: T. R. Decker, Chief 8/26/91 Date Signed
Radiological Effluents and Chemistry Section
Radiological Protection and Emergency Preparedness Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope:

This routine, unannounced inspection was conducted in the areas of confirmatory measurements,plant chemistry, radiological effluents, and the post accident sampling system (PASS).

Results:

The confirmatory measurement results for beta emitters were reviewed, and the Sr-89 and Sr-90 results were in disagreement with known values (Paragraph 3). The licensee had a program to monitor the accuracy of vendor analyses and a supplementary NRC confirmatory measurements sample for Sr-89 and Sr-90 analyses would be sent to the plant.

The Unit 2 PASS had been evaluated against NUREG 0737 criteria during plant operating conditions and an IFI was subsequently closed (Paragraph 2). One IFI concerning the evaluation of the PASS for containment atmosphere sampling and analysis was identified (Paragraph 2).

The Semiannual Radiological Effluent Report for the last half of 1990 documented a large number of effluent instrumentation inoperable for greater than 30 days (Paragraph 4) due to plant modifications. The majority of the plant modifications had been completed, and during the first half of 1991, only three HR service water monitors were inoperable for greater than 30 days.

The plant had adopted the Electric Power Research Institute (EPRI) guidelines for chemistry control (Paragraph 6). Since the Unit 2 began power ascension on May 23, 1991, the unit had little steady-state chemistry data to evaluate. However, July - August, 1991 DEI values indicated good fuel integrity, and reactor coolant contaminants had been typically maintained within EPRI guidelines.

The Makeup Water Treatment Plant had been able to supply sufficient water of the appropriate purity to meet plant needs (Paragraph 6).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

S. Armstrong, Process Control Supervisor
*M. Bajestani, Technical Support Manager
*L. Clady, Quality Assurance
*J. Danier, Compliance Engineer, Licensing
*R. Hires, Nuclear Engineer, Operations Support
R. Holland, Analytical Chemist
*G. Little, Operations Support Supervisor
K. Nesmith, Chemist
*E. Ridgell, Compliance Engineer
*J. Sabados, Supervisor Chemistry Technical Support
*P. Salas, Compliance Engineer, Licensing
*J. Scalice, Plant Manager
L. Smith, General Supervisor, Instrumentation and Control
*J. Wallace, Compliance Engineer, Licensing
C. White, Analytical Chemist

Nuclear Regulatory Commission

R. Bernhard, Project Engineer
*E. Christnot, Resident Inspector
K. Ivey, Resident Inspector
*P. Kellogg, Chief, TVA Projects Section 2
*C. Patterson, Senior Resident Inspector

*Attended exit interview

2. Licensee Action on Previous Inspection Findings (92701)

(Closed) Inspector Followup Item (IFI) 50-260/90-02-01: Evaluate the post accident sampling system (PASS) under operating conditions against NUREG-0737 criteria.

The Browns Ferry PASS was designed and built by General Electric, and the Unit 2 PASS was installed during 1991. Two other PASS had been purchased for the other units but had not yet been installed. The PASS had the capability to obtain the following samples:

- Diluted (100:1) liquid reactor coolant grab samples (10 milliliters total volume)

- Undiluted degassed liquid reactor coolant samples (0.2 milliliters and 10 milliliters)

- Undiluted dissolved gas samples from the reactor coolant (1-5 cubic centimeters)

- Undiluted containment atmosphere samples (14.1 cubic centimeters)

NUREG-0737, Item II.B.3 established eleven criteria for the PASS. These criteria specified the types of samples to be taken, sampling times, accuracies, and sensitivities of sample analyses, limits of radiation dose to operators, and design considerations. The inspector evaluated the Browns Ferry facility PASS against the eleven criteria.

Through review of selected records, observation of sampling equipment operation, discussions with licensee representatives, and inspection of the installed system, the inspector verified that the PASS criteria have been met except as noted below.

a. NUREG-0737, Item II.B.3, Criterion (1), states that the licensee shall have the capability to obtain and analyze reactor coolant and containment atmosphere samples within three hours.

   The licensee demonstrated the ability to obtain a reactor coolant sample and to complete the required analyses within a three hour time period. The licensee did not collect and analyze a containment atmosphere sample since there was insufficient radioactivity to make a comparison between the PASS and normal containment sampling. The PASS containment atmosphere sampling and analysis is discussed further in Section b.

b. NUREG-0737, Item II.B.3, Criterion (2a) and Criterion (9) state that [1] the licensee shall provide onsite radiological analysis capability to quantify noble gases, iodines, and nonvolatile radionuclides in reactor coolant and containment atmosphere that may be indicators of core damage, and [2] the sensitivity of the onsite liquid sample analysis capability should permit measurement of nuclide concentration in the range of one microcurie/gram (uCi/gm) to ten curies/gram (Ci/gm).

   The inspector observed a portion of the licensee's emergency response drill which dealt with operation of the PASS. The licensee sampled and analyzed a reactor coolant sample with the following results:

Isotopic Results for Reactor Coolant

Radionuclide	Isotopic Activity (uCi/ml) PASS Sample Undiluted	Normal Reactor Coolant Undiluted
Na-24	4.35 E-3	4.24 E-3
Sr-91	8.04 E-4	1.05 E-3
Sr-92	2.89 E-3	3.22 E-3
Nb-95	3.73 E-4	2.45 E-4
I-131	2.71 E-4	1.76 E-4
I-132	3.41 E-3	3.59 E-3
I-133	3.10 E-3	2.71 E-3
I-134	1.13 E-2	1.28 E-2
I-135	6.94 E-3	6.50 E-3
Xe-135	2.10 E-4	3.82 E-4
Cs-138	1.20 E-3	1.21 E-3

Although good comparisons were obtained between the PASS and normal reactor coolant analytical results, the licensee informed the inspector that the PASS sample had been counted on the detector face using the efficiency file for the normal reactor coolant sample to calculate the isotopic activities. The PASS and normal reactor coolant sample geometries were similar but not identical. The PASS sample volume was 10 milliliters of liquid in a glass vial while the normal reactor coolant volume was 20 milliliters of liquid in a vial. Analyzing the samples on the detector face provided better counting statistics, but the counting systems were calibrated to count PASS samples 10 centimeters from the detector face. The licensee resampled and reanalyzed reactor coolant (normal sample point and PASS) and counted the samples using the PASS geometry with the following results:

Isotopic Results for Reactor Coolant

Radionuclide	Isotopic Activity (uCi/ml) PASS Sample Diluted	PASS Sample Undiluted	Normal Reactor Coolant Undiluted
Na-24	5.09 E-3	4.51 E-3	4.90 E-3
Sr-92	1.21 E-2	2.40 E-3	3.47 E-3
I-132	3.83 E-3	3.40 E-3	4.13 E-3
I-133	2.79 E-3	9.37 E-4	2.88 E-3
I-134	1.39 E-2	1.24 E-2	1.68 E-2
I-135	ND*	5.73 E-3	5.80 E-3
Xe-135	8.63 E-4	5.77 E-4	6.87 E-4

*Not Detected

The inspector was not able to evaluate a containment atmosphere sample since the plant did not have sufficient activity to make a comparison between normal containment sampling and the PASS. The inspector informed the licensee that verification of the PASS for containment atmosphere sampling and analysis would be considered an IFI (50-260/91-28-01).

c. NUREG-0737, Item II.B.3, Criterion (2b) states that the licensee shall be able to measure hydrogen levels in the containment atmosphere.

The licensee had two redundant hydrogen analyzers which had been previously installed to fulfill the requirements of NUREG-0737, Item II.F.1.6 for monitoring containment hydrogen concentration. These monitors would also meet the requirements of Item II.B.3, Criterion (2B). Since the licensee currently did not have hydrogen in the containment atmosphere, the inspector reviewed latest set of channel calibrations conducted July 24, 1991 for Channel A and July 26, 1991 for Channel B. Both channels had been satisfactorily calibrated against known concentrations of hydrogen gas.

Additionally the licensee's PASS had the capability to obtain undiluted gas samples from the drywell and suppression pool atmospheres. The gas samples could then be transported to the chemistry laboratory for analysis.

d. NUREG-0737, Item II.B.3, Criterion (2c) and Criterion (4) state that the licensee shall have the onsite capability to quantify dissolved gases in the reactor coolant.

The inspector observed collection of an undiluted dissolved gas sample from the reactor coolant. Subsequent analysis of the sample for hydrogen and oxygen by gas chromatography showed less than one percent by volume for both hydrogen and oxygen.

e. NUREG-0737, Item II.B.3, Criterion (2c) and Criterion (5) state that the licensee shall have the capability to provide a chloride analysis within 96 hours of the sample being taken.

The inspector observed collection of an undiluted PASS reactor coolant sample and subsequent analysis for chloride by ion chromatography. Analytical results were as follows:

Chloride Concentration (parts per billion-ppb)

PASS Sample Undiluted	Normal Reactor Coolant Undiluted
97	5

The results of the analysis indicated possible chloride contamination. The licensee collected a second PASS undiluted sample as indicated in Section b and reanalyzed for chloride with the following results:

Chloride Concentration (ppb)

PASS Sample Undiluted	Normal Reactor Coolant Undiluted
12	5

The licensee indicated that an evaluation would be performed to assure that in the future, the sample containers were not contaminated with trace amounts of chloride.

f. NUREG-0737, Item II.B.3, Criterion (3) states that reactor coolant and containment atmosphere sampling during post accident conditions shall not require an isolated auxiliary system to be placed in operation in order to use the PASS.

The inspector discussed the sampling points with cognizant licensee personnel. When the reactor was pressurized, the PASS coolant sampling point would be the jet pump instrument piping. This sampling point did not require opening any primary containment isolation valves. If the reactor was not pressurized, the PASS coolant sampling point would be the Residual Heat Removal (RHR) heat exchanger "C" when the RHR was operating in the suppression pool cooling mode. Collection of samples during this cooling mode would require the opening of two primary containment isolation valves which had been environmentally qualified. The same sample point could be used to collect samples when the RHR system was operating in the shutdown cooling mode. However the shutdown cooling mode would require opening the shutdown cooling isolation valves which were not environmentally qualified and were not accessible during post accident conditions.

Containment atmosphere samples would be collected from the drywell and suppression chamber through the isolation valves used for the hydrogen/oxygen monitoring system. The isolation valves were environmentally qualified.

g. NUREG-0737, Item II.B.3, Criterion (6) states that personnel shall be able to obtain samples from the PASS and not exceed a radiation dose of 5 Rem whole body or 75 Rem to the extremities.

The inspector reviewed the memorandum "Browns Ferry Nuclear Plant-Postaccident Sampling Radiation Exposure Evaluation," dated March 20, 1987. The plant's time-motion study used general area dose rates, sampling times and sample dose rates supplied by two vendors in order to calculate the expected radiation doses. The memorandum referenced PASS sample analysis in a separate post accident chemical laboratory (PACL) which the licensee had originally intended to establish. The dose projections included the use of the PACL and were reported as 1.3 Rem whole body and 11.4 Rem extremities.

However, plant personnel had subsequently decided to use the normal chemistry laboratory for PASS analysis. The inspector requested that the dose projections be recalculated to include use of the normal chemistry laboratory. The recalculated doses were slightly lower-1.2 Rem whole body and 11.3 Rem extremities. The licensee had also calculated a worst case isotopic concentration for the reactor coolant to be 1.48 curies/gram.

h. NUREG-0737, Item II.B.3, Criterion (7) requires the licensee to have the capability to quantify the boron concentration of the reactor coolant system under accident conditions.

The inspector observed collection of an undiluted PASS reactor coolant sample and subsequent analysis for boron by ion chromatography. The analytical results showed less than 5 parts per million (ppm) boron which would be expected since normally the reactor coolant would not contain boron. The inspector questioned whether the boron analysis by ion chromatography would be accurate for high concentrations of boron expected during accident conditions. The licensee provided a memo "Boron Analysis by Ion Chromatography," dated January 29, 1990 which summarized a study to quantify higher concentrations of boron (10 ppm to 1000 ppm). Boron concentrations (78 ppm) determined from the ion

chromatography method were within seven percent of the values determined from a mannitol titration.

i. NUREG-0737, Item II.B.3, Criterion (8) states that if inline monitoring is used for any sampling and analysis capability, the licensee shall provide backup sampling, through grab sampling.

The only inline monitors were pressure indicators for the analysis of the total dissolved gas concentration of the reactor coolant. The licensee demonstrated the capability to collect and analyze grab samples of gas stripped from the reactor coolant for hydrogen and oxygen concentrations.

j. NUREG-0737, Item II.B.3, Criterion (10) requires the accuracy, range, and sensitivity to be adequate to provide pertinent data to the operator in order to describe radiological and chemical status of the reactor coolant systems.

The licensee's range and accuracy for various PASS analyses are summarized in the following table:

Analysis	Range	Accuracy
Chloride	0.5-20 ppm 0.05-0.5 ppm	±10 percent ±0.05 ppm
Boron	50-1000 ppm	±50 ppm
Total Dissolved Gases	25-55 cc/kg 50-400 cc/kg	±50 percent ±30 percent
Dissolved Oxygen	4-8 ppm 8-20 ppm	±60 percent ±30 percent
pH	1-13	±0.3 units
Radionuclides-Liquid or Containment Atmosphere	1 uCi/ml - 10 Ci/ml	±50 percent

The inspector compared the licensee's supplied values with the accuracy and range requirements in NUREG-0737 II.B.3 criteria clarification. The licensee's estimated accuracy range for total dissolved gases and dissolved oxygen were greater than those listed in NUREG-0737 and the licensee's upper limit for total dissolved gases was 400 cc/kg as compared to a NUREG 0737 upper limit of 2000 cc/kg. The licensee provided the inspector

with a copy of the letter from W. Johnston, Assistant Director, Materials, Chemical and Environmental Technology, NRC to Mr. G. Sherwood, General Electric Company, dated July 17, 1984. The letter's subject was "Summary of GE/BWROG/NRC Meeting on GE PASS Dissolved Gas Sampler on May 2, 1984." The letter documented NRC's acceptance of the GE range and accuracy values for total dissolved gases and dissolved oxygen.

k. NUREG-0737, Item II.B.3, Criterion (11), requires the licensee to consider provisions for purging sample lines, minimizing sample loss or distortion, preventing blockage of sample lines, disposing of samples, providing flow restriction to limit coolant loss in the event of sample line rupture, and filtering ventilation of the PASS sample station.

Liquid sample lines could be flushed and portions of the liquid sample lines in the PASS could be flushed with demineralized water. The liquid residues from sample collection or line flushing were returned to the torus. Gaseous sample lines could be flushed with nitrogen or air. Ventilation exhaust from the PASS panel area was routed into the secondary containment by maintaining a slight negative pressure on the panel. During accident conditions, the secondary containment atmosphere would be routed through the Standby Gas Treatment System which was equipped with high efficiency particulate air (HEPA) filters and charcoal absorber beds.

l. Regulatory Guide 1.91, Revision 3, recommends analysis for pH.

The licensee collected an undiluted reactor coolant sample and measured the pH. The results were as follows:

	PASS Sample Undiluted	Normal Reactor Coolant Undiluted
pH	6.0	6.0

m. NUREG-0737, Item II.B.4, requires the licensee to develop and implement a training program to teach the use of installed equipment and systems provided for the control or mitigation of accidents in which the core is severely damaged.

The licensee had developed a formalized training program which included classroom instruction and hands-on training. The inspector reviewed documentation of

training for 13 technicians in the areas of PASS setup and operation, gamma spectroscopy for PASS samples, pH determinations, boron and chloride determinations by ion chromatography, and hydrogen and oxygen determinations by gas chromatography. A total of 13 technicians had been qualified during the first half of 1991 in operation of the PASS.

n. The licensee had developed operating procedures that covered various aspects of PASS equipment operation and subsequent analyses. The inspector reviewed selected portions of the following procedures associated with the PASS:

1) CI-903, Boron and Chloride Analysis in Boron Matrix by Ion Chromatography, Revision 1, April 22, 1991

2) CI-904, Gamma Spectroscopy on PASS Samples, Revision 1, September 18, 1990

3) CI-905, Post Accident Sample Analysis: pH, Revision 0, June 13, 1990

4) CI-906, Post Accident Sampling Analysis: Primary Gas Determination: Hydrogen and Oxygen, Revision 1, March 14, 1991

5) CI-910, PASS Setup Procedure, Revision 2, July 5, 1991

6) CI-911, PASS Collector Drain Procedure, Revision 2, July 5, 1991

7) CI-912, PASS Small Volume Liquid Sampling Procedure, Revision 2, July 5, 1991

8) CI-913, PASS Large Volume Liquid and/or Dissolved Gas Sampling Procedure, Revision 2, July 5, 1991

From a review of the procedures, the inspector concluded that the procedures adequately addressed PASS operations and subsequent chemical and radiochemical analyses.

IFI 50-260/91-28-01: Evaluate PASS for containment atmosphere sampling and analysis.

One IFI was identified.

3. Confirmatory Measurements (84750)

10 CFR 20.201(a) defines a "survey" as an evaluation of the radiation hazards incident to the production, use, release, disposal or presence of radioactive materials or other sources of radiation under a specific set of conditions.

10 CFR 20.201(b) requires that each licensee shall make or cause to be made such surveys as: (1) may be necessary for the licensee to comply with the regulations and, (2) are reasonable under the circumstances to evaluate the extent of radioactive hazards that may be present.

As part of the NRC Confirmatory Measurements program, spiked liquid samples were sent to the plant on October 8, 1990, for selected radiochemical analyses. The NRC received the analytical results from Browns Ferry in a letter dated December 11, 1990. The comparison of licensee results to the known values are presented in Attachment 1 and the acceptance criteria for the comparison are listed in Attachment 2. The Sr-89 and Sr-90 results were in disagreement being almost twice the known values. Iron-55 and H-3 results were in agreement. The inspector reviewed 1988 and 1989 NRC confirmatory measurement results for Browns Ferry and noted that the Sr-89 and Sr-90 results were in agreement for both years. The inspector discussed the results with the licensee during the current inspection. The licensee had used a vendor for these analyses and the Tennessee Valley Authority (TVA) had established a quarterly crosscheck program with the vendor. The results of the TVA fourth quarter 1990 crosscheck with the vendor showed agreement for Sr-89 and Sr-90. The licensee had requested an additional spiked sample for Sr-89 and Sr-90 analysis as documented in the letter from P. Carier, Manager, Site Licensing, TVA to D. Collins, Chief, Radiological Protection and Emergency Preparedness Branch, NRC dated March 1, 1991. The inspector informed the licensee that an additional spiked liquid sample for Sr-89 and Sr-90 analyses would be sent to Browns Ferry for followup analyses. The results of the additional spiked liquid sample would be discussed during future inspections.

No violations or deviations were identified.

4. Radiological Effluents (84750)

The Radiological Effluent Technical Specification (RETS) Manual, Section F.2, states requirements for the Semiannual Radiological Effluent Report including timeliness, content, and format.

The inspector reviewed the reports issued for the first and

second halves of calendar year 1990 to determine compliance and reviewed data from previous reports to evaluate trends in liquid and gaseous releases. The effluent information presented in the following table was obtained from current and previous effluent reports:

EFFLUENT RELEASE SUMMARY FOR BROWNS FERRY UNITS 1, 2, AND 3

Activity Released (curies)	1988	1989	1990
Gaseous Effluents:			
Fission and Activation Products	0.0	0.0	0.0
Iodines and Particulates	1.76E-3	1.86E-4	1.88E-4
Tritium	5.92E-1	2.00E-1	5.94E-1
Liquid Effluents:			
Fission and Activation Products	2.42E-1	1.71E-1	3.02E-1
Tritium	1.46E0	7.01E-1	2.07E-1

The low levels of released activity reflected that the units had been shut down since 1985. Due to the extended outage, radionuclides with short half-lives had decayed and only radionuclides with long half-lives were being released as a result of outage activities. The 1990 cumulative total dose (total body or organ other than thyroid) was calculated to be 2.30E-1 mRem and the 1990 cumulative total thyroid dose was calculated to be 9.68E-2 mRem. These values were less than one percent of the 40 CFR 190 limits for total dose (25 mRem total body or organ other than thyroid and 75 mRem thyroid).

The report for the second half of 1990 documented a large number of effluent instrumentation inoperable for greater than 30 days. The inoperable instrumentation included the offgas post-treatment monitors and associated sample flow abnormal alarms for all three units; the main stack monitors and associated sample flow abnormal alarms; the reactor and turbine buildings ventilation monitor systems for all three units; the radwaste building ventilation monitor system; the control room recorders in panel 1-9-44; the RHR service water monitors for all three units; and the liquid radwaste effluent flow loop 0-FR-77-60. During December, 1989, the Unit 2 offgas sample flow abnormal annunciator and the pressure annunciator were declared inoperable. This resulted in both Unit 2 offgas posttreatment monitors being

declared inoperable. The cause of the failed annunciator was traced to a defective offgas sample pump which was replaced during July, 1990.. Additionally, on July 20, 1990, all inputs to the main stack were isolated in order to perform the stack dilution fan modification which was completed during 1991. The reactor, turbine, and radwaste building ventilation monitor systems were removed from service on October 31, 1990 as part of a system upgrade for the entire building ventilation monitoring system. Additionally, two independent control modules with recorders were installed in the Unit 1 control room. These upgrades were completed during 1991. The liquid radwaste effluent flow loop was declared inoperable on June 21, 1989 due to inaccuracies between the tank level as determined from the flow transmitter as compared to the actual tank level. The dual channel flow instrumentation was replaced with a single channel digital instrumentation during 1990 and the design package was closed by Nuclear Engineering during 1991. The six residual heat removal (RHR) service water monitors were declared inoperable during 1989 due to problems related to the sample pump automatic starting circuitry. However, only three of the RHR service water monitors were required to be operable in order to support Unit 2 operations. The portions of the RHR service water system associated with the three monitors not required to support Unit 2 operation had been physically cut and capped. The inspector determined that, for the first half of 1991, only the three RHR service water monitors required to support Unit 2 operations would be reported in the semiannual effluent report as being inoperable for greater than 30 days. All of the other previously inoperable monitors documented in the July - December 1990 Semiannual Effluent Report had been returned to service.

No violations or deviations were identified.

5. Environmental Monitoring (84750)

The RETS Manual, Section F.1 states the requirements for timeliness, format, and content of the Annual Radiological Environmental Operating Report.

The inspector reviewed the Annual Radiological Environmental Operating Report for 1990. For 1990 air samples, gross beta activities were consistent with levels reported in previous years, and only natural radioactivity was detected by gamma spectroscopy of air particulate samples. Very low levels of iodine-131 were detected (slightly above the lower limit of detection) in 13 charcoal canister samples. However since the plant had been shut down since 1985, the activity was not attributed to Browns Ferry. Low levels of radionuclides associated with radioactive fallout from previous

atmospheric nuclear weapons tests were detected in selected milk, vegetation, and soil samples. No radioisotopes identified in these terrestrial monitoring samples were attributed to the Browns Ferry Plant. Surface water samples analytical results showed positive gross beta activity and low levels of Sr-89 in one sample, and tritium in one upstream control sample. Again, since the plant had been shut down since 1985, the Sr-89 activity was not attributed to Browns Ferry. The licensee's evaluation indicated that the identification of Sr-89 was an artifact of the calculational process. Average beta activity in indicator drinking water samples (3.0 pCi/liter) was slightly below the average beta activity in control drinking water samples (3.1 pCi/liter). Cesium-137 was identified in three fish samples; however, the Cs-137 concentration in the downstream samples averaged 0.04 pCi/gm while the Cs-137 concentration in the upstream sample averaged 0.1 pCi/gm. Cesium-137, Co-60, and Cs-134 were detected in sediment samples. The Cs-137 values were similar to preoperational data and the identified Cs-137 was not attributed to plant operations. Cobalt-60 and Cs-134 concentrations averaged 0.06 pCi/gm and 0.02 pCi/gm respectively in downstream samples. The licensee's dose assessment to the general public from these activities indicated a negligible dose equivalent.

From a review of the environmental report, the inspector concluded that the plant had had negligible impact upon the surrounding environment and that the environmental report fulfilled the RETS requirements.

No violations or deviations were identified.

6. Plant Chemistry (84750)

Technical Specification 3/4.6.b, Coolant Chemistry describes the requirements and responsibilities for the Chemistry program.

The licensee's chemistry program was described in the procedure PMI 24.4, "Conduct of Chemistry," Revision 4, dated November 16, 1990. The inspector reviewed the procedure and noted that the licensee had adopted the Electric Power Research Institute's (EPRI) guidelines for chemistry parameters. Since Unit 2 began power ascension on May 23, 1991, the unit had little steady-state chemistry data to evaluate. However, the inspector reviewed July - August, 1991 daily logsheets of chemistry parameters for reactor water. Chloride and sulfate levels were typically below 5 parts per billion (ppb), and silica levels, which had peaked at 180 ppb on July 8, were steadily trending downward to 60 ppb on August 6, 1991. The DEI values ranged from 2E-4 uCi/ml to 2E-3 uCi/ml, indicating good fuel

integrity. The plant had experienced a minor chemistry transient after a planned reactor scram on August 2, 1991. On this date, reactor coolant conductivity peaked at 0.5 umho/cm and sulfate concentrations peaked at 230 ppb. The licensee was still evaluating the data but preliminary evaluations indicated that the transient was caused by resin throw from the inservice demineralizers.

The inspector toured the Makeup Water Treatment Plant and discussed operation with cognizant licensee and vendor personnel. The licensee was using a vendor supplied and operated water treatment system which was located outside the plant's protected area. Water treatment consisted of a prefilter, a reverse osmosis unit, and a series of demineralizers including two cation beds, three anion beds and one mixed bed. The reverse osmosis unit had been installed August, 1990 to reduce the total organic carbon (TOC) concentrations in the makeup water. Prior to installation of the reverse osmosis unit, TOC concentrations were typically 150 ppb. After installation of the unit, the TOC concentrations were reduced to typically less than 50 ppb. The inspector reviewed July - August, 1991 analytical data for the makeup water. Conductivity values ranged from 0.055 umho/cm to 0.060 umho/cm. Silica and iron concentrations were less than 10 ppb, and sulfate and chloride levels were less than 2 ppb. The Makeup Water Treatment Plant could provide purified water at the rate of 200 gallons per minute which was sufficient for normal plant needs. The licensee informed the inspector that during plant startup, sufficient water had been provided by operating the Makeup Water Treatment Plant for additional shifts. The inspector concluded that the Makeup Water Treatment Plant could provide sufficient water of the appropriate purity to meet the plant's operational needs.

No violations or deviations were identified.

7. Exit Interview

The inspection scope and results were summarized on August 9, 1991, with those persons indicated in Paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Dissenting comments were not received from the licensee.

The confirmatory measurement results for beta emitters were reviewed, and the Sr-89 and Sr-90 results were in disagreement with known values (Paragraph 3). The licensee had a program to monitor the accuracy of vendor analyses and a supplementary NRC confirmatory measurements sample for Sr-89 and Sr-90 analyses would be sent to the plant.

One IFI concerning the evaluation of the PASS under operating conditions against NUREG-0737 criteria was closed (Paragraph 2).

One IFI concerning the evaluation of the PASS for containment atmosphere sampling and analysis was identified (Paragraph 2).

The Semiannual Radiological Effluent Report for the last half of 1990 documented a large number of effluent instrumentation inoperable for greater than 30 days (Paragraph 4) due to plant modifications. The majority of the plant modifications had been completed, and during the first half of 1991, only three RHR service water monitors were inoperable for greater than 30 days.

The plant had adopted the EPRI guidelines for chemistry control (Paragraph 6). Since the Unit 2 began power ascension on May 23, 1991, the unit had little steady state chemistry data to evaluate. However, July - August, 1991 DEI values indicated good fuel integrity, and reactor coolant contaminants had been typically maintained within EPRI guidelines.

The Makeup Water Treatment Plant had been able to supply sufficient water of the appropriate purity to meet plant needs (Paragraph 6).

Item Number	Category, Description, and Reference
50-260/91-28-01	IFI - Evaluate the PASS for containment atmosphere sampling and analysis (Paragraph 2).

CONFIRMATORY MEASUREMENT COMPARISONS OF H-3, Fe-55, Sr-89, AND Sr-90 ANALYSES FOR BROWNS FERRY NUCLEAR PLANT REPORTED ON DECEMBER 11,1990

Isotope	NRC (uCi/ml)	Licensee (uCi/ml)	Resolution	Ratio (Licensee/NRC)	Comparison
H-3	3.89±0.16 E-5	3.94E-05	24	1.01	Agreement
Fe-55	5.84±0.23 E-5	4.54E-05	25	0.78	Agreement
Sr-89	9.59±0.38 E-5	1.82E-04	25	1.90	Disagreement
Sr-90	2.74±0.11 E-6	5.32E-06	25	1.94	Disagreement

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 = $\frac{\text{NRC Reference Value}}{\text{Associated Uncertainty}}$