ARKANSAS POWER & LIGHT COMPANY
POST OFFICE BOX 551 LITTLE ROCK, ARKANSAS 72203 (501) 371-4000

November 24, 1982

ØCAN118212

Director of Nuclear Reactor Regulation
ATTN: Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Director of Nuclear Reactor Regulation
ATTN: Mr. J. F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: Arkansas Nuclear One - Units 1 & 2
Docket No. 50-313 & 50-368
License No. DPR-51 & NPF-6
NUREG-0737 Item II.B.3
Post Accident Sampling System

Gentlemen:

Your letter of July 1, 1982, (ØCNAØ78201) requested AP&L submit information on how we satisfied the criteria of NUREG-0737 Item II.B.3. On October 7, 1982, (ØCNA1Ø82Ø8) a clarification of the criteria was sent. Attached is the information requested in the same format as the request. Also attached are P&ID's of the Post Accident Sampling System (PASS) to aid in your review.

Very truly yours,

John R. Marshall

John R. Marshall
Manager, Licensing

A046

JRM:MCS:sl

Attachments

ATTACHMENT 1

Criterion: (1) "The licensee shall have the capability to promptly obtain reactor coolant samples and containment atmosphere samples. The combined time allotted for sampling and analysis should be 3 hours or less from the time a decision is made to take a sample."

Clarification: "Provide information on sampling(s) and analytical laboratories locations including a discussion of relative elevations, distances and methods for sample transport. Responses to this item should also include a discussion of sample recirculation, sample handling and analytical times to demonstrate that the three-hour time limit will be met (see (6) below relative to radition exposure). Also describe provisions for sampling during loss of off-site power (i.e. designate an alternative backup power source, not necessarily the vital (Class IE) bus, that can be energized in sufficient time to meet the three-hour sampling and analysis time limit)."

Response: (1) PASS samples can be taken from the following sources: 1) hot leg, 2) pressurizer water, 3) pressurizer gas, 4) containment sump, and 5) containment atmosphere. AP&L has implemented an on-line sampling system to accomplish the analysis of these samples. AP&L has the capability to analyze a PASS sample well within the three-hour requirement. Also, upon a total loss of station power the PASS equipment can be powered by aligning one of the four emergency diesels to one of the PASS load centers. Please note that normal power backup is provided by an auto transfer from Unit 1 and Unit 2 buses B3 and 2B7 to the PASS Motor Control Center.

The PASS equipment is located on elevation 354 of a new sampling building just west of the existing auxiliary building. The new sampling facility was required because the existing sample room would be uninhabitable during accident conditions. A complete heating, ventilation and air conditioning (HVAC) system is provided in the new facility with the required exhaust filtration and radiation monitoring of all effluent.

The entire piping network inside the PASS building has been designed to provide demineralization water for flushing the piping. Flushing capability is continuously available by use of remotely operated valves.

Criterion: (2) "The licensee shall establish an on-site radiological and chemical analysis capability to provide, within the three-hour time frame established above, quantification of the following:

(a) certain radionuclides in the reactor coolant and containment atmosphere that may be indicators of the degree of core damage (e.g., noble gases; iodines and cesiums, and non-volatile isotopes);

(b) hydrogen levels in the containment atmosphere;

(c) dissolved gases (e.g., H_2), chloride (time allotted for analysis subject to discussion below), and boron concentration of liquids.

(d) Alternatively, have inline monitoring capabilities to perform all or part of the above analyses."

Clarification: (2) (a) "A discussion of the counting equipment capabilities is needed, including provisions to handle samples and reduce background radiation (ALARA). Also, a procedure is required for relating radionuclide concentrations to core damage. The procedure should include:

1. Monitoring for short and long-lived volatile and non-volatile radionuclides such as ^{133}Xe, ^{131}I, ^{137}Cs, ^{134}Cs, ^{85}Kr, ^{140}Ba, and ^{88}Kr (see Vol. II, Part 2, pp. 524-527 of Rogovin Report for further information).

2. Provisions to estimate the extent of core damage based on radionuclide concentrations and taking into consideration other physical parameters such as core temperature data and sample location.

(b) Show a capability to obtain a grab sample, transport and analyze for hydrogen.

(c) Discuss the capabilities to sample and analyze for the accident sample species listed here and in Regulatory Guide 1.97 Rev. 2.

(d) Provide a discussion of the reliability and maintenance information to demonstrate that the selected on-line instrument is appropriate for this application. (See (8) and (10) below relative to backup grab sample capability and instrument range and accuracy.)"

Response: (2) (a) AP&L has an on-line sampling system which utilizes an undiluted sample for analysis. The isotopic analysis is performed by the radionuclide analyzer. A germanium crystal sees the gamma rays of the sample through the alignment of the collimator (See attached P&ID). The wide collimator window setting is used for normal sampling, and a much smaller window is used during accident conditions. This information is fed from the germanium crystal through an amplifier to a computer which identifies and quantifies the radionuclides present based on counts and energy levels.

While AP&L does have the ability to monitor for the appropriate radionuclide concentrations, we have not developed a procedure to relate these concentrations to core damage. Due to the number of variables involved in making an assessment of core damage and the resulting general nature of any conclusions drawn from such a procedure we do not feel that such a procedure is necessary. We note that this provision is not included in the original NUREG 0737 requirements.

(b) AP&L can provide a grab sample for off-site analysis. The attached P&ID's show the grab sample vessel and piping configuration. A sample is physically obtained by lining up the valving such that high pressure reactor coolant (or containment atmosphere) is directed through the sample vessel. The sample vessel is then valved off and the tubing is flushed with demineralized water. The vessel is then ready to be separated from the sample tubing by releasing the quick disconnects. An electric sample cart system is used to transport the sample vessel out of the building to a truck for transport to Oak Ridge Laboratory.

(c) The listed sample species are sampled and analyzed by the on-line PASS system shown in the attached P&ID's. PASS is also described in part by the response to criteria 1 in this letter

(d) AP&L will be using this system for normal sampling as well as post accident sampling. Therefore, the equipment will be maintained and personnel will be cognizant of it's proper operation. Furthermore, an extensive inventory of spare parts is presently available on-site for ready access. The grab sample system serves as the final backup to the on-line system. AP&L has an agreement with the Oak Ridge National Laboratory for the off-site analysis of the grab sample if needed.

Criterion: (3) "Reactor coolant and containment atmosphere sampling during post accident conditions shall not require an isolated auxiliary system [e.g., the letdown system, reactor water cleanup system (RWCUS)] to be placed in operation in order to use the sampling system."

Clarification: "System schematics and discussions should clearly demonstrate that post accident sampling, including recirculation, from each sample source is possible without use of an isolated auxiliary system. It should be verified that valves which are not accessible after an accident are environmentally qualified for the conditions in which they must operate."

Response: (3) The PASS RCS collection scheme does not require an isolated auxiliary system (i.e., letdown) be in service to obtain a sample. The sample points discussed in the above response #1 have independent isolation valves. These isolation valves are environmentally qualified per IEEE-323 (1974), IEEE-344 (1975), and IEEE-382 (1972).

Criterion: (4) "Pressurized reactor coolant samples are not required if the licensee can quantify the amount of dissolved gases with unpressurized reactor coolant samples. The measurement of either total dissolved gases or H_2 gas in reactor coolant samples is considered adequate. Measuring the O_2 concentration is recommended, but is not mandatory."

Clarification: "Discuss the method whereby total dissolved gas or hydrogen and oxygen can be measured and related to reactor coolant system concentrations. Additionally, if chlorides exceed 0.15 ppm, verification that dissolved oxygen is less than 0.1 ppm is necessary. Verification that dissolved oxygen is <0.1 ppm by measurement of a dissolved hydrogen residual of ≥ 10 cc/kg is acceptable for up to 30 days after the accident. Within 30 days, consistent with ALARA, direct monitoring for dissolved oxygen is recommended."

Response: (4) The chemical analysis of the RCS is performed on-line utilizing a pressurized sample. AP&L has the capability of analyzing the sample for the following: hydrogen, oxygen, chloride, boron, and pH. The backup grap sample is also a pressurized sample for off-site analysis.

Criterion: (5) "The time for a chloride analysis to be performed is dependent upon two factors: (a) if the plant's coolant water is seawater or brackish water and (b) if there is only a single barrier between primary containment systems and the cooling water. Under both of the above conditions the licensee shall provide for a chloride

analysis within 24 hours of the sample being taken. For all other cases, the licensee shall provide for the analysis to be completed within 4 days. The chloride analysis does not have to be done on-site."

Clarification: "BWR's on sea or brackish water sites and plants which use sea or brackish water in essential heat exchangers (e.g. shutdown cooling) that have only single barrier protection between the reactor coolant are required to analyze chloride within 24 hours. All other plants have 96 hours to perform a chloride analysis. Samples diluted by up to a factor of one thousand are acceptable as initial scoping analysis for chloride, provided (1) the results are reported as ____ ppm Cl (the licensee should establish this value; the number in the blank should be no greater than 10.0 ppm Cl) in the reactor coolant system and (2) that dissolved oxygen can be verified at <0.1 ppm, consistent with the guidelines above in clarification no. 4. Additionally, if chloride analysis is performed on a diluted sample, an undiluted sample need also be taken and retained for analysis within 30 days, consistent with ALARA."

Response: (5) As discussed in Response (4), AP&L has provisions for on-line chloride analysis. Also, since Arkansas Nuclear One is a fresh water plant with four days for the performance of the chloride analysis, the off-site grab sample analysis could also be completed within the time limit.

Criterion: (6) "The design basis for plant equipment for reactor coolant and containment atmosphere sampling and analysis must assume that it is possible to obtain and analyze a sample without radiation exposures to any individual exceeding the criteria of GDC 19 (Appendix A, 10 CFR Part 50) (i.e., 5 rem whole body, 75 rem extremities). (Note that the design and operational review criterion was changed from the operational limits of 10 CFR Part 20 (NUREG-0578) to the GDC 19 criterion (October 30, 1979, letter from H. R. Denton to all licensees)."

Clarification: "Consistent with Regulatory Guide 1.3 or 1.4 source terms, provide information on the predicted man rem exposures based on person-motion for sampling, transport and analysis of all required parameters."

Response: (6) AP&L's objective for utilizing on-line sampling was to obtain an undiluted sample and to minimize radiation exposure to personnel. During an accident condition all necessary valves for proper system alignment are remotely operated from the PASS facility computer room. The radiation exposure to personnel would be a maximum of 100 mrem/hr. The maximum dose rate would occur if

the grab sample were used. This would result in a contact dose rate of 1 R/hr. It is estimated that one man could perform the complete grab sample technique and transport it out of the building in 30 minutes, resulting in a maximum dose of 500 mrem.

Criterion: (7) "The analysis of primary coolant samples for boron is required for PWRs. (Note the Rev. 2 of Regulatory Guide 1.97 specifies the need for primary coolant boron analysis capability at BWR plants.)"

Clarification: "PWR's need to perform boron analysis. The guidelines for BWR's are to have the capability to perform boron analysis but they do not have to do so unless boron was injected."

Response: (7) Boron analysis is provided by the on-line analyzer. The sample is pressurized at 50 psi. The boron analysis is also available utilizing the grab sample vessel and off-site analysis. As stated in our letter of March 9, 1982 (ØCANØ382Ø3), we are experiencing problems with our boron analysis equipment. However, we are working closely with the vendor, Orion Research Inc. of Cambridge, Massachusetts, to resolve these problems.

Criterion: (8) "If in-line monitoring is used for any sampling and analytical capability specified herein, the licensee shall provide backup sampling through grab samples and shall demonstrate the capability of analyzing the samples. Established planning for analysis at off-site facilities is acceptable. Equipment provided for backup sampling shall be capable of providing at least one sample per day for 7 days following onset of the accident and at least one sample per week until the accident condition no longer exists."

Clarification: "A capability to obtain both diluted and undiluted backup samples is required. Provisions to flush in-line monitors to facilitate access for repair is desirable. If an off-site laboratory is to be relied on for the backup analysis, an explanation of the capability to ship and obtain analysis for one sample per week thereafter until accident condition no longer exists should be provided."

Response: (8) As discussed in the previous items, AP&L has a grab sample system as backup to the on-line sampling system. Also, the grab sample can be utilized for either pressurized or unpressurized samples. Oak Ridge National Laboratory is under contract to AP&L to provide the grab sample off-site analysis if required.

Criterion: (9) "The licensee's radiological and chemical sample analysis capability shall include provisions to:

(a) Identify and quantify the isotopes of the nuclide categories discussed above to levels corresponding to the source terms given in Regulatory Guide 1.3 or 1.4 and 1.7. Where necessary and practicable, the ability to dilute samples to provide capability for measurement and reduction of personnel exposure should be provided. Sensitivity of on-site liquid sample analysis capability should be such as to permit measurement of nuclide concentration in the range from approximatley 1μ Ci/g to 10 Ci/g.

(b) Restrict background levels of radiation in the radiological and chemical analysis facility from sources such that the sample analysis will provide results with an acceptably small error (approximately a factor of 2). This can be accomplished through the use of sufficient shielding around samples and outside sources, and by the use of a ventilation system design which will control the presence of airborne radioactivity."

Clarification: (9) (a) "Provide a discussion of the predicted activity in the samples to be taken and the methods of handling/dilution that will be employed to reduce the activity sufficiently to perform the required analysis. Discuss the range of radionuclide concentration which can be analyzed for, including an assessment of the amount of overlap between post accident and normal sampling capabilities.

(b) State the predicted background radiation levels in the counting room, including the contribution from samples which are present. Also provide data demonstrating what the background radiation levels and radiation effect will be on a sample being counted to assure an accuracy within a factor of 2."

Response: (9) (a) AP&L has installed an in-line isotopic monitoring system with the capability of measuring isotopic activity from $<10^{-4}$ μCi/g to >10 Ci/g. This same system is used for both post accident and normal sampling.

(b) The predicted background radiation levels in the PASS facility computer area during worst case conditions are from 75 to 100 mrem/hr.

Criterion: (10) "Accuracy, range, and sensitivity shall be adequate to provide pertinent data to the operator in order to describe radiological and chemical status of the reactor coolant systems."

Clarification: "The recommended ranges for the required accident sample analyses are given in Regulatory Guide 1.97, Rev. 2. The necessary accuracy within the recommended ranges are as follows:

- Gross activity, gamma spectrum: measured to estimate core damage, these analyses should be accurate within a factor of two across the entire range.

- Boron: measure to verify shutdown margin.

In general, this analysis should be accurate within ±5% of the measured value (i.e., at 6,000 ppm B the tolerance is ±300 ppm while at 1,000 ppm B the tolerance is ±50 ppm). For concentrations below 1,000 ppm, the tolerance band should remain at ±50 ppm.

- Chloride: measured to determine coolant corrosion potential.

For concentrations between 0.5 and 20.0 ppm chloride, the analysis should be accurate within ±10% of the measured value. At concentrations below 0.5 ppm, the tolerance band remains at ±0.05 ppm.

- Hydrogen or Total Gas: monitored to estimate core degradation and corrosion potential of the coolant.

An accuracy of ±10% is desirable between 50 and 2000 cc/kg but ±20% can be acceptable. For concentration below 50 cc/kg, the tolerance remains at ±5.0 cc/kg.

- Oxygen: monitored to assess coolant corrosion potential.

For concentrations between 0.5 and 20.0 ppm oxygen, the analysis should be accurate within ±10% of the measured value. At concentrations below 0.5 ppm, the tolerance band remains at ±0.05 ppm.

- pH: measured to assess coolant corrosion potential.

Between a pH of 5 to 9, the reading should be accurate within ±0.3 pH units. For all other ranges, ±0.5 pH units is acceptable.

To demonstrate that the selected procedures and instrumentation will achieve the above listed accuracies, it is necessary to provide information demonstrating their applicability in the post accident water chemistry and radiation environment. This can be accomplished by performing tests utilizing the standard test matrix provided below or by providing evidence that the selected procedure or instrument has been used successfully in a similar environment."

STANDARD TEST MATRIX
FOR
UNDILUTED REACTOR COOLANT SAMPLES IN A POST-ACCIDENT ENVIRONMENT

Constituent	Nominal Concentration (ppm)	Added as (chemical salt)
I^-	40	Potassium Iodide
Cs^+	250	Cesium Nitrate
Ba^{+2}	10	Barium Nitrate
La^{+3}	5	Lanthanum Chloride
Ce^{+4}	5	Ammonium Cerium Nitrate
Cl^-	10	
B	2000	Boric Acid
Li^+	2	Lithium Hydroxide
NO^-_3	150	
NH^+_4	5	
K^+	20	
Gamma Radiation (Induced Field)	10^4 Rad/gm of Reactor Coolant	Adsorbed Dose

NOTES:

1) Instrumentation and procedures which are applicable to diluted samples only, should be tested with an equally diluted chemical test matrix. The induced radiation environment should be adjusted commensurate with the weight of actual reactor coolant in the sample being tested.

2) For PWRs, procedures which may be affected by spray additive chemicals must be tested in both the standard test matrix plus appropriate spray additives. Both procedures (with and without spray additives) are required to be available.

3) For BWRs, if procedures are verified with boron in the test matrix, they do not have to be tested without boron.

4) In lieu of conducting tests utilizing the standard test matrix for instruments and procedures, provide evidence that the selected instrument or procedure has been used successfully in a similar environment.

"All equipment and procedures which are used for post accident sampling and analyses should be calibrated or tested at a frequency which will ensure, to a high degree of reliability, that it will be available if required.

Operators should receive initial and refresher training in post accident sampling, analysis and transport. A minimum frequency for the above efforts is considered to be every six months if indicated by testing. These provisions should be submitted in revised Technical Specifications in accordance with Enclosure 1 of NUREG-0737. The staff will provide model Technical Specifications at a later date."

Response: (10) Gamma Spectrum: During Acceptance Testing the isotopic activities used to evaluate core damage have typically been well within a factor of two.

- Boron: Range 10-6500 ppm. During Acceptance Testing Boron Analyses have typically been within <10% down to 100 ppm boron.
- Chloride: Range 0.1-100 ppm. The in-line analyzer is currently being tested by the vendor to achieve an accuracy of <10%.
- Dissolved Hydrogen: Range 0-100 cc/kg. During acceptance testing, its accuracy was typically within 10%.
- Dissolved Oxygen: Range 0-20 ppm. During acceptance testing, its accuracy was typically within 10%.
- pH: Range 0-14. The vendor is currently working on improving the pH analyzers accuracy.

Criterion: (11) "In the design of the post accident sampling and analysis capability, consideration should be given to the following items:

(a) Provisions for purging sample lines, for reducing plateout in sample lines, for minimizing sample loss or distortion, for preventing blockage of sample lines by loose material in the RCS or containment, for appropriate disposal of the samples, and for flow restrictions to limit reactor coolant loss from a rupture of the sample line. The post accident reactor coolant and containment atmosphere samples should be representative of the reactor coolant in the core area and the containment atmosphere following a transient or accident. The sample lines should be as short as possible to minimize the volume of fluid to be taken from containment. The residues of sample collection should be returned to containment or to a closed system.

(b) The ventilation exhaust from the sampling station should be filtered with charcoal absorbers and high-efficiency particulate air (HEPA) filters."

Clarification: (11) (a) "A description of the provisions which address each of the items in clarification 11.a should be provided. Such items as heat tracing and purge velocities should be addressed. To demonstrate that samples are representative of core conditions, a discussion of mixing, both short and long term, is needed. If a given sample location can be rendered inaccurate due to the accident (i.e., sampling from a hot or cold leg loop which may have a steam or gas pocket) describe the backup sampling capabilities or address the maximum time that this condition can exist.

BWR's should specifically address samples which are taken from the core shroud area and demonstrate how they are representative of core conditions.

Passive flow restrictors in the sample lines may be replaced by redundant, environmentally qualified, remotely operated isolation valves to limit potential leakage from sampling lines. The automatic containment isolation valves should close on containment isolation or safety injection signals.

(11) (b) A dedicated sample station filtration system is not required, provided a positive exhaust exists which is subsequently routed through charcoal absorbers and HEPA filters."

Response: (11) (a) The PASS sample lines have provisions for flushing. This system can be flushed remotely from the PASS computer room, thereby reducing radiation exposure to workers.

The reactor coolant sample is normally returned to the reactor coolant makeup tank. However, during an accident the reactor coolant sample will be returned to the containment building. The attached P&ID's show this arrangement.

In order to obtain a "fresh" RCS sample, the system is run for 20 minutes before readings are taken. The distance and sample velocity were considered in calculating the run time before sample reading.

(b) The PASS building is equiped with an independent HVAC system. This HVAC system includes an exhaust filtration unit for filtering all air flow leaving the PASS building. The filtration is performed by HEPA filter units and charcoal absorbers.