CP&L

Carolina Power & Light Company

JAN 28 1983

Office of Nuclear Reactor Regulation
ATTN: Mr. D. B. Vassallo, Chief
Operating Reactors Branch No. 2
United States Nuclear Regulatory Commission
Washington, DC 20555

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324
LICENSE NOS. DPR-71 AND DPR-62
NUREG-0737 ITEM II.B.3 POST-ACCIDENT SAMPLING
IMPLEMENTATION SUBMITTAL

Dear Mr. Vassallo:

In response to your letter of August 9, 1982, you will find enclosed our submittal documenting Carolina Power & Light Company's (CP&L) planned actions to satisfy each criterion of NUREG-0737, Item II.B.3 for Brunswick Units 1 and 2.

Responses to some items are incomplete pending completion of CP&L's ongoing procedure development and acceptance testing and the availability of a General Electric report being prepared for the BWR Owners' Group.

Implementation of the enclosed actions will be completed in accordance with the schedules submitted via our letter of April 23, 1982. Final design details and procedures will be available at the plant site for post-implementation review as required by NUREG-0737, Item II.B.3.

Please contact our staff should you require additional information regarding this response.

Yours very truly,

S. R. Zimmerman
Manager
Licensing & Permits

AWS/pgp (5877C8T2)
Enclosure

cc: Mr. D. O. Myers (NRC-BSEP)
Mr. J. P. O'Reilly (NRC-RII)
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RESPONSE TO NUREG-0737, ITEM II.B.3
POST ACCIDENT SAMPLING CAPABILITY
BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 & 2
CAROLINA POWER & LIGHT COMPANY

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.

RESPONSE

GENERAL DISCUSSION

1. Design Philosophy

The Post-Accident Sampling System (PASS) is designed to obtain representative liquid and gas samples from within the primary containment for radiological and chemical analyses following a possible loss-of-coolant accident (LOCA). The basic system consists of a liquid and gas sample station located outside the secondary containment (Reactor Building) in the Turbine Building breezeway. Each unit has its own sampling system. Each sampling and control station is located near the unit's Reactor Building personnel access doors. The underlying philosophy is to meet the requirements of NUREG-0737, to minimize exposure by minimizing the required sample sizes, to optimize the weight of shielded sample containers in order to facilitate movement through potentially high level radiation areas, and to provide adequate shielding at the sample station and in the laboratory. The system is designed to provide useful samples under all conditions ranging to a full LOCA.

2. Gas Samples

Provision has been made to obtain gas samples from the drywell and suppression pool atmospheres (via H_2/O_2 Monitor Systems AT-4409 & AT-4410), the secondary containment (Reactor Building, adjacent to air lock at 20' Elevation) atmosphere and the Standby Gas Treatment (SBGT) System discharge to the main stack. The sample system is designed to operate at pressures ranging from sub-atmospheric to the design pressures of the primary containment one hour after a loss-of-coolant accident. Heat traced sample lines are used to prevent precipitation of moisture and resultant loss of iodine in the sample lines. The gas samples may be passed through a particulate filter and silver zeolite cartridge for determination of particulate activity and total iodine activity by subsequent counting of the samples on a gamma spectrometer system. Alternately, the sample flow bypasses the iodine sampler, is chilled to remove moisture, and a 15 milliliter grab sample can be taken for determination of gaseous activity and for gas composition by gas chromatography. This size sample vial has been adopted for all gas samples to be consistent with present off-gas sample vial counting factors.

3. Liquid Samples

A sample line is provided to obtain reactor coolant samples from two points in the jet pump pressure instrument system (No. 14 & No. 6 jet pump) when the reactor is at pressure. This sample location is recommended over the normal reactor sample points as the Reactor Water Clean-up (RWCU) System is expected to be isolated under accident conditions and it is possible that the recirculation line containing the normal reactor water sample lines may be secured. The jet pump pressure system has been determined to be an optimum sample point for accident conditions. The pressure taps are well protected from damage and debris. If the recirculation pumps are secured, there is normally excellent circulation of the bulk of the coolant past these taps, and the pressure taps are located sufficiently low to permit sampling at a reactor water level even below the lower core support plate.

A single sample line is also connected to both loops in the Residual Heat Removal (RHR) System. This provides a means of obtaining a reactor coolant sample when the reactor is depressurized and at least one of the RHR loops is operated in the shutdown cooling mode. Similarly, a suppression pool liquid sample can be obtained from the RHR loop lined up in the suppression pool cooling mode.

The sample system primary isolation valves are controlled from the main control room panels XU-75 and XU-79. The sample system is designed for a purge flow of 1 gpm, which is sufficient to maintain turbulent flow in the sample line. Purge flow is returned to the suppression pool. The high flush flow also serves to alleviate cross-contamination of the samples when switching from one sample point to another.

Since the liquid samples obtained from the jet pump flow instrument sample lines must flow thru the flow switch that isolates the RIP valve on a line break, an automatic time delay override of that switch is incorporated in the sample valve control logic to prevent RIP isolation on initial surge flow into an empty sample line. The sample flow rate will be adjusted to 1 gpm, which is less than the flow switch setting. Timing out of the override then allows the flow switch to operate normally to provide isolation in the event of a sample line break.

The RHR samples are drawn through valves connected to the existing RHR sample lines outboard of the E11-F079A & B and E11-F080A & B sample valves. Since these valves close on reactor water low level (LL1) and drywell high pressure, CAC isolation overrides switches CAC-CS-4178 and CAC-CS-4179 which are located on the RTC board. In conjunction with these changes, the local control switches on the RHR instrument racks at (-) 17' elevation have been relocated to panels XU-75 and XU-79.

All liquid samples are taken into septum bottles mounted on sampling needles. The sample panel is basically a by-pass loop on the sample purge line. In the normal lineup, the sample flows through a conductivity cell (readable range 0.1 to 1000 micro ohms/cm) and then through a ball valve bored out to a 0.10 milliliter volume. Flow through the sample panel is established, the valve is rotated 90 degrees, and a syringe is used to flush the sample plus a measured volume of diluent (generally 10 milliliters) through the valve and into the sample bottle. This provides an initial dilution of 100:1 and supplies a sample for further dilution and subsequent counting on a gamma spectrometer. Alternately, the sample flow can be diverted through a 70 milliliter bomb to obtain a large pressurized volume. This 70 milliliter volume can be circulated and depressurized into a gas sampling chamber. A carrier gas is added and the dissolved gases are stripped from the coolant sample. A 15 milliliter vial gas sample can then be obtained for gas chromatography and quantitative analysis of the dissolved gases associated with the 70 milliliter liquid volume. Ten milliliter aliquots of this degassed liquid can also be taken for off-site chemical analysis requiring a relatively large sample. A radiation monitor in the liquid sample enclosure monitors liquid flow from the sample station to provide immediate assessment of the sample activity level. This monitor also provides information as to the effectiveness of the demineralized water flushing of the sample system following sample operation.

4. Sample Station

The piping station, which is installed within the Reactor Building, includes sample coolers and control valves which select liquid sample points. The sample station, located in the Turbine Building breezeway, consists of both a wall and floor mounted frame and enclosures. Included within the sample station are equipment trays which contain modularized liquid and gas samplers. The lower liquid sample portion of the sample station is shielded with 6 inches of lead brick, whereas the upper gas sampler requires 2 inches of lead. The total weight of the wall mounted portion of the system is approximately 7000 pounds.

The control instrumentation is installed in two standard cabinet control panels. One of these panels contains the conductivity and radiation level readouts. The other control panel contains the flow, pressure, and temperature indicators, and various control switches. A graphic display panel installed directly below the main control panel shows the status of the pumps and valves at all times. The panel also indicates the relative position of the pressure gages and other items of concern to the operator. The use of this panel will improve operator comprehension and assist in trouble shooting operations.

5. Sampling Tools

Appropriate sample handling tools are supplied with the sample station. A gas sampler vial positioner and gas vial cask are included. The gas vial is installed and removed by use of the vial positioner through the front of the gas sampler. The vial is then manually dropped into the cask with the positioner which allows the vial to be maintained about 3 feet from the individual performing the operation.

The small volume liquid sample is remotely obtained through the bottom of the sample station by use of the small volume cask and cask positioner. The cask positioner holds the cask and positions the cask directly under the liquid sampler. The sample vial is manually raised within the cask to engage the hypodermic needles. When the sample vial has been filled, the bottle is manually withdrawn into the cask. The sample vial is always contained within lead shielding during this operation. The cask is then lowered and sealed prior to transport to the laboratory.

A large volume cask and cask positioner is used to remotely obtain the large volume liquid sample through the bottom of the sample station by use of the cask positioned. The positioner holds the cask and vial. The cask is positioned directly under the liquid sampler and the vial is remotely elevated for filling and remotely returned within the cask.

A 15 milliliter bottle is contained within the lead shielded cask. This sample bottle is raised from its location in the cask to the sample station needles for bottle filling. The sample station will only deliver 10 milliliters to this sample bottle. When filled, the bottle is withdrawn into the cask. The sample bottle is always shielded by 5-6 inches of lead when in position under the sample station and during the fill and withdraw cycles, thereby reducing operator exposure.

The cask is transported to the required position under the sample station by a four wheel dolly cask positioner. When in position, this cask is hydraulically elevated approximately 1.5 inches by a small hand pump for contact with the sample station shielding under the liquid sample enclosure floor. The sample bottle is raised, held, and lowered by a simple push/pull cable. The cask is sealed by a threaded top plug that inserts above the sample bottle. The weight of this large volume cask is approximately 700 pounds.

The particulate filters and iodine cartridges are removed via a drawer arrangement. The quantity of activity which is accumulated on the cartridges is controlled by a combination of flow orificing and time sequence control of the flow valve opening; in addition, the deposition of iodine is monitored during sampling by the use of a radiation detector installed adjacent to the cartridge. These samples will hence be limited to activity levels which will not require shielded sample carriers to transport the samples to the laboratory.

6. Timing

Detailed time - motion studies will not be completed until system acceptance testing is in progress; however, CP&L expects no difficulty in satisfying the three hour criterion.

CRITERION 2

The licensee shall establish an onsite radiological and chemical analysis capability to provide, within the 3-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 nonvolatile isotopes);

(b) hydrogen levels in the containment atmosphere;

(c) dissolved gases (e.g., hydrogen), chlorides (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.

RESPONSE

(a) The Post-Accident Radiological Analysis Laboratory (Counting Room) is located in the Service Building at elevation 20'-0" adjacent to the chemistry laboratory. The counting room has the capability to identify and quantify radionuclides in the reactor coolant and containment atmosphere samples to levels corresponding to the source terms given in Regulatory Guides 1.3 and 1.7. The counting room is equipped with three germanium detectors and two computerized multichannel analyzers.

The Plant Emergency Procedures contain provisions to estimate the extent of core damage based upon sample locations, radionuclide concentrations, fuel temperature, and other physical parameters. Refinement of these procedures is expected upon receipt of further information being prepared by General Electric.

(b&c) The Post-Accident Chemistry Laboratory is located in the Service Building at ground elevation, 20'-0". The laboratory is capable of analyzing and quantifying the following analysis.

- Hydrogen, oxygen, and nitrogen levels from containment atmosphere gas samples via gas chromatography.

- Total dissolved gas concentration in liquid samples is obtained by sampling the gas phase over a specific liquid volume, then applying the appropriate corrections.

- Chloride levels from reactor coolant using ion chromatography, within the 3-hour requirements (BSEP's RHR Service Water System is brackish in composition).

- Boron levels from reactor coolant using the Carminic Acid method. Boron analysis using ion chromatography is being evaluated.

(d) The above described capabilities preclude the need for inline monitoring capabilities. BSEP's system is designed for grab-sample operation only.

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.

RESPONSE

Sample availability does not depend upon operation of any isolated auxiliary systems.

Liquid samples are driven by either reactor system pressure through the jet pump flow instrument lines or by RHR pump discharge pressure through extensions of the normal RHR system sample lines.

Primary containment gas samples are obtained from taps in the Containment Atmosphere Monitoring System which is designed for, and required to be, operable during accident conditions.

Valves added to interface the PASS with plant systems have been selected with seismic and environmental qualifications demonstrating their ability to operate in an accident environment.

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 Hydrogen gas in reactor coolant samples is considered adequate. Measuring the Oxygen concentration is recommended, but is not mandatory.

RESPONSE

No capability to grab sample pressurized reactor coolant has been installed.

Alternatively, equipment for stripping dissolved gases from a fixed-volume pressurized liquid sample is provided in the General Electric PASS station. A fifteen milliliter vial gas sample is thus obtained for hydrogen/oxygen analysis via gas chromatography and for quantitative analysis of total dissolved gases.

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 onsite.

RESPONSE

BSEP's coolant water fits the brackish/single barrier criterion and chloride analysis capability within 24 hours is, therefore, a requirement.

The chloride analysis is performed on the coolant grab sample via the ion chromatography technique.

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)).

RESPONSE

Detailed time-motion studies will not be completed until system acceptance testing is in progress; however, minimizing personnel exposure has been a critical basis in both CP&L's and G.E.'s design efforts on this system. No difficulty is anticipated in demonstrating by those time-motion studies that this criterion will be satisfied.

CRITERION 7

The analysis of primary coolant samples for boron is required for PWRs. (Note that Revision 2 of Regulatory Guide 1.97, when issued, will likely specify the need for primary coolant boron analysis capability for BWR plants.)

RESPONSE

BSEP has the capability to analyze coolant boron concentrations using the Carminic Acid method. In addition, the applicability of analysis via ion chromatography is still being evaluated.

CRITERION 8

If inline 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 offsite 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.

RESPONSE

The General Electric PASS station is designed for grab sampling only. Capability of performing all required sample analyses is provided in the onsite chemistry and radiological laboratories.

In addition, Babcock and Wilcox has been contracted to provide backup offsite analysis services at their facility in Lynchburg, Virginia. A specially designed shipping cask for high activity samples is being purchased thru a cooperative utilities group.

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 onsite liquid sample analysis capability should be such as to permit measurement of nuclide concentration in the range from approximately 1 μCi/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 ventilation system design which will control the presence of airborne radioactivity.

RESPONSE

(a) BSEP's counting room has the capability to identify and quantify radionuclides in the reactor coolant and containment atmosphere samples to levels corresponding to the source terms given in Regulatory Guides 1.3 and 1.7. The counting room is equipped with three germanium detectors and two computerized multichannel analyzers.

(b) The Radiochemistry Laboratory Gamma Spectroscopy System can perform analyses within a factor of 2 using extended geometrics. Determination of special shielding requirements is contingent on finalizing the estimates of local dose rates expected in the lab area during accident conditions.

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.

RESPONSE

The Radiochemistry Laboratory Gamma Spectroscopy System can perform analyses within a factor of 2 using extended geometrics.

The Post - Accident Chemistry Laboratory Equipment ranges, sensitivities and accuracies with dilution are:

ION	RANGE	SENSITIVITY	ACCURACY
Cl^-	.5 to 20.0 ppm	.5 ppm	±10%
H_2	$\leq$ 1 to 100%	1%	±10%
O_2	$\leq$ 1 to 30%	1%	±10%
Boron	20 to 6000 ppm	20 ppm	±10%
pH	1 to 14	-	±.2 pH units

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 adsorbers and high-efficiency particulate air (HEPA) filters.

(c) Guidelines for analytical or instrumentation range are given below in Table II.B.3-1.

RESPONSE

(a) The installed system will have the capability to flush all liquid sample and return lines with demineralized water and to purge all gas sample and return lines with nitrogen.

The primary containment and SBGTS gas sample lines are heat traced to prevent sample distortion via condensation.

Redundant sample taps are provided for the reactor coolant, suppression pool and containment atmospheric samples to insure that alternate flow paths are available should a sample tap become blocked by debris.

The primary containment and SBGTS gas sample flows and all liquid sample flows are returned to the suppression pool. The secondary containment gas sample is returned to the secondary containment. Grab samples left in the lab area after analysis will be stored in a shielded container for later appropriate disposal.

Line break protection is provided on the reactor coolant sample lines via the restricting orifices and flow switch controlled isolation valves installed in the jet pump flow instrument sensing lines. The suppression pool liquid and primary containment gas sample lines have remote operated isolation valves that can be closed in case of a line break. In any event, fluid lost thru any sample line break is limited by the restricting effect of the .370 inch I.D. of the $1/2$ inch sample tubing and by the short sample flow durations.

Representativeness of the utilized reactor coolant and suppression pool (RHR) samples is justified by the following excerpt from a discussion provided by General Electric:

"The Post Accident Sampling System (PASS) takes liquid samples for either the Jet Pump discharge instrument lines, or if the reactor is not of sufficient pressure to force the sample to the station, the discharge of the RHR Pump. In the first instance, the sample is from the reactor. In the second it is from the suppression chamber.

For the Jet Pump discharge sample point, one of two basic conditions will exist. A small break may occur, which will allow the reactor water level to be maintained at or near the normal water level, or a large break, exemplified by a recirculation pump suction line, may occur wherein the water level may be controlled only by the height of the Jet Pumps and the abilitity to add water to the vessel. With a nearly normal water level, or at least water in the upper plenum, it has been established in other documentation that natural circulation will occur, with a large loop from the downcomer to the shroud region via the Jet Pumps.

Another loop may exist within the shroud depending upon the lack of primary recirculation flow rate. With the thermal conditions pumping water up through the core and back down past the tap from which the PASS sample is taken, a representative relationship will exist which will allow the results of the sample to be related to the condition of the core.

For the large break condition in which a normal water level cannot be maintained, the Jet Pump discharge can still supply a representative sample. In the case of a BWR 4, the Low Pressure Core Spray system supplies water to flood the core. This flow will be down through the core then up through the Jet Pumps to exit the break. Again, flow past the sample point directly from the core will assure a representative sample because one of the two LPCS sprays is capable of supplying ten times as much water as is required for replacement of core boil off after only ten minutes.

As reactor pressure decays or is lost, the sample point at the Jet Pump discharge is no longer available, so the RHR pump discharge must be utilized. This is water from the suppression pool volume which will not at first be representative of any core condition. Samples should be from the reactor as long as possible both for a more direct and therefore faster response to core conditions and to give the suppression pool more time to reach a representative condition. Of course, with a small break reactor pressure stays up so that the sample point need not be switched.

With emergency cooling flowing from the suppression pool to the injection points and past the core either by forced flow or by thermal action then subsequently past the Jet Pumps to the pool, the only criteria for representation is the pressure of the reactor and the time since the various flow paths were established. Placement of the sample points is, for all cases, excellent."

Representativeness of the primary containment gas sample is assured in that each of the redundant gas sample lines connect to the inlet sample manifold of one of the Containment Atmospheric Monitoring System's hydrogen/oxygen analysis cabinets. Each of these manifolds can be valved

to select samples from three drywell elevations and the suppression chamber.

The sample lines are routed as directly as possible from the primary taps to the sample station. The length of the lines is dictated by primary tap location, support location considerations, slope requirements and ALARA. Since the GE sampler unit actually encloses the outside end of the reactor/turbine building sample penetration assembly, the volume of fluid routed outside of the secondary containment is held to an absolute minimum.

Any gas leakage within the sampler unit is swept back to the secondary containment thru the 3" vent pipe. Potential liquid leakage is collected in a sump in the bottom of the sampler unit and discharged thru the liquid sample return line to the suppression pool.

(b) The ventilation exhaust from the sampling station flows directly back to secondary containment via a 3" pipe provided in the reactor building/turbine building sample penetration assembly. During accident conditions the secondary containment is only vented thru the Standby Gas Treatment System which includes the required charcoal adsorbers and HEPA filters.

(c) Reference table not included in NUREG.

IMPLEMENTATION

Installation should take place by January 1, 1982.

RESPONSE

Installation completion at BSEP has extended beyond this date. Current schedule is in accordance with our letter of April 23, 1982.

TYPE OF REVIEW

A post-implementation re .ew will be performed.

DOCUMENTATION REQUIRED

Operating Reactors - By January 1, 1982 have available for review the final design details of the implementation of the above position and clarifications. The final design includes piping and instrumentation diagrams (P&ID's), together with either (a) a summary description of procedures for sample collection, sample transfer or transport, and sample analysis, or (b) copies of procedures for sample collection, sample transfer or transport, and sample analysis. If deviations to the above position or clarification are necessary, provide detailed explanation and justification for the deviations by January 1, 1982.

RESPONSE

Final design details and procedures will be available at the site for post-implementation review following the installation completion date stated in our letter of April 23, 1982.

TECHNICAL SPECIFICATION CHANGES REQUIRED

Changes to technical specifications will be required.

RESPONSE

Proposed technical specifications changes for BSEP were submitted to the NRC via our letter of June 11, 1982.

(5877C8T2)