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SUBJECT: Forwards info in response to NRC 820902 ltr re NUREG-0737, Item II.B.3, "Post-Accident Sampling Sys." W/two oversize drawings.Aperture cards are available in PDR.

"See Rcpts"

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February 6, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Post Accident Sampling System
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Crutchfield:

Please find attached our response to your letter of September 2, 1982 in which you requested information addressing the criterion of NUREG-0737, Item II.b.3. To aid in your review, we have also enclosed the Design Criteria, a P&ID and an equipment layout drawing for the Ginna Post Accident Sampling System.

Very truly yours,

Roger W. Kober

Roger W. Kober
Vice President
Electric and Steam Production

Attachment

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Response to NRC

NUREG-0737, Item II.b.3

Criterion 1:

Requirement:

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 radiation 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).

Additional Guidance: NUREG-0737 states that the licensee should be able to perform sampling and analysis within 3 hours of deciding to take the sample. Our clarification section asks how the 3 hour limit is to be met during a loss of offsite power. It was not meant to imply that the sampling system had to be operational during a loss of offsite power. Rather the intent was if there is a loss of offsite power, can you meet the three hour limit.

Response: A description of the Ginna Post Accident Sampling System (PASS) was provided in the RG&E September 4, 1981 submittal to the NRC, and in the enclosed copy of the PASS Design Criteria, Revision 1. The system consists of the three panels and associated sample lines. The shielded Liquid and Gas Sample Panel (LGSP) located at elevation 253' in the south section of the Intermediate Building provides reactor coolant, containment sump and containment atmosphere sampling capability. Control

and monitoring of the LGSP is accomplished by the Control Panel (CP) and Instrument Panel (IP) located in the Hot Shop at elevation 253' approximately thirty feet away from the LGSP. Analytical laboratories are available on site in the Service Building at elevation 271' and in a remote trailer located approximately 300 feet west of the Service Building at elevation 271'. Grab samples of Containment Building sump fluid and reactor coolant can be collected at the LGSP, transported in a lead shielded container to the next elevation and passed through a "passbox" to the radioactive chem lab for analysis. Containment air samples are also collected at the LGSP and transported manually to the "passbox" for isotopic analysis in the radiochem lab. Hydrogen and oxygen analysis of containment air is performed in-line by gas chromatography.

Tables 1-1 through 1-6 represent expected typical collection time, analysis time and total time for the following tasks:

1. Undiluted primary coolant grab sample
2. Diluted primary coolant grab sample
3. Gas analysis of primary coolant grab sample
4. Diluted containment air grab sample
5. Boron analysis of undiluted primary coolant grab sample
6. Chloride analysis of diluted primary coolant grab sample

Tables 1-7 through 1-10 represent the time involved for performing in-line analysis for the following:

1. Hydrogen analysis of primary coolant
2. Boron analysis of primary coolant
3. Dissolved oxygen, pH and conductivity measurement of primary coolant
4. Gas analysis of containment air.

Table 1-11 represents the time required for the more likely situation where several analyses would be performed at the PASS and grab samples obtained for lab analysis.

It is important to note that collection times for grab samples are based on obtaining the samples at the LGSP. However, undiluted primary coolant grab sample capability has been preserved in the nuclear sample room utilizing the original Ginna sampling system. Undiluted containment air samples can be obtained at containment penetrations in the intermediate building north basement floor and the auxiliary building intermediate building floor. The PASS has been designed for both normal and post-accident operation and although it has the capability of providing undiluted containment sump, reactor coolant and containment air grab samples, in the post-accident mode of operation these samples would probably be diluted.

There are three (3) power source circuits that provide the power requirements for the PASS. The power supply for the waste transfer pump originates at a class IE bus which is supplied by diesel power in the event of loss of offsite power.

The control and instrument power requirements of the PASS are provided by non-essential 480 V bus 13. The power for the waste evacuating compressor and the containment air sample line heat tracing system is provided by non-essential 480 V bus 15.

Emergency procedure E-4, Loss of All AC Power, requires that the above-mentioned non-essential busses be stripped of all loads during a loss of offsite power. Subsequently, bus tie breakers can be closed tying the unloaded non-essential busses to essential busses supplied by diesel power. Specific pieces of equipment, such as air compressors, are then loaded to the non-essential busses. Power circuits for the PASS are included in those circuits energized during this event when requested by the Health Physics Department. The time required to energize the PASS in the event of a loss of all offsite AC power would be less than an hour. As can be seen in the attached tables, even allowing an hour for restoration of power, samples can still be obtained and analyzed within three hours.

Table 1-1

Undiluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Fill Bottle	2
o Flush System	5
o Exit	1
Total	48

Isotopic Analysis

o Remove sample from pass box to hood; transfer 15 mls of sample to beaker and add acid and boiling beads.	1
o Boil Sample; Cool in water bath	8
o Pipette 1 ml to 50 ml volumetric bottle and dilute to 50 mls and mix.	1
o Transfer 50 ml diluted sample to count room and place in steel counting safe.	1
o Count sample	5
o Dispose of sample	1
	17 min

Total time to collect and analyze an undiluted primary coolant sample is about one hour.

Table 1-2

Diluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Dilute and Fill	20
o Extract Sample	2
o Flush	20
o Exit	1
Total	83

Isotopic Analysis

o Remove 15 ml sample from pass box; transfer sample to beaker and add acid and boiling beads	1
o Boil Sample; Cool in water bath	8
o Pipette sample into 50 ml bottle	1
o Transfer dilute sample to count room and place in steel counting safe	1
o Count sample	5
o Dispose of sample	1
	17 min

Total time to collect and analyze a diluted primary coolant sample is about one and two-thirds hours.

Table 1-3

Gas Analysis of Primary Coolant Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Strip Gas	5
o Flush	5
o Collect Sample	2
o Exit	1
Total	53

Gas Analysis

o Remove collection bulb from passbox	1
o With syringe remove predetermined sample volume from glass collection bulb to counting vial to counting vial	1
o Transfer vial to Count Room and place in counting safe	1
o Count sample	5
o Disposal of sample	1
	9 min

To collect an undiluted primary coolant sample at PASS, strip gases and analyze in lab takes approximately one hour.

Table 1-4

Diluted Containment Air Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access	1
o System Checkout	5
o Purge	5
o Dilute Sample	2
o Remove	2
o Flush	10
o Exit	1
Total	56

Sample Analysis

o Remove sample from passbox	1
o With syringe remove 5 cc from collection bulb to collection to counting vial	1
o Transfer vial to count room and place in counting safe	1
o Count Sample	5
o Dispose of sample	1
	9 min

To collect and analyze a diluted containment air sample takes approximately one hour.

Table 1-5

Boron Analysis of Undiluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Extract Sample	2
o Flush System	5
o Exit	1
Total	48

Boron Analysis

o Sample removed from "passbox"	1
o 20 ml of sample is placed in beaker and moved to to titration rig.	1
o Mannitol added to beaker	1
o Automatic titration with NaOH of sample along with pH determination	2
o Dispose of sample	1
	6 min

Total time to collect and analyze an undiluted primary coolant sample in the lab for Boron is approximately one hour.

Table 1-6

Chloride Analysis of Diluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Suit-up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Dilute and Fill	20
o Extract Sample	2
o Exit	1
Total	63

Chloride Analysis

o Set up instrument and flush	*30
o Prepare sample	15
o Analyze sample 3 times	60
	75 min

*This step is done simultaneously with sample collection.

Chloride analysis of reactor coolant takes approximately two-and-a-quarter hours.

Table 1-7

Hydrogen Analysis of Primary Coolant

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Access	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Strip Gas	5
o G.C. Analysis	4
o Flush	5
o Exit	1
Total	45

Table 1-8

Boron Analysis of Primary Coolant

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Access	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o Remote Sample Analysis	60
o Flush System	10
o Exit	1
Total	101

Table 1-9

Dissolved Oxygen, pH and Conductivity Measurement of Primary Coolant

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Access	1
o System Checkout	5
o System Purge	5
o Take Readings	5
o Flush System	5
o Exit	1
Total	42

Table 1-10

Gas Analysis of Containment Air

Sample Collection

Task	Time Required (min)
o Obtain a Special Work Permit	20
o Access	1
o System Checkout	5
o System Purge	10
o Sample Analysis	4
o Flush System	10
o Exit	1
Total	51

Table 1-11

Primary System Sample

Task	Time Required (min)
o Special Work Permit	20
o Suit up in Scott Airpack	10
o Access to LGSP	1
o System Checkout	5
o Purge to VCT	3
o Purge LGSP	1
o pH, Cond., Dissolved O_2	2
o Strip Gases from Sample	5
o H_2 Analysis of Stripped Gases	4
o Remove Sample Bomb for Isotopic	2
o Transport to passbox	1
o Flush Sample Lines for Dilution	10
o Fill Tank	10
o Purge LGSP for Dilution Sample	3
o Dilution	20
o Take Sample	3
o Transport to Passbox	1
o Purge LGSP for Boron	3
o Start Boron Analyzer	1
o Exit Area	1
o Return to Obtain Boron Result After 1 Hour	5
o Flush Panel	10
o Exit	1
	122 min.

Criterion 2:

Requirement:

Criterion: (2) The licensee shall establish an onsite radiological and chemical analysis capability to provide, within 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 nonvolatile 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: (a) A discussion of the counting equipment capabilities is needed, including provisions to handle samples and reduce background radiation to minimize personnel radiation exposures (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 back-up grab sample capability and instrument range and accuracy.)

Additional Guidance: Clarification 2(d) of our original request asked for a discussion of the reliability and maintenance information to demonstrate that the selected on-line instrument is appropriate for this application. A detailed reliability analysis is not required to satisfy the staff concerns in this area. The staff needs enough data to provide reasonable assurance that the on-line instrument will function when needed.

Response: 2(a) Radionuclide Indications of Core Damage

The primary counting equipment for identification of gamma emitting isotopes is a Tracor/Northern multichannel analyzer model TN-4000, computer based analyzer, using either a Ge(Li) crystal with approximately 8% efficiency or an intrinsic germanium crystal of approximately 10% efficiency. The equipment is located in the Health Physics counting room located one floor above and approximately 80 feet from the sampling panel of the Post Accident Sampling System (PASS).

The room containing the counting equipment has 8 inch solid cement block walls and is lined on the wall facing the containment building with one inch of lead. Lead bricks have been placed to shield against shine from the basement area of the Intermediate Building.

Where practical, sample lines have recently been relocated from areas of heavy traffic and radioactive sensitivity (i.e., the count room) to take advantage of existing and newly installed shield walls. Sample lines from the reactor coolant system (RCS) are 3/8" unshielded lines which come the closest distance to the count room at their penetration to the containment

building; a distance of approximately 30 feet. The 1/2" unshielded containment air sampling line passes the count room at the next lower elevation beneath a 5" concrete floor slab at a distance of 20 feet. A 1/2" unshielded containment sump sample line is also located at the next lower elevation at a distance of 80 feet. Radiation from the liquid sample lines is minimized by flushing with condensate water after use. The containment air sample line is designed to be purged with either argon or nitrogen gas.

In the event of an accident causing high levels of radiation in samples, the Post Accident Sampling System (PASS) has the capability to dilute all samples thereby minimizing radiation exposure in sample handling. Lead pigs will be used to transfer grab samples from the sample point to the radiochem lab. Extension tools are available for handling radioactively hot samples as well as a portable lead shield that the Health Physics Technician can utilize while performing analyses.

Dilutions of liquid samples can be done within the sample panel at a design ratio of 1:1000. A diluted sample aliquot can be removed from the PASS for analysis of gamma emitting isotopes. Undiluted samples can be obtained from the sample panel and the nuclear sample room, but during post accident operation the dilution capability of the PASS will be utilized if required.

Diluted gas grab samples from the primary system or containment atmosphere can be obtained. The design dilution can be either 1:200 or 1:2000, depending on which is necessary to make counting of the gases possible.

If the Health Physics counting room is not available, a second counting room is available in the environmental trailer. This counting room is equipped with a Tracor/Northern multichannel analyzer model TN-11, computer based analyzer, using a Ge(Li) crystal with approximately 23% efficiency.

Both counting rooms are such that shelves can be placed above the crystals to give extended counting distances. This allows the ability to count samples with higher radiation readings. Samples to 600 mR/hr can be counted directly when placed on the most distant shelf.

Ginna Procedure PC-25.4 (attached), Guidelines for Interpreting Post-Accident Sampling Results to Estimate Core Damage, has been implemented to provide an early assessment of potential fuel damage based upon radiological and plant instrument indications. RG&E is a participant in a working group under the Westinghouse Owners Group which is defining the objectives and methodology of a generic core damage assessment procedure. It is anticipated that guidelines resulting from this effort will be incorporated into applicable Ginna procedures. No specific schedule is available at this time.

(b) Hydrogen levels in the containment atmosphere

Hydrogen in containment atmosphere can be measured in one of three ways. Through the PASS, a measurement can be made using the Baseline Model 1030A gas chromatograph. This unit is built into the sample panel and gives the capability of measuring gases directly from containment as well as the dissolved gases in the primary coolant.

A second system available for measurement of the percent hydrogen in containment atmosphere are the two recently installed hydrogen monitors manufactured by Delphi Systems Division of Comsip Inc. These units can be used to measure the hydrogen content up to 10% in air.

A third method is to use the lab unit and obtain a diluted grab sample from the PASS or an undiluted grab sample from a separate sampling location in the Intermediate Building or Auxiliary Building. The sample is then transported to the primary laboratory for analysis of hydrogen in the lab unit. This unit is currently used to determine hydrogen in the Reactor Coolant System.

(c) The Ginna lab facilities in conjunction with the PASS meet the requirements of the accident sampling capabilities of Regulatory Guide 1.97, Revision 2 as described here and in response to Criterion 10.

Gross activities from 10 uCi/ml to 10 Ci/ml will be analyzed in the plant lab using a gas flow proportional counter. Samples with high activity will be diluted before transport to the lab.

Isotopic analyses of samples will be performed by a Tracor-Northern model 4000 multi-channel gamma spectrometer.

Boron content of reactor coolant is measured by an in-line Ionics Digichem Analyzer model 3250 with range capability of 20-6000 ppm.

A portable Dionex ion chromatograph is available in the lab to measure chlorides in the range of 10 ppm to 100 ppm.

Dissolved hydrogen in reactor coolant is measured by stripping the gas from the coolant in the PASS. The stripped gas is then sampled and analyzed by a Baseline Industries model 1030A gas chromatograph which is an integral part of the PASS. The gas chromatograph range is 10-2000 cc/Kg.

Dissolved oxygen is measured by the in-line Leeds and Northrup analyzer model 7931 of the PASS. This analyzer has ranges of 0-20 ppm, 0-2 ppm and 0-200 ppb.

The PASS contains an in-line Leeds and Northrup pH monitor model 7075-3 capable of measuring pH from 1 to 13.

The hydrogen and oxygen content of containment air can be determined by the gas chromatograph of the PASS or grab samples can be collected at the PASS for lab analysis. Isotopic analysis of containment air is performed in the lab on a collected grab sample from a location in the Intermediate Building (north) or a location on the intermediate floor of the auxiliary building.

The Ginna PASS is designed with containment sump sampling capability. All samples processed by the PASS can either be discharged to the containment sump or to the waste systems.

(d) The PASS has the following in-line capability:

- perform analysis of reactor coolant and containment sump liquids for pH, conductivity, and dissolved oxygen;
- degas primary coolant and perform in-line analysis for dissolved hydrogen;
- perform in-line hydrogen and oxygen analysis for containment air;
- perform in-line boron analysis of primary coolant;
- perform in-line chloride analysis of primary coolant with a portable chloride analyzer. (Although the portable chlorine analyzer can be used in-line, it is preferable to obtain diluted grab samples and perform the chloride analysis in the radiochem lab.);
- provide in-line dilution for containment air and primary coolant grab samples.

The Ginna PASS was designed for both normal and post-accident operation. It is the intent to use the PASS on a daily basis as practical, thus providing an up-to-date status of equipment.

In general, the in-line equipment chosen for the PASS is standard commercially available equipment. Each device has been modified as required, and subsequently qualified by the NUS Corporation for use during normal and post-accident conditions.

Maintenance considerations were an important aspect of the design of the PASS. The gas chromatograph and boron analyzer were modified so that a minimum amount of detection and analysis parts are located behind the LGSP shield wall where high radiation fields may exist. Only the probes of the pH, conductivity and oxygen analyzers are located in the LGSP with the receivers located on the instrument panel. The boron analyzer and gas chromatograph were modified such that components that may be radioactively sensitive were remotely located from the LGSP. Further, the piping of the LGSP can be flushed internally as well as externally with an integrated spray system to facilitate maintenance of the LGSP.

Criterion 3:

Requirement:

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: Attached drawing 33013-1141 is a P&ID of the Post Accident Sampling System (PASS) that illustrates the flow paths for required post accident samples. The PASS reactor coolant sample lines tie into the original sample lines at the containment sample penetrations. During post-accident operation, recirculation of reactor coolant samples is from the original sample lines, through new piping and PASS heat exchangers, through bypass valve V-10016 around the PASS Liquid and Gas Sample Panel (LGSP) to the PASS waste tank. When the level of the waste tank reaches a predetermined point, the waste transfer pump starts automatically and pumps the contents of the tank through V-10006, V-1723, V-1728 and V-10023 to the containment sump. Remote operated valves V-10000, V-10001, V-10002 and V-10003 have been installed to enable initiation of reactor coolant sample flow to the PASS. V-10000 provides a pressurizer steam space sample, V-10001 provides a pressurizer liquid space sample, V-10002 provides a reactor coolant B hot leg sample and V-10003 provides a containment sump sample.

These valves are exterior to the containment and will not be subjected to an adverse environment in the event of a major accident. Reactor coolant sample line isolation valves which are a part of the original sample system and which are necessary for PASS recirculation and sampling are located inside the containment building. Valve 955, reactor coolant system "B" loop hot leg sample line isolation valve has been qualified for the design post-LOCA environment. The qualification of valve 955 insures that reactor coolant recirculation and subsequent analysis by the PASS is available in the post accident situation.

When the PASS is aligned to analyze reactor coolant or containment sump samples, the samples are routed through the same line as the previously described recirculation path with one exception. Instead of passing through the bypass valve V-10016, the samples pass through V-10017 to the LGSP for analysis then drain to the PASS waste tank. With the exception of the previously mentioned sample line isolation valves, valve 10023 (the PASS discharge valve to containment sump) and valve 10024 (the air supply valve to the PASS containment sump sample pump), all remotely operated valves involved in liquid sample recirculation and sample analysis and the waste transfer pump are located outside containment and are not subjected to an adverse environment in the event of a major accident. Valves V-10023 and V-10024 have been qualified to withstand the environment inside containment accompanying a LOCA. The

containment sump sample pump is an air operated positive displacement pump that the manufacturer certifies to meet the specifications delineated in the procurement specification.

The PASS containment air sample lines (sample and sample return) tie into the plant containment air sample lines just downstream of isolation valves V-1598 and V-1597 at the containment penetrations. To recirculate a containment air sample, the isolation valves are opened, the PASS containment air sample inlet remote operated valve V-10009 is opened, various remote operated valves within the LGSP are opened, and the PASS containment air sample return valve V-10010 is opened. A vacuum pump within the LGSP withdraws the air from containment and discharges it back to containment or to the plant vent system. Within the LGSP, the recirculation circuit bypasses the analysis equipment. During sampling, the sample path is the same as the recirculation path except that once the sample is inside the LGSP, it is routed to the analysis equipment.

The Ginna PASS has the capability to sample the containment sump. An air driven pump mounted on the wall of the containment sump pumps liquid from the sump up to the containment sump pump's discharge line to the PASS. The PASS ties into the sump pump's discharge line downstream of the containment isolation valves V-1728 and V-1723 located outside of the containment. Containment sump sampling and recirculation is a batch

type of operation because of the common length of sump pump discharge line that is used to both provide containment sump sample fluid to the PASS and discharge containment sump sample from the PASS. In the recirculation mode, sump fluid is pumped up to the containment sump pump's discharge line, through the containment isolation valves for the line, through a remote operated admission valve V-10003 to the PASS, through the PASS heat exchange, through the LGSP bypass valve V-10016 and to the PASS waste tank behind the shielding of the LGSP. After a sufficient purge time, the sump fluid is diverted to the LGSP for analysis and discharged to the same holdup tank. After analysis, the sample pump in containment is turned off. A remote valve, V-10023, inside containment in a line to the sump from the sump pump's discharge line is opened. The PASS waste transfer pump is started and the contents of the waste holdup tank are pumped back to the sump. To recirculate, sample, and remove sample fluid from the PASS requires remote operation of just two valves inside of containment: the air supply valve for the sample pump V-10024 and the valve in the discharge line to the sump V-10023.

Criterion 4:

Requirement:

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 minimizing personnel radiation exposures (ALARA), direct monitoring for dissolved oxygen is recommended.

Response: The Post Accident Sampling System is equipped with in-line instrumentation to perform dissolved hydrogen and oxygen analyses of reactor coolant. The analyses involve operator actions at the Electric Control Panel/Instrument Panel (ECP/IP). Hydrogen analyses are performed using a gas chromatograph (GC), and dissolved oxygen analyses are performed using a dissolved oxygen probe and analyzer. The controller, analyzer and recorder for the GC and the analyzer and indicator for the oxygen analyzer are located in the remote Instrument Panel (IP) to reduce operator exposure.

Dissolved Hydrogen Analysis

All system components associated with gas stripping operations are initially purged with argon to dry the gas expansion vessel which collects stripped gases. The gas expansion vessel and

connecting lines which route the gases are evacuated as is the gas chromatograph. Reactor coolant is routed through the LGSP and a pressurized sample is isolated within a 10 ml sampling flask. The dissolved gases are stripped from the pressurized sample into the previously evacuated expansion vessel. Nitrogen gas is purged through the sample flask to strip any remaining gases into the expansion vessel. A pressure control valve limits the pressure within the vessel to 35 psia.

LGSP valving is opened to route the stripped gases to the in-line gas chromatograph. The gas chromatograph contains a loop sampling selector valve. The sample loop is loaded with stripped gases by remote operation at the ECP.

After isolating the gas samples, the GC controller is used to remotely inject a 0.25 ml sample into the GC. In the automatic mode, the complete analysis is controlled by the GC microprocessor which has been preprogrammed by entry of a step, time, and command code sequence.

The gas chromatograph in the IP/LGSP employs a thermal conductivity detector system to separate and measure hydrogen (and other gases). Argon is utilized as the carrier gas. As each component of a sample is eluted through chromatographic columns, a thermal conductivity detector senses and indicates its presence by the difference in thermal conductivity of the gas of interest relative to that of the carrier gas.

The result, after a complete sample has passed through the system, is a chromatogram with a peak for each separate component. Concentration of an unknown sample is determined by comparing the peak height of the sample with calibration curves developed for the gas chromatograph. Calibration curves relate peak height to cc/kg for each attenuation setting selected. Analyses for hydrogen can be completed within 2 minutes after loading the sampling loop. Based on testing data provided by NUS, the Baseline Model 1030A gas chromatograph installed in the system may be used to accurately determine dissolved hydrogen concentration in the range of 50-2,000 cc/kg (STP) with an accuracy of $\pm$ 10 percent. Experimental data indicate that it is possible to measure dissolved hydrogen concentrations as low as 1.0 cc/kg (STP).

The IP is equipped with a dual set of hydrogen standards which are to be used to verify the validity of calibration curves prior to initiating any gas stripping operations. The calibration gases can be routed to the GC for analyses by remote operation from an ECP/IP.

The Baseline system can also be used to determine total gas concentrations with modifications to the sequence program, operating column temperature, and sample loop size. This was previously identified under the discussion of Criterion 2(d).

Dissolved Oxygen Analysis

To measure dissolved oxygen, primary coolant is remotely directed through the in-line Leeds and Northrup Model 7931 oxygen analyzer probe located in the LGSP. The signal developed at the probe is transmitted to the IP where it is conditioned in the Leeds and Northrup Model 7931 receiver and presented on its direct readout meter.

The probe has a permanent electrolyte which is sealed at the rear with an expansion chamber to compensate for pressure changes. Physically, the sensor consists of three electrodes and a thermistor for temperature compensation. Two multiple electrodes are interspaced on the supporting substrate and covered with an electrolyte; these electrodes are connected as anode and cathode. The third or reference electrode is mounted in the center of the electrode support and is also in contact with the electrolyte. The anode and cathode perform oxygen generation and reduction functions while the reference electrode maintains the correct electro-chemical potential.

When the probe is placed into the sample stream, oxygen diffuses through the membrane and is reduced at the cathode, and an equal amount of oxygen is generated at the anode. The diffusion continues until the oxygen tension on both sides of the membrane is equal and a balance exists. The electrical circuitry is arranged such that the current necessary to

maintain this equilibrium is converted to read out the dissolved oxygen concentration in the solution.

The reactions are as follows:

At cathode: $O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$

At anode: $O_2 + 4H^+ + 4e^- \longleftarrow 2H_2O$

Note: No oxygen or acid is consumed.
No water is produced.
No net reaction.

As mentioned previously, the receiver amplifies and conditions the probe signal for various types of optional readouts, alarms and control functions as well as providing a means of calibration.

The instruments specifications are $\pm$ 10% accuracy through a range of 0.01-20 ppm and thus meet the NRC criterion (see Criterion 10).

Criterion 5: (Chloride Analysis)

Requirement:

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.

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: The analysis of chloride in the primary system is not required within 24 hours since the Ginna water supply is not brackish nor does it have only a single barrier between the primary containment systems and the cooling water. Ginna would, therefore, have 96 hours in which to make the analysis for chloride. Ninety-six hours after the accident an unshielded 15 ml sample of reactor coolant would have an activity of 6R at one foot. The sample would be taken from the PASS and transported in a shielded container to the radiochem lab for analysis by ion chromatography using a Dionex model 2020i system. The Dionex system requires a 0.25 ml volume for the analysis which takes

20 minutes after injection. In practice a sample is analyzed three times totaling 1 hour in analysis time. However, the operator need only be in attendance for approximately 1 minute during the injection phase (See Table 1-6 for a detailed timing analysis).

The analysis for dissolved oxygen is from a direct reading Leeds and Northrup dissolved oxygen monitor with a design sensitivity to 10 ppb dissolved oxygen in water (0.01 ppm) and thus meets the NRC criterion of 0.1 ppm. The measurements of the two chemical parameters will allow the personnel at Ginna to take corrective measures as required.

Criterion 6:

Requirement:

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 personnel exposures based on person-motion for sampling, transport and analysis of all required parameters.

Additional Clarification: Clarification 6 requested information on the predicted man-rem exposures based on person-motion sampling, transport and analysis of all parameters. This information is necessary to confirm that the licensee has made adequate provisions to meet GDC 19 requirements.

Response: In 1979 the Rochester Gas and Electric conducted a design review in response to Item 2.1.6.b of NUREG-0578 to determine whether post-accident radiation fields unduly limited personnel access to areas necessary for mitigation of or recovery from an accident; or unduly degrade the proper operation of safety equipment. This study (see reference 1) included time-person-motion studies of grab sample collection and analysis. As a result of this study several modifications to the plant and procedures were implemented. In the interim, a study was ongoing to investigate the benefits of the various new designs of Post Accident Sampling Systems (PASS).

The benefits derived in terms of ALARA, post-accident sampling capability, and improvement of normal operation sampling

capabilities prompted the RG&E to contract the NUS Corporation to design a Post Accident Sampling System compatible with the existing Ginna sample system. Inherent to the design, extensive shielding calculations were made to determine radiation dose to an individual performing a sample analysis with the PASS or collecting a sample with the PASS for analysis in the lab. Results are provided in Tables 6-1 through 6-11. Dose rates used in constructing these tables are based on dose rates that would exist one hour after the accident.

Table 6-1

Undiluted Reactor Coolant Sample

Sample Collection

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access	1 min	-	-	(1) 40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	(3) 400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Fill Bottle	2 min	(2) 21 R/hr	(4) 26.7 R/hr	1589 mr
o Flush System	5 min	193 mr/hr	(5) 593-363 mr/hr	40 mr
o Exit	1 min	21 R/hr	40 mr	390 mr
			Total	2100 mr

Sample Analysis

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Remove 15 ml from passbox to hood; transfer to beaker; add acid and boiling beads	0.5 min	120 R/hr unshielded	20 mr/hr	1020 mr
	0.5 min	21 R/hr unshielded	20 mr/hr	195 mr
o Boil sample; cool in water bath behind lead brick	10 sec	120 R/hr	20 mr/hr	333 mr
	7 min	-	20 mr/hr	3 mr
o Pipette 1 ml to 50 ml volumetric bottle and dilute to 50 ml	1 min	120 R/hr	20 mr/hr	2000 mr
o Transfer 50 ml diluted sample to count room steel counting safe	1 min	8 R/hr	20 mr/hr	133 mr

Table 6-1 (continued)

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Count Sample	5 min	-	20 mr/hr	100 mr
o Dispose of sample	1 min	8 R/hr		133 mr
			Total	3914 mr

Assumptions:

1. Sampling takes place one hour after the accident.
2. Background radiation level at control panel is reduced by a factor of 10 by new solid concrete wall.
3. Background during recirculation reflects sample lines filled with sample.
4. 20 mr background in radiochem lab from containment shine through 1 ft concrete shield wall.

Notes:

(1) Provided by study of reference 1. A person would receive a 40 mr dose transversing the path from the "change area" to the LGSP through various radiation fields in one minute of time.

(2) Calculated for a 15 ml sample in a 2 inch thick lead container using a reference 1 figure of 600 R/hr for a 75 ml unshielded sample at one foot.

(3) 230 mr contribution from PASS sampling plus 170 mr accident background for area.

(4) 25 R/hr contribution from PASS sampling plus 1.7 R/hr accident background for area.

(5) Sample left at LGSP until flushing is complete.

Table 6-2

Diluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Dilute and Fill	20 min	-	400 mr/hr	133 mr
o Extract Sample	2 min	(1) 120 mr/hr	26.7 R/hr	894 mr
o Flush	20 min	12 mr/hr	400-170 mr/hr	99 mr
o Exit	1 min	120 mr/hr	40 mr/hr	42 mr
			Total	1249 mr

Sample Analysis

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Remove 15 ml sample from passbox to hood; transfer to beaker; add acid and boiling beads	1 min	120 mr/hr	20 mr/hr	2 mr
o Boil sample; cool in water bath behind lead brick	8 min	120 mr/hr	20 mr/hr	18 mr
o Pipette sample into 50 ml bottle	1 min	120 mr/hr	20 mr/hr	2 mr
o Transfer diluted sample to count room steel counting safe	1 min	8 mr/hr	20 mr/hr	1 mr

Table 6-2 (continued)

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Count Sample	5 min	-	20 mr/hr	2 mr
o Dispose of sample	1 min	8 mr/hr		
			Total	25 mr

Assumptions:

1. A 75 ml unshielded sample with a dose of 600 R/hr at one foot converts to 120 R/hr at 1 foot for a 15 ml sample. This then is diluted by 1000 in LGSP.

2. Sample is left at LGSP until flushing is completed.

Table 6-3

Gas Analysis of Primary Coolant Grab Sample

Sample Collection

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Strip Gas	5 min	-	400 mr/hr	33 mr
o Flush	5 min	-	400-170 mr/hr	24 mr
o Collect Sample	2 min	4.4 R/hr	1.7 R/hr	203 mr
o Exit	1 min	4.4 R/hr	-	113 mr
			Total	454 mr

Gas Analyses

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Remove collection bulb from passbox	1	4.4 R/hr	20 mr/hr	74 mr
o Remove predetermined sample volume from collection bulb to counting vial	1	4.4 R/hr	20 mr/hr	74 mr
o Transfer vial to Count Room and place in counting safe	1	1.5 R/hr	20 mr/hr	25 mr
o Count sample	5	-	20 mr/hr	2 mr
o Dispose of sample	1	1.5 R/hr	20 mr/hr	25 mr
			Total	200 mr

Notes: 1. 4.4 R/hr is the unshielded dose rate of the 15 ml striped gas sample at 1 foot.

2. Assumed 5 ml of sample put in counting vial.

Table 6-4

Diluted Containment Air Grab Sample

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge	5 min	-	173 mr/hr	14 mr
o Dilute Sample	2 min	-	173 mr/hr	6 mr
o Remove	2 min	14 mr/hr	1950 mr/hr	66 mr
o Flush	10 min	-	195-170 mr/hr	30 mr
o Exit	1 min	14 mr/hr	-	40 mr
			Total	210 mr

Sample Analysis

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Remove sample from passbox a predetermined amount	1 min	14 mr/hr	20 mr/hr	-
o Remove from collection bulb to counting vial	1 min	14 mr/hr	20 mr/hr	-
o Transfer vial to counting safe	1 min	14 mr/hr	20 mr/hr	2 mr
o Count sample	5 min	14 mr/hr	20 mr/hr	3 mr
o Dispose of sample	1 min	14 mr/hr	20 mr/hr	
			Total	5 mr

Assumptions:

1. Gas dilution factor 200.
2. Sample is 35 ml and 2.8 undiluted.
3. Containment air sample 2 orders of magnitude less than primary coolant sample.

Table 6-5

Boron analysis of Undiluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1	-	-	40 mr
o System Checkout	5	-	170 mr/hr	14 mr
o Purge to VCT	3	-	400 mr/hr	20 mr
o Purge LGSP	1	-	400 mr/hr	7 mr
o Extract Sample	2	21 R/hr	26.7 R/hr	1589 mr
o Flush System	5	193 mr/hr	593-363 mr/hr	40 mr
o Exit	1	21 R/hr	-	390 mr
			Total	2100 mr

Sample Analysis

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Sample removed from "passbox"	1	21 R	20 mr/hr	350 mr
o Two ml of sample is placed in beaker and moved to titration rig	1	16 R	20 mr/hr	267 mr
o Mannitol added to beaker	1	16 R	20 mr/hr	267 mr
o Titration of NaOH to sample along with sample determination	2	16 R	20 mr/hr	533 mr
o Dispose of sample	1	16 R	20 mr/hr	267 mr
			Total	1684 mr

Table 6-6

Chloride Analysis of Diluted Primary Coolant Grab Sample

Sample Collection

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Dilute and Fill	20 min	-	400 mr/hr	133 mr
o Extract Sample	2 min	120 mr/hr	26.7 R/hr	894 mr
o Flush	20 min	12 mr/hr	400-170 mr/hr	99 mr
o Exit	1 min	120 mr/hr		42 mr
			Total	1249 mr

Chloride Analysis

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Set up instrument and flush	*30 min		20 mr/hr	10 mr
o Prepare sample	15 min	120 mr/hr	20 mr/hr	30 mr
o Analyze sample 3 times	60 min	120 mr/hr	20 mr/hr	140 mr
o Dispose of sample	1 min	120 mr/hr	20 mr/hr	2 mr
			Total	182 mr

* This step is done simultaneously with sample collection.

Table 6-7

Hydrogen Analysis of Primary Coolant

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Strip Gas	5 min	-	400 mr/hr	33 mr
o G.C. Analysis	4 min	-	400 mr/hr	27 mr
o Flush	5 min	-	400-170 mr/hr	24 mr
o Exit	1 min	-	-	40 mr
			Total	205 mr

Table 6-8

Boron Analysis of Primary Coolant

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to CP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o Start Analysis Program	1 min	-	400 mr/hr	7 mr
o Exit	1 min	-	-	40 mr
o Access to CP	1 min	-	-	40 mr
o Flush	10 min	-	400-170 mr/hr	48 mr
o Exit	1 min	-	-	40 mr
			Total	256 mr

After start of automatic analysis, operator leaves and returns one hour later.

Table 6-9

Dissolved Oxygen, pH, and Conductivity of Primary Coolant

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o System Purge	5 min	-	400 mr/hr	34 mr
o Take Readings	5 min	-	400 mr/hr	34 mr
o Flush System	5 min	-	400-170 mr/hr	24 mr
o Exit	1 min	-	-	40 mr
			Total	186 mr

This analysis can be performed simultaneous with any other remote primary coolant analysis.

Table 6-10

Gas Analysis of Containment Air

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr	14 mr
o Purge	10 min	-	173 mr	28 mr
o GC Analysis	5 min	-	173 mr	15 mr
o Flush	10 min	-	173-170 mr	30 mr
o Exit	1 min	-	-	40 mr
			Total	167 mr

Assumptions:

1. Containment air sample dose 2 orders of magnitude less than coolant sample at the control panel based on NUS source terms.

Table 6-11

Primary System Sample

Task	Time Required	Sample Dose Rate	Background	Integrated Dose
o Access to LGSP	1 min	-	-	40 mr
o System Checkout	5 min	-	170 mr/hr	14 mr
o Purge to VCT	3 min	-	400 mr/hr	20 mr
o Purge LGSP	1 min	-	400 mr/hr	7 mr
o pH, Cond., Dis. O_2	2 min	-	400 mr/hr	13 mr
o Strip Gases	5 min	-	400 mr/hr	33 mr
o H_2 Analysis of Gases	4 min	-	400 mr/hr	27 mr
o Remove Sample (isotopic)	2 min	4.4 R/hr	26.7 R/hr	1036 mr
o Transport to Passbox	1 min	4.4 R/hr	26.7 R/hr	518 mr
o Flush Sample Lines for Dilution	10 min	-	400-170 mr/hr	48 mr
o Fill Tank	10 min	-	170 mr/hr	28 mr
o Purge LGSP for Dilution	3 min	-	400 mr/hr	20 mr
o Dilution	20 min	-	400 mr/hr	133 mr
o Take Sample	3 min	120 mr/hr	1.7 R/hr	91 mr
o Transport to Passbox	1 min	120 mr/hr		42 mr
o Purge LGSP for Boron	3 min		400 mr/hr	20 mr
o Start Boron Analyzer	1 min		400 mr/hr	7 mr
o Exit Area	1 min			40 mr
o Return for Boron Analysis Results	5 min		400 mr/hr	33 mr
o Flush Panel	10 min		400-170 mr/hr	48 mr
o Exit	1 min			40 mr
			Total	2258 mr

Criterion 7:

Requirement:

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

Clarification: PWRs need to perform boron analysis. The guidelines for BWRs are to have the capability to perform boron analysis but they do not have to do so unless boron was injected.

Response: The Ginna PASS is equipped with an Ionics digichem model 3250 boron analyzer. This analyzer has a capability of automatically measuring boron concentration in primary coolant from 20-6000 ppm. The analyzer is an in-line instrument that is controlled from the PASS remote instrument panel located in the hot shop. Upon establishing reactor coolant sample flow to the boron analyzer, the analyzer can be programmed to analyze once every 20 minutes continuously and record boron concentration without requiring an operator in attendance.

In addition, if the in-line boron analyzer were not available, undiluted primary coolant grab samples will be obtained at either the PASS or the original plant nuclear sample room. The grab samples will be handled with extension tools and transported to the radio-chem lab in shielded containers. In the radio-chem lab, the samples will be analyzed for boron content by the manual titration method.

Criterion 8:

Requirement:

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.

Clarification: A capability to obtain both diluted and undiluted backup samples is required. Provisions to flush inline 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: In-line sampling and analysis is provided for pH, conductivity, dissolved O_2, dissolved H_2, and boron. The PASS also provides the capability to obtain grab samples of undiluted and diluted reactor coolant, containment sump, containment air and reactor coolant stripped gas samples. This provides the capability to perform backup analyses in the radiochem lab at Ginna for each parameter normally measured in line. All in-line monitors can be flushed.

Dissolved gases from reactor coolant are stripped from a 10 ml pressurized liquid sample which is collected in-line behind the LGSP shield wall. The stripped gases are routed from a gas expansion vessel through a duel range dilution loop and then to a grab sample collection bulb for isotopic analysis in the radiochem lab or to the in-line gas chromatograph (GC) for O_2 or H_2 analyses.

Dissolved hydrogen analyses are performed in-line in the gas chromatograph. To alleviate possible deleterious effects of radiation on the equipment, the GC has been compartmentalized so that sections of the instrument that may be affected by radiation are located in the instrument panel which is in a lower radiation area while those sections not affected are in the LGSP. The GC has a programmed argon purge cycle automatically initiated after analysis of each sample. The gas dilution loops have the capability to be purged with either argon or nitrogen.

Analyses of reactor coolant samples for pH, conductivity, and dissolved oxygen are performed in-line within the LGSP. Remote readouts are indicated on the instrument panel (IP) located in the hot shop and the in-line probes are located within the LGSP.

Reactor coolant system sample lines and their associated fluid circuits in the LGSP, including the in-line monitors, can be flushed from the containment penetrations with condensate water to the waste system or containment sump. The containment air sample lines can be purged with argon or nitrogen.

The boron analyzer has been compartmentalized in the same manner as the GC. Components and sections with higher failure probability have been located remote from the potentially high radiation area of the LGSP. Like the GC, the boron analyzer

programmer has an automatic flush cycle that rinses its fluid circuits with condensate water.

Although diluted and undiluted backup grab sample capability is available, versatility of PASS flushing systems and equipment location will not inhibit repair of in-line monitors because of residual contamination.

Although the PASS provides the capability to collect undiluted back-up grab samples, the necessity for their collection and development of separate analysis capability, especially in the case of chlorides, may not be warranted for the following reasons.

- If the dissolved hydrogen concentration is verified to exceed 10 cc/kg, the dissolved oxygen, chloride and pH measurements need only be performed within the first 30 days. This is sufficient time to flush all panel lines and remove and replace any probes or components to permit performing analyses in-line.

- If the dissolved hydrogen is <u>not</u> verified to exceed 10 cc/kg, the dissolved oxygen measurement time requirement is dependent on the chloride analysis. Chloride measurement is required within 24 or 96 hours under the above hydrogen condition.

The 24 or 96 hour time frame is sufficient to flush all panel lines, repair and/or replace components, and recalibrate the systems.

Alternate backup chloride analysis capability is not considered appropriate within the 24 or 96 hour period due to known chemical interferences of alternate procedures or the large sample sizes required. To date, the IC technique is the only procedure applicable to performing post-accident chloride analyses.

Criterion 9:

Requirement:

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 uCi/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: (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: (a) Radionuclide measurement capability

The PASS as installed gives the capability of diluting the samples taken, both liquid and gaseous, so that a grab sample can be taken and counted on the laboratory multichannel

analyzer. The analyzer is connected to a germanium crystal detector which can identify gamma emitting isotopes. Dilution can be done at a design factor of 1000 within the PASS. The grab sample can be used to identify and quantify the gamma emitting isotopes in the sample. The sensitivity of the laboratory counting equipment is such that activity levels of major peaks in the range of 10^{-1} uCi/gm can be counted directly.

The release from overheating the core would include greater activities of iodines and cesiums. These would range up to 3E4 uCi/gm total activity. With dilution within the PASS it is possible to count a grab sample on existing equipment for identification and quantification of isotopic activities.

The gap release due to cladding failure would release total noble gas activity of approximately 3E3 uCi/gm. By diluting with a design factor of 200 or 2000, this gas grab sample could be counted directly for identification and quantification of isotopic activity.

The release of fission products from a postulated core melt accident could be identified and quantified by diluting within the PASS by a factor of 1000 (further dilution if required would be done in the lab) and counting on existing equipment which has a counting capability of up to an activity level of 600 R. (See clarification 9a.)

(b) Counting facility background contributions

Background radiation in the counting room would be caused mainly by shine from the containment. To minimize this source, additional shielding has been added to the wall between the containment and the counting equipment. Direct radiation from the sample lines can be minimized by flushing the lines with water after sampling. All ventilation is through charcoal or returned to containment. All liquids can be returned to the containment sump. Predicted maximum radiation levels from plant sources at the counting room is approximately 2 mr. If, in the unlikely event that the counting room becomes unusable because of background radiation, the counting room operation can be moved to another counting area normally used for environmental counting, which has been calibrated for accident type samples. It is not likely that background radiation levels or other samples would have any effect on sample count since, a) background is negligible in the count room, b) 4 inches of lead will surround sample being counted, and c) other samples will be controlled administratively. However, when analyzing very dilute or low activity levels that are encountered during normal operation, it can be expected that the accuracy of the results (dilution/counting equipment) will exceed a factor of 2 by nature of instrument sensitivity. In this case, however, dilution would not be necessary for sampling.

Criterion 10:

Requirement:

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
Ra^{+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: The Cyrus Wm. Rice Division of NUS Corporation developed and tested the methods selected for post-accident boron, chloride, dissolved hydrogen and oxygen pH and conductivity analyses. The selection of analysis equipment for the Ginna Post Accident Sampling System was based on results of this test program. The accuracies and ranges of the PASS instruments are as follows.

- Boron: Range 20-6000 ppm. Accuracies within $\pm$ 5% above 1000 ppm have been demonstrated during testing.
- Chloride: Range with design dilution of 1000 is 10 ppm - 100 ppm. Accuracy $\pm$ 10%.
- Dissolved H_2: 10 cc/kg - 2000 cc/kg. Accuracy $\pm$ 10%.
- Dissolved O_2: Range 0.1-20 ppm. Accuracy $\pm$ 10%.
- pH: Range 1-13. Accuracy $\pm$ 0.3, pH $> 5 < 9$; $\pm$ 0.5 pH $< 5 > 9$.
- Gamma Spectrum: Testing to date has found a liquid dilution factor of, typically, between 800 and 1200. It is expected that specific isotopes of highly radioactive post accident samples can be identified within a factor of 2. Testing in this area, however, is continuing at present. Because of the low specific isotopic activities available for testing, it has been difficult to attain a factor of 2 for all desired isotopes even with manual dilution. Currently, we are continuing investigating methodology and equipment.

Criterion 11:

Requirement:

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.

BWRs 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 Post Accident Sampling System has the capability to access four (4) liquid sample sources. These sources are the "B" reactor coolant loop, pressurizer steam space, pressurizer liquid space and the "A" containment sump.

The purging circuit for the containment sump sample is from the sump, to the sump sample pump, the PASS coolers, purge bypass line around the LGSP to the PASS waste tank. On a batch operation basis, the PASS waste transfer tank is pumped by the PASS waste transfer pump back to the containment sump during post-accident operation or to the Plant waste hold-up system during normal operation. The sump pump is designed to provide up to a 1 gpm flow rate at a discharge pressure of 50 psig. The sump sample line is a 1/2 inch diameter line and the reactor coolant and pressurizer sample lines are 3/8 inch diameter. Design criteria of the PASS is that pipe sizing is such that sufficient velocity is assured to minimize plateout and assure representative samples. Pipe routing is such that dead legs, low points and other similar crud trap orientations are avoided as much as practicable.

The purge circuit for the 3/8 inch liquid sample lines is source, PASS coolers, purge bypass line around LGSP, PASS waste tank, PASS waste transfer pump and return to containment sump. During normal operation the purge bypasses the PASS

waste tank and flows directly to the volume control tank (specific components are delineated in Criterion 3). Flow rates in excess of 0.6 gpm (approximately 3.4 fps) have been achieved through these sample lines with the reactor coolant system at operating pressure.

The size of the sample lines provides passive restriction. Redundant isolation valves are located in each of the liquid sample lines that close with containment isolation and safety injection signals. Additionally, a PASS remote-manual operated isolation valve is located in close proximity downstream of the second isolation valve in each sample line and augments isolation capability.

The liquid sample lines can be flushed with condensate water from their respective containment penetration through the PASS to the waste transfer tank and ultimately back to the containment sump during post-accident operation or the Plant liquid waste system during normal operation. This flushing capability, lack of passive flow restrictors, a sump sample pump suction screen, and the aforementioned design criteria for pipe sizing and configuration, minimize the possibility of sample line blockage.

The PASS containment air sample and air sample return lines tap into the Plant containment air radiation monitoring lines at the containment penetrations. From the penetrations, both

lines run directly to the LGSP. In the containment air sample circuit, air samples are withdrawn from and returned to containment through 1/2 inch diameter sample lines by a vacuum pump of approximately 2 scfm capacity. This provides a purge velocity of 55 ft/sec. The purging circuit is the same as the sample circuit except that the internal analysis circuits of the LGSP are bypassed. Flushing of both the containment air sample line and air sample return line can be accomplished with either argon or nitrogen. The air sample line is heat traced and can be maintained at temperatures up to 400°F. The sample line size provides passive restriction and two redundant automatic isolation valves in the sample return line and one in the sample line close with a safety injection or containment isolation signal. The sample line single automatic isolation valve was addressed in NUREG-0821, Integrated Plant Safety Assessment Systematic Evaluation Program, R. E. Ginna Nuclear Power Plant.

The containment air sample line takes suction from the intermediate floor of the containment building near a large opening in the floor which is a part of the equipment accessway from the operating floor to the basement. Over the years sampling at this point has been proven representative of the containment atmosphere when compared with periodic grab samples taken throughout the building. In the event that this sample line is not available, grab samples will be taken on the north side of the containment in the intermediate building basement or on

the south side of the containment building on the intermediate floor of the auxiliary building.

The primary source of reactor coolant sampling is from the reactor coolant system "B" loop hot leg sample point located in close proximity to the reactor vessel. Short of sampling the reactor vessel itself, this sample point is as representative of reactor chemistry as practicable. In the event that sampling capability is lost from the "B" loop sample line, the pressurizer liquid space sample line will provide a coolant sample assuming a water level in the pressurizer. If there is no water level in the pressurizer (long term) then the sump sample will provide information assuming a LOCA.

(11)(b) The Liquid and Gas Sample Panel (LGSP) of the PASS has a six inch diameter exhaust duct from the panel plenum to the "controlled access ventilation system." The tie-in point is upstream of the HEPA and charcoal filters of the system.

References

1. L. D. White, Jr. letter, "Three Mile Island Lessons Learned Short-Term Requirements," to Dennis Ziemann dated 12/28/79. Appendix A