Portland General Electric Company

Bart D. Withers Vice President

December 17, 1982

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington DC 20555

Dear Sir:

NUREG-0737, Action Items II.B.3 and III.D.3.4

The information contained in Attachment 1 is being submitted pursuant to the NRC request dated June 30, 1982 regarding NUREG-0737 Item II.B.3, Post-Accident Sampling Capability.

With regards to NUREG-0737 Item III.D.3.4, Control Room Habitability, the scheduled operation date for the sulfur dioxide and ammonia detectors of January 1, 1983 has been revised to March 31, 1983. Although the installation of the detectors is still anticipated to be completed by January 1, an additional period of time is needed to correct any problems that may occur during startup testing and to develop and approve emergency procedures for dealing with sulfur dioxide and ammonia releases.

In addition, we would like to identify a correction to the information supplied in the PGE to NRC letter dated January 2, 1981. The response to Criterion 8(b) under Action Item III.D.3.4 states that the chlorine detection system meets the criteria given in Regulatory Guide 1.95. Although this system does indeed protect the control room operators against both onsite and offsite accidental chlorine releases, it was designed before Regulatory Guide 1.95 was issued by the NRC. The chlorine detection system is described in Section 9.4.1 of the original FSAR and meets the design criteria specified therein. This design was reviewed and approved by the NRC during the Trojan Operating License review. The erroneous information was also included in Section 6.4.4.2.1 of the 1982 Updated FSAR, and a correction will be made accordingly in the 1983 Updated FSAR. Please note that since Regulatory Guide 1.95

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applies only to chlorine detection systems, this correction will not have an impact on ammonia and sulfur dioxide detectors which are being installed in response to Action Item III.D.3.4.

Sincerely,

Bart D. Withers
Vice President
Nuclear

Attachment

c: Mr. Lynn Frank, Director
State of Oregon
Department of Energy

Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
U. S. Nuclear Regulatory Commission

ADDITIONAL INFORMATION ON NUREG-0737 ACTION ITEM II.B.3

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 three hours or less from the time a decision is made to take a sample.

CLARIFICATION (1)

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 [ie, designate an alternative backup power source, not necessarily the vital (Class le) bus, that can be energized in sufficient time to meet the three-hour sampling and analysis time limit].

RESPONSE (1)

The Reactor Coolant System (RCS) liquid Post-Accident Sampling System (PASS) consists of equipment with the locations and functions described below.

Equipment Identification No.	Description	Location (Refer to 1982 Updated FSAR Figure 1.2-12)	Function
C-347	RCS liquid PASS equipment rack	Trojan Aux Building, El. 45 ft, radiation sample room	Recirculates, isolates, depressurizes, and degasses RCS liquid to facilitate taking grab samples.
C-345	RCS liquid PASS solenoid valve rack	Trojan Aux Building, El. 45 ft, radiation sample room	Provides pressurized instrument air supply to the air-operated control valves.
RE-5624A&B	Gross gamma radiation detectors	Trojan Aux Building, El. 45 ft, radiation sample room	Provides gross gamma radiation indication of reactor coolant liquid over the range of 10^{-1} to 10^{7} mrem/hr.
C-346	RCS liquid PASS demineralized dilution water	Trojan Aux Building, El. 45 ft, access entryway radiation sample room	Provides demineralized water source for preparing accurate dilutions of reactor coolant liquid from C-347.

C-344	RCS liquid PASS control panel	Trojan Aux Building, outside north wall of radiation sample room	Provide remote control and instrument data indication for C-347, C-345, and RE-5624A & B.
	RCS liquid PASS grab sample cask with pallet truck	Trojan Aux Building, radiation sample room (mobile)	Provides shielded mobile container for moving grab samples to the radiochemistry laboratory.
	RCS liquid PASS off-gas grab sample, syringe and extension handling tool	Trojan Aux Building, radiation sample room (mobile)	Provides means to obtain, handle, and transport reactor coolant off gas, and Containment atmosphere samples to the chemical laboratory.

The Containment atmosphere PASS consists of equipment with the following locations and functions.

Equipment Identification No.	Description	Location (Refer to 1982 Updated FSAR Figure 1.2-15)	Function
C-348	Containment atmosphere PASS equipment rack	Trojan Aux Building, El. 93 ft, inside purge exhaust room adjacent to north wall	Recirculates and isolates Containment atmosphere flow to obtain grab samples.
C-287	Containment atmosphere PASS control panel	Trojan Aux Building, El. 93 ft, outside north wall of purge exhaust room	Provides remote control and instrument data indication for C-348.
	Containment atmosphere PASS grab sample cask with pallet truck	Trojan Aux Building, El. 93 ft, outside north wall of purge exhaust room (mobile)	Provides shielded mobile container for moving grab samples to the radiochemistry laboratory.
	Containment atmosphere PASS grab sample handling tools	Trojan Aux Building, El. 93 ft, outside north wall of purge exhaust room (mobile)	Provides means to obtain, handle, and transport the grab samples.

The chemical laboratory includes equipment with the locations and functions described below.

Equipment Identification No.	Description	Location (Refer to 1982 Updated FSAR Figure 1.2-12)	Function
	Hewlett-Packard Model 5730A gas chromatograph	Trojan Aux Building, El. 45 ft, chemical laboratory	Provides identification and quantification of the hydrogen gas in the RCS liquid off-gas grab sample and the Containment atmosphere grab sample.
	Nuclear Data Model 6685 PHA/NID Gamma Spectroscopy System	Trojan Aux Building, El. 45 ft, counting room	Provides identification and quantification of volatile and nonvolatile isotopes in reactor coolant by analysis of liquid and gaseous reactor coolant samples.
	Chemical analysis station with fume hood	Trojan Aux Building, El. 45 ft, chemical laboratory	Provides ventilated analysis station for wet chemical analysis of grab samples and sample preparation for gamma spectroscopy.
	Small reversible metering pump	Trojan Aux Building, El. 45 ft, chemical laboratory	Provides means to pump RCS liquid PASS grab sample between the grab sample cask and the analysis station under the fume hood.
	Vehicle designated for mobile grab sample analysis	Mobile	Provides means to transport the PASS grab samples to a suitable location for detailed analysis.

The table below provides a basic outline of the RCS liquid PASS operational steps and the estimated time required for each step.

Operational Step No.	Description of Step	Estimated Time Required for Step
1	Prepare for post-accident sampling and access RCS liquid PASS station	30 minutes

Operational Step No.	Description of Step	Estimated Time Required for Step
2	Recirculate, isolate, degas and obtain RCS liquid and off-gas grab samples	30 minutes
3	Transport RCS liquid and off-gas grab samples to chemical laboratory and perform analysis for hydrogen, boron, radionuclides, chloride, pH, total gas, and oxygen (via hydrogen)	1 hour 30 minutes

The actual times required for each operational step of the RCS liquid PASS will be determined empirically during the startup testing and training periods. The total time required to access, obtain, analyze grab samples, and to provide analytical data, is approximately 2 hours and 30 minutes.

The table below provides a basic outline of the Containment atmosphere PASS operational steps and the estimated time required for each step.

Operational Step No.	Description of Step	Estimated Time Required for Step
1	Prepare for post-accident sampling and access Containment atmosphere PASS station	30 minutes
2	Recirculate, isolate purge inlet and exit lines, and obtain grab samples	30 minutes
3	Transport grab samples to the chemical laboratory and perform analysis for hydrogen and iodine	1 hour 30 minutes

The actual times required for each operational step of the Containment atmosphere PASS will be determined empirically during the startup testing and training periods. The total time to access, obtain, and analyze grab samples, and to provide analytical data, is approximately 2 hours and 30 minutes.

Post-accident sampling for RCS liquid and for Containment atmosphere may proceed simultaneously, in which case the total sampling and analysis cycle is less than three hours.

The RCS liquid PASS samples are taken using the normal sample lines from the RCS A and C hot legs, or from the RHR System pumps discharge. The Containment atmosphere PASS samples are taken using the sample lines for the new post-accident hydrogen analysis panels recently installed to meet the requirements of NUREG-0737, Item II.F.1.6. The Containment atmosphere sample inlet line is minimized in length, heat-traced, and insulated to help ensure a representative iodine sample is obtained. The recirculation time required to obtain representative RCS liquid and Containment atmosphere samples has been calculated to be less than 15 minutes for each. The calculated recirculation times are based on the minimum sample flow rates and assumed three sample inlet line volume changes.

The electrical power supply to both the RCS liquid and Containment atmosphere PASS is from MCC B-32, which is a non-ESF MCC, powered from Unit Substation Transformer 2. In the event of loss of off-site power, the emergency backup power source for MCC B-32 is supplied from Emergency Diesel Generator 2; automatic transfer takes less than 10 seconds. Each control panel is equipped with an electrical outlet for local emergency lighting if necessary.

System schematics and an operational interface summary are provided under response to Criterion (3) below.

CRITERION (2)

The licensee shall establish an on-site 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 (eg, noble gases, iodines and cesiums, and nonvolatile isotopes);

(b) hydrogen levels in the Containment atmosphere;

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

(d) Alternatively, have in-line monitoring capabilities to perform all or part of the above analyses.

CLARIFICATION (2)(a)

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

1. Monitoring for short- and long-lived volatile and nonvolatile 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.

CLARIFICATION (2)(b)

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

CLARIFICATION (2)(c)

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

CLARIFICATION (2)(d)

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

RESPONSE (2)(a)1

Counting capabilities include two (2) germanium-type semiconductor detectors used in conjunction with a Nuclear Data 6600 series computer spectrum analyzer. This system is capable of determining absolute activities of all the radionuclides listed in Clarification (2)(a) when samples are counted in available geometries. Multiple geometries for each of the two detectors have been established and calibration for these geometries is maintained. The geometries span a wide range of potential activities in both liquid and gaseous forms. Liquid solutions ranging from 10^{-7} to 10 μCi/cc can be counted with no sample treatment other than transferring the solution to the proper container. Gaseous activities between 10^{-6} and 10^{6} μCi/cc can be counted with existing Marinelli flask or gas bomb geometries. Gaseous activities greater than 10^{-3} μCi/cc can be diluted to the necessary range in existing Marinelli flasks or gas vessels.

The liquid PASS will provide an undiluted or diluted, degassed sample of the reactor coolant liquid. Dilution factors have been designed for a range from 50:1 to 1,500:1. The resultant aliquot is transferred to the radiochemistry lab, where a final dilution will be prepared for counting in one of the available geometries. The volatile radionuclides will have been stripped from this liquid aliquot; therefore, a sample of the off gas will be taken to provide determination of the volatile isotopes. Dilution of a small volume of the diluted, stripped gas will be removed from the reactor coolant PASS via a gas-tight syringe. The contents of the syringe will be injected into a Marinelli flask for counting or gaseous dilution.

In the event that airborne/background radiation precludes the use of the present counting facility, provisions have been made to transport the necessary counting equipment and the diluted samples to an alternate location where the counting equipment can be set up and the samples counted. At this point, the samples will have been diluted to an activity level where they will be easily handled.

RESPONSE (2)(a)2

The extent of core damage can be estimated by comparing post-accident dissolved gas and Containment atmosphere sample analyses data with the values in the 1982 UFSAR Table 15.0-5 for the different isotopes of iodine, xenon, and krypton. The radionuclide inventory in the reactor coolant and Containment atmosphere can be proportioned to either the total gap region activity or the total core activity as tabulated in Table 15.0-5, to provide an estimate of the amount of core damage for either cladding failure or loss of pellet geometric integrity, respectively.

The radiochemical determinations, along with in-core and ex-core detector readings, may further be used in conjunction with core thermocouple data to further estimate the extent of cladding failure and/or possible locations of high failure rate.

RESPONSE (2)(b)

The primary indication of hydrogen concentration in Containment will be provided by the Containment hydrogen monitors installed to meet the requirements of NUREG-0737, Item II.F.1.6 (redundant Class 1E equipment). As a backup, hydrogen concentration in Containment can be determined through use of the Containment atmosphere PASS. The Containment atmosphere PASS includes a grab sample chamber that is fitted with a rubber septum for obtaining a sample with a syringe. The syringe grab sample can be transported to the chemical laboratory using the syringe-handling tool or the grab sample cask and pallet truck. The syringe grab sample will be introduced into a gas chromatograph in the chemical laboratory, and the hydrogen content determined.

The dissolved gases in the RCS liquid sample are stripped from the liquid by recirculating argon gas through the isolated sample. A grab sample of the off gas is obtained from behind a shield wall using a sampling syringe with an extension handling tool. If the gross gamma indication is high, the RCS liquid off gas can be remotely diluted prior to obtaining the syringe grab sample. The syringe grab sample can also be diluted into a desired gaseous geometry in the laboratory prior to counting.

RESPONSE (2)(c)

Sampling for nonvolatile isotopes and dissolved species will be performed as described in Item (2)(a)1 above, and the sample will be diluted as necessary. Gaseous sampling will be obtained as described in Item (2)(b) above for Containment atmosphere hydrogen, diluted to an appropriate gaseous geometry, and counted. If necessary, gamma spectrometric analysis of both liquid and gaseous samples will be performed at a remote location.

The diluted liquid sample can also be analyzed over the ranges outlined in Regulatory Guide 1.97 by the following methodology:

boron (boric acid)	titrimetry (NaOH, Mannitol)
chloride	ion-selective electrode (See Note 1 below)
gamma spectrometric	as described in Response (2)(a)1 above
dissolved hydrogen	gas chromatography
total gas	pressure indication from gas stripping operation
dissolved oxygen	via dissolved hydrogen and/or total gas
pH	glass combination electrode

Gaseous parameters will be determined as follows:

hydrogen	gas chromatography
oxygen	not determined (See Note 2 below)
gamma spectrum	as described in Response (2)(a)1 above

NOTES: 1. Analytical results for this parameter will be available in 96 hours, since Trojan does not use brackish water.

2. No provisions have been made for the determination of dissolved or atmospheric oxygen.

RESPONSE (2)(d)

The only on-line instrumentation used is the gross RCS liquid radiation detectors, which provide PASS operator with remote indication of the sample activity level. The radiation detectors consist of a low-range Geiger Muller tube, and a high-range ion chamber which will be periodically calibrated. Malfunction will not prevent the acquisition of samples or results from the RCS liquid PASS. The PASS consists of off-line grab sample instrumentation and data for all other portions of the system.

CRITERION (3)

Reactor coolant and Containment atmosphere sampling during post-accident conditions shall not require an isolated auxiliary system [eg, the letdown system, reactor water cleanup system (RWCUS)] to be placed in operation in order to use the sampling system.

CLARIFICATION (3)

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

RESPONSE (3)

The RCS liquid and Containment atmosphere PASS piping and instrument diagrams (P&ID) are shown on M-231, Sheets 4 and 5, respectively. The RCS liquid PASS sample inlet is from the RCS hot legs or from the RHR pumps recirculation line as shown on P&IDs M-201 and M-205, respectively. These sample points are part of the existing primary sample sy tem and lead to the primary sample conditioning panel as shown on P&ID M-231, Sheet 1. Sampling from the RCS hot leg requires operation of the inside-Containment Isolation Valves MO-5653 and MO-5654 and the outside-Containment Isolation Valve CV-5655. Sampling from the RHR pumps recirculation lines requires operation of the Isolation Valves CV-1782 and CV-1783 as well as the actuation of the RHR System.

The RCS liquid PASS sample discharge is to the volume control tank (VCT) using the existing primary sampling system discharge lines as shown on P&IDs M-202 and M-231, Sheet 1, respectively. Sample discharge to the VCT requires operation of Isolation Valve CM-006, which will be maintained normally opened. The 2,992-gallon-capacity VCT should normally be, at most, two-thirds full. This allows approximately 1,000-gallon capacity available for PASS recirculation, which is sufficient for over 100 PASS operations. The operation of the RCS liquid PASS equipment in Rack C-347 is from the remote Control Panel C-344. All valves in C-347 required for recirculation and sampling are Nupro bellows-seal, air-operated control valves made of 316 stainless steel.

The Containment atmosphere PASS sample inlet and discharge utilize the Post-Accident Hydrogen Analysis System A-loop sample inlet and outlet as shown on P&ID M-243. Sample inlet from this line requires operation of inside-Containment Isolation Valve SV-5643 and outside-Containment Isolation Valve MO-5677. Sample discharge requires operation of inside-Containment Isolation Valves MO-5672 and outside-Containment Isolation Valve MO-5678. Backup sample discharge utilizes the Hydrogen Analysis System A-loop pump and is lined up by local extension stem operation of Isolation Valve SS-490. Both sample inlet and discharge are directly connected to the Containment atmosphere. The operation of the new Containment atmosphere PASS equipment in Rack C-348 is from the mote Control Panel C-287. All valves in C-348 required for recirculation and sampl. are Nupro bellows-seal, air-operated control valves made of 316 stainless steel.

All existing valves named above have been addressed by our response to the Commission's IE Bulletin 79-01B environmental qualification requirements or will be addressed in future responses.

Copies of the P&IDs named above (M-201, 202, 205, 231, Sheets 1, 4, 5, and M-243) are attached for reference.

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 (4)

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 >10cc/kg is acceptable for up to 30 days after the accident. Within 30 days, consistent with ALARA, direct monitoring for dissolved oxygen is recommended.

RESPONSE (4)

The Trojan RCS liquid PASS has the capability to determine remotely the total dissolved gases in the RCS liquid by change in pressure indication after stripping gases from the isolated liquid, and to determine the hydrogen content by laboratory analysis of the RCS liquid off-gas grab sample with the gas chromatograph. To measure the dissolved gas in the RCS liquid, 75 ml of pressurized sample is isolated in the sample cylinder. The 150-ml off-gas cyclinder and tubing connected to the 75-ml sample cylinder is purged with argon gas and partially evacuated by the system Vacuum Pump P-288. The argon pressure in this known partially evacuated volume is recorded. The isolated, pressurized RCS liquid sample is then allowed to expand into the connecting volume. The off-gas and argon gas is recirculated through the liquid and off-gas loop with System Pump P-287 to strip all of the dissolved gases from the RCS liquid. The pump is stopped, and the final pressure is recorded. The change in pressure for the known volume allows the operator to determine the total dissolved gas. This entire operation is performed remotely from Control Panel C-344.

The hydrogen content (and oxygen via hydrogen) can also be determined by completing the steps described above and then proceeding as follows. The operator uses the gas-sampling syringe with extension handling tool to obtain an off-gas grab sample from the off-gas sample chamber that is fitted with a rubber septum. Access is from behind a shield wall by removal of the 2-in.-diameter shield plug. The off-gas grab sample is hand-carried, using the syringe extension handling tool, across the hall to the chemical laboratory. The off-gas grab sample is then injected into a gas chromatograph, which will determine the hydrogen content. The total dissolved gas and hydrogen, determined as described above, will be representative of the RCS liquid because of duplication and similarity with the normal proven RCS Sampling System parameters and methods.

Total dissolved gas is determined by pressure indication as part of reactor coolant liquid sampling procedure described above. Verification that dissolved oxygen is less than .1 ppm will be by measurement of hydrogen concentration >10 cc per kg. Direct measurement for dissolved oxygen will not be determined. It is assumed that residual hydrogen and chloride levels will be sustained so as to preclude the necessity of experimentally determining dissolved oxygen concentrations directly.

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 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 four days. The chloride analysis does not have to be on-site.

CLARIFICATION (5)

BWRs on sea or brackish water sites, and plants which use sea or brackish water in essential heat exchangers (eg, 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 (4). Additionally, if chloride analysis is performed on a diluted sample, an undiluted sample need also be taken and retained for analysis within 30 days, consistent with ALARA.

RESPONSE (5)

Trojan, a PWR, obtains water from the nonbrackish Columbia River. Historical data show peak chloride Columbia River concentration to be less than 7 ppm and average chloride concentration approximately 5 ppm. In addition, Trojan has a component cooling water system, which separates the Service Water System from in-Containment systems. Service water itself would enter Containment only as direct feed in the unlikely event of loss of other sources of cooling water. While there are other sources of chloride, they are not significant.

The chloride analysis of the RCS liquid can be determined from the RCS liquid grab sample. The RCS liquid grab sample is obtained as follows. The isolated degassed 75-ml volume of RCS liquid from Criterion (4) above is allowed to gravity settle and fill a calibrated 1-cc volume in a four-way valve. The calibrated 1-cc volume in the four-way valve is then flushed with measured demineralized dilution water into the grab sample cask. The flush path is purged with argon to evacuate all liquid from lines and mix the grab sample. The grab sample is then disconnected from the inlet and outlet lines and transported to the chemical laboratory with the pallet truck. Chloride analysis can be performed in the chemical laboratory by use of selective ion electrode. The lower level of chloride detectability in a 1000:1 diluted sample is 10 ppm chloride. A 1000:1 dilution is used during the worst-case accident. The RCS liquid PASS has substantial flexibility in remote dilution of the grab sample, which enables detecting chloride at levels below 10 ppm, consistent with ALARA considerations if the RCS activity is less than the worst case.

The flexibility of the PASS is such that an undiluted RCS sample can also be obtained by routing into a shielded 15-ml grab sample container. The isolated, shielded 15-ml grab sample can then be disconnected and transported in the shielded cask to the chemical analysis laboratory and retained for additional analyses. The undiluted grab sample can be obtained anytime after the accident, but in order to keep doses to personnel ALARA, the sample will be taken only if deemed desirable for further evaluation. Direct measurement of dissolved oxygen will not be determined with the Trojan PASS.

As noted, Trojan does not plan on analyzing the undiluted sample in the worst-case situation. Nevertheless, as described, we have flexibility and capability of obtaining meaningful chloride results as needed while maintaining doses ALARA.

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) (ie, 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 20, 1979 letter from H. R. Denton to all licensees).]

CLARIFICATION (6)

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

RESPONSE (6)

The equipment layout and shielding is consistent with GDC 19 with design basis area dose rates as follows:

A. 1 rem/hr or less for all remote PASS operations to condition and isolate grab samples.

B. 5 rem/hr or less with estimated exposure times of five minutes or less for behind-shielding access to obtain grab samples.

C. 1 rem/hr or less for all transport, analysis, and flushing operations.

D. 1 rem/hr or less during all laboratory analysis work.

When the PASS equipment is installed, time/motion data will be taken for the sampling and analysis operations and determination of predicted man-rem exposures. Assuming the worst-case design basis source terms provided by NUREG-0737, Item II.B.2, leading to the maximum area dose rates, the following estimated doses result from the operation steps and estimated times from Criterion (1):

RCS LIQUID PASS

Operational Step Number	Estimated Dose (rems)
1	0.0
2	0.5
3	1.5
Total estimated dose:	2.0

CONTAINMENT ATMOSPHERE PASS

Operational Step Number	Estimated Dose (rems)
1	0.0
2	0.5
3	1.5
Total estimated exposure:	2.0

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 (7)

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 (7)

Boron analysis is addressed in Criterion (2)(c) above and Criterion (10) below.

CRITERION (8)

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

CLARIFICATION (8)

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

RESPONSE (8)

The Trojan PASS does not utilize in-line monitoring for the required analyses, but rather obtains grab samples remotely and manually. The methods used to analyze these grab samples are described in detail in the response to Criterion (10). As shown in the RCS liquid PASS P&ID M-231, Sheet 4, the sample inlet line to the Equipment Rack C-347 is monitored for gross gamma radiation indication over the range of 10^{-4} rads/hr to 10^{4} rads/hr with a Geiger-Muller tube (RE-5624A) and an ion chamber (RE-5624B). The sample inlet line can be remotely flushed with demineralized water from the Control Panel C-344 in order to reduce the dose rates in the radiation sample room and facilitate access for repairs.

Radionuclide analysis on diluted grab samples can be transported to an alternate location where the counting equipment can be set up and the radionuclide analysis of liquid and gaseous samples can be performed. This backup analysis will only be required if background radiation levels are so high that the counting equipment in the counting room cannot be used.

CRITERION (9)

The licensee's radiological and chemical sample analysis capability shall include provisions to:

(a) Identify and quantify the isotopes of the nuclide categories discussed above to levels corresponding to the source terms given in Regulatory Guide 1.3 or 1.4 and 1.7. Where necessary and practicable, the ability to dilute samples to provide capability for measurement and reduction of personnel exposure should be provided. Sensitivity of on-site liquid sample analysis capability should be such as to permit measurement of nuclide concentration in the range from 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 two). This can be accomplished through the use of sufficient shielding around samples and outside sources and by the use of a ventilation system design which will control the presence of airborne radioactivity.

CLARIFICATION (9)(a)

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

CLARIFICATION (9)(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 two.

RESPONSE (9)(a)

The predicted design basis activity in the RCS liquid is 2.3 Ci/cc for undiluted, undegassed RCS liquid. The RCS liquid PASS sample that is remotely diluted up to 1,500:1 will be transported in a shielded airtight container. The grab sample will be pumped to the analysis station in the fume hood through capillary tubing, shielded where practical. The diluted RCS liquid can then be further diluted into the desired geometry and transported to the appropriate counting equipment for radionuclide analysis as described in Criterion (2)(a). Following the chemical and radionuclide analysis, the grab sample is then pumped back into the shielded transport cask and followed with a demineralized water flush and purge to clear the capillary lines and pump.

The RCS liquid off gas can be remotely:

A. Diluted as desired.

B. Have its pressure adjusted to atmospheric.

C. Be isolated for obtaining a grab sample using a syringe.

The syringe is operated, transported, and emptied using an extension handling tool. The sample is injected into a known dilution volume to obtain the desired geometry and dilution for the radionuclide analysis. The waste radioactive gas samples are vented to the fume hood.

The range of possible sample activity levels can cover from the worst-case to the minimum for normal sampling by varying the sample dilution. The sampling and analysis methods have accuracies as described in Criterion (10) below. These accuracies will be verified with empirical data obtained during the system startup and testing.

RESPONSE (9)(b)

Predicted background radiation level in the counting room is 0.05 mR/hr which is similar to normal operation values. The grab samples retained for radionuclide analysis will be diluted sufficiently so that the sample activity is comparable to normal sampling conditions. The counting equipment is in a separate room from the chemical laboratory and from the sample rooms. The sources from grab samples drop off rapidly with distance and are removed and shielded from the counting area so that there is no impact on the radionuclide-counting equipment. The inaccuracies of the radionuclide analysis introduced from the background radiation and from the radiation effect of the diluted grab sample being counted are expected to be within a factor of two. During functional testing of the PASS, the empirical results will verify the accuracies. As stated in the response to Criterion (8) above, remote counting capabilities are available should counting room radiation levels become sufficiently high due to airborne activity to preclude use of the counting room equipment in place.

CRITERION (10)

Accuracy, range, and sensitifity shall be adequate to provide pertinent data to the operator in order to describe radiological and chemical status of the reactor coolant systems.

CLARIFICATION (10)

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 percent of the measured value (ie, at 6,000 ppm B, the tolerance is ±300 ppm, while at 1,000 ppm, 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 percent 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 percent is desirable between 50 and 2,000 cc/kg, but ±20 percent 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 percent 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

Constituient	Nominal Concentration (ppm)	Added as (Chemical Salt)
I-	40	Potassium Iodide
Cs+	250	Cesium Nitrate
Ba+2	10	Barium Nitrate
La+3	5	Lanthanum Chloride
Ce+4	5	Ammonium Cerium Nitrate
Cl-	10	
B	2,000	Boric Acid
Li+	2	Lithium Hydroxide
NO_3^-	150	
NH_4^+	5	
K+	20	
Gamma Radiation (Induced Field)	10^4 Rad/gm of Reactor Coolant	Adsorbed Dose

Notes:

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

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

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

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

All equipment and procedures which are used for post-accident sampling and analyses should be calibrated or tested at a frequency which will ensure, to a high degree of reliability, that it will be available if required. Operators should receive initial and refresher training in post-accident sampling, analysis and transport. A minimum frequency for the above efforts is considered to be every six months if indicated by testing. These provisions should be submitted in revised Technical Specifications in accordance with Enclosure 1 of NUREG-0737. The staff will provide model Technical Specifications at a later date.

RESPONSE (10)

The PASS equipment was designed to meet the requirements of NUREG 0737, Item II.B.3 by providing accurate representative grab samples to be analyzed using procedures modified to handle the more radioactive PASS diluted grab samples. The PASS sampling and analysis design basis capabilities for the RCS liquid are provided in the following table. The analyses parameters, methods, design basis ranges, design basis accuracies, and design basis time are included in the table. The accuracies listed below will be verified during the PASS startup testing period using the empirical data and results.

Parameter	Method	Design Bases Range	Design Bases Accuracy	Design Bases Time Frame
Gross Activity Gamma Spectrum	1. Gamma spectroscopy	1. Liquid: w/o dilution: 10^{-7} to 10^{1} μCi/cc	1. ±50 percent	1. Less than 3 hours
		2. Gaseous: w/o dilution: 10^{-6} to 10^{-3} μCi/cc		
Gross Gamma Dose Rate	1. Geiger-Muller tube	1. 10E-4 rad/hr to 10E1 rad/hr	1. ±50 percent	1. Less than 3 hours
	2. Ion chamber	2. 10E-1 rad/hr to 10E4 rad/hr	2. ±50 percent	2. Less than 3 hours
Boron (Boric Acid)	1. Titrimetry (NaOH Manitol) 1,000:1 dilution.	1. 1,000 ppm to 6,000 ppm boron	1. ±5 percent	1. Less than 3 hours
Chloride	1. Ion selective electrode, 1,000:1[(1)] diluted sample	1. Greater than or equal to 20 ppm chloride	1. ±10 percent	1. Less than 96 hours
		2. 10 ppm chloride to 20 ppm chloride	2. Varies from ±100 percent to ±10 percent, respectively	2. Less than 96 hours
Dissolved Hydrogen	1. Gas chromatograph	1. 50 to 2,000 cc/kg	1. ±10 percent	1. Less than 3 hours
		2. 0 to 50 cc/kg	2. ±5 cc/kg	2. Less than 3 hours

Parameter	Method	Design Range	Design Bases Accuracy	Design Bases Time Frame
Total Dissolved Gas	1. Change in pressure	1. 50 to 2,000 cc/kg	1. ±10 percent	1. Less than 3 hours
Dissolved Oxygen	1. Via dissolved hydrogen concentration at greater than 10 cc/kg NOTE: Direct measurement of dissolved oxygen is not performed by the Trojan PASS.	1. Verifies that dissolved oxygen is less than 0.1 ppm	1. Not applicable	1. Less than 3 hours
pH	1. pH electrode on 1,000:1 diluted sample(2)	1. See Note 2	1. See Note 2	1. Less than 3 hours

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(1) For chloride capability refer to Criterion (5).

(2) pH is not measured in an undiluted sample. Assessment of pH is made by comparing the diluted sample pH to the theoretical pH for the known boric acid and caustic concentrations. This is only a qualitative measurement, hence, no range or accuracy is given. Though qualitative, this method will sufficiently determine the pH to be within the RCS pH limit of 4.2 to 10.5. The undiluted sample (see Criterion 5) can be analyzed concurrently for pH and chloride when necessary. Even if pH is outside the normal range, actions will be dictated by the activity, not the pH.

The data provided by the RCS liquid PASS as indicated in the table above represents the design basis post-accident conditions as described under Criterion 6 and 9. The lower range detectabilities and increased accuracies for the boron, chloride, dissolved oxygen, and pH, implied in the June 30, 1982 criteria guideline clarification to NUREG 0737, Item II.B.3 are not included as part of the design basis data described in the table above. The RCS liquid PASS has substantial flexibility in remote dilution of the grab samples which would enable lower range detectabilities and increased accuracies for boron, chloride, and pH. However, ALARA considerations and assessment of the relative value of the PASS data will be evaluated prior to reducing the RCS liquid PASS dilutions.

All of the laboratory equipment used in the Trojan PASS has been sucessfully used in similar environments, including radiation exposures, at many other nuclear facilities such as Hanford. The equipment to be installed for the PASS has all been verified to be able to withstand the anticipated maximum radiation exposures for sufficient time to complete the required analyses. The equipment will be maintained and calibrated on a routine basis to ensure that the PASS is ever ready for service. Trojan does not intend to run the test matrix provided in the criterion since we use the instrumentation in our daily sampling procedures at Trojan. The test matrix suggested is close to the normal RCS condition.

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 (ie, 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.

CLARIFICATION (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 RCS liquid PASS samples lines are not heat-traced except where required to preclude moisture damage to the vacuum pump.

Inasmuch as the PASS liquid sample is drawn from the same location as the samples of reactor coolant taken during normal operations, any post-accident sample taken when conditions approximate those of normal operation, with respect to coolant flow (including natural circulation), should be representative of the coolant in the core. For any accident where the RHR System is operational, the PASS will take a sample from the RHR System. The RHR sample should be representative of the coolant in the core.

It is true that the sample taps can be rendered inaccurate due to the presence of steam or gas in the hot legs the samples are drawn from. In this event, the core thermocouples alone would be used to assess core conditions until such time as a representative reactor coolant sample could be taken.

The entire PASS within the Control/Auxiliary Building is capable of being flushed with demineralized water and purged with argon gas following each sample and prior to the following sample. The dead legs in the system have been minimized in the design and construction of the system so that old-to-new sample mixing is negligible. System flushes and purges will clean virtually all internal surfaces in the PASS. The residues of analyzed grab samples as well as the sample lines will be flushed to the VCT with demineralized water and purged to the GCH with argon. The system includes reduced-flow areas in the tubing (flow control coils, valve orifices, and line filter) to restrict flow until the system is isolated in the unlikely event of a line break.

Most of the new PASS equipment, including all of the flow controllers, restrictors, and filters, is bypassed until the sample flowing through the inlet line is representative of core conditions and ready to be isolated. All of the newly installed PASS valves are remotely operated 316 stainless steel, bellows-seal valves that can isolate the system. The Containment isolation valves can also be remotely operated to isolate the sample system.

The Containment atmosphere (PASS) sample is drawn directly from the Containment atmosphere through the inboard and outboard Containment isolation valves of the sample inlet line for the A-loop Post-Accident Hydrogen Analysis System. The sample inlet line is heat-traced to minimize iodine plate out. The length of the sample inlet line both inside and outside the Containment has been minimized to also help reduce iodine plate out. Alternate sampling origination points inside the Containment are possible by operation of other valves to compare locations inside the Containment. The entire system, including all branch lines, will be purged with nitrogen following each sample and prior to the next sample. The nitrogen purge is to the Containment and will clean the sample lines and make the old-to-new sample mixing negligible. All system process valves are remotely operated 316 stainless steel, bellows-seal valves capable of isolating the system, as are the Containment isolation valves. The sample lines penetrating the Containment are reduced from 1-in.-diameter pipe to 3/8-in.-diameter tubing inside the purge exhaust room and further reduced to 1/4-in.-diameter tubing leading to each grab sample container outside the purge exhaust room to restrict flow until Containment isolation valves are closed in the unlikely event of a line break.

RESPONSE (11)(b)

The PASS is a leaktight system. The valves used in the PASS are bellows-sealed, helium leak tested to ensure there is no stem leakage. All joints are welded where practical, or use proven leaktight compression fittings, and are helium-leak-tested to ensure no leakage. Any conceivable system failures leading to a leak will be isolated by operational procedure. The maximum potential leakage from the RHR System, tabulated in the 1982 Updated FSAR, Table 6.3-12, is far in excess of any potential leakage from the PASS equipment, which is considered negligible in comparison. Filtration is provided by HEPA filters in the Fuel and Auxiliary Building ventilation exhaust. Carbon absorbers are not required.

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