9.3.2 Process Sampling Systems

The process sampling systems comprise the following:

- Nuclear sampling system (NSS).
- Secondary sampling system (SECSS).
- Severe accident sampling system (SASS).
- Hydrogen monitoring system (HMS).

The HMS is described in Section 6.2.5.2.2.

Activity monitoring associated with main steam are described in Sections 10.3.5.5 and 11.5.4.1.

These process sampling systems provide centralized and local facilities for obtaining liquid and gaseous samples for the purpose of determining the physical and chemical characteristics and control parameters by measurements and analyses. Samples are obtained from the following:

- Primary and secondary coolant.
- Containment atmosphere.
- Liquid and gaseous waste treatment systems.
- In-containment refueling water storage tank (IRWST).

There is no shared equipment and there are no shared sample functions among the liquid waste management and gaseous waste management subsystems. Refer to Figure 11.2-1 and Figure 11.3-1. The liquid tanks are vented to a common header which discharges gases to the Radioactive Waste Processing Building Ventilation System and on to the vent stack. Liquid sampling is handled by sampling subsystem KUB while gaseous sampling is handled by sampling subsystem KUF. The gaseous waste management subsystem has residual radioactive liquid constituents from condensation and collected by the KTA system for processing in the LWS. There is no shared equipment or sampling.

The process sampling systems are a subset of the process and effluent monitoring system, which is described in Section 11.5.

9.3.2.1 Design Bases

The processing sampling systems perform the following safety-related functions:

- Maintain containment isolation. Sample lines in the process sampling systems penetrating the containment are capable of isolation upon receipt of a containment isolation signal (CIS) from the reactor protection system.

- Maintain integrity of reactor coolant pressure boundary (RCPB). Motor-operated isolation valves in three NSS lines connected to the reactor coolant system (RCS) maintain RCPB integrity.

- Maintain the component cooling water system's (CCWS) capability to perform it's safety related functions by maintaining the integrity of the CCWS' pressure boundary at the interface (i.e. sample coolers) between NSS and CCWS and SECSS and CCWS. This is a secondary design function.

The process sampling systems have the following design basis requirements and criteria:

- The process sampling systems are designed to provide engineering information based upon sound radiation protection principles to achieve occupational doses and doses to members of the public as low as is reasonably achievable (ALARA) (10 CFR 20.1101(b)).

- Safety-related portions of the process sampling systems are designed, fabricated, erected and tested to quality standards commensurate with the importance of the safety functions to be performed (GDC 1).

- Safety-related portions of the process sampling systems are designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami and seiches without loss of capability to perform their safety functions (GDC 2).

- Non-safety-related portions of the process sampling systems are designed to monitor variables and systems over their anticipated ranges to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core and the RCPB (GDC 13).

- Non-safety-related portions of the process sampling systems are designed to maintain the integrity of the RCPB by sampling for chemical species that can affect the RCPB (GDC 14).

- Non-safety-related portions of the process sampling systems are designed to reliably control the rate of reactivity changes by sampling the boron concentration (GDC 26).

- Non-safety-related portions of the process sampling systems are designed to monitor fission products, hydrogen, oxygen and other substances that may be released into the reactor containment; and also, monitor the concentration and quality of fission products released to the environment following postulated accidents (GDC 41).

- Non-safety-related portions of the process sampling systems include means to suitably monitor the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences (AOO) (GDC 60).

- Non-safety-related portions of the process sampling systems are designed to monitor the fuel storage and radioactive waste systems and detect conditions that may result in excessive radiation levels (GDC 63).

- Non-safety-related portions of the process sampling systems include means for monitoring the reactor containment atmosphere, spaces containing components for recirculation of loss-of-coolant accident (LOCA) fluids, effluent discharge paths and the plant environs for radioactivity that may be released from normal operations, including AOOs and postulated accidents (GDC 64).

- Non-safety-related portions of the process sampling systems are designed to have provisions for a leakage detection and control program to minimize the leakage from those portions of the process sampling systems outside of the containment that contain or may contain radioactive material following an accident (10 CFR 50.34(f)(2)(xxvi)).

The process sampling systems are designed to meet the following functional criteria:

- Obtain liquid and gaseous samples from the primary coolant, liquid and gaseous waste treatment systems, auxiliary systems and inside containment.

- Purge sampling lines and reduce plateout (buildup of chemical residue) in sample lines, demonstrating compliance with RG 1.21, position C7. Sample lines are normally flushed/purged with sample media.

- Representative samples from gaseous process streams and tanks are in accordance with American National Standards Institute/Health Physics Society (ANSI/HPS) Standard N13.1-1999 (Reference 2). These criteria conform to RG 1.21, position C6.

- Size RCS sample lines to minimize loss of reactor coolant following rupture of sample line.

- Continuously monitor secondary side activity and chemistry.

- Recycle secondary side samples to steam generator blowdown demineralizing system.

- Continuously monitor and obtain manual grab samples from selected points in the secondary side, main cycle and auxiliary systems.

- Sample glove boxes are purged by taking air from the room atmosphere. The air is passed through pre-filters, made available for purging, then discharged to the appropriate gaseous system.

- Maintenance and decontamination connections are either temporary or completely removed upon termination of the flush. Non-contaminated systems that are permanently connected are protected by a backflow preventor or differential pressure.

- Process sample systems prevent the inadvertent transfer of contaminated fluids to non-contaminated drainage systems by sending contaminated fluids either back to the system being sampled or to an appropriate radwaste system. Flushing or purging media are routed to the appropriate system.

9.3.2.2 System Description

9.3.2.2.1 General Description

Refer to Section 12.3.6.5.2 for process sampling system design features which demonstrate compliance with the requirements of 10 CFR 20.1406.

9.3.2.2.1.1 Nuclear Sampling System

The NSS obtains liquid and gaseous samples from the primary coolant, liquid and gaseous waste treatment systems, and auxiliary systems, in order to determine the characteristics of these samples by measurements and analyses. NSS samples are categorized as active liquid samples, slightly active liquid samples and gaseous samples. The NSS is contained within the Nuclear Island (NI).

Active Liquid Samples

The NSS continuously collects active liquid samples from the RCS at three different locations:

- Crossover leg loop 3.

- Pressurizer (liquid phase).

- Hot leg loop 1.

Each line is equipped with a motor-operated sampling isolation valve in close proximity to the sampling point and two containment isolation valves (CIV).

Samples of the reactor coolant are taken degassed or non-degassed in order to analyze separately either the dissolved gases or the degassed liquid.

Sample (glove) boxes are used to collect active liquid grab samples from:

- CPS.

- Coolant supply and storage system (CSSS).

- Coolant treatment system (CTS).

- Chemical and volume control system (CVCS).
- Four trains of low head safety injection (LHSI) system.
- NSS (upstream of boron meter).

The NSS also collects local grab samples, specifically for corrosion product sampling, from:

- CPS - upstream and downstream of mechanical filters.
- Fuel pool purification system (FPPS) - upstream and downstream of mechanical filter.

To obtain a sample, the respective sample line is chosen by opening the associated solenoid valve. The sample flow rate is adjusted by control valves using local flow meters. After an elapsed purge time has passed to achieve a representative sample, the grab sample is taken inside a glove box. It is possible to perform parallel sampling from all connected systems. Sample glove boxes are used to confine spills and limit any liquid or gaseous release to the environment.

In consideration of ALARA principles:

- One sample stream is degassed at a time to remove dissolved noble gases. The sample stream is routed through a multiple position valve into a degassing vessel. The vessel is purged before sampling to avoid cross-contamination. When the vessel inlet is isolated, dissolved gases are stripped off the liquid by nitrogen. Grab samples are taken from the vessel.
- The primary sample station and collection tank are shielded by being located in separate rooms, which reduces exposure by isolating the radiation source.
- Refer to Section 12.3.1.9.2 for additional information on sampling station accessibility and shielding.

To provide assurance that representative samples are obtained from liquid processes, sample points are located in turbulent flow zones (where applicable). For tanks, samples are taken from the bulk volume to avoid low points and sediment traps. Tanks with a high solids content will have provisions for agitation prior to sampling. Sample lines are flushed with sample fluid for a sufficient period of time prior to sample extraction in order to remove sediment deposits and air and gas pockets. This design conforms to RG 1.21, position C.6.

Slightly Active Liquid Samples

The NSS collects slightly active liquid grab samples from auxiliary systems containing slightly active liquids. Sample (glove) boxes are used to obtain grab samples from:

- Four safety injection system (SIS) accumulators inside Reactor Building (RB).
- Reactor boron and water makeup system (RBWMS).
- Fuel pool cooling system (FPCS).
- FPPS.
- Coolant degasification system (CDS).
- CTS.

Sample types taken include:

- Liquid grab.
- Degassed liquid grab.

Gaseous Samples

The NSS collects local gaseous grab samples from:

- Gaseous waste processing system (GWPS).
- CSSS.
- NSS (backfeed vessel).
- Nuclear island drain/vent system (NIDVS). This includes process drains inside Fuel Building (FB), Nuclear Auxiliary Building (NAB) and Safeguard Buildings.

Gaseous grab samples are taken as close as possible to the components and systems to be sampled in order to get a representative sample. The equipment is installed in accessible areas.

Each sample point consists of a sample withdrawal and return line. Typically, the withdrawal line belongs to the system or component being sampled, while the return line usually belongs to the GWPS. Quick connections are attached at the end of both lines, to connect a special transportable gas sample vessel. The vessel is equipped with the counterpart of the quick connections and additional isolation valves.

To perform sampling, the differential pressure between different parts of a system or between a system and the GWPS is used so that the samples are routed through the gas sample vessel.

In the return line, there is a flow measurement to monitor that gas is routed to the sample vessel. After a sufficient flushing period, when a representative sample is present in the gas-sampling vessel, it is disconnected and the content is examined in the laboratory. The sample pipes are as short as possible, but sampling in an accessible area during plant operation is provided. There are no low points in the lines to avoid water pockets.

9.3.2.2.1.2 Secondary Sampling System

The SECSS consists of the following:

- Steam generator blowdown sampling system.
- Turbine Island (TI) SECSS.

The steam generator blowdown sampling system collects liquid samples from the steam generators (SG), steam generator blowdown system (SGBS) and the SG blowdown demineralizing system in order to perform water quality analyses.

There are four SG blowdown sampling lines, one coming from each SG. Each sample line has provisions to take a sample from three different locations of its associated SG. There are three sampling lines coming from the SG blowdown demineralizing system allowing for analysis at these locations. Flow is extracted from these lines and fed to gamma activity measurement equipment. This allows each steam generator to be monitored separately and continuously for radioactivity carryover to the secondary side. These monitors enable the identification or verification of the defective steam generator. (Refer to Section 11.5.1, Table 11.5-1, Monitors R-46 through R-49.)

SG blowdown samples that are collected with enough residual pressure to be transported are directed to the sample backfeed tank for recycle. As much liquid as possible is routed to the tank in order to minimize liquid waste. Samples are continuously recycled to the SGBS by the sample backfeed pump. The samples are recycled upstream of the SG blowdown demineralizing system processing equipment to allow regular treatment. In the event that the SGBS path is unavailable, the liquids are directed to a sump in the NIDVS.

The TI SECSS monitors key chemical parameters that relate to the quality of process fluids in the steam-condensate-feedwater cycle and the quality of various other process fluids. It provides a centralized sampling and analysis facility in the Turbine Building (TB), where both continuous monitoring and manual grab samples are taken from selected points in the secondary side, main cycle and auxiliary piping systems. The interconnecting sample transport tubing runs between the process sampling extraction point and the centralized sampling and analysis facility.

9.3.2.2.1.3 Severe Accident Sampling System

The SASS collects representative gaseous and liquid samples from inside the containment following a severe accident for the purpose of confirming whether the containment atmosphere contains airborne activity. Samples are obtained from:

- Equipment rooms inside containment.
- Annular rooms inside containment.
- IRWST, via severe accident heat removal system (SAHRS).

A description of severe accident evaluations and the SAHRS is provided in Section 19.2.

9.3.2.2.2 Component Description

A list of processes or equipment that have sampling points, the number of sampling points, the type of sample (grab or continuous) and the process measurement to be performed at each location in the NSS and SECSS is provided in Table 9.3.2-1—Primary Side Sampling Points, and Table 9.3.2-2—Secondary Side Sampling Points, respectively.

A simplified diagram of the NSS and SASS is provided in Figure 9.3.2-1—Nuclear Sampling System, and Figure 9.3.2-2—Severe Accident Sampling System, respectively.

Table 3.2.2-1 provides the seismic and other design classifications for the components in the NSS and SASS. Components are designed to the codes and standards applicable to their equipment classification.

9.3.2.2.3 System Operation

Nuclear Sampling System

The NSS is designed for manual operation on an intermittent basis (except for continuous sampling of reactor coolant) under all plant conditions ranging from plant start up, full power operation to hot and cold shutdown (as long as a normal power supply is available).

During normal plant operation, the sampling lines from hot leg 1, crossover leg 3 and the liquid phase of the pressurizer are continuously in operation. They permanently route samples from inside the RB to downstream cooling and online analyzers in the centralized laboratory. Liquid and gaseous grab samples are also taken intermittently during normal plant operation for laboratory analysis in order to control the quality of the fluids as specified in the plant chemical handbook.

During plant shutdown and refueling conditions while in the RHR mode, samples are taken from the RHRS and routed via the online boron measurement. During plant start up and shutdown conditions, the boric acid measurement for criticality monitoring is performed.

In a post accident condition, sampling of primary water remains a necessary function. Samples from the primary coolant can also be drawn during beyond design basis events as long as the primary circuit is pressurized to transport a sample in the sample lines to the centralized sample room in the NAB and normal power is available.

Secondary Sampling System

The SECSS is designed to operate during all modes of plant operation.

The various systems listed in Table 9.3.2-2 are sampled in accordance with the secondary side water chemistry program. All sample points in the TB are conveyed to a centralized monitoring station in the TB. A local sample station is provided for each of the following: demineralized water storage tank, circulating water cooling water basin make up, closed cooling water system. The SG blowdown samples are conveyed to a centralized blowdown sample monitoring station in the NAB. Samples are conditioned to the proper flowrate, pressure and temperature via valves and sample coolers and then analyzed. The samples from SG blowdown are recycled back to the SG blowdown system. The samples from the TI SECSS centralized monitoring station are recycled to the main condenser.

Severe Accident Sampling System

The SASS is not operational during normal power conditions. It is only placed in operation following a severe accident. In all other cases of abnormal plant operating conditions, the SASS is not required to operate.

9.3.2.3 Safety Evaluation

The design of safety-related portions of the process sampling systems satisfies 10 CFR 20.1101(b) regarding achieving ALARA occupational doses and doses to members of the public.

- The process sampling systems are designed to reduce the potential doses to plant personnel who operate, service and inspect the systems. The station layout and design features (e.g., use of sample glove boxes in NSS, sample streams in SECSS are returned to either the SGBS or NIDVS, NSS and SASS sample lines contain passive flow restrictions to limit loss of coolant following a rupture of a sample line) contribute to maintaining ALARA occupational doses and doses to members of the public.

The design of safety-related portions of the process sampling systems satisfies GDC 1 regarding system components being designed, fabricated, erected and tested to quality standards commensurate with the importance of the safety functions to be performed.

- The design of safety-related, water-containing components in the process sampling systems is consistent with the quality group classifications and standards given in RG 1.26.

The design of safety-related portions of the process sampling systems satisfies GDC 2 regarding the effects of natural phenomena.

- Safety-related portions of the process sampling systems are located in the RB, Safeguard Buildings and FB. These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, tsunami and seiches. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the bases for the adequacy of the structural design of the buildings.
- Safety-related portions of the process sampling systems are designated Seismic Category I and designed to remain functional during and following a safe shutdown earthquake (SSE). Sections 3.7 and 3.9 provide the design loading conditions that are considered.
- The design of safety-related components in the process sampling systems is consistent with the seismic design classifications given in RG 1.29.

The design of the processing sampling systems satisfies GDC 13 regarding monitoring variables and systems that can affect the fission process, the integrity of the reactor core and the RCPB.

- The NSS obtains and analyzes key chemistry parameters such as conductivity, and hydrogen and oxygen concentrations in the RCS during normal plant operation and after an accident, if normal power is available. The control of corrosive chemical attack increases plant safety by decreasing the probability that the RCPB is compromised due to degradation from corrosive chemical attack.
- The SASS obtains and analyzes gaseous and liquid samples from the containment atmosphere and IRWST following a severe accident.
- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4.

The design of the process sampling systems satisfies GDC 14 regarding maintaining the integrity of the RCPB by sampling for chemical species that can affect the RCPB.

- The NSS collects primary water chemistry data. Verification that key chemical parameters are within prescribed limits provides assurance that the RCPB and fuel cladding are not adversely affected by chemical attack.
- The portion of the NSS that includes the RCPB is designed, fabricated, erected and tested so as to have a low probability of abnormal leakage, rapidly propagating failure and gross rupture. Sampling for corrosion products is used to verify key chemistry parameters.
- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4.

- The U.S. EPR steam generator water and feedwater quality requirements are based on the EPRI Secondary Water Chemistry Guidelines (Reference 1). Refer to Section 10.3. Meeting these EPRI guidelines is consistent with satisfying the guidelines in RG 1.21, Position C.2.
- The SASS does not serve as part of the RCPB. Therefore, GDC 14 is not applicable to the SASS.

The design of the process sampling systems satisfies GDC 26 regarding reliably controlling the of reactivity changes by sampling the boron concentration.

- To verify the boron concentration, the NSS samples boron concentration by obtaining samples from the RCS and boric acid storage tanks downstream of the RBWMS pumps.
- The SASS obtains and analyzes liquid samples from the IRWST following a severe accident. The containment atmosphere sample can be diluted by a factor of 1:1000, 1:100 or 1:10. The containment scrubbing liquid sample can be diluted by a factor of 1:1000. The IRWST sample can be diluted by a factor of 1:1000 or 1:100. The default setting for samples is a factor of 1:1000.
- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4. Therefore, GDC 26 is not applicable to the SECSS.

The design of the process sampling systems satisfies GDC 41 regarding controlling fission products by reducing the concentration and quality of fission products released to the environment following postulated accidents.

- The NSS obtains and analyzes liquid samples from the RCS after an accident.
- The NSS measures chemistry parameters in the LHSI system and SIS accumulators. These measurements confirm the chemical additive concentration is within prescribed limits and that a sufficient chemical supply is available during postulated accidents.
- The SASS obtains and analyzes gaseous samples from the containment atmosphere following a severe accident. The containment and IRWST samples are highly diluted in Safeguard Building (SB) 4. The highly diluted sample is pumped to the Fuel Building where a manual sample is taken. The samples are then purged and flushed back to the containment/IRWST to avoid cross contamination with the next sample and reduce the radiological impact on the system.
- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4. Therefore, GDC 41 is not applicable to the SECSS.

The design of the process sampling systems satisfies GDC 60 regarding suitably controlling the release of radioactive materials in gaseous and liquid effluents and handling radioactive solid wastes produced during normal reactor operation, including AOOs.

- The design of the NSS prevents the inadvertent transfer of contaminated fluids to non-contaminated drainage systems.

- The design of the NSS and SASS purges and drains the sample stream back to the system being sampled, if possible, or to an appropriate radwaste system. This is consistent with the guidelines in RG 8.8, Positions 2.d.(2), 2.f.(3) and 2.f.(8).

- The NSS and SASS sample lines contain passive flow restrictions (equivalent to line size) to limit loss of coolant following a rupture of a sample line. This is consistent with the guidelines in RG 8.8, Position 2.i.(6).

- Safety-related CIVs close on receipt of a CIS and contain radioactive material inside the RB. Refer to Section 6.2.4.

The design of the process sampling systems satisfies GDC 63 regarding monitoring fuel storage and radioactive waste systems and detecting conditions that may result in excessive radiation levels.

- NSS analysis capabilities provide assurance that the release of radioactive materials to the environment is controlled through the use of sampling boxes.

- The SASS does not interface with plant systems that monitor fuel storage and radioactive waste systems. Therefore, GDC 63 is not applicable to the SASS.

- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4. Therefore, GDC 63 is not applicable to the SECSS.

The design of the process sampling systems satisfies GDC 64 regarding monitoring the containment atmosphere, spaces containing components for recirculation after a LOCA, effluent discharge paths and the plant environs for radioactivity that may be released from normal operations, AOOs and postulated accidents.

- The NSS monitors for radioactivity that may be released during normal operations, AOOs and postulated accidents.

- The NSS provides information to indicate the potential for being breached or the actual breach of the barriers to fission product release (i.e., RCPB).

- The NSS provides information regarding the release of radioactive materials, which allows for early indication of the need to initiate other protective actions.

- The SASS obtains and analyzes gaseous samples from the containment atmosphere following a severe accident.

- The only safety-related function of the SECSS is containment isolation. Refer to Section 6.2.4. Therefore, GDC 64 is not applicable to the SECSS.

The design of the process sampling systems satisfies 10 CFR 50.34(f)(2)(xxvi) regarding having provisions for a leakage detection and control program to minimize the leakage from those portions of the process sampling systems outside of the containment that contain or may contain radioactive material following an accident.

- The NSS samples the RCS to provide information necessary to assess and control the plant under accident conditions.
- The SASS obtains and analyzes gaseous samples from the containment atmosphere following a severe accident for the purpose of confirming whether the containment atmosphere contains airborne activity.
- The NSS and SASS contains proper equipment to prevent unnecessary high exposures to workers and minimize leakage from the system to maintain exposure ALARA.
- Safety-related CIVs close on receipt of a CIS and contain radioactive material inside the RB. Refer to Section 6.2.4.
- The design of the process sampling systems satisfies 10 CFR 50.34(f)(2)(viii) as it relates to the capability of collecting samples from the reactor coolant (NSS) and containment (SASS).
- The design of the process sampling systems satisfies 10 CFR 50.34(f)(2)(xvii) regarding having provisions for a continuous sampling of radioiodines and particulates in gaseous effluents from the potential accident release points.

9.3.2.4 Inspection and Testing Requirements

Components in the process sampling systems are inspected and tested during plant startup. Refer to Section 14.2 (test abstract #071, #092, #100 and #204) for initial plant startup test program. The components are designed to permit periodic testing and inservice inspections during plant operation. System components are monitored during operation to demonstrate satisfactory functioning of the equipment. A description of the inservice testing program and inservice inspection program is provided in Section 3.9.6 and Section 6.6, respectively.

9.3.2.5 Instrumentation Requirements

During normal plant operation, continuous sampling of the reactor coolant and steam generator blowdown is performed by online monitors. These sample lines are automatically isolated on a CIS.

Normal plant process condition indication (e.g., pressure, temperature and flow) are used by plant operations personnel to verify system status before manual samples are taken.

9.3.2.6 References

1. EPRI Report 1008224, “Pressurized Water Reactor Secondary Water Chemistry Guidelines,” Revision 6, Electric Power Research Institute, December 2004.

2. ANSI/HPS N13.1-1999, “Guide to Sampling Airborne Radioactive Materials in Stacks and Ducts,” American National Standards Institute/Health Physics Society, 1999.

Table 9.3.2-1—Primary Side Sampling Points
Sheet 1 of 3

Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement	Range[4]	Response Time[4]	Sensitivity[4]	Maximum anticipated drift between calibrations[4]
LHSI/RHR	4	Grab	See Notes 1,2				
CVCS	2	Continuous	Boron	0.015-20 ppb	6 minutes	± 3% or 0.005 ppb, whichever is greater	<1% of reading (per year)
			Hydrogen	0-10 ppm	20 seconds	± 3% or ± 60 ppb, whichever is greater	<1% of reading (per year)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Conductivity	0.02-2,000 µS/cm	20 seconds	± 0.1 °F of temperature	<1% of reading (per year)
			Activity (gamma)	See Table 11.5-1, Monitor R-51 through R-54			
RCS	2	Continuous	Boron	0.015-20 ppb	6 minutes	± 3% or 0.005 ppb, whichever is greater	<1% of reading (per year)
			Hydrogen	0-10 ppm	20 seconds	± 3% or ± 60 ppb, whichever is greater	<1% of reading (per year)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Conductivity	0.02-2,000 µS/cm	20 seconds	± 0.1 °F of temperature	± 0.1 °F of temperature
			Activity (Beta)	See Table 11.5-1, Monitor R-41			

Table 9.3.2-1—Primary Side Sampling Points
Sheet 2 of 3

Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement	Range[4]	Response Time[4]	Sensitivity[4]	Maximum anticipated drift between calibrations[4]
Pressurizer	1	Continuous	Boron	0.015-20 ppb	6 minutes	± 3% or 0.005 ppb, whichever is greater	<1% of reading (per year)
			Hydrogen	0-10 ppm	20 seconds	± 3% or ± 60 ppb, whichever is greater	<1% of reading (per year)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Conductivity	0.02-2,000 µS/cm	20 seconds	± 0.1 °F of temperature	<1% of reading (per year)
			Activity (Beta)	See Table 11.5-1, Monitor R-41			
CPS	6	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
SIS Accumulators	4	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
RBWMS (boric acid pump)	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
			Tritium concentration	Table 11.5-1, Sample Point R-45			
FPCS	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
FPPS	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
			Tritium concentration	Table 11.5-1, Sample Point R-39			
CDS	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
CTS	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A

Table 9.3.2-1—Primary Side Sampling Points
Sheet 3 of 3

Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement	Range[4]	Response Time[4]	Sensitivity[4]	Maximum anticipated drift between calibrations[4]
GWPS	4	Grab	Activity (gamma and beta)	See Table 11.5-1, Monitors R-1 and R-2			
			See Notes 1,2,3	N/A	N/A	N/A	N/A
CSSS	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
NIDVS (primary effluents)	3	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
			Tritium concentration	Table 11.5-1, Sample Point R-40			
			Tritium concentration	Table 11.5-1, Sample Point R-44			
NSS (backfeed tank)	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
Severe Accident Sampling System (SASS)	2	Grab	See Note 6	N/A	N/A	N/A	N/A

Notes:

1. Specific properties of liquid and gaseous grab samples to be measured are identified in plant procedures.

2. Laboratory instruments used to measure grab samples are identified in plant procedures for noble gas, iodine, and aerosols. Manufacturer's operating manual shall be consulted for calibration, measuring, maintenance, and cleaning and storage requirements.

3. Calibrating gases and solution for instrumentation are per the manufacturer's operating manual.

4. Values are typical; the actual values will meet or exceed the listed parameters.

5. Continuous on-line monitoring systems will be in accordance with ASTM D 3864 and ANSI N42.18-2004.

6. Contains containment atmosphere and IRWST (see Section 7.5.2.1.1).

Table 9.3.2-2—Secondary Side Sampling Points
Sheet 1 of 6

Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
SG Blowdown	15	Continuous/ grab	Activity (gamma)	See Table 11.5-1, Monitor R-46 through R-49			
			Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Specific Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
			pH	1-11 pH	30 seconds	±0.02 pH	<1% of reading (per standard solution volume)
Feedwater (upstream valve chamber)	1	Continuous/ grab	Specific Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			pH	1-11 pH	30 seconds	±0.02 pH	<1% of reading (per standard solution volume)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)

Table 9.3.2-2—Secondary Side Sampling Points
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Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
Feedwater Pumps discharge (combined with start-up feedwater pump)	1 per pump (5 total)	Continuous/ grab	Hydrazine	0-200 ppb	4 minutes	±2 ppb	<1% of reading (per year)
			Specific Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			pH	1-11 pH	30 seconds	±0.02 pH	<1% of reading (per standard solution volume)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
Main Steam (upstream HP turbine)	4	Continuous/ grab	Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Degassed Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)

Table 9.3.2-2—Secondary Side Sampling Points
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Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
Main Steam Lines (upstream of HP turbine)	4	Continuous	Activity (gamma)	See Table 11.5-1, Monitors R-55 through R-58			
Main Steam (downstream reheater)	2	Continuous/ grab	Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Degassed Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
Reheater Drain	4	Continuous/ grab	Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Degassed Cation Conductivity	0.06 to 1000 μS/cm	30 seconds	0.001 to 1 μS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
Auxiliary Steam System	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
Auxiliary Steam Condensate	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A

Table 9.3.2-2—Secondary Side Sampling Points
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Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
Condensate Pump Discharge	1	Continuous/ grab	Specific Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
Condensate Polisher Discharge	Site Specific	Continuous/ grab	Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)
Condenser Hotwell	6	Continuous	Cation Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
			Oxygen	0-20,000 ppb	30 seconds	± 2 ppb	<1% of reading (per year)
			Sodium	0.1 – 1000 ppb	2 minutes	±0.1 ppb	<1% of reading (per year)

Table 9.3.2-2—Secondary Side Sampling Points
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Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
Moisture Separator Drains	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
HP Heater Drains	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
LP Heater Drains	2	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
Clean Drains	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
			Tritium concentration	Table 11.5-1, Sample Point R-65			
Demineralized Water Storage Tank	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
Closed Cooling Water System	1	Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
Circulating Water Cooling Water Basin Makeup	1	Continuous	pH	1-11 pH		±0.02 pH	<1% of reading (per standard solution volume)
			Specific Conductivity	0.06 to 1000 µS/cm	30 seconds	0.001 to 1 µS/cm (depends on range)	± 1% of measured value or ± digit (whichever is greater)
Turbine Building Drains	1	Continuous/ Grab	See Notes 1,2,3	N/A	N/A	N/A	N/A
			Activity (gamma)	Table 11.5-1, Monitor R-50			
Vent System for Air Removal	1 Per System	Continuous	Activity (gamma)	Table 11.5-1, Monitor R-3			

Table 9.3.2-2—Secondary Side Sampling Points
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Process or Equipment	Number of Sample Points	Type of Sample[5]	Process Measurement of Continuous Samples	Range[4]	Response Time[4]	Sensitivity[4]	Maximum Anticipated Drift between Calibrations[4]
CCWS	1	Continuous/ Grab	Activity (gamma)	Table 11.5-1, Monitors R-35 through R-38			
	1	Continuous/ Grab	Activity (gamma)	Table 11.5-1, Monitor R-64			
Safety Chilled Water System	1	Continuous	Activity (gamma)	Table 11.5-1, Monitors R-59 and R-60			
Chilled Water Supply for Gaseous Waste Disposal Sampling System	1	Grab	Tritium concentration	Table 11.5-1, Sample Point R-61			
Essential Service Water System	1	Continuous/ Grab	Activity (gamma)	Table 11.5-1, Monitors R-66 through R-69			
	1	Continuous/ Grab	Activity (gamma)	Table 11.5-1, Monitor R-70			

Notes:

1. Specific properties of liquid and gaseous grab samples to be measured are identified in plant procedures for noble gas, iodine, and aerosols.
2. Laboratory instruments used to measure grab samples are identified in plant procedures. Manufacturer's operating manual shall be consulted for calibration, measuring, maintenance, and cleaning and storage requirements.
3. Calibrating gases and solution for instrumentation are per the manufacturer's operating manual.
4. Values are typical; the actual values will meet or exceed the listed parameters.

5. Continuous on-line monitoring systems will be in accordance with ASTM D 3864 and ANSI N42.18-2004.

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