11.5 Process and Effluent Radiological Monitoring and Sampling Systems

The information in this section of the reference ABWR DCD, including all subsections and tables, is incorporated by reference with the following departures and supplements.

STD DEP T1 3.4-1

STD DEP 7.1-1 (Table 11.5-1)

STD DEP 7.2-1

STD DEP 11.5-1 (replaced Table 11.5-1, Table 11.5-2, and Table 11.5-3; revised Table 11.5-7)

11.5.1.1.2 Radiation Monitors Required for Plant Operation

STD DEP 11.5-1

The Process Radiation Monitoring System also provides the following design objectives:

(1) Monitors Gaseous Effluent Streams

(f) ~~(a)~~~~Incinerator stack discharge~~

The Service Building HVAC system contains radiation monitors to monitor radioactivity in the supply air inlet. Functioning of these monitors is described in Subsection 9.4.8.

11.5.1.2.2 Radiation Monitors Required for Plant Operation

STD DEP 7.1-1

The radiation subsystem that monitors liquid discharges from the radwaste treatment system shall have provisions to alarm and initiate automatic closure of the waste discharge valve on the affected treatment system prior to exceeding the normal operation limits specified in ~~technical specifications~~ the Offsite Dose Calculation Manual *as required by Regulatory Guide 1.21.*

11.5.2.1.1 ~~*Main Steamline (MSL) Radiation Monitoring*~~ (Not Used)

STD DEP 7.2-1

This departure changes Main Steamline Radiation Monitors from safety to non-safety. Therefore, this section has been moved to Subsection 11.5.2.2.12.

11.5.2.1.2 Reactor Building HVAC Radiation Monitoring

STD DEP 11.5-1

The system consists of four redundant instrument channels. Each channel consists of a ~~digital gamma-sensitive GM~~ detector and a ~~control room~~ radiation monitor. Power is *supplied to channels A, B, C, and D monitors from vital 120 VAC Divisions 1, 2, 3 and 4, respectively.* ~~*A two-pen recorder powered from the 120 VAC instrument bus allows the output of any two channels to be recorded by the use of selection switches.*~~

Each radiation monitor has ~~*four*~~ three *trip circuits: two upscale* ~~*one downscale and one inoperative similar to MSL radiation monitors*~~ and one downscale/inoperative.

A high-high, ~~*inoperative*~~ *or a* ~~*downscale*~~ downscale/inoperative *trip in the radiation monitor results in a channel trip which is provided to LDS. Any two-out-of-four channel trips will result in the initiation by LDS of the Standby Gas Treatment System (SGTS) and in the isolation of the secondary containment (including closure of the containment purge and vent valves and closure of the Reactor Building ventilating exhaust isolation valves).*

Each radiation monitor will display the measured radiation level in ~~*mGy/h*~~ mSv/h.

11.5.2.1.3 Fuel Handling Area Ventilation Exhaust Radiation

STD DEP 11.5-1

This subsystem monitors the radiation level in the fuel handling area ventilation exhaust duct. The system consists of four channels which are physically and electrically independent of each other. Each channel consists of a ~~*digital gamma-sensitive GM*~~ *detector and a* ~~*control room*~~ *radiation monitor. Power for channels A, B, C, and D is supplied from the vital 120 VAC Divisions 1, 2, 3 and 4, respectively.*

Each radiation monitor has ~~*four*~~ three *trip circuits: two upscale* ~~*one downscale and one inoperative similar to the MSL radiation monitors*~~ and one downscale/inoperative. *This subsystem performs the same trip functions as those described in Subsection 11.5.2.1.2 for the Reactor Building HVAC* ~~*exhaust*~~ *radiation monitoring.*

11.5.2.1.4 Control Building HVAC Radiation Monitoring

STD DEP 11.5-1

The Control Building HVAC Radiation Monitoring Subsystem is provided to detect the radiation level in the normal outdoor air supply, automatically closes the outdoor air intake and the exhaust dampers, and initiates automatically the emergency air filtration system. The emergency air filtration system fans shall be started ~~*and area exhaust fans stopped*~~ *on high radiation.*

Each radiation channel consists of a ~~*digital gamma-sensitive GM*~~ *detector and* ~~*a*~~ *radiation monitor* ~~*which is located in the control room*~~*.*

Each radiation monitor has ~~*four*~~ three trip circuits: two upscale ~~*one inoperative and one downscale*~~ and one downscale/inoperative. *All trips are displayed on the appropriate radiation monitor and each actuates a control room annunciator.*

11.5.2.1.5 Drywell Sumps Discharge Radiation Monitoring

STD DEP 11.5-1

This subsystem monitors the radiation level in the liquid waste transferred in the drain line from the drywell LCW and HCW sumps to the Radwaste System. One monitoring channel is provided in each sump drain line. Each ~~channel uses an ionization chamber which~~ detector *is located on the drain line from the sump just downstream from the outboard isolation valve. The output from each ~~sensor~~* detector *is fed to a radiation monitor in the control room for display, recording and annunciation.*

11.5.2.2.1 Offgas Pre-Treatment Radiation Monitoring

STD DEP 11.5-1

A continuous sample is extracted from the offgas pipe via a stainless steel sample line. It is then passed through a sample chamber and a sample panel before being returned to the suction side of the steam jet air ejector (SJAE). The sample chamber is a stainless steel pipe which is internally polished to minimize plateout. It can be purged with room air to check detector response to background radiation by using a three-way solenoid-operated valve. The valve is controlled ~~by a switch located in~~ from *the main control room. The sample panel measures and indicates sample line flow. A ~~digital gamma-sensitive GM~~ detector is positioned adjacent to the vertical sample chamber and is connected to radiation monitors ~~in the main control room~~* which then send the data to the main control room to display.

The radiation monitor has ~~four~~ three *trip circuits: two upscale (high-high and high),* *~~one downscale and one inoperative~~* and one downscale/inoperative.

11.5.2.2.2 Offgas Post-Treatment Radiation Monitoring

STD DEP 7.1-1

STD DEP 11.5-1

This subsystem monitors radioactivity in the offgas piping downstream of the offgas system charcoal ~~absorbers~~ adsorbers *and upstream of the offgas system discharge valve. A continuous sample is extracted from the Offgas System piping, passed through the offgas post-treatment sample panel for monitoring and sampling, and returned to the Offgas System piping. The sample panel has a pair of filters (one for particulate collection and one for halogen collection) in parallel (with respect to flow) with two ~~identical GM~~ detectors. Two radiation monitors ~~in the main control room~~ analyze ~~and~~* the data and then send the data to the main control room to *visually display the measured gross radiation level*.

Each radiation monitor has four *trip circuits: ~~that indicate~~* three upscale (*high-high-high, high-high, high*)*, and* one *downscale/inoperative. ~~Each trip is visually displayed on the radiation monitor~~*. Each trip is determined by the radiation monitor and then sent for visual display to the main control room. *The trips actuate corresponding main control room annunciators: offgas post-treatment high-high-high radiation, offgas post-*

treatment high-high radiation, and offgas post-treatment high and downscale/inoperative monitor.

High or low flow measured at the sample panel actuates an annunciator in the control room to indicate abnormal flow.

The high-high-high and downscale trip/inoperative outputs initiate closure of the offgas system discharge ~~and bypass valves~~ valve. *The high-high-high trip setpoint is ~~determined so that valve closure is initiated prior to exceeding technical specification limit. Any one high-high channel trip initiates alignment of the Offgas System flow valves to achieve treatment through the charcoal vault.~~* provided in the Offsite Dose Calculation Manual. Any one High channel trip from the gaseous channels closes the offgas bypass valve.

11.5.2.2.3 Charcoal Vault Radiation Monitoring

STD DEP 11.5-1

The charcoal vault is monitored for gross gamma radiation level with a single instrument channel. The channel includes a digital sensor and converter, and a radiation monitor. The sensor is located outside the vault on the HVAC exhaust line from the vault. The radiation monitor ~~is located in the main control room~~ analyzes the data and then sends the data for visual display to the main control room. *The channel provides for sensing and readout of gross gamma radiation over a range of six logarithmic decades ~~(0.01 to 10^4 mGy/h)~~*.

The monitor has ~~one adjustable~~ two trip circuits: one *upscale trip circuit ~~for alarm~~ and one ~~downscale~~* downscale/inoperative *trip ~~for instrument trouble~~.* The trip outputs are alarmed in the main control room*. Power to the monitor is supplied from 120 VAC vital non-1E bus.*

11.5.2.2.4 Plant Stack Discharge Radiation Monitoring

STD DEP 11.5-1

A representative sample is continuously extracted from the ventilation ducting through an isokinetic probe in accordance with ANSI N13.1 and passed through the stack ventilation sample panels for monitoring and sampling, and returned to the ventilation ducting. Each sample panel has a pair of filters (one for particulate collection and one for halogen collection) in parallel (with respect to flow) for continuous gaseous radiation sampling. The radiation detector assembly consists of a shielded gas chamber that houses a ~~scintillation~~ detector and a check source. The extended range detector assembly consists of ~~an ionization~~ a *chamber which measures radiation levels up to ~~3700~~* 3.7 x 10^3 *MBq/cm^3. A radiation monitor ~~in the main control room~~ analyzes ~~and visually displays~~* the data and then sends it to the main control room to display *the measured radiation level. These sensors are qualified to operate under accident conditions.*

The radiation monitor ~~initiates~~ ~~trips~~ has three trip circuits*: ~~for alarm indications on~~* two upscale (*high-high, high*)*, and* one *~~low~~* downscale/inoperative *radiation from each detector assembly.* These trip outputs are alarmed in the main control inoperative room. *Also, the sampled line is monitored for high or low flow indications and alarming.*

11.5.2.2.5 Radwaste Liquid Discharge Radiation Monitoring

STD DEP 11.5-1

Liquid waste can be discharged from the sample tanks containing liquids that have been processed through one or more treatment systems such as evaporation, filtration, and ion exchange. During the discharge, the liquid is extracted from the liquid drain treatment process pipe, passed through a liquid sample panel which contains a detection assembly for gross radiation monitoring, and returned to the process pipe. The detection assembly consists of a ~~scintillation~~ detector mounted in a shielded sample chamber equipped with a check source. A radiation monitor ~~in the control room~~ analyzes and transmits the measured gross radiation level to the main control room for visual display. *~~and visually displays the measured gross radiation level.~~*

11.5.2.2.6 Reactor Building Cooling Water Radiation Monitoring

STD DEP T1 3.4-1

STD DEP 11.5-1

Each channel consists of a ~~scintillation~~ detector which is located in a well near the RCW heat exchanger exit pipe. ~~Radiation detected from the three channels is multiplexed and fed into a common radiation monitor~~. The output signal from each detector is sent to a separate radiation monitor*. This monitor provides ~~individual channel trips~~* two trip circuits*:* one upscale *~~on high~~* (high) *~~radiation level~~ and* one *downscale/inoperative indication for annunciation in the control room. Power to the monitors is provided from the non-1E vital 120 VAC source.*

11.5.2.2.8 Turbine Building Ventilation Exhaust Monitoring

STD DEP T1 3.4-1

STD DEP 11.5-1

This subsystem monitors the vent discharge in the Turbine Building for gross radiation levels. This includes the discharge from the mechanical vacuum pump. The monitoring is provided by four channels (two redundant sets). Two redundant channels monitor radiation in the compartment area air exhaust duct and the other two redundant channels monitor the radiation in the ventilation system air exhaust from the clean area. Each channel uses a digital detector located adjacent to the monitored exhaust duct. ~~The outputs from each set of detectors are multiplexed and then fed into two separate radiation monitors for display, recording and annunciation~~. The output signal from each detector is processed by a separate radiation monitor and then transmitted to the main control room for alarm and display*. Each monitor provides ~~alarm trips on~~*

~~radiation high~~ two trip circuits: one upscale (high) *and* one *~~on radiation low (one~~ downscale/inoperative~~)~~.*

11.5.2.2.9 Turbine Gland Seal Condenser Exhaust Discharge Monitoring

STD DEP T1 3.4-1

STD DEP 11.5-1

This subsystem monitors the offgas releases to the stack from the turbine gland seal system. The offgas releases are continuously sampled and monitored for noble gases by a ~~scintillation~~ detector. ~~The output signal is multiplexed and then fed to a shared radiation monitor in the main control for display, recording and annunciation~~ The output signal from each detector is processed by a separate radiation monitor and then transmitted to the main control room for alarm and display*. This monitor provides ~~two~~* three *trip ~~alarms~~* circuits: two upscale, (high-high*, ~~one on radiation~~*, *high) and one on radiation low (downscale/inoperative)*.

11.5.2.2.10 Standby Gas Treatment System Radiation Monitoring

STD DEP 11.5-1

Two ~~ionization chamber~~ detectors are physically located downstream of the exhaust fans on the exhaust duct to the stack and are utilized to monitor the high levels of radioactivity expected under accident conditions. Two other ~~scintillation~~ detectors are used during offgas sampling of the gas exhaust to the stack to monitor the normal level of radioactivity expected during normal plant operation.

The subsystem consists of four instrumented channels. Each channel consists of a detector and a ~~main control room~~ radiation monitor.

Each radiation monitor has ~~four~~ three *trip circuits: two upscale* (high-high and high)*, one inoperative and one ~~downscale~~* downscale/inoperative*. All trips are displayed on the appropriate radiation monitor and each actuates a main control room annunciator for high-high, high and low/inoperative indications.*

11.5.2.2.11 *~~Incinerator Stack Discharge Radiation Monitoring~~* (Not Used)

STD DEP 11.5-1

~~This subsystem monitors the radioactivity in the discharge from the incinerator stack during burning of low radioactive waste. A representative sample from the discharge path is drawn through an isokinetic probe and routed to a local sample panel in the Radwaste Building for monitoring and particle collection. The sample panel houses the radiation detector assembly, a pair of filters for collection of airborne particulates and halogens, the vacuum pumps and associated plumbing, and a gamma check source for testing operability of the radiation channel. Also, the sample panel includes provisions for purging from the Radwaste Building control room.~~

~~*The local sample panel and the radiation monitor are powered from 120 VAC instrument power.*~~

~~*The radiation monitor initiates trips on high and high-high levels and on downscale/inoperative indication. These trips are alarmed in the Radwaste Building control room. On high-high trip, the incinerator exhaust fans are shutdown to terminate any further discharge from the stack.*~~

11.5.2.2.12 Main Steamline (MSL) Radiation Monitoring

STD DEP 7.2-1

STD DEP 11.5-1

This subsystem monitors the gamma radiation level of the steam transported by the main steamlines in the MSL tunnel. The normal radiation level is produced primarily by coolant activation gases plus smaller quantities of fission gases being transported with the steam. ~~*In the event of a gross release of fission products from the core, the monitoring channels provide trip signals to the Leak Detection and Isolation System.*~~

The MSL radiation monitors consist of four redundant instrument channels. Each channel consists of a local detector ~~*(ion chamber)*~~ *and a control room radiation monitor. Power for channels A, B, C, and D monitors is supplied from vital 120 VAC divisions 1, 2, 3 and 4, respectively. All four channels are physically and electrically independent of each other.*

The detectors are physically located near the main steamlines (MSL) just downstream of the outboard MSIVs in the steam tunnel. The detectors are geometrically arranged and are capable of detecting significant increases in radiation level with any number of main steamlines in operation. Table 11.5-1 lists the location and range of the detectors.

Each radiation monitor has four trip circuits: two upscale (high-high and high), one downscale (low), and one inoperative. Each trip is visually displayed on the affected radiation monitor. ~~*A high-high or inoperative trip in the radiation monitor results in a channel trip which is provided to the Reactor Protection System (RPS) and to the Leak Detection and Isolation System (LDS).*~~ *Any two-out-of-four channel trip results in* ~~*initiation of MSIV closure, reactor scram,*~~ *main condenser mechanical vacuum pump (MVP) shutdown, and MVP line discharge valve closure. High and low trips do not result in a channel trip. Each radiation monitor displays the measured radiation level in* ~~*mGy/h*~~ mSv/h. *All channel trips are annunciated in the main control room.*

11.5.3 Effluent Monitoring and Sampling

11.5.3.4 Setpoints

STD DEP 7.1-1

The trip setpoints that initiate automatic isolation functions are specified in the plant ~~*Technical Specifications*~~ Instrument Setpoint Summary Report *as indicated in Table 11.5-1.*

11.5.4.3 Implementation of General Design Criterion 64

STD DEP 11.5-1

Radiation levels in radioactive and potentially radioactive process streams are monitored for radioactivity releases. These include:

(3) ~~Carbon~~ Charcoal *vault vent*

~~(5) Incinerator stack discharge~~

11.5.5.1 Inspection and Tests

STD DEP 11.5-1

The following monitors have alarm trip circuits which can be tested by using test signals or portable gamma sources:

(9) ~~Carbon vault vent~~ Charcoal vault *exhaust*

The following monitors include built-in check sources and purge systems which can be operated from the main control room:

~~(7) Incinerator stack discharge~~

11.5.5.2 Calibration

STD DEP 11.5-1

Calibration of radiation monitors is performed using certified commercial radionuclide sources traceable to the National Institute of Standards and Technology. ~~The overall reproducibility of calibration is limited to ±15%. The source-detector geometry during primary calibration will be mechanically precise enough to ensure that positioning errors of either instruments or radiation sources do not affect the calibration accuracy by more than ±3%~~*. Each continuous monitor is calibrated during plant operation or during the refueling outage if the detector is not readily accessible. Calibration can also be performed on the applicable instrument by using liquid or gaseous radionuclide standards or by analyzing particulate iodine or gaseous grab samples with laboratory instruments.*

~~The following monitors display the gross gamma signal in counts/min:~~

~~(1) Offgas post-treatment~~

~~(2) Plant stack discharge (low to normal levels)~~

~~(3) Radwaste liquid discharge~~

~~(4) SGTS offgas discharge (low to normal levels)~~

~~(5) Reactor Building cooling water intersystem leakage~~

~~*(6) Radwaste Building ventilation exhaust*~~

~~*(7) Main turbine gland seal condenser offgas exhaust*~~

~~*(8) Incinerator stack discharge*~~

~~*The following monitors are calibrated to provide measurements of the gross gamma dose rate in mGy/h:*~~

~~*(1) Main steamline tunnel area*~~

~~*(2) Reactor Building ventilation exhaust*~~

~~*(3) Fuel handling area ventilation exhaust*~~

~~*(4) Charcoal vault vent exhaust*~~

~~*(5) Control Building air intake supply*~~

~~*(6) Turbine Building ventilation exhaust*~~

~~*(7) SGTS offgas discharge (high level)*~~

~~*(8) Offgas pre-treatment*~~

~~*(9) Drywell sump liquid discharge*~~

~~*(10) Plant stack discharge (high level)*~~

11.5.5.3 Maintenance

STD DEP 11.5-1

All channel detectors and *electronics*~~*, and recorders*~~ *are serviced and maintained on* ~~*an annual*~~ a periodic *basis or in accordance with manufacturers' recommendations to ensure reliable operations.* ~~*Such maintenance includes cleaning, lubrication and assurance of free movement of the recorder in addition to the replacement or adjustment of any components required after performing a test or calibration check*~~ For sampling systems, skids are designed in order to allow periodic maintenance and cleaning*. If any work is performed which would affect the calibration, a recalibration is performed at the completion of the work.*

11.5.6 COL License Information

11.5.6.1 Calculation of Radiation Release Rates

The following site-specific supplement addresses COL License Information Item 11.4.

The Offsite Dose Calculation Manual (ODCM) contains the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. The ODCM addresses the methods for the conversion of the radiation measurements of gaseous discharge from the main plant stack into release rates.

11.5.6.2 Compliance with the Regulatory Shielding Design Basis

The following site-specific supplement addresses COL License Information Item 11.5.

The operations of the sampling systems for Standby Gas Treatment and main stack effluent monitoring will be implemented by operation and maintenance procedures. The design will, as demonstrated in shielding calculations, comply with the shielding requirements for accident conditions, as stipulated in NUREG-0737, Item II.F.1, clarification 2 of Attachment 2. Equipment design or procurement specifications will contain the necessary shielding requirements. (COM 11.5-1)

11.5.6.3 Provisions for Isokinetic Sampling

The following site-specific supplement addresses COL License Information Item 11.6.

Procedures will be developed prior to fuel load, consistent with ABWR Licensing Topical Report ~~NEDO~~ NEDO-33297, dated January 2007, "Advanced Boiling Water Reactor (ABWR) Procedures Development Plan," to include the collection techniques used to extract representative samples of radioactive iodines and particulates. Collecting and sampling procedures will require isokinetic conditions within 20% of the flow rate are maintained to assure that a representative sample from the effluent stream is taken as stipulated in NUREG-0737, Item II.F.1, clarification 3 of Attachment 2. (COM 11.5-2)

11.5.6.4 Sampling of Radioactive Iodines and Particulates

The following site-specific supplement addresses COL License Information Item 11.7.

Procedures will be developed prior to fuel load, consistent with ABWR Licensing Topical Report ~~NEDO~~ NEDO-33297, dated January 2007, "Advanced Boiling Water Reactor (ABWR) Procedures Development Plan," to include the collection techniques used to extract representative samples of radioactive iodines and particulates to be used following an accident to quantify releases for dose calculations and assessment as stipulated in NUREG-0737, Item II.F.1-2. (COM 11.5-3)

11.5.6.5 Calibration Frequencies and Techniques

The following site-specific supplement addresses COL License Information Item 11.8.

Procedures will be developed prior to fuel load, consistent with ABWR Licensing Topical Report ~~NEDO~~ NEDO-33297, dated January 2007, "Advanced Boiling Water Reactor (ABWR) Procedures Development Plan," to specify the calibration frequencies and techniques for the radiation sensors based on equipment data provided by the vendor. (COM 11.5-4)

11.5.7S Additional Information

This subsection supplements the information provided in the reference DCD as discussed in Section C.III.1.11.5 of Regulatory Guide 1.206.

An offsite dose calculation manual (ODCM) for STP 1 & 2 has been reviewed and approved by the NRC. It contains descriptions of the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. It also describes how liquid and gaseous effluent release rates are derived and parameters used in setting instrumentation alarm setpoints to control or terminate effluent releases. The ODCM also contains the radiological environmental monitoring program which samples and analyzes radiation and radionuclides in the environs of the existing plant, using local land use census data in identifying all potential radiation exposure pathways associated with radioactive materials present in liquid and gaseous effluents and direct external radiation from the plant. The ODCM for STP 3 & 4 will be integrated into the 1 & 2 ODCM, taking into account the appropriate differences between the existing and new units.

Compliance with the cost benefits analysis requirements of 10 CFR 50 Appendix I is demonstrated using the generic template submitted as an NEI topical report and is incorporated by reference. The FSAR will be revised with reference to the NEI topical report when the information is available.

Table 11.5-1 Process and Effluent Radiation Monitoring Systems

Monitored Process	No. of Channels	Sample Line or Detector Location	Channel Range*	Setpoint ACF Trip	Setpoint Scale
A. Safety-Related Monitors					
Main steamline tunnel area	4	Immediately down- stream of plant main steamline isolation valve	$1E^{-2}$ to $1E^{4}$ mSv/h	Instrument Setpoint Summary Report	6 dec. log
Reactor Building vent exhaust	4	Exhaust duct upstream of exhaust ventilation isolation valve	$1E^{-4}$ to 1 mSv/h	Instrument Setpoint Summary Report	4 dec. log
Control Building air intake	8†	Intake duct upstream of intake ventilation isolation valve	$1E^{-4}$ to 1 mSv/h	Instrument Setpoint Summary Report	4 dec. log
Drywell sump discharge	2	Drain line from LCW & HCW sumps	$1E^{-2}$ to $1E^{4}$ mSv/h	Instrument Setpoint Summary Report	6 dec. log
Fuel handling area air vent exhaust	4	Locally above operating floor	$1E^{-4}$ to 1 mSv/h	Instrument Setpoint Summary Report	4 dec. log
B. Monitors Required for Plant Operation					
Radwaste liquid discharge	1	Sample line	10^{-1} to 10^{4} cpm	Instrument Setpoint Summary Report	5 dec. log
Reactor Building cooling water system	3	RCW Hx line exit	10^{-1} to 10^{4} cpm	None	5 dec. log
Offgas post- treatment	2	Sample line	10 to 10^{6} cpm	Offsite Dose Calculation Manual	5 dec. log
Offgas pre-treatment	1	Sample line	$1E^{-2}$ to $1E^{4}$ mSv/h	None	6 dec. log
Charcoal vault vent	1	On charcoal vault HVAC exhaust line	$1E^{-2}$ to $1E^{4}$ mSv/h	None	6 dec. log
Plant stack discharge	2	Sample line	10 to 10^{6} cpm	None	5 dec. log
		~~Sample line~~	10^{-13} to 10^{-6} Amps ($1E^{-2}$ to $1E^{4}$ mSv/h)	None	6 dec. log

ACF = Automatic Control Function

Table 11.5-1 Process and Effluent Radiation Monitoring Systems (Continued)

Monitored Process	No. of Channels	Sample Line or Detector Location	Channel Range*	Setpoint ACF Trip	Setpoint Scale
B. Monitors Required for Plant Operation (Continued)					
Radwaste Building exhaust vent	1	Exhaust ducts	10 to 10^6 cpm	None	5 dec. log
Turbine Building vent exhaust	4	Exhaust duct	1EE-4 $^{-4}$ to 1 mSv/h	None	4 dec. log
Standby Gas Treatment System offgas	2	SGTS exhaust air duct downstream of exhaust fans	1 to 10^6 cpm	None	6 dec. log
			10^{-13} to 10^{-6} Amps (1E-2 $^{-2}$ to 1E^4 mSv/h)	None	6 dec. log
Turbine gland seal condenser offgas	1	Sample line	1 to 10^6 cpm	None	6 dec. log

ACF = Automatic Control Function;

* The channel range specified in this table is the equipment measuring or display range of the indicated parameter. Refer to Tables 11.5-2 and 11.5-3 for the dynamic detection range of the monitoring channel expressed as concentration in units of megabecquerels per cubic centimeter, referenced to a specific nuclide. These channel ranges are estimated based on existing plants.

† 4 Channels for each air intake

Table 11.5-2 Process Radiation Monitoring System (Gaseous and Airborne Monitors)

Radiation Monitor	Configuration	Dynamic Detection Range*	Principal Radionuclides Measured	Expected Activity†	Alarms and Trips
Offgas post-treatment	Offline	3.7 x$10^{–5}$ to 3.7 MBq/cm^3	Xe-133‡ Cs-137 I-131	1.1 x 10^{-3} MBq/cm^3	Flow H/L DNSC/INOP High High-High HIgh-High-High
Offgas pre-treatment	Adjacent to sample chamber	3.7 x$10^{–5}$ to 3.7x10^2 MBq/cm^3	Noble gases fission products	~1.1x10^{-2} MBq/cm^3	High-High High DNSC/INOP Flow H/L
Main steamline tunnel area	Adjacent to steamlines	3.7x10^{-8} to 3.7x10^2 MBq/cm^3	Coolant activation gases	~6.4x10-^{2} MBq/cm^3	High-High High DNSC INOP
Charcoal vault	Inline	3.7x10^{-5} to 37 MBq/cm^3	Noble gases	Negligible	High Low
T/B vent exhaust	Inline	3.7x10^{-7} to 3.7x10^{-3} MBq/cm^3	Xe-133‡ Xe-135	~1.48x10^{-6} MBq/cm^3	High DNSC/INOP
Reactor Building vent exhaust	Inline	3.7x10^{-7} to 3.7 x 10^{-3} MBq/cm^3	Noble gases Xe-133‡ Xe-135	~1.48x10^{-6} MBq/cm^3	High-High High DNSC/INOP
Plant stack discharge (normal range)	Offline	3.7 x 10^{-9} to 3.7x10^{-3} MBq/cm^3	Xe-133‡ Cs-137 I-131	~1.85x10^{-6} MBq/cm^3	High-High High DNSC/INOP Flow H/L
Plant stack (high-range)	Offline	3.7x10^{-4} to 3.7x10^3 MBq/cm^3‡	Xe-133‡	~1.85x10E-6 $^{-6}$ MBq/cm^3	Flow H/L DNSC/INOP High High-High

Table 11.5-2 Process Radiation Monitoring System (Gaseous and Airborne Monitors) (Continued)

Radiation Monitor	Configuration	Dynamic Detection Range*	Principal Radionuclides Measured	Expected Activity†	Alarms and Trips
Radwaste Building ventilation exhaust	Offline	3.7×10^{-9} to 3.7×10^{-3} MBq/cm^3	Xe-133‡ Cs-137 I-131	~3.7×10^{-7} MBq/cm^3	High-High High DNSC/INOP Flow H/L
Gland seal condenser exhaust discharge	Offline	3.7×10^{-9} to 3.7×10^{-3} MBq/cm^3	Xe-133 Cs-137‡ I-131	~3.7×10^{-8} MBq/cm^3	High-High DNSC/INOP Flow H/L
Control Bldg. HVAC air intake	Inline	3.7×10^{-7} to 3.7×10^{-3} MBq/cm^3	Xe-133†	Negligible	High-High High DNSC/INOP
Standby Gas Treatment System exhaust	Offline	3.7×10^{-9} to 3.7×10^{-3} MBq/cm^3	Noble gases Cs-137‡ I-131	~1.85×10^{-8} MBq/cm^3	High-High High DNSC/INOP Flow H/L
	Inline	3.7×10^{-4} to 3.7×10^{3} MBq/cm^3‡	Noble gases	~1.85×10^{-8} MBq/cm^3	High-High High DNSC/INOP
Fuel handling area exhaust	Inline	3.7×10^{-5} to 3.7×10^{-1} MBq/cm^3	Noble gases	~2.22×10^{-4} MBq/cm^3	High-High High DNSC/INOP

* Dynamic Detection Range is calculated based on the radionuclides and the sensitivity of the radiation monitor to the radionuclides. As this calculation is based on vendor supplied info (sensitivity of the monitor), these values are estimated.

† Expected activities are estimated and are based on existing plants.

‡ Sensitivity based upon this radionuclide.

Table 11.5-3 Process Radiation Monitoring System (Liquid Monitors)

Radiation Monitor	Configuration	Dynamic Detection Range*	Principal Radionuclides Measured	Expected Activity†	Alarms & Trips
Radwaste liquid discharge	Offline	3.7×10^{-9} to 3.7×10^{-4} MBq/cm^3	Cs-137‡ Co-60	~3.7×10^{-8} MBq/cm^3	High/High High DNSC/INOP
Reactor Building cooling water intersystem leakage	Inline	3.7×10^{-7} to 3.7×10^{-2} MBq/cm^3	Cs-137* Co-60	~2.22×10^{-6} MBq/cm^3	High DNSC/INOP
Drywell sump drain liquid discharge	Inline	3.7×10^{-4} to 3.7×10^{2} MBq/cm^3	Gross Gamma Cs-137*	~1.85×10^{-3} MBq/cm^3	High-High High DNSC/INOP

* Dynamic Detection Range is calculated based on the radionuclides and the sensitivity of the radiation monitor to the radionuclides. As this calculation is based on vendor supplied info (sensitivity of the monitor), these values are estimated.

† Expected activities are estimated and are based on existing plants.

‡ Sensitivity based upon this radionuclide.

DNSC—Downscale Indication

INOP—Monitor Inoperative

Table 11.5-7 Radiological Analysis Summary of Gaseous Effluent Samples

Sample Description	Sample Frequency	Analysis	Sensitivity MBq/L	Purpose
~~3. Incinerator stack discharge~~	~~As above~~	~~As above~~	~~As above~~	~~Effluent record~~