17.0 QUALITY ASSURANCE

17.1 QUALITY ASSURANCE DURING DESIGN AND CONSTRUCTION

The Westinghouse Water Reactor Divisions Quality Assurance Program is described in Reference 1.

See the WAPWR integrated PDA submittal for a description of the complete WAPWR Quality Assurance Program, including modifications to reflect the expanded design and construction scope of the WAPWR Nuclear Power Block.

17.1.1 References

1. "Westinghouse Water Reactor Divisions Quality Assurance Plan," WCAP-8370, Revisions 9a, Amendment 1, February, 1981.

F. Provide temporary onsite storage of packaged wastes in the event of delay or disruption of offsite shipping schedules.

G. Package radioactive solid wastes for offsite shipment and burial in accordance with applicable Department of Transportation (DOT) and Nuclear Regulatory Commision (NRC) regulations.

The solid waste management system shall be designed and constructed in accordance with Regulatory Guide 1.143 and shall be designed to collect, solidify, package, and store radioactive wastes so as to maintain radiation exposure to plant operation or maintenance personnel as low as is reasonably achievable (ALARA) in accordance with GDC 60 of 10 CFR 50, Appendix A, and Regulatory Guide 8.8 in order to maintain personnel exposures below 10 CFR 20 requirements. Design features incorporated to maintain ALARA criteria shall include (but are not limited to) remote system operation, remotely actuated flushing, and shielding of components containing radioactive materials.

11.5 PROCESS AND EFFLUENT RADIOLOGICAL MONITORING AND SAMPLING SYSTEMS

The process and effluent radiation monitoring systems (PERMS) monitor radiation levels in selected plant process systems and in plant effluents. A description of the area radiation monitoring system is found in Subsection 12.3.4 of RESAR-SP/90 PDA Module 11, "Radiation Protection".

The PERMS operates in conjunction with regular and special radiation surveys and with a chemical and radiological sampling program performed by the plant staff to provide timely, sufficient information for continued safe plant operation.

11.5.1 Design Bases

The PERMS is designed to:

A. Provide equipment and criteria to ensure plant performance which meets applicable regulatory requirements for normal operation and for transient situations that might be expected to occur.

B. Provide support data to health physics personnel to aid them in limiting release of activity to the environment and limiting exposure to operation and maintenance personnel to as low as reasonably achievable.

C. Provide early warning of a system or equipment malfunction that could lead to a health hazard or plant damage.

D. Provide a reliable and usable tool to monitor plant-related radioactivity.

E. Provide support to the plant for compliance with applicable Nuclear Regulatory Commission guidelines including:

1. 10 CFR 50, Appendix I.

2. 10 CFR 20.

3. Regulatory Guide 1.21.

4. Regulatory Guide 8.8.

5. Regulatory Guide 1.45.

6. General Design Criteria 60, 63, and 64.

7. Regulatory Guide 1.97.

8. ANSI N13.1-1969.

The scope of PERMS regarding radiological monitoring following accidents as required by General Design Criterion 64 and Regulatory Guide 1.97 is limited to releases associated with the postulated design basis accidents. Post accident radiation monitoring is discussed in Subsection 11.5.5. Although PERMS is generally a surveillance system, there are certain monitors that perform a safety function. Such monitors meet the normal requirements for safety grade equipment. For safety-related monitors, redundancy is relied upon to maintain surveillance in case of a single failure.

11.5.2 System Description

11.5.2.1 Digital Radiation Monitoring System

The process and effluent radiation monitoring system (PERMS) is based on a distributed digital microprocessor approach, where each radiation monitor is self-contained and consists of a detector and a data processing module (DPM) that contains the microprocessor. The DPM is the basic control center for each PERMS channel. Each complete channel consists of a monitor with power

supply and preamplifier; a local dedicated data processing module containing a digital buffer and microprocessor with alarm outputs; and access to readout modules (cathode ray tube (CRT) and printer).

The PERMS collects and displays all the information available from the field-mounted detectors on a CRT and hardcopy printer on demand. This is accomplished by either the communications console or the safety-related display console (SRDC) located in the control room. The communications console receives data from the DPMs (both standard and safety-related) and interfaces with a minicomputer and the technical support center (Figure 11.5-1). The SRDC displays data received from the safety-related channels which are composed of safety-related Class 1E components (Figure 11.5-2). The safety-related DPMs also interface with the communications console with one-way data transmission. The communications console is shown in Figure 11.5-3.

11.5.2.2 Monitor Description

The radiation monitors fall into five different functional classifications:

A. Process monitors, which determine concentrations of radioactive material in plant fluid systems.

B. Effluent monitors, which measure radioactivity discharged to the environs.

C. Airborne monitors, which provide operator information on airborne concentrations of radioactive gases and particulate radioactivity at various points in the ventilation system ducts (See Figure 11.5-4).

D. Area monitors, which provide operator information on external gamma radiation levels at fixed points throughout the plant.

E. Post-accident (or high range) monitors, designed to assess and follow potential pathways for release of radioactive materials during accident conditions.

Table 11.5-1 gives the design parameters for the PERMS.
Table 11.5-2 lists the detectors used in the PERMS.
Table 11.5-3 lists the conditions of service for PERMS.

11.5.2.3 Monitor Functions

The following is a description of each monitor:

A. Airborne Process and Effluent Monitors

1. PE-1 - Plant Vent Effluent Air Particulate Monitor (Low Range)

The purpose of this monitor is to continuously monitor air particulate activity as it is discharged to the environment through the main plant vent and provide data necessary to ensure that particulate activity releases from the plant vent are below specified limits.

The monitor also serves as a backup to the containment vent particulate monitor PE-10. Since the main plant vent discharges directly to the atmosphere, the data from this monitor are most representative of particulate activity releases to the plant environs. Should the activity exceed a specified level, a high radiation level alarm will be annunciated to indicate that an increase in particulate release has occurred. The specific source of release within the plant may be determined through analysis of the monitors upstream of the vent monitor and/or with portable monitoring devices.

2. PE-2 - Plant Vent Effluent Iodine Monitor (Low Range)

The purpose of this monitor is to continuously monitor iodine activity as it is discharged to the environment through the main plant vent and provide data necessary to ensure that gaseous iodine activity releases from the plant vent are below specified limits.

The monitor also serves as a backup to the containment vent radioiodine monitor PE-11. Since the main plant vent discharges directly to the atmosphere, the data from this monitor are most representative of the iodine activity releases to the plant environs. Should the activity exceed a specified level, a high radiation level alarm will be annunciated to indicate that an increase in gaseous iodine release has occurred. The specific source of release within the plant may be determined through analysis of the monitors upstream of the vent monitor and/or with portable monitoring devices.

3. PE-3 - Plant Effluent Radiogas Monitor (Low Range)

The purpose of this monitor is to continuously monitor the gaseous activity as it is discharged to the environment through the main plant vent and provide data necessary to ensure that the gaseous activity releases from the plant vent are below specified limits.

The monitor also serves as a backup to other monitored streams that are routed to the main plant vent, including the gaseous waste processing system effluent PE-38, fuel building PE-41 A and B, and containment PE-12 gas monitors. Since the main plant vent discharges directly to the atmosphere, the data from this monitor are most representative of gaseous activity releases to the plant environs. Should the activity exceed a

specified level, a high radiation level alarm will be annunciated to indicate that an unexpected increase in gaseous release has occurred. The specific source of release within the plant may be determined through analysis of the monitors upstream of the vent monitor and/or with portable monitoring devices.

4. PE-10 - Containment Vent Effluent Air Particulate Monitor

The purpose of this monitor is to measure air particulate radioactivity in the containment purge vent and provide data necessary to ensure that the release rate through the containment vent during purging is below specified limits.

The containment purge flow is filtered and routed through the main plant vent, where activity is again monitored by the plant vent air particulate monitor PE-1 and then discharged to the atmosphere.

This monitor initiates automatic closure of the containment purge supply and exhaust duct valves for high radiation levels.

5. PE-11 - Containment Vent Effluent Iodine Monitor

The purpose of this monitor is to measure gaseous iodine activity in the containment purge vent and provide data necessary to ensure that the release rate through the containment vent during purging is below specified limits.

The containment purge flow is filtered and routed through the main plant vent, where activity is again monitored by the plant vent radioiodine monitor PE-2 and then discharged to the atmosphere.

This monitor initiates automatic closure of the containment supply and exhaust duct valves for high radiation levels.

6. PE-12 - Containment Vent Effluent Radiogas Monitor

The purpose of this monitor is to measure gaseous activity in the containment purge vent and provide data necessary to ensure that the release rate through the containment vent during purging is below specified limits.

The containment purge flow is routed through the main plant vent, where the activity is again monitored by the plant vent gas monitor PE-3 and then discharged to the atmosphere.

This monitor initiates automatic closure of the containment supply and exhaust duct valves for high radiation levels.

7. PE-13 - Containment Atmosphere Process Air Particulate Monitor

The purpose of this monitor is to measure air particulate radioactivity in the containment atmosphere and provide information for determining allowable personnel access to the containment.

The monitor can also be utilized to provide an indication of reactor coolant system leakage as part of the reactor coolant leak detection system. An intermediate radiation alarm alerts the operator that a predetermined level in the containment has been exceeded.

8. PE-29 - Containment Atmosphere Iodine Cartridge

The purpose of this monitor is to measure airborne iodine radioactivity in the containment atmosphere and provide

information for determining allowable personnel access to the containment.

The cartridge may also be used to provide an indication of reactor coolant system leakage.

9. PE-14 - Containment Atmosphere Process Radiogas Monitor

The purpose of this monitor is to measure gaseous radioactivity in the containment atmosphere and provide information for determining allowable personnel access to the containment.

The monitor can also be utilized to provide an indication of reactor coolant system leakage as part of the reactor coolant leak detection system. An intermediate radiation alarm alerts the operator that a predetermined activity level in the containment has been exceeded.

10. PE-23 - Selective Cubicle Air Particulate Monitor

The purpose of this monitor is to monitor individual component cubicles to locate sources of leakage within the plant.

The cubicle spaces about components which are susceptible to leakage are monitored for air particulate activity, e.g., emergency core cooling system (ECCS) pump rooms. Sample line and valving arrangement is such that several component cubicles can be sequentially sampled and monitored for high activity levels.

This monitor can also be used to check the room's airborne activity prior to entry.

11. PE-24 - Selective Cubicle Radiogas Monitor

The purpose of this monitor is to monitor individual component cubicles to locate sources of leakage within the plant.

The cubicle spaces about components which are susceptible to leakage are monitored for gaseous activity, e.g., ECCS pump rooms. Sample line and valving arrangement is such that several component cubicles can be sequentially sampled and monitored for high activity levels.

This monitor can also be used to check the room's airborne activity prior to entry.

12. PE-26 - Radwaste Building Effluent Air Particulate Monitor

The purpose of this monitor is to continuously monitor air particulate activity prior to discharge to the environment through the radwaste building vent and provide data necessary to ensure that particulate activity releases from the vent are below specified limits.

If the radwaste building vent is routed directly to the atmosphere, the collection of data from this monitor is representative of particulate activity releases to the plant environs.

13. PE-27 - Radwaste Building Effluent Iodine Monitor

The purpose of this monitor is to continuously monitor gaseous iodine activity prior to discharge to the environment through the radwaste building vent and provide data necessary to ensure that gaseous iodine activity releases from the vent are below specified limits.

If the radwaste building vent is routed directly to the atmosphere, the collection data from this monitor is representative of gaseous iodine activity releases to the plant environs.

14. PE-28 - Radwaste Building Effluent Radiogas Monitor

The purpose of this monitor is to continuously monitor the gaseous activity passing through the radwaste building vent and provide data necessary to ensure that the gaseous activity releases from the vent are below specified limits.

If the radwaste building vent is routed directly to the atmosphere, the collection of data from this monitor is representative of gaseous activity releases to the plant environs.

15. PE-30A and PE-30B - Control Room Air Intake Process Radiogas Monitor

The purpose of this monitor is to continuously monitor the control room supply air for gaseous activity that could be present in the atmosphere following an accident.

A high alarm signal will automatically switch the control room ventilation system from the normal operating mode to the accident mode using safety grade filtration trains.

16. PE-31 - Gaseous Waste Processing System Process Radiogas Monitor

The purpose of this monitor is to continuously monitor the gaseous activity of the gaseous waste processing system recirculation stream.

17. PE-38 - Gaseous Waste Processing System Effluent Radiogas Monitor

The purpose of this monitor is to continuously monitor the gaseous activity discharged from the waste gas processing system and provide data necessary to ensure that gaseous activity releases are below specified levels.

The activity is routed to the auxiliary building exhaust and, in turn, to the plant vent (and again monitored by PE-3).

A high radiation alarm signal isolates the gaseous waste processing system discharge line.

18. PE-41A and PE-41B - Fuel Handling Building Effluent Radiogas Monitors

The purpose of this monitor is to continuously monitor the gaseous activity discharged from the fuel handling building and provide data necessary to ensure that gaseous activity releases are below specified limits.

The activity is filtered and routed to the plant vent, where it is again monitored by the plant vent monitors PE-1, 2, and 3 prior to discharge to the atmosphere. In the event of a fuel handling accident inside the fuel handling building, PE-41A and B are capable of detecting the high activity in order to switch the fuel handling building ventilation system from the normal operating mode to the accident mode, which includes safety-related filtration units.

B. Liquid Process and Effluent Monitors

1. PE-16 - Boron Recycle Liquid Process Monitor

The purpose of this monitor is to continuously monitor the boric acid evaporator distillate for high activity, which would be indicative of an evaporator malfunction.

A high alarm signal will initiate diversion of distillate flow from the reactor makeup water storage tank to a recycle holdup tank via the evaporator feed demineralizer.

Remote readout and audio/visual (A/V) alarm are provided at the boron recycle system panel.

2. PE-17A and B - Component Cooling Water Process Monitor

The purpose of this monitor is to continuously monitor the component cooling loop for activity indicative of a leak of radioactive water into the component cooling system.

3. PE-18 - Waste Liquid Effluent Monitor

The purpose of this monitor is to monitor waste disposal system liquid releases from the plant and provide data necessary to ensure that liquid waste activity discharges are below specified limits.

A high alarm signal initiates automatic valve closure on the liquid waste discharge line to prevent further activity release.

Remote readout and A/V alarm are provided at the liquid section of the waste processing system control panel.

4. PE-19 - Steam Generator Sample Liquid Process Monitor

The purpose of this monitor is to monitor the liquid phase of the secondary side of the steam generators for activity (which would be indicative of primary to secondary system leaks) and to provide backup information to the air ejector gas monitor PE-15.

A/V alarm is provided at the isolation valve controls in the secondary side of sampling area.

5. PE-20A and B - Nuclear Service Water Process Monitor

The purpose of this monitor is to continuously monitor the nuclear service water loop for activity and to prevent otherwise undetected activity release from the service water system, which represents a potential release path to the environment.

During normal operation, these monitors will indicate one of the following conditions:

a. Leak from equipment processing radioactive water into nuclear service cooling water.

b. Leak from equipment processing radioactive liquid into auxiliary component cooling water system coincident with leak to nuclear service cooling water.

c. Leak from equipment processing radioactive liquid into component cooling water system coincident with leaks to nuclear service cooling water.

6. PE-21 - Steam Generator Blowdown Liquid Processes Monitor

The purpose of this monitor is to monitor the steam generator blowdown liquid for activity in the event of primary to secondary system leakage and provide data necessary to ensure that the steam generator blowdown processing system discharges to the environment are below desired limits.

This monitor also provides indication of a steam generator blowdown processing system malfunction.

A high alarm signal automatically closes the steam generator blowdown processing system isolation valves and discharge lines.

Remote readout and A/V alarm are provided at the steam generator blowdown system panel.

7. PE-22 - Turbine Building Drain Liquid Effluent Monitor

The purpose of this monitor is to continuously monitor the secondary side liquid drains for activity released in the event of primary to secondary system leakage.

8. PE-25 - Auxiliary Steam Condensate Return Liquid Process Monitor

The purpose of this monitor is to continuously monitor the auxiliary steam condensate returns for inleakage of radioactivity from components which utilize auxiliary steam.

These components include the recycle evaporators and waste evaporators.

A high alarm signal provides operator warning so that action may be taken to avoid further radioactive contamination of the auxiliary steam condensate.

Remote readout and A/V alarm are provided at evaporator steam supply system panel.

9. PE-43 - Chemical and Volume Control System Letdown Monitor

The purpose of this monitor is to monitor the chemical and volume control system letdown liquid process and provide indication of abnormal activity levels in the reactor coolant system.

11.5.2.4 Alarm Setpoints

Each of the PERMS airborne and liquid monitors (excluding passive cartridge monitors PE-29, PE-33, PE-34, and PE-44A and B) has two alarm setpoints, i.e., intermediate and high. When the radiation level being monitored reaches the intermediate setpoint, a visual indication alerts plant personnel of the monitor reading. If the high setpoint is reached, an alarm will be annunciated. The high alarm setpoint also triggers the control function for those monitors so equipped: gas monitors PE-10, 11, and 12, PE-15, PE-30A and B, PE-38, PE-41A and B; and liquid monitors PE-16, PE-18, and PE-21.

In determining setpoints, two criteria were applied:

A. The intermediate alarm setpoint must be at least twice the detector sensitivity to avoid alerts caused by "noise" at the low end of the detector's range.

B. The high alarm setpoint must be at least 1.5 times the intermediate alarm setpoint.

These intermediate and high alarm setpoints are given in Table 11.5-4. Note that the setpoints are initial and are subject to modification as plant operating experience is developed.

11.5.2.5 Inservice Inspection, Calibration, and Maintenance

The operability of each channel of the PERMS is checked frequently with a source positioned remotely from the main control room or manually at the monitor. The PERMS and area radiation monitoring system are functionally tested periodically and are calibrated during each refueling.

The periodic test is used to verify the operability of alarms, automatic valves, and pumps. This is performed by lowering the setpoint below background, starting pumps where necessary, and verifying the operation of alarms, valves, and pumps.

Calibration of all monitors is normally conducted every 12 months. Generally, this procedure is conducted during refueling to minimize the effect on plant operation and limit occupational exposures. Calibration is conducted using a source which will allow indication in a low, mid, and high range, except for the high range monitors where high range calibration could result in undesirable exposures to plant personnel. Calibration of high range monitors is performed in accordance with manufacturer's recommendation.

Provisions for minimizing sample deposition through, electropolishing sampling chambers and purging, have been made.

11.5.3 Effluent Monitoring and Sampling

11.5.3.1 Plant Sampling System

The plant sampling system is described below.

11.5.3.2 Sampling Requirements for Process and Effluent Radiation Monitoring System (PERMS)

The primary means of quantitatively evaluating the isotopic activity levels in process and effluent paths is a program of sampling and laboratory measurements. Gross activity measurements, as provided by the process and effluent monitors, are generally not acceptable for showing compliance with effluent release limits. However, the continuous gross monitors (both process and effluent) can be calibrated by normalizing against the results of specific radionuclide analysis, and in this way, the gross measurement from the continuous monitors may be used to determine the isotopic activity concentration in process streams and the total isotopic activity released in effluent paths. Tables 11.5-5 and 11.5-6 present information for the sampling system associated with the PERMS monitors, for both gaseous and liquid monitors. These tables include the following information for each PERMS monitor:

- Sample identification (including fluid type, sample point location, and sample type).
- Type of analysis required.
- Sample collection frequency.
- Analysis frequency.
- Purpose.

Sample points are located at the PERMS monitor location unless a sample point that will serve to calibrate the monitor already exists in the system.

For all effluent paths, the columns labeled "type of analysis required", "sample collection frequency", and "analysis frequency" are based on the

requirements set forth in Regulatory Guide 1.21. For all process paths, similar information was based on engineering judgment.

The requirements of General Design Criterion 64, Monitoring Radioactivity Releases, are satisfied by this sampling program and the associated radiological monitors described in Subsection 11.5.2.

11.5.4 Process Monitoring and Sampling

The requirements of General Design Criterion 60, Control of Releases of Radioactive Materials to the Environment, have been addressed. Monitors used to initiate automatic closure of isolation valves in liquid and gaseous systems are described in Subsection 11.5.2.

The requirements of General Design Criteria 63, Monitoring Fuel and Waste Storage, have been addressed. Radiation monitors used in the radioactive waste processing systems are discussed in Subsection 11.5.2.

11.5.5 Post-accident Radiation Monitoring (PAMS)

In addition to the process and effluent radiation monitoring system (PERMS) described in Subsection 11.5.2, radiological monitors are also included in the post-accident monitoring system (PAMS) as required by General Design Criterion 64 and Regulatory Guide 1.97. The function of the radiation monitors in this system is to detect, compute, and indicate the radiation levels at selected plant locations, and to actuate alarms should these levels exceed predetermined values. Thus, the control room operating staff is provided with the information on radiation levels needed to help assess and maintain the safety of the plant and its environs following the occurrence of any design basis accident.

The PAMS radiation monitors supplement the PERMS and area radiation monitoring system (ARMS). The following is a description of each monitor:

A. PE-44A - Plant Vent Air Particulate Monitor

The purpose of this monitor is to continuously monitor air particulate activity as it is discharged to the environment through the main plant vent and to provide data necessary to estimate that particulate activity releases from the plant vent are below specified limits.

B. PE-44B - Plant Vent Effluent Iodine Monitor

The purpose of this monitor is to measure airborne iodine radioactivity in the plant vent.

C. PE-44C - Plant Vent Radiogas Monitor

The purpose of this monitor is to continuously monitor the gaseous activity as it is discharged to the environment through the main plant vent and provide data necessary to ensure that the gaseous activity releases from the plant vent are below specified limits.

D. PE-45A, PE-45B, PE-45C, and PE-45D - Main Steam Line Monitors

The purpose of this monitor is to detect steam generator tube leakage and to monitor this potential effluent release path. One detector is used on the main steam line of each steam generator upstream of the main steam line isolation and atmospheric dump valves.

E. PE-33 - Condenser Air Ejector and Steam Packing Exhauster Passive Air Particulate Monitor

The purpose of this monitor is to continuously measure particulate gas activity in the discharge from the air ejector exhaust header of the condensers (which is indicative of a primary to secondary system

leak) and steam packing exhauster monitor effluent path and to estimate magnitude of release of radioactivity.

F. PE-34 - Condenser Air Ejector and Steam Packing Exhauster Passive Iodine Cartridge

The purpose of this monitor is to continuously measure iodine activity in the discharge from the air ejector exhaust header of the condensers (which is indicative of a primary to secondary system leak) and steam packing exhauster monitor effluent path and to estimate magnitude of release of radioactivity.

G. PE-15 - Condenser Air Ejector and Steam Packing Exhauster Radiogas Monitor

The purpose of this monitor is to continuously measure gaseous activity in the discharge from the air ejector exhaust header of the condensers (which is indicative of a primary to secondary system leak) and steam packing exhauster effluent path and to estimate magnitude of release of radioactivity.

A high radiation alarm signal from this monitor will automatically divert the air ejector discharge flow through charcoal and high efficiency particulate air filtration banks.

Table 11.5-7 gives the design parameters for the PAMS radiation monitors. Table 11.5-8 presents the detector requirements for the PAMS radiation monitors. Table 11.5-9 lists the conditions of service for the PAMS radiation monitors.

Sampling requirements for the PAMS radiation monitors (where applicable) are included with the PERMS on Table 11.5-5.

Alarm setpoints for the PAMS radiation monitors are given in Table 11.5-10.

Some monitors described in this section are utilized for normal operations as well as for accident conditions. Likewise, some of the area radiation monitors described in Subsection 12.3.4 of RESAR SP/90 PDA Module 11, "Radiation Protection" are also used for post-accident monitoring. The grouping presented in this report, recognizing that some of these monitors are multifunctional, was so chosen to maintain clarity while avoiding duplication.

TABLE 11.5-1 (SHEET 1 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Gas								
Plant Vent Effluent (Low Range)								
PE-1 (particulate)	Effluent, offline	NNS[a]	B 31.1	Sample probe and flowmeter only	X	X	None	Non-Class 1E diesel backed
PE-2 (iodine)	Effluent, offline	NNS	B 31.1					
PE-3 (radiogas)	Effluent, offline	NNS	B 31.1					
Containment Vent Effluent								
PE-10 (particulate)	Effluent, offline	NNS	B 31.1	Sample probe and flowmeter only	X	X	Yes; closes containment purge supply and exhaust ducts	Non-Class 1E diesel backed
PE-11 (iodine)	Effluent, offline	NNS	B 31.1					
PE-12 (radiogas)	Effluent, offline	NNS	B 31.1					
Containment Atmosphere								
PE-13 (particulate)	Airborne, offline	NNS	B 31.1	Yes	X	X	None	Non-Class 1E diesel backed
PE-29 (iodine)	Airborne, offline iodine cartridge	NNS	B 31.1	Yes		X	None	
PE-14 (radiogas)	Airborne, offline	NNS	B 31.1	Yes				

TABLE 11.5-1 (SHEET 2 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Cubicle Air Monitor								
PE-23 (particulate)	Airborne, offline	NNS	B 31.1	No	X	X	None	Non-Class 1E diesel backed
PE-24 (radiogas)	Airborne, offline	NNS	B 31.1	No				
Radwaste Building								
PE-26 (particulate)	Effluent, offline	NNS	B 31.1	No	X	X	None	Non-Class 1E diesel backed
PE-27 (iodine)	Effluent, offline	NNS	B 31.1	No				
PE-28 (radiogas)	Effluent, offline	NNS	B 31.1	No				
Control Room Intake								
PE-30A PE-30B	Airborne, inline	SC-3/1E	NA	Yes			Yes; switches control room ventilation to safety grade filtration train	Class 1E
Gaseous Waste Processing System								
PE-31	Process, inline	NNS	ASME[b] III-3	Yes[c]			None	Non-Class 1E

TABLE 11.5-1 (SHEET 3 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Gaseous Waste Processing System Effluent								
PE-38	Effluent, inline	NNS	ASME III-3	Yes(c)			Yes; isolates GWPS(d) discharge	Non-Class 1E
Fuel Handling Building Effluent								
PE-41 A PE-41 B	Effluent inline	SC-3/1E	NA	Yes			Yes; switches building to accident mode of operation including safety-related filtration units	Class 1E

TABLE 11.5-1 (SHEET 4 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Liquid								
Boron Recycle PE-16	Process, offline	NNS	B 31.1	No			Initiates diversion of distillate flow to recycle holdup tank via the evaporator feed demineralizer	Non-Class 1E
Component Cooling Water PE-17A PE-17B	Process, offline	NNS	ASME III-3	Yes(c)			None	Non-Class 1E
Waste Liquid Effluent PE-18	Effluent, offline	NNS	B 31.1	No			Initiates automatic valve closure of liquid waste discharge line	Non-Class 1E

TABLE 11.5-1 (SHEET 5 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Steam Generator Liquid PE-19	Process, offline	NNS	B 31.1	No			None	Non-Class 1E
Nuclear Service Water PE-20A PE-20B	Process, offline	NNS	ASME III-3	Yes(c)			None	Non-Class 1E
Steam Generator Blowdown PE-21	Process, offline	NNS	B 31.1	No			Closes steam generator blowdown processing system isolation valves and discharge lines	Non-Class 1E diesel backed
Turbine Building Drain PE-22	Effluent, offline	NNS	B 31.1	No			None	Non-Class 1E diesel backed
Auxiliary Steam Condensate Return PE-25	Process, offline	NNS	B 31.1	No			None	Non-Class 1E

TABLE 11.5-1 (SHEET 6 OF 6)

DESIGN PARAMETERS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Pump	Automatic Control Function	Power Supply
Chemical and Volume Control System Letdown PE-43	Process, offline	NNS	ASME III-3	Yes(c)			None	Non-Class 1E

a. NNS - Nonnuclear safety.
b. ASME - American Society of Mechanical Engineers.
c. Structural integrity only.
d. GWPS - Gaseous Waste Processing System

TABLE 11.5-2 (SHEET 1 OF 4)

DETECTOR REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Location	Detector Type	Radiation Zone (MR/h)	Major Isotopes	Detectable Range ($\mu Ci/cm^3$)
Gas					
Plant Vent Effluent (Low Range)					
PE-1 (particulate)	Plant vent	Beta scintillation	0.25-2.5	I-131, I-133, Cs-134, CS-137, Co-58, Co-60, Sr-90	1.0E-11 to 1.0E-6
PE-2 (iodine)	Plant vent	Gamma scintillation	0.25-2.5	I-131, I-133, I-135	1.0E-11 to 1.0E-6
PE-3 (radiogas)	Plant vent	Beta scintillation	0.25-2.5	Xe-133, Xe-135, Kr-85, Ar-41	5.0E-7 to 5.0E-2
Containment Vent Effluent					
PE-10 (particulate)	Containment vent	Beta scintillation	0.25-2.5	I-131, I-133, Cs-134, CS-137, Co-58, Co-60	1.0E-11 to 1.0E-6
PE-11 (iodine)	Containment vent	Gamma scintillation	0.25-2.5	I-131, I-133, I-135	1.0E-11 to 1.0E-6
PE-12 (radiogas)	Containment vent	Beta scintillation	0.25-2.5	Xe-133, Xe-135, Kr-85, Ar-41	5.0E-7 to 5.0E-2
Containment Atmosphere					
PE-13 (particulate)	Containment bldg	Beta scintillation	0.25-2.5	I-131, CS-137, Co-58, Co-60	1.0E-11 to 1.0E-6
PE-29 (iodine)	Containment bldg	Passive iodine cartridge	0.25-2.5	I-131, I-133	NA
PE-14 (radiogas)	Containment bldg	Beta scintillation	0.25-2.5	Xe-133, Xe-135, Kr-85, Ar-41	5.0E-7 to 5.0E-2

TABLE 11.5-2 (SHEET 2 OF 4)

DETECTOR REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Location	Detector Type	Radiation Zone (MR/h)	Major Isotopes	Detectable Range ($\mu Ci/cm^3$)
Cubicle Air Monitor					
PE-23 (particulate)	Aux bldg	Beta scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	1.0E-10 to 1.0E-5
PE-24 (radiogas)	Aux bldg	Beta scintillation	0.25-2.5	Xe-133, Xe-135, Kr-85	5.0E-7 to 5.0E-2
Radwaste Building Effluent					
PE-26 (particulate)	Radwaste bldg	Beta scintillation	0.25-2.5	I-131, I-133, Cs-134, CS-137, Co-58, Co-60, Sr-90	1.0E-11 to 1.0E-6
PE-27 (iodine)	Radwaste bldg	Gamma scintillation	0.25-2.5	I-131	1.0E-11 to 1.0E-6
PE-28 (radiogas)	Radwaste bldg	Beta scintillation	0.25-2.5	Xe-133, Kr-85	1.0E-8 to 1.0E-3
Control Room Air Intake					
PE-30A, PE-30B	Control room	Thin walled G-M tubes	< 0.25	Xe-133, Xe-135, Kr-85, I-131, I-133, Co-58, Co-60	1.0E-6 to 1.0E-1
Gaseous Waste Processing System					
PE-31	Aux. bldg	G-M tubes	2.5-15	Xe-133, Xe-135, Kr-85	1.0E-1 to 1.0E+4
Gaseous Waste Processing System Effluent					
PE-38	Aux. bldg	G-M tube	0.25-2.5	Xe-133, Xe-135, Kr-85	1.0E-1 to 1.0E+4

TABLE 11.5-2 (SHEET 3 OF 4)

DETECTOR REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Location	Detector Type	Radiation Zone (MR/h)	Major Isotopes	Detectable Range ($\mu Ci/cm^3$)
Fuel Handling Building Effluent					
PE-41A PE-41B	Fuel handling bldg	Thin walled G-M tube	0.25-2.5	Xe-133, Xe-135, Kr-85	1.0E-6 to 1.0E-1
Liquid					
PE-16 (boron recycle)	Aux bldg	Gamma scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-17A and B (component water)	Aux bldg	Gamma scintillation	0.25	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-18 (waste liquid effluent)	Aux bldg	Gamma scintillation	2.5-15	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	1.0E-6 to 1.0E-1
PE-19 (steam generator liquid)	Aux bldg	Gamma scintillation	2.5-15	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-20A and B (nuclear service water)	Aux bldg	Gamma scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2

TABLE 11.5-2 (SHEET 4 OF 4)

DETECTOR REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Location	Detector Type	Radiation Zone (MR/h)	Major Isotopes	Detectable Range ($\mu Ci/cm^3$)
PE-21 (steam generator blowdown)	Aux bldg	Gamma scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-22 (turbine bldg drain)	Turbine bldg	Gamma scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-25 (aux steam condensate return liquid)	Aux bldg	Gamma scintillation	0.25-2.5	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	4.0E-7 to 4.0E-2
PE-43 (CVCS letdown)	Aux bldg	Gamma scintillation	100-250	Co-58, Co-60, I-131, I-133, Cs-134, Cs-137	1.0E-2 to 1.0E+3

TABLE 11.5-3 (SHEET 1 OF 4)

CONDITIONS OF SERVICE FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Sample Fluid	Process Fluid Conditions		Ambient Conditions at Detector		
		Temperature (°F)	Pressure (psig)	Temp (°F)	Pressure (psig)	Relative Humidity (%)
Gas						
Plant vent effluent PE-1	Gas	40-104	0	32-120	0	35-70
Plant vent effluent PE-2	Gas	40-104	0	32-120	0	35-70
Plant vent effluent PE-3	Gas	40-104	0	32-120	0	35-70
Containment vent effluent PE-10	Gas	60-120	0	32-120	0	35-70
Containment vent effluent PE-11	Gas	60-120	0	32-120	0	35-70
Containment vent effluent PE-12	Gas	60-120	0	32-120	0	35-70
Containment atmosphere PE-13	Gas	60-120	(-1.5)-3	40-104	0	20-95
Containment atmosphere PE-29	Gas	60-120	(-1.5)-3	40-104	0	20-95
Containment atmosphere PE-14	Gas	60-120	(-1.5)-3	40-104	0	20-95

TABLE 11.5-3 (SHEET 2 OF 4)

CONDITIONS OF SERVICE FOR PROCESS AND EFFLUENT RADIATION MONITORS

		Process Fluid Conditions		Ambient Conditions at Detector		
Monitor	Sample Fluid	Temperature (°F)	Pressure (psig)	Temp (°F)	Pressure (psig)	Relative Humidity (%)
Cubicle air monitor PE-23	Gas	60-110	0	40-104	0	20-95
Cubicle air monitor PE-24	Gas	60-110	0	40-104	0	20-95
Radwaste effluent PE-26	Gas	40-104	0	40-104	0	20-95
Radwaste effluent PE-27	Gas	40-104	0	40-104	0	20-95
Radwaste effluent PE-28	Gas	40-104	0	40-104	0	20-95
Control room intake PE-30A and PE-30B	Gas	17-98	(-3)-0	17-98	(-3)-0	20-100
Gaseous waste processing PE-31	Gas	70-140	0.5-2	40-104	0	20-95
Gaseous waste processing system PE-38	Gas	70-140	3-100	40-104	0	20-95
Fuel handling building effluent PE-41A and B	Gas	40-104	0	40-104	(-0.25)-0 (in. WG)	20-95

TABLE 11.5-3 (SHEET 3 OF 4)

CONDITIONS OF SERVICE FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Sample Fluid	Process Fluid Conditions: Temperature (°F)	Process Fluid Conditions: Pressure (psig)	Ambient Conditions at Detector: Temp (°F)	Ambient Conditions at Detector: Pressure (psig)	Ambient Conditions at Detector: Relative Humidity (%)
Liquid						
Liquid boron recycle PE-16	Liquid	140	65	40-104	0	20-95
Component cooling water PE-17A and B	Liquid	108	24	40-104	0	20-95
Waste liquid effluent PE-18	Liquid	100	110	40-104	0	20-95
Steam generator liquid PE-19	Liquid	130	300	40-104	0	20-95
Nuclear service water PE-20A and B	Liquid	108	90	40-104	0	20-95
Steam generator blowdown PE-21	Liquid	130	300	40-104	0	20-95

TABLE 11.5-3 (SHEET 4 OF 4)

CONDITIONS OF SERVICE FOR PROCESS AND EFFLUENT RADIATION MONITORS

		Process Fluid Conditions		Ambient Conditions at Detector		
Monitor	Sample Fluid	Temperature (°F)	Pressure (psig)	Temp (°F)	Pressure (psig)	Relative Humidity (%)
Turbine bldg drain PE-22	Liquid	80	20	40-104	0	40-85
Aux steam condensate return PE-25	Liquid	240	35	40-104	0	20-95
Chemical and volume control system letdown PE-43	Liquid	140	350	40-104	0	20-95

TABLE 11.5-4

ALARM SETPOINTS FOR PROCESS AND EFFLUENT
RADIATION MONITORS

	Initial Setpoints ($\mu Ci/cm^3$)	
Gas Monitors	Intermediate	High
PE-1	(Later)	(Later)
PE-2	(Later)	(Later)
PE-3	(Later)	(Later)
PE-10	(Later)	(Later)
PE-11	(Later)	(Later)
PE-12	(Later)	(Later)
PE-13	(Later)	(Later)
PE-14	(Later)	(Later)
PE-23	(Later)	(Later)
PE-24	(Later)	(Later)
PE-26	(Later)	(Later)
PE-27	(Later)	(Later)
PE-28	(Later)	(Later)
PE-29	(Later)	(Later)
PE-30A, B	(Later)	(Later)
PE-31	(Later)	(Later)
PE-38	(Later)	(Later)
PE-41A	(Later)	(Later)
PE-16	(Later)	(Later)
PE-17A and B	(Later)	(Later)
PE-18	(Later)	(Later)
PE-19	(Later)	(Later)
PE-20A and B	(Later)	(Later)
PE-21	(Later)	(Later)
PE-22	(Later)	(Later)
PE-25	(Later)	(Later)
PE-43	(Later)	(Later)

TABLE 11.5-5 (SHEET 1 OF 3)

AIRBORNE RADIOLOGICAL SAMPLING REQUIREMENTS FOR PERMS

Monitor	Sample Identification: Fluid	Location	Type	Analysis Required	Collection Frequency	Sample Analysis Frequency	Purpose
PE-1 (gaseous release pathway)[a]	Ventilation air effluent	At monitor	Particulate	Gamma emitters[b] Gross alpha SR-89, SR-90	Continuous Continuous Continuous	Weekly Monthly comp Quarterly comp	Provide quantitative activity release data. Calibration of continuous monitors.
PE-2 (gaseous release pathway)[a]	Ventilation air effluent	At monitor	Iodine	I-131 I-133, I-135	Continuous Continuous	Weekly Monthly	
PE-3 (gaseous release pathway[a]	Ventilation air effluent	At monitor	Radiogas Vapor Sample	Principal radiogas H-3	Weekly[c] Monthly	Weekly[c] Monthly	
PE-10	Containment ventilation air	At monitor	Particulate	Gamma emitters[b] Gross alpha SR-89, SR-90	Continuous Continuous Continuous	Weekly Monthly comp Quarterly comp	Provide diagnostic backup data to PE-1, 2 and 3 and PE-13, 29, and 14.
PE-11	Containment ventilation air	At monitor	Iodine	I-131 I-133, I-135	Continuous Continuous	Weekly Weekly	Determine effectiveness of containment vent filters.
PE-12	Containment ventilation air	At monitor	Radiogas Vapor Sample	Principal radiogas H-3	Weekly[c] Monthly	Weekly[c] Monthly	
PE-13	Containment atmosphere	At monitor	Particulate	Gamma emitters[b] Gross alpha SR-89, SR-90	Continuous Continuous Continuous	Weekly Monthly comp Quarterly comp	Determine personnel access time limit inside containment. Calibration of monitor.
PE-29	Containment atmosphere	At monitor	Passive iodine cartridge	I-131 I-133, I-135	Continuous Continuous	Weekly Monthly	Determine personnel access time limit inside containment.
PE-14	Containment atmosphere	At monitor	Radiogas Vapor sample	Principal radiogas H-3	Weekly[c] Monthly	Weekly[c] Monthly	

TABLE 11.5-5 (SHEET 2 OF 3)

AIRBORNE RADIOLOGICAL SAMPLING REQUIREMENTS FOR PERMS

Monitor	Sample Identification: Fluid	Location	Type	Analysis Required	Collection Frequency	Sample Analysis Frequency	Purpose
PE-23	Variable cubicle atmosphere	At monitor	Particulate	Gamma emitters[b] Gross alpha Sr-89, Sr-90	When PE-23 or 24 indicates a high alarm	When PE-23 or or 24 indicates a high alarm	Provide quantitative isotopic activity data.
PE-24	Variable cubicle atmosphere	At monitor	Radiogas iodine	Principal radiogas I-131	When PE-23 or 24 indicates a high alarm	When PE-23 or or 24 indicates a high alarm	Determine personnel access.
PE-26 (gaseous release pathway)[a]	Radwaste building effluent	At monitor	Particulate	Gamma emitters[b] Gross alpha SR-89, SR-90	Continuous Continuous Continuous	Weekly Monthly comp Quarterly comp	Provide quantitative activity release data. Calibration of continuous monitors.
PE-27 (gaseous release pathway)[a]	Radwaste building effluent	At monitor	Iodine	I-131 I-133, I-135	Continuous Continuous	Weekly Monthly	
PE-28 (gaseous release pathway[a]	Radwaste building effluent	At monitor	Radiogas Vapor Sample	Principal radiogas H-3	Weekly Monthly	Weekly Monthly	
PE-30A and PE-30B	Control room air intakes	Control room intake duct	Radiogas iodine	Principal radiogas I-131	PE-30A or B indicates a high alarm	PE-30A or B indicates a high alarm	Determine isotopic activity in control room following accident.
PE-31	Gaseous waste	At monitor	Radiogas	Principal radiogas Principal gamma emitters	Weekly	Weekly	Determine activity inventory waste gas system.
PE-33 (gaseous release pathway)[d]	Condenser air ejector effluent	At monitor	Passive particulate cartridge	Gamma emitters Gross alpha Sr-89, Sr-90	Continuous Continuous Continuous	Weekly Monthly comp Quarterly	Provide quantitative activity release data.
PE-34 (gaseous release pathway)[a]	Condenser air ejector effluent	At monitor	Passive iodine cartridge	I-131 I-133, I-135 H-3	Continuous Continuous Monthly	Weekly Monthly Monthly	

TABLE 11.5-5 (SHEET 3 OF 3)

AIRBORNE RADIOLOGICAL SAMPLING REQUIREMENTS FOR PERMS

Monitor	Sample Identification: Fluid	Location	Type	Analysis Required	Collection Frequency	Sample Analysis Frequency	Purpose
PE-15 (gaseous release pathway)(a)	Condenser air ejector effluent	At monitor	Radiogas	Principal radiogas	Weekly(c)	Weekly(c)	Provide quantitative activity release data. Calibration of continuous monitors.
PE-38	Gaseous waste system effluent (batch)	Use system sample at decay tank and at monitor	Radiogas Iodine	Principal radiogas I-131 Principal gamma emitters	Prior to release	Prior to release	Determine identify and quantity in effluent.
PE-41A and B	Fuel handling bldg ventilation air	At monitor	Radiogas Iodine vapor sample	Principal radiogas I-131 H-3	Weekly Weekly Monthly	Weekly Weekly Monthly	Provide quantitative isotopic activity data.
PE-44A, PE-44B, PE-44C (gaseous release pathway)	Ventilation air effluent	At monitor	Passive particulate cartridge Passive iodine cartridge Radiogas Vapor sample	Gamma emitters Gross alpha, Sr-89, Sr-90 I-131, I-133 I-135 Principal radiogas H-3	Continuous Continuous Continuous Continuous Continuous Weekly Monthly	Weekly Monthly comp Quarterly Weekly Weekly Monthly	Provide quantitative activity release data. Calibration of continuous monitors.

a. These monitors require sampling in accordance with Regulatory Guide 1.21.

b. Including I-131, Ba-140, and La-140. When quantities of released radioactivity are insufficient to provide an accurate measurement of principal radionuclides, gross beta radioactivity measurements should be made.

c. (1) After a refueling, process change, or other occurrence which could alter a mixture of radionuclides.
(2) After unexplained variance from an established norm.

d. Condensed liquid from the sample chiller must be analyzed for the isotopes listed in conjunction with PE-33 and PE-34, and results from this analysis must be included with the analysis results of PE-33 and PE-34.

TABLE 11.5-6 (SHEET 1 OF 2)

LIQUID RADIOLOGICAL SAMPLING REQUIREMENTS FOR PERMS

Monitor	Sample Identification			Analysis Required	Collection Frequency	Sample Analysis Frequency	Purpose
	Fluid	Location	Type				
PE-16	Dilute H_3BO_3	At monitor	Liquid sample	Gross beta-gamma Dissolved gases	Each batch Monthly	Each batch Monthly	Evaluate performance of evaporator. Evaluate radioactive quality of water to reactor makeup storage tank. Calibration of continuous monitor.
PE-17A and B	Component cooling water liquid	At monitor	Liquid sample	Gross beta-gamma Dissolved gases	Weekly	Weekly	Detect activity leakage into component cooling system. Calibration of continuous monitor.
PE-18[a][b]	Waste liquid effluent (batch release)	Use system sample at waste monitor tank and at monitor	Liquid sample	Gamma emitters H-3 Gross alpha Dissolved gases Sr-89, Sr-90	Each batch Each batch Each batch 1 batch/month Each batch	Each batch Monthly comp Monthly comp 1 batch/month Quarterly comp	Provide quantitative activity release data. Calibration of continuous monitors.
PE-19	Steam generator liquid	At monitor	Liquid sample	Gross beta-gamma I-131 H-3	Weekly Weekly Weekly	Weekly Weekly Weekly	Detect primary-secondary system leaks; continuous monitor. Locate leaking steam generator. Determine magnitude of primary to secondary leakage.
PE-20A and B[a]	Nuclear service water liquid effluent (continuous release)	At monitor	Liquid sample	Gamma emitters H-3 Gross alpha Dissolved gases Sr-89, Sr-90	Weekly Monthly Monthly Monthly Quarterly	Weekly Monthly Monthly Monthly Quarterly	Provide quantitative activity release data. Calibration of continuous monitors.

TABLE 11.5-6 (SHEET 2 OF 2)

LIQUID RADIOLOGICAL SAMPLING REQUIREMENTS FOR PERMS

Monitor	Sample Identification			Analysis Required	Collection Frequency	Sample Analysis Frequency	Purpose
	Fluid	Location	Type				
PE-21(a)	Steam generator blowdown system liquid process and/ or effluent	At monitor	Liquid sample	Gamma emitters H-3 Gross alpha Dissolved gases Sr-89, Sr-90	Weekly Monthly Monthly Monthly Quarterly	Weekly Monthly Monthly Monthly Quarterly	Provide quantitative activity release data. Calibration of continuous monitors.
PE-22(a)(b)	Turbine bldg liquid effluent (continuous)	Turbine bldg drain tanks and sumps, and at monitor	Liquid sample	Gamma emitters H-3 Gross alpha Dissolved gases Sr-89, Sr-90	Weekly/ each batch Monthly/ each batch Monthly/ each batch Monthly/ each batch Quarterly/ each batch	Weekly/ each batch Monthly/ each batch Monthly/ each batch Monthly/ each batch Quarterly/ each batch	Provide quantitative activity release data. Calibration of continuous monitors.
PE-25(a)	Condensed aux steam	At monitor	Liquid sample	Gross Dissolved gases	Weekly Monthly	Weekly Monthly	Detect activity leak into aux steam. Calibration of continuous monitor.
PE-43	Letdown liquid	At monitor	Liquid sample	Gamma emitters	Weekly	Weekly	To detect abnormal activity levels in the reactor coolant system.

a. These monitors require sampling in accordance with Regulatory Guide 1.21.

b. Sampling also required to provide process concentration following activation of control function.

Additional Note:

When operational or other limitations preclude analysis of each batch, weekly composites are within the regulatory guide.

TABLE 11.5-7 (SHEET 1 OF 2)

DESIGN PARAMETERS FOR POST-ACCIDENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Charcoal Cartridge Particulate Filter	Pump	Automatic Control Function
Plant Vent Effluent								
PE-44A (particulate)	Effluent passive particulate filter	Cat. 2	B 31.1	Yes[a]		X	X	None
PE-44B (iodine)	Effluent passive iodine cartridge	Cat. 2	B 31.1	Yes[a]		X	X	None
PE-44C (radiogas)	Effluent G-M	Cat. 2	B 31.1	Yes[a]			X	None
Main Steam Line								
PE-45A PE-45B PE-45C PE-45D	Strap on	SC-3/1E	NA	Yes[a]				None

TABLE 11.5-7 (SHEET 2 OF 2)

DESIGN PARAMETERS FOR POST-ACCIDENT RADIATION MONITORS

Monitor	Monitor Type	Safety Classification	Mechanical Code	Seismic Qualification	Moving Filter	Charcoal Cartridge Particulate Filter	Pump	Automatic Control Function
Condenser Air Ejector and Steam Packing Exhauster								
PE-33	Effluent passive particulate filter	NNS[b]	B 31.1	No		X	X	None
PE-34	Effluent passive iodine cartridge	NNS	B 31.1	No		X	X	None
PE-15	Effluent G-M	NNS	B 31.1	No			X	Yes; diverts air ejector discharge through charcoal filtration

a. These monitors are qualified to perform their function following design basis seismic event.
b. NNS - Nonnuclear safety.

TABLE 11.5-8

DETECTOR REQUIREMENTS FOR POST-ACCIDENT RADIATION MONITORS

Monitor	Location	Detector Type	Radiation Zone (MR/h)	Major Isotopes	Detector Range ($\mu Ci/cm^3$)
Plant Vent Effluent					
PE-44A (particulate)	Plant vent	Passive particulate	0.25-2.5 (10-100 r/h)[a]	I-131, I-133, Cs-134, Cs-137 Co-58, Co-60, Sr-90	NA
PE-44B (iodine)		Passive iodine cartridge	0.25-2.5 (10-100 r/h)	I-131, I-133	NA
PE-44C (radiogas)		Beta scintillation	0.25-2.5 (10-100 r/h)	Xe-133, Xe-135, Kr-85	1.0E-6 to 1.0E+4 for Xe-133
Main Steam Line					
PE-45A PE-45B PE-45C PE-45D	MSIV areas	Strap on gamma	0.25-2.5 (10-100 r/h)	Xe-133, Xe-135, Kr-85m, Kr-88	1.0E-1 to 1.0E+3
Condenser Air Ejector and Steam Packing Exhauster					
PE-33 (particulate)	Turbine bldg	Passive particulate filter	< 0.25 (10-100 r/h)	Cs-134, Cs-137, Co-58, Co-60	NA
PE-34 (iodine)	Turbine bldg	Passive iodine cartridge	< 0.25 (10-100 r/h)	I-131, I-133	NA
PE-15 (radiogas)	Turbine bldg	Beta scintillation	< 0.25 (10-100 r/h)	Xe-133, Xe-135, Kr-85 Kr-88	5.0E-7 to 1.0E+5 for Xe-133

a. Values in parentheses for accident conditions.

TABLE 11.5-9

CONDITIONS OF SERVICE FOR POST-ACCIDENT RADIATION MONITORS

Monitor	Sample Fluid	Process Fluid Conditions		Ambient Conditions at Detector		
		Temperature (°F)	Pressure (psig)	Temp (°F)	Pressure (psig)	Relative Humidity (%)
Plant Vent Effluent						
PE-44A	Gas	40-104	0	32-120	0	35-70
		(40-120)[a]	(0)	(32-120)	(0)	(20-100)
PE-44B	Gas	40-104	0	32-120	0	35-70
		(40-120)[a]	(0)	(32-120)	(0)	(20-100)
PE-44C	Gas	40-104	0	32-120	0	35-70
		(40-120)[a]	(0)	(32-120)	(-3 to 15)	(20-100)
Main Steam Line						
PE-45A	NA	NA	NA	5-126	0	10-100
PE-45B				(5-126)	(0)	(10-100)
PE-45C						
PE-45D						
Condenser Air Ejector and Steam Packing Exhauster						
PE-33	Gas	94-210		40-104	0	40-85
				(40-120)	(0)	(20-95)
PE-34	Gas	94-210		40-104	0	40-85
				(40-120)	(0)	(20-95)
PE-15	Gas	94-210		40-104	0	40-85
				(40-120)	(0)	(20-95)

a. Values in parentheses for accident conditions.

TABLE 11.5-10

ALARM SETPOINTS FOR POST-ACCIDENT RADIATION MONITORS

	Initial Setpoints ($\mu Ci/cm^3$)	
Monitor	Intermediate	High
PE-44A	NA, passive monitor	---
PE-44B	NA, passive monitor	---
PE-44C	(Later)	(Later)
PE-45A	(Later)	(Later)
PE-45B	(Later)	(Later)
PE-45C	(Later)	(Later)
PE-45D	(Later)	(Later)
PE-33	NA, passive monitor	---
PE-34	NA, passive monitor	---
PE-15	(Later)	(Later)

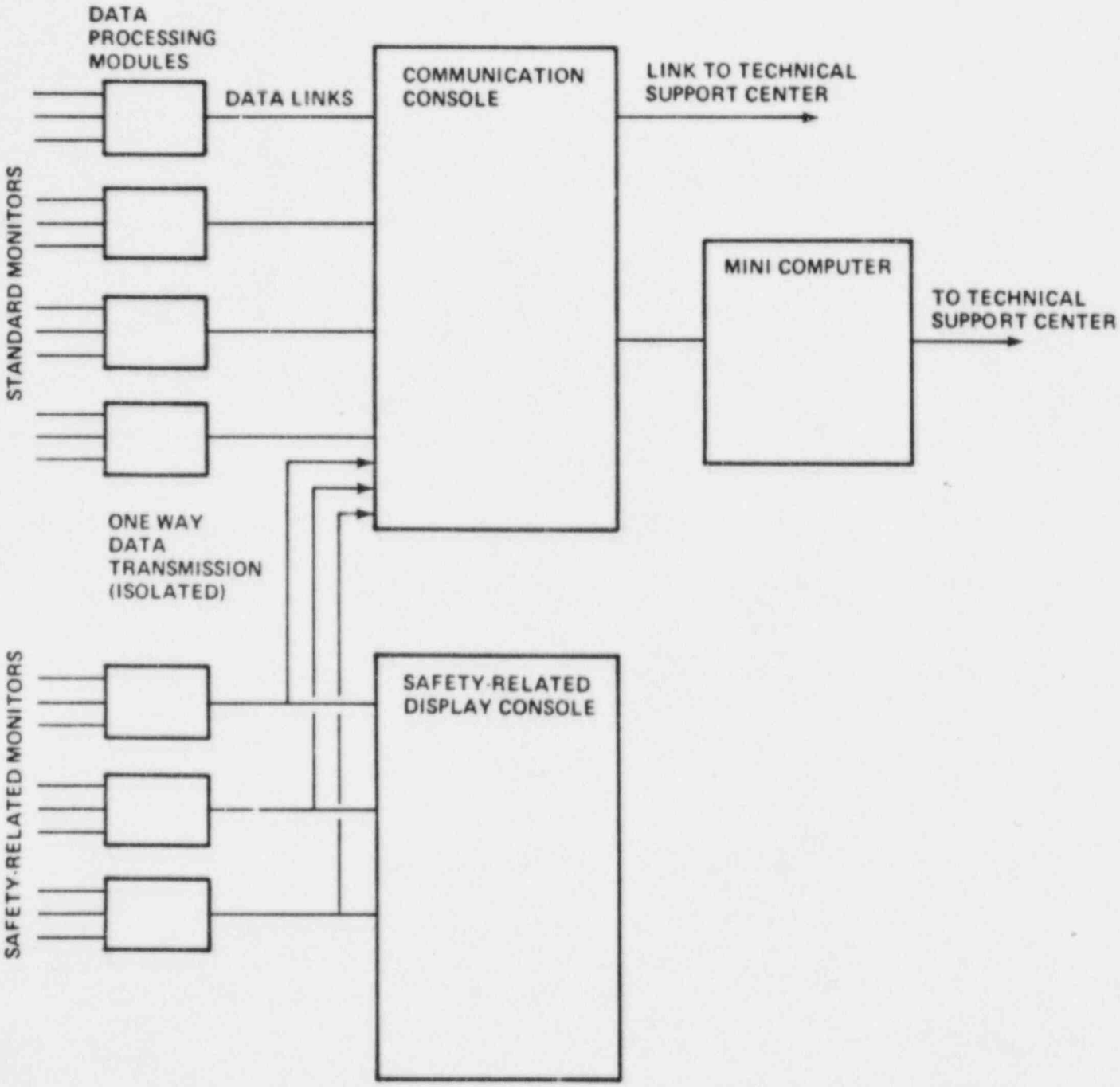

FIGURE 11.5-1. RADIATION MONITORING SYSTEM BLOCK DIAGRAM

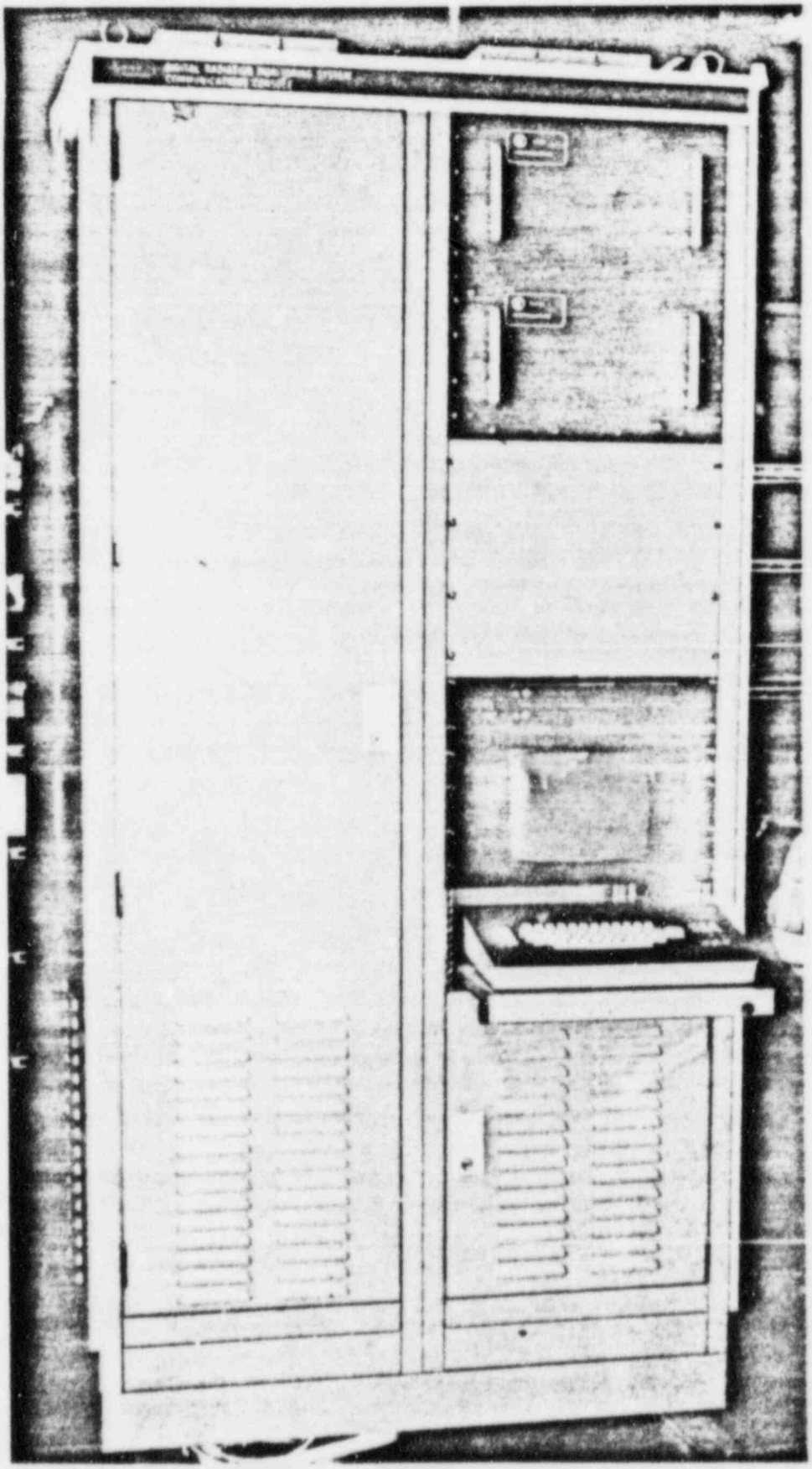

FIGURE 11.5-3. PERMS COMMUNICATION CONSOLE

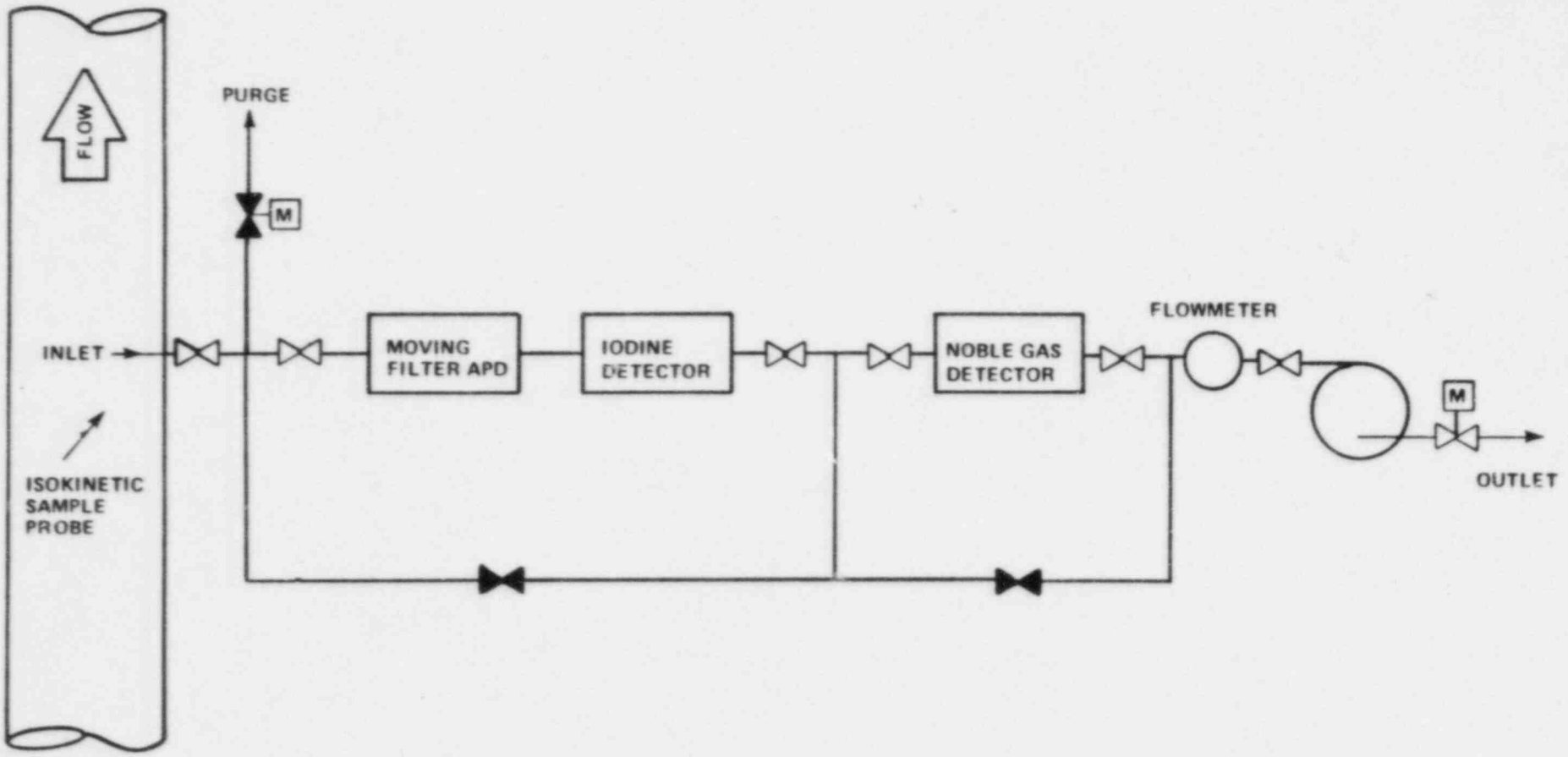

FIGURE 11.5-4. THREE-CHANNEL AIRBORNE MONITORING ASSEMBLY