CERTAIN COMPONENTS
SAFETY RELATED

GAI System Diagrams: See Table VIII

INFORMATION ONLY

FINAL

SYSTEM DESIGN DESCRIPTION

PLANT RADIATION MONITORING SYSTEM

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY
PERRY NUCLEAR POWER PLANT
UNITS 1 AND 2

N/A — —
System Engineer Date

C.S. Engineer 7-15-85
Date

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System Designation D17

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1.0 INTRODUCTION

This document presents a description of the Plant Radiation Monitoring System for Perry Nuclear Power Plant Units 1 and 2. The Plant Radiation Monitoring System consists of in-plant radiation monitor subsystems which provide detection, measurement, and indication of the level of radioactivity in selected plant process systems, water systems, and plant ventilation systems. In addition, the atmosphere of certain areas of the plant is also monitored for radioactivity. Area monitoring is presented in the D-21 System Description. Post Accident Monitoring is presented in the D-19 System Description.

The Plant Radiation Monitoring System (D-17) includes the following subgroups of monitors:

a. Airborne Monitors and Atmospheric Monitors
b. Gaseous Effluent Monitors
c. Process System Monitors
d. Liquid System Monitors

Location of radiation monitor subsystems are shown on GAI Plant Layout Diagrams E-013-003 to E-013-009. System Diagrams are listed in Table VIII.

Process system radiation monitors and liquid system radiation monitors (except where noted) are supplied by the General Electric Company under the NSSS Contract. Portions of these process radiation monitoring subgroups are safety related.

1.1 SYSTEM FUNCTIONS

The functions of the Plant Radiation Monitoring System are:

a. To detect, measure, indicate, and record the levels of radioactivity within:

   1. Plant ventilation systems
   2. The atmosphere of selected areas of the plant
   3. Selected plant water systems
   4. Liquid and gaseous effluent release paths
   5. Principal process streams

b. To alarm when predetermined radiation levels are exceeded.

c. To provide a sampling and collection medium for analysis samples.

d. To maintain control over the release of radionuclides from the plant in gaseous and liquid effluents.

e. To record the rate of release of radioactive material from the plant.

f. To provide input signals to the reactor protection system and the containment and reactor vessel isolation control system, and for other control functions.

1.2 CRITERIA REQUIREMENTS

The codes, standards and guides to which this system and its components comply, the interface relationship with other systems, the system component ambient environmental requirements, and the system design bases are as follows:

1.2.1 Codes and Standards

The system is designed in accordance with the applicable requirements or guidelines set forth in the following codes, guides, and standards:

a. 10 CFR 20, Standards for Protection Against Radiation.

b. 10 CFR 50, "Appendix A, "General Design Criteria for Nuclear Power Plant":
Criterion 13 - Instrumentation and Control

Criterion 60 - Control of Releases of Radioactive Materials to the Environment

Criterion 63 - Monitoring Fuel and Waste Storage

Criterion 64 - Monitoring Radioactivity Releases.

c. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants".

d. U.S. NRC Regulatory Guide 1.21 (June 1974), "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water- Cooled Nuclear Power Plant".

e. U.S. NRC Regulatory Guide 1.45 (May 1973), "Reactor Coolant Pressure Boundary Leakage Detection Systems".

f. U.S. NRC Regulatory Guide 1.75 (February 1974), "Physical Independence of Electric Systems".

g. U.S. NRC Regulatory Guide 8.8 (July 1974), "Information Relevant to Maintaining Occupational Radiation Exposure as Low as Practicable". (System supplements requirements of RG 8.8).

h. American National Standards Institute (ANSI) Standards:

1. ANSI N13.1 - 1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities".

2. ANSI N13.2 - 1969, "Guide for Administration Practices in Radiation Monitoring", (Section 5.3.4.).

i. Codes, standards and supplemental documents for the G. E. supplied process monitors are listed in the Design Specification Data Sheets for the Design Specification 22A3767.

j. NUREG-0737, "Clarification of TMI Action Plan Requirements." November (1980), U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

1.2.2 System Interfaces

The Process Radiation Monitoring System interfaces with the following plant systems:

a. Selected ventilation systems
b. Selected process systems
c. Selected circulating water systems
d. The electrical system
e. The main annunciator system
f. The main computer system
g. The reactor protection system
h. Post accident radiation monitoring system (D-19)

1.2.3 Ambient Environmental Conditions

The Plant Radiation Monitoring System equipment is designed to operate under the following environmental conditions:

Pressure	- 1.0 to 1.0 W.G. (inches of water)
Temperature	4.0 to 120° F
Relative Humidity	20 to 90%

1.2.4 Design Basis

The design bases for the Plant Radiation Monitoring System are as follows:

a. To furnish quantitative information to the reactor operator and to operations personnel on the level of radioactivity in principal plant liquid and gaseous process streams, liquid and gaseous effluent release paths, plant ventilation systems, and selected areas of the plant.

b. To provide a system which can aid in minimizing personnel exposure to airborne radioactivity, and maintain occupational radiation exposure as low as practicable.

c. To aid in maintaining release of radioactive materials in liquid and gaseous effluent paths to unrestricted areas as far below the limits specified in 10 CFR 20 as practicable.

d. To control the release of radioactive materials in gaseous and liquid plant effluents in compliance with General Design Criterion 60.

e. To provide monitoring of radioactivity releases, generated as a result of normal or emergency operation of the plant, in effluent discharge paths as required by General Design Criterion 64.

f. To provide an analysis sample medium from which the quantity of each principal radionuclide released to the environment can be determined in compliance with Regulatory Guide 1.21 (except for tritium samples).

g. To furnish information to substantiate radiation surveys as required by 10 CFR 20, and provide supporting documentation of working environments.

h. To initiate operation of the reactor protection system and the reactor vessel and containment isolation control system.

i. To provide instrumentation to monitor plant ventilation systems, principal liquid or gaseous process systems, effluent discharge paths, or certain principal areas of the plant for level of radioactivity during and following an incident.

j. To augment and supplement the Leak Detection System in detecting leakage from the Reactor Coolant Pressure Boundary.

k. To provide overall plant monitoring of airborne radioactivity and reasonable assurance that the ambient airborne radiation levels are below those requiring special monitoring equipment.

l. To augment and supplement other monitoring systems, such as the Area Radiation Monitoring System, in the detection of incidents involving release of radioactive material.

m. To aid in the protection of the plant personnel from exposure to airborne radioactive materials in excess of those allowed by 10 CFR 20.

n. To provide alarms for each channel (warning, high radiation, or channel failure) and alarms for each subsystem (sampler bypassed or sample flow low).

o. To provide a hard copy record of radiation levels in all monitored systems.

p. To continuously monitor the plant ventilation systems for airborne radioactivity in order to permit an assessment to be made of the radiological hazards to be encountered within various regions of plant buildings, and to call attention to equipment malfunction or component failure resulting in the release of radioactivity.

q. To provide instrumentation for use as the basis for initiating actions related to the plant radiation emergency plan.

The monitor consists of a sampling system which draws air through a fixed particulate collection filter, a halogen collection cartridge, and a gaseous measuring channel where gross Beta activity can be detected.

The equipment enclosures H51-P073 and H51-P074 are located in the Intermediate Building, 620'-6" elevation. Each readout module is located on panel H13-P804 in the control room and recorded on panel H13-P600. No control functions are associated with this radiation monitor.

Indication and alarms for each channel are provided in the control room and indication is provided on the equipment enclosure.

2.1.8 Gaseous Effluent Radiation Monitoring

The gaseous effluent radiation monitoring subgroup functions to:

a. Meet the requirements of 10 CFR 50, GDC 64, by monitoring effluent discharge paths for radioactivity that may be released from normal operations, abnormal occurrences, and postulated accidents.

b. Meet the requirements of 10 CFR 20, by monitoring and sampling gaseous effluents to ensure that stated release limits are not exceeded (dilution may be required to meet noble gas limits).

c. Meet the requirements of Regulatory Guide 1.21, by representative sampling of gaseous effluents to provide a means for determining in the laboratory the quantity of each principal radionuclide release to the environment.

d. Verify the effectiveness of radioactive control systems and provide warning to the operator of accidental releases.

e. Provide information to plant personnel to ensure that radioactive material in gaseous effluents is minimized.

f. Provide alarms and indication to the operator when radioactivity limits in the gaseous effluent have been exceeded.

g. Continuously record the radioactivity level in gaseous effluent streams.

h. Provide information which may be used as a basis for initiating actions related to the plant radiation emergency plan.

i. Meet the requirements of Reg. Guide 1.97, Rev.2 and NUREG-0737 for monitoring gaseous effluents after an accident. (This is in conjunction with the D19 instrumentation.)

j. Provide a method to disseminate gaseous effluent release data by interfacing with the ERIS and MIDAS computer systems.

k. Provide data which can be used to determine release rates. This function is accomplished by the incorporation of engineering conversion factors into the MIDAS computer system, which in conjunction with exhaust air flow rate, provides for the calculation of release rates within the accuracy specified by Reg. Guide 1.97, Rev. 2.

The plant gaseous effluent radiation monitors are discussed below; see D-806-001 and Table IV and Table IX.

a. Off-Gas Vent Pipe Radiation Monitors (1D17K830 and 2D17K830)

This unit monitors a sample of the off-gas vent pipe discharge downstream of the exhaust fans, Ref. D-912-622, for particulate, iodine, and gas activity and provides samples of the collected particulate and halogen for laboratory analysis. See D-806-008, D-856-008, D-806-022, and D-856-022.

A representative sample is continuously extracted from the unit off-gas vent pipe effluent path through an isokinetic probe in accordance with ANSI N13.1-1969 with the feature of regulating the sample flow in proportion to the discharge flow (autokinetic). This 1 inch sample line has been heat traced to preclude any condensation. A 1-CFM portion of this representative sample is taken by another probe and passed through the monitor to detect the particulate, iodine, and gas activity, which are indicated on ratemeters in the control room on panel H13-804 and recorded on panel H13-P600.

The autokinetic sampling panel H51-P146 and the monitor sampler enclosure H51-P169 are located in the Turbine Building at 620'-6". Interlocks associated with this monitor are used to initiate sampling and monitoring by D19 System (D19P400) upon a high radiation trip.

The autokinetic sample supply pump is powered from the non-IE diesel backed Stub Bus which ensures system availability.

The sampling unit motor-blower assembly is powered from non-IE diesel backed electrical bus F1C08 (F2C08) to ensure system availability.

b. Plant Vent Radiation Monitors (1D17K780 and 2D17K780)

This unit monitors a sample of the plant vent discharge, Ref. D-912-613, for particulate, iodine, and gas activity and provides samples of the collected particulate and halogen for laboratory analysis. See D-806-007, D-856-007, D-806-023, and D-856-023. A representative sample is continuously extracted from the unit plant vent effluent path through an isokinetic probe in accordance with ANSI N13.1-1969 with the feature of regulating

the sample flow in proportion to the discharge flow (autokinetic). This 1 inch sample line has been heat traced to preclude any condensation. A 1-CFM portion of this representative sample is taken by another probe and passed through the monitor to detect the particulate, iodine, and gas activity which are indicated on ratemeters in the control room on panel H13-P804 and recorded on panel H13-P600.

The autokinetic sampling panel H51-P149 and the monitor sampler enclosure H51-P086 are located in the Intermediate Building at 682'-6". Interlocks associated with this monitor are used to initiate sampling and monitoring by the D19 System (D19P300) upon a high radiation trip.

The autokinetic sample supply pump is powered from the non-IE diesel backed Stub Bus thereby ensuring system availability. The sampling unit motor-blower assembly is powered from non-IE diesel backed electrical bus F1C08 to ensure system availability.

c. Turbine Building- Heater Bay Exhaust Radiation Monitors (1D17K850 and 2D17K850)

This unit monitors a sample of the turbine building and heater bay stack discharge, Ref. D-912-621, for particulate, iodine, and gas activity and provides samples of the collected particulate and halogen for laboratory analysis. See D-806-022, D-806-023, D-856-022, and D-856-023.

A representative sample is continuously extracted from the Unit Turbine Building/Heater Bay stack effluent path through an isokinetic probe in accordance with ANSI N13.1-1969 with the feature of regulating the sample flow in proportion to the discharge flow (autokinetic). This 1 inch sample line has been heat traced to preclude any condensation. A 1-CFM portion of this representative sample is taken by another probe and passed through the monitor to detect the particulate, iodine and gas activity which are indicated on ratemeters in the control room on panel H13-P804 and recorded on panel H13-P600.

The autokinetic sampling panel H51-P757 and the monitor sampler enclosure H51-P756 are located in the Heater Bay at 667'-6". Interlocks associated with this monitor are used to initiate sampling and monitoring by the D19 System (D19P500 & D19K580) upon a high radiation trip.

The autokinetic sample supply pump is powered from the non-IE diesel backed Stub Bus to assure system availability. The sampling unit motor-blower assembly is powered from non-IE diesel backed electrical bus F1B08 to assure system availability.

d. Steam Packing Exhaust Radiation Monitoring System (1D17K840 and 2D17K840)

3.2 NORMAL OPERATION

The system is normally energized. Observation of the readout module meter, the recorder, or the local meter on the equipment enclosure indication panel provides indication of the instrument channel radiation level. Alarm lights at the equipment enclosure provide local information as to equipment malfunction, operating status, or system alarm conditions. Movable atmospheric radiation monitors provide local audible alarms and indication only to warn personnel of high airborne radiation or equipment failure. Alarm lamps and annunciator points alert the control room operator of alarm conditions.

3.3 SHUTDOWN

No unusual shutdown procedure is required for the equipment. Detailed instructions are provided in the Vendor's instruction manual. Channels with interlock outputs will normally be in trip mode when shutdown

3.4 EMERGENCY OPERATION

In the case of a plant emergency, as may result from a LOCA or loss of off-site power, the main steam line radiation monitoring system and the containment ventilation exhaust radiation monitoring system are not required to operate. In the case of a LOCA, their protection function is accomplished by the LOCA signal. In the case of a complete loss of power to the RPS buses, the channels would trip the failsafe mode and accomplish their protection function.

The remaining subsystems of the plant radiation system are not required to operate in the case of a LOCA or loss of off-site power; however, this system receives power from the nonessential load diesel-backed bus (see Section 2.1.3) to ensure system availability to the control room operator. The availability of this system increases the quantity of information needed for the operator to interpret the nature and extent of an incident involving the release of radioactivity.

In the case of a LOCA, the plant radiation monitoring system is available to the reactor operator upon re-energizing the stub-bus.

4.0 SAFETY PRECAUTIONS

The equipment in this system has power supplies which produce high voltages. Procedures to be followed for operation and maintenance of the system are described in the system instruction manual.

Standard health physics procedures must be followed in handling test and calibration radioactive sources and radioactive check sources.

TABLE IV
GASEOUS EFFLUENT RADIATION MONITOR
SUBGROUP
UNITS 1 AND 2

Subsystem Tag No	Radiation Monitor Subsystem	Sample Point	Instrument Channels	Function of Subsystem
1D17K830 (2D17K830)	Off-Gas Vent Pipe Radiation Monitor	Off-Gas Vent Pipe	GSP HSP PSP	Local and Control Room indication and alarms interlock with D19 System
1D17K780	Plant Vent Radiation Monitor Sampler	Plant Vent Autokinetic	GSP HSP PSP	Local and Control Room alarms and indication interlock with D19 System
1D17K850 (2D17K850)	Turbine Building - Heater Bay Exhaust Radiation Monitor	HB/T8 stack Autokinetic Sampler	GSP HSP PSP	Local and Control Room alarms and indication interlock with D19 System
1D17K840 (2D17K840)	Steam Packing Exhaust Radiation Monitor	Steam packing exhauster effluent line	GSP - inline	Control Room alarms and indication

NOTE Tag Numbers prefixed by 1D17 are components associated with Unit No. 1
Tag Numbers prefixed by 2D17 are components associated with Unit No. 2

GSP = Gas chamber scintillator
HSP = Halogen cartridge scintillator
PSP = Particulate filter scintillator

TABLE VII
ISOKINETIC PROBES

UNITS 1 AND 2

	Ventilation System	(1) Monitor No.	(1) Isokinetic Probe No.	Duct (inches)	Design Flow CFM
M14	Containment Vessel and Drywell Purge	1D17K660	1D17N661A	48 x 48	5,000
			1D17N661B	48 x 48	30,000
M15	Reactor Bldg. Annulus Exhaust Gas Treatment	1D17K690A	1D17N691A	14 x 16	400 (2)
		1D17K690B	1D17N691B	14 x 16	400 (2)
M36	Off-Gas Bldg. Ventilation System	1D17K760	1D17N761	30 x 46	15,000
M38	Auxiliary Bldg. Ventilation System	1D17K700	1D17N701	30 x 90	30,500

COMMON TO BOTH UNITS

M25	Control Room HVAC and Emergency Recirculation System	D17K770	D17N771	38 x 32	11,540
M31	Radwaste Bldg. Ventilation System	D17K720	D17K721A	32 x 90	30,000
			D17K721B	32 x 90	30,000
M33	Intermediate Bldg. Ventilation System	D17K730	D17K731	46 x 46	27,400
M40	Fuel Handling Area Ventilation System	D17K710	D17K711	40 x 70	30,000

NOTES

1. Unit 1 has 1 preceding the number, i.e., 1D17K---
   Unit 2 had 2 preceding the number

2. With no recycle to the annulus space, 2000 CFM is possible. Probe nozzle designed for high flow.