Florida Power
CORPORATION

August 17, 1981
File: 3-0-26
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Mr. Darrell G. Eisenhut
Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72
NUREG-0737, Item II.F.1, Additional
Accident Monitoring Instrumentation

Dear Mr. Eisenhut:

By letter dated July 3, 1981, Florida Power Corporation committed to submit documentation describing the noble gas effluent monitors and the iodine/particulate gaseous effluent monitors by August 17, 1981.

The attached report describes proposed equipment and system configuration for monitoring the Reactor Building purge duct and the Auxiliary Building vent exhaust duct. The above monitors and the Main Steam line monitors (implemented under NUREG-0578, Item 2.1.8.b short-term) provide the required monitoring of all potential accident release paths.

The attached five (5) copies of "Post-Accident Effluent Particulate, Iodine, and Noble Gas Monitors" are herein submitted for your review.

Very truly yours,

Patsy Y. Baynard

Dr. P. Y. Baynard
Manager
Nuclear Support Services

Attachments

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POST-ACCIDENT EFFLUENT PARTICULATE, IODINE, AND NOBLE GAS MONITORS

August 17, 1981

INTRODUCTION

In order to satisfy the requirements of NUREG-0578, NUREG-0737, and Regulatory Guide 1.97 the existing gaseous effluent monitors, RM-A1 (containment purge exhaust) and RM-A2 (combined auxiliary building and fuel handling building exhaust), will be upgraded to provide continuous radioactive measurement and recording of the noble gas, and continuous sampling for radioactive iodine and particulate concentrations likely to be present under post-accident conditions. Power supplies for existing equipment are from vital sources as will be the case for all new instruments.

In addition, the post-accident sampling system for the containment atmosphere sampling and analysis has been configured to also provide the flexibility of monitoring RM-A1 and RM-A2 sample points. This system will permit the on-line quantitative measurement of the radionuclide content of the above plant release points.

II. UPGRADED CONTAINMENT AND AUXILIARY BUILDING NOBLE GAS RADIOIODINE AND PARTICULATE MONITORS

The existing RMS equipment permits the measurement of noble gas fission products in the effluent streams from the containment building vent (RM-A1) and the combined auxiliary and fuel handling building vent (RM-A2). The units also collect and monitor particulate and iodine activities. The existing equipment provides measurement capability for noble gas fission products in the range of 10^{-6} to 10^{-2} $\mu Ci/cm^3$ (as Kr-85), particulate in the range of 10^{-11} to 10^{-7} $\mu Ci/cm^3$ (as Cs-137) and iodine in the range of 10^{-11} to 10^{-7} $\mu Ci/cm^3$ (as I-131). To comply with Regulatory Guide 1.97 and NUREG-0737 post-accident requirements, the upper noble gas limits must be increased to 10^{5} $\mu Ci/Cm^3$ for the containment vent monitor and to 10^{3} $\mu Ci/cm^3$ for the auxiliary/fuel handling building monitor. This will be accomplished by installing two additional wide range, halogen-quenched GM detectors on the sample lines from each exhaust vent. These will be measuring the noble gas content after the sample line emerges from the existing monitoring units (ie. RM-A1 and RM-A2). The configuration is shown in the attached figure. The mid-range detector is measuring the noble gas content of the flowing gas stream in a 3 liter chamber with "reentrant" geometry, i.e. similar to a Marinelli beaker configuration. The high-range detector is viewing the shielded sample line through a collimator slot. Both detectors are the Victoreen Model 857-10 and are connected to Victoreen Model 856-10 readout modules which also power the detectors. Copies of the descriptive product literature on these and other components are included in the Appendix. Together, the detector pair will cover the range of from 10^{-3} $\mu Ci/cm^3$ to 10^{5} $\mu Ci/cm^3$ (for the containment building air effluent) or to 10^{3} $\mu Ci/cm^3$ (for the auxiliary building air effluent). In addition, to comply with Regulatory Guide 1.97 and NUREG-0737 post-accident requirements, the upper particulate and iodine collection and analyzing capability must be increased to 10^{-3} $\mu Ci/cm^3$. This will be accomplished by providing dedicated High Range Particulate Filters and silver zeolite iodine absorption units with the capability for onsite laboratory analysis. These units and their location will be designed such that plant personnel can remove, replace, and transport the samples for the onsite analysis facility with radiation exposures that are not in excess of GDC 19. Thus, this lab analysis will provide the extended range required.

Where practical, the lower range detector systems will be bypassed by the sample air flow when the noble gas concentration exceeds their range so as to protect their integrity and keep them operable for use when the radioactive noble gas concentrations returns to normal.

All exhaust air from these sampling and monitoring systems will be returned to an appropriate exhaust duct so as to avoid contamination of the room air in the vicinity of the monitor units.

III. POST-ACCIDENT GAS RADIOLOGICAL ANALYSES SYSTEM

Basically, the GAS, post-accident analysis system consists of an on-line isotopic analysis subsystem which will identify and quantitatively measure the radionuclide in the containment building atmosphere. This unit is the APT Automated Isotopic Measurement System (AIMS) which utilizes a high resolution germanium detector to provide gamma-ray spectroscopic information by which the individual fission product concentrations within the sample can be determined. This AIMS unit is automatically controlled by an internal computer system which also provides the computational ability needed for reduction of the gamma-ray spectral data to produce individual nuclide concentration values. A descriptive information sheet on the AIMS unit is attached.

IV. SUMMARY DESCRIPTION OF PROCEDURES FOR OPERATION AND CALIBRATION

A. Noble Gas, Particulate, and Iodine Monitoring

Following modifications, the RM-A1 and RM-A2 units will still function as before in a "normal" operation mode. Should the normal range of measurement on the units be exceeded, the operator will isolate the low range measurement components to prevent excessive contamination and radiation damage to the subsystem. The operator can then monitor the output from the mid-range unit and isolate this component should its range also be surpassed by the gaseous fission product concentration encountered in the sampled effluent. In addition, upon the above switch over to the high-range mode, sample collection of particulates and iodines can also be initiated. The duration of this collection period will be determined by the activity level of the sample. Upon completion of sample collection, the sample units may be removed for onsite counting. As the concentration returns towards normal levels, the more sensitive measurement subsystems may be reactiviated by appropriate valve alignment.

Existing, low range calibrations for RM-A1 and RM-A2 will be used with necessary calculated conversion from Kr-85 units to Xe-133 equivalents provided to the system operators. The newly added mid-range and high-range detectors will be supplied with factor calibrations against standardized Xe-133 concentrations where practical. Otherwise, calculated sensitivity values will be used. Check source response will be employed to routinely determine the relative detector response after installation.

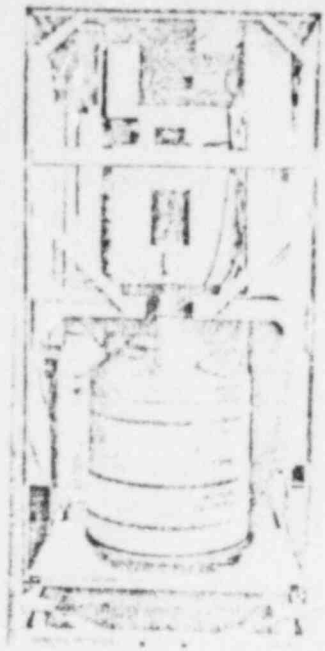
B. AIMS Operation and Calibration

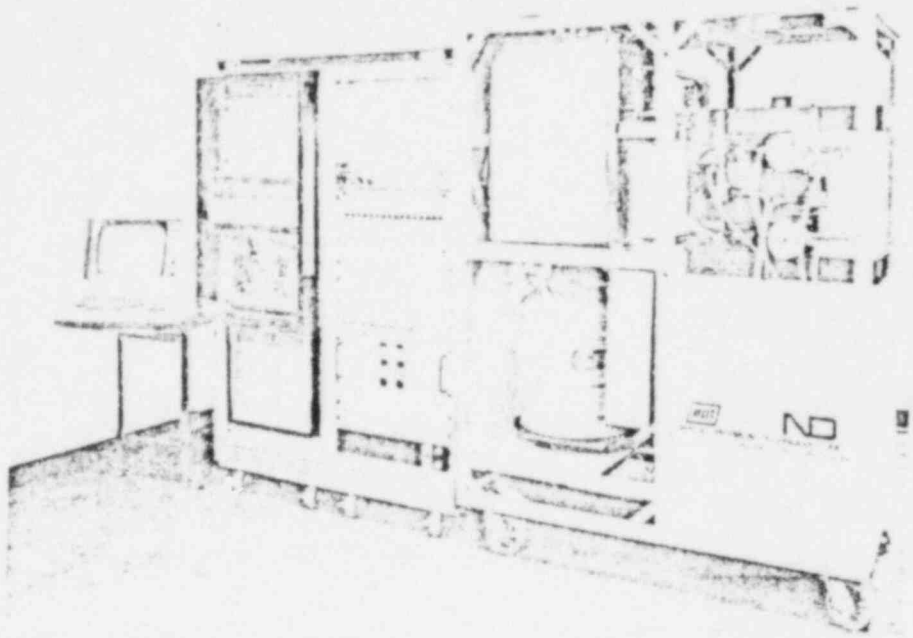
The Automated Isotopic Measurement System (AIMS), manufactured by Applied Physics Technology, Inc., is aligned to the desired vent duct so as to measure the isotopic content of this sample. The AIMS is computer controlled and automatically performs changes in sample flow paths and collimator position appropriate to changes in the concentration of radionuclides in the flowing sample. In this way, overloading of the germanium detector system and the resulting data distortion are avoided.

The AIMS for the CAS sample provides temperature and pressure measurements and also provides the operator with timely information to indicate adequate sample flow rates and to permit the necessary sample density correction calculations to be performed by the controlling computer.

The AIMS units are equipped with a mixed nuclide standard calibration source containing BA-133, Cs-137, and Co-60 to provide gamma rays in the range of 80 to 1332 keV. The automated system will regularly perform a calibration against this standard. The operating software for the AIMS contains stored absolute counting efficiency data for each of the sample line/moving collimator combinations which were experimentally measured at the factory. Any changes in the built-in source counting efficiency curves will reflect changes in detector operating parameters that will affect the actual sample line counting efficiencies in a proportional fashion. Therefore, changes in the counting efficiency as measured for the built-in standard will be used to correct or modify the stored efficiency coefficients for each actual sample geometry.

AUTOMATED ISOTOPIC MEASUREMENT SYSTEM





- REAL-TIME ISOTOPIC ANALYSIS OF REACTOR COOLANT AND CONTAINMENT AIR
- UNATTENDED OPERATION IN HIGH RADIATION ENVIRONMENT
- BROAD OPERATING RANGE - NORMAL TO ACCIDENT LEVELS (10^{-4} TO 10^{7} μCi/ml)
- AUTOMATIC CALIBRATION WITH INTERNAL CALIBRATION SOURCE
- MEASUREMENTS AT R_x COOLANT TEMPERATURE AND PRESSURE
- COMPATIBLE WITH CHEMICAL ANALYSIS SYSTEMS

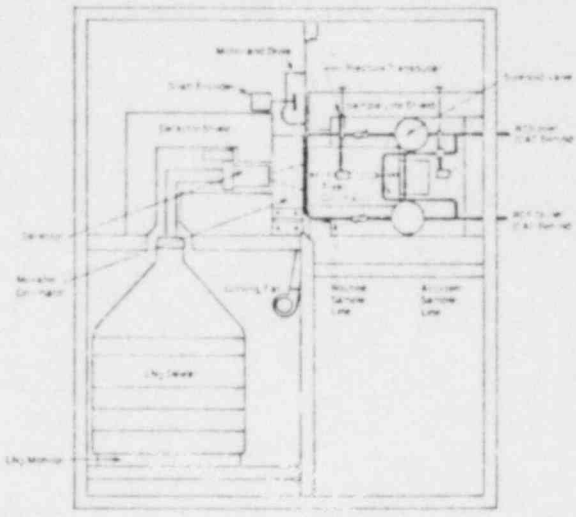
The APT Automated Isotopic Measurement System (AIM) provides the expanded capabilities for post-accident coolant analysis as required by Section 2.1.8 of NUREG 0578. With the AIM system, the operator can trace fuel failure events on a live-time basis without the excessive personnel radiation exposure associated with repeated manual sampling and analysis operations.

AIM is a second generation development based on previous APT systems for continuous fission product analysis in CANDU reactors.

The AIM system consists of two basic units: a shielded measurement cabinet which contains the sampling line manifold and valving, motorized calibrator and intrinsic germanium detector; and a control/analysis instrumentation cabinet which contains the electronics and computer systems. All components in the measurement cabinet are designed to operate in a post accident environment while sensitive computer components are in an air-conditioned cabinet that can be remotely located.

SHIELDED MEASUREMENT CABINET

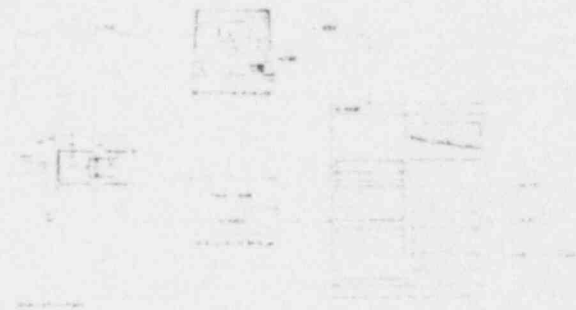
The wide range of measurement capability is achieved by the use of multiple counting geometries for both RC and CA samples. A tungsten lined collimator with multiple apertures is used to view the appropriate sample line. Sample flow through close in (routine) and faraway (accident) sample lines is automatically directed by computer controlled solenoid valving based on gross count rate measurement. All liquid flow paths are designed for reactor temperature and pressure conditions to assure representative samples and to minimize degradation and crud buildup. A planar or coaxial germanium detector is selected based on the measurement emphasis desired. The coaxial detector is favored for low count rate and high energy (normal) conditions. The planar detector is favored whenever accuracy of high count rate and lower energy range measurements (accident) is deemed most important. Automatic calibration is performed using a mixed radionuclide calibration source.



ELECTRONICS / COMPUTER CABINET

All system analysis and control functions are performed by the ND6685 computer and ND68DC data collector/control module. The ND68DC handles acquisition and storage of all system parameters (i.e., pressure and temperature sensors, collimator position). The unit also provides for automatic and manual control of all solenoid valves. Analog and digital input capability can be expanded to provide readout and control of chemical analysis systems.

The ND6685 computer provides for all data acquisition and analysis functions as well as overall control of the system through the ND68DC. Current isotopic analysis results are printed at the operator console, or may be transmitted to the TSC, EOF, or control room.



DIMENSIONS / WEIGHTS

Measurement Cabinet (Collimator / Detector)

H 60 inches
L 50 inches — Total Weight 4000 pounds
W 31 inches

Electronics Computer Cabinet (Dual Cabinet Configuration)

H 63 inches
L 36 inches — Total Weight 600 pounds
W 42.5 inches

(Measurement and Electronics Cabinet may be located up to 4500 feet apart)

OPTIONS

- Chemical Analysis System: APT can provide a turn-key system including analysis provisions for required chemical parameters or tie into an existing system.

- Grab Sample: Diluted or undiluted grab samples with electric cart for moving shielded sample casks.

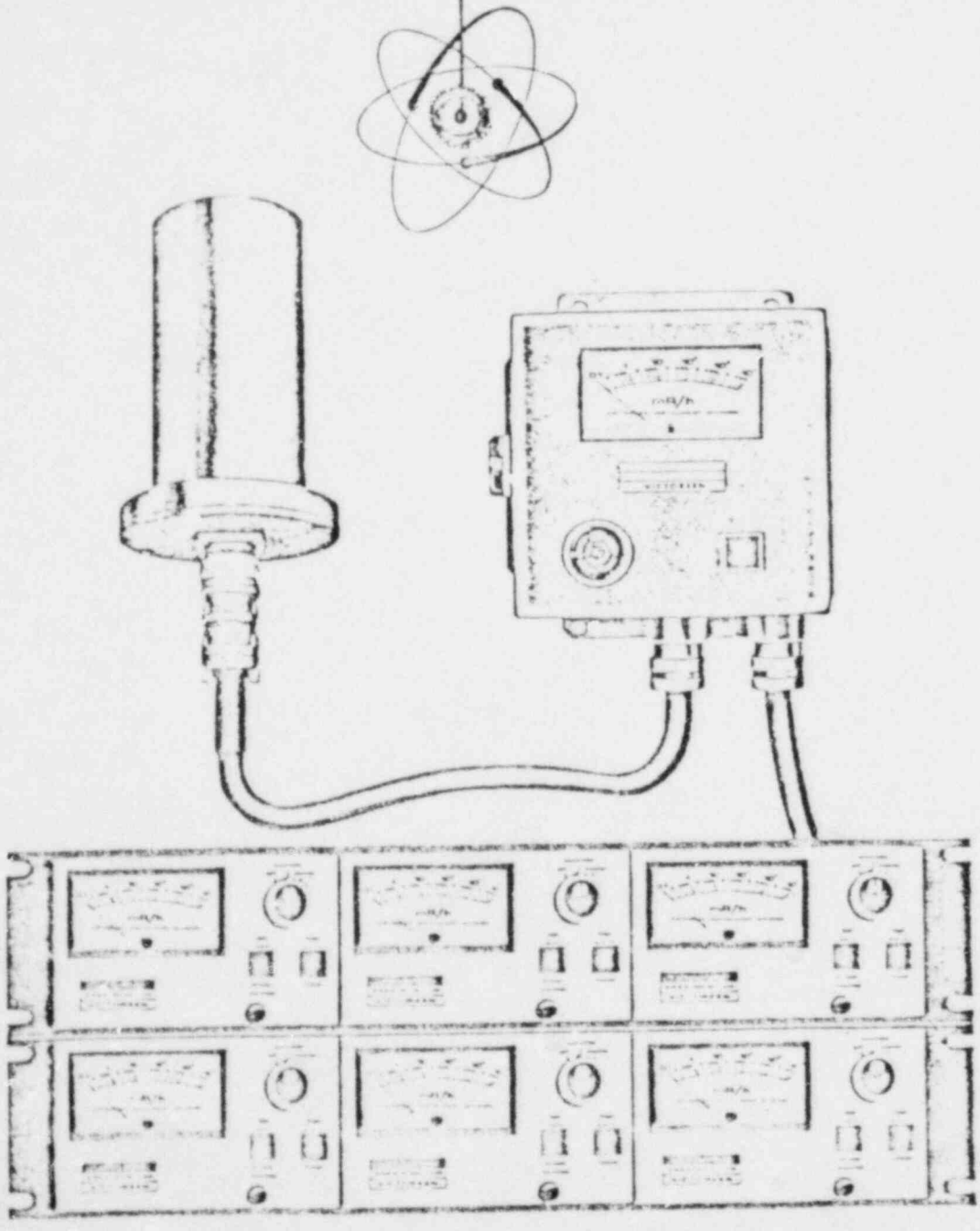
AMPA

MONITOR

855

- Seismic Tested and Proven Rugged
- Individual Power Supplies Allow Independent Operation of Every Channel
- Five Decades of True Log Readout
- Simple, Economic and Reliable Operation
- Interchangeable Detectors and Readouts

MONITORING SYSTEMS



Area monitoring systems detect and measure ambient gamma radiation. The VICTOREEN 855 Area Monitoring System achieves this in and around nuclear reactors, accelerators, irradiators and other facilities where radiation emitting materials are handled or processed. The Code of Federal Regulations determines limits on radiation exposure. Part of Title 10 of the CFR specifically states that persons having in their possession fissionable materials must have an operating criticality alarm system. The VICTOREEN 855 Area Monitor provides the necessary criticality alarm capabilities.

Typically, an area monitoring system will utilize a detector in any location where personnel might possibly be exposed to an adverse amount of radiation. For reactor facilities, these areas consist of the following: inside and outside the containment, fuel storage and handling areas, reactor beam ports, hold-up tanks, coolant loops, normal working areas such as labs, hallways and control rooms.

Monitoring of residual radiation is required around accelerator and irradiator facilities. Additional areas needing area monitoring are beam switching yards, target and control areas.

Radiochemistry labs should have at least one detector in each room of normal size and several strategically located in larger open areas. The readout console, including the alarm set controls, should be located in areas under supervisory control. In addition to issuing a warning of high radiation levels, the alarm trip can be used to actuate interlock devices or other safety options.

SYSTEM DESCRIPTION

The 855 Area Monitoring System consists of two essential parts, the Readout Module and the Detector. The detector converts the incident gamma radiation into an electrical signal which is transmitted to the readout module with a multi-conductor cable. Two ranges are available 0.01 mR/hr to 10^3 mR/hr or 0.1 mR/hr to 10^4 mR/hr. Two checking systems are provided to test the integrity of the system; one continuous and one on-command.

A continuously lit green light on the front panel indicates the system is ON and will go out upon signal or power failure. The On-Command checking system consists of a minute amount of radioactivity that pivots into position impinging radiation onto the sensing element when the green light is depressed. This causes an upscale reading verifying system integrity.

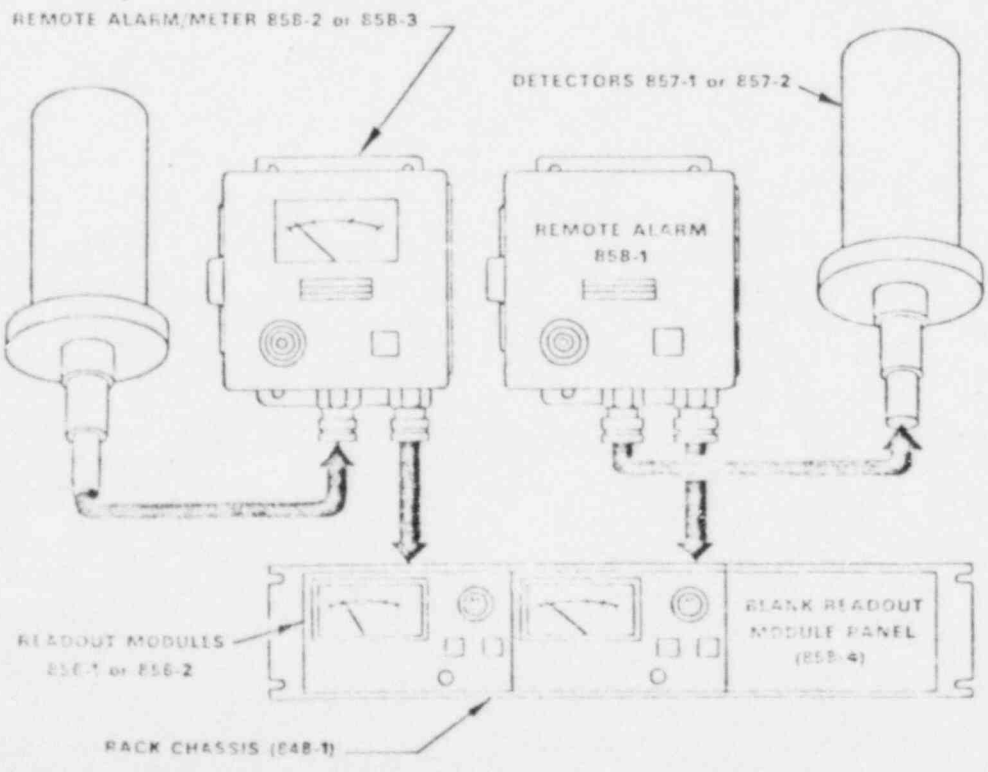
In addition to the failsafe alarm light, a red high radiation alarm light is included on the front panel.

This is a non-contacting adjustable alarm. Rotating the front panel knob to the "Alarm Point" position causes the meter to indicate where the alarm point is set. Adjustment of the alarm set point is accomplished by partially withdrawing the module from its housing and turning a 15-turn potentiometer. In addition to the red high alarm light indication on the front panel, outputs from a relay are located on the rear of the chassis to operate external alarms.

Each channel (detector/readout combination) has its own independent power supply eliminating possibility of losing many channels of instrumentation with the failure of one power supply.

The compact modular solid state design permits mounting three readout modules in a 19 inch wide relay rack chassis only 3½ inches high. The rugged weather-proof detector comes equipped with a mounting bracket for easy installation.

Certified test data has shown that 855 Area Monitoring Systems will continue to operate with a seismic load of 1 G in the horizontal and vertical direction over frequency range of 1 — 30 Hz.



THEORY OF OPERATION

VICTOREEN 855 Area Monitoring Systems consist essentially of a halogen quenched G-M tube whose pulses drive a multiple pump ratemeter circuit. The output from the pump circuit is a true log d.c. signal directly related to the radiation intensity.

The G-M tube is shielded with appropriate filter material to provide the necessary Energy Correction for conversation of cpm to Roentgen/hr.

A built-in anti-saturation circuit prevents the system readings from falling off full scale during over-range conditions.

Natural background and check source contribution holds the system in the non-failure condition. If for any reason, the system stops responding to radiation, a failure condition will be indicated on the readout module.

ACCESSORIES

The 858-1 Remote Alarm is a visual and audible alarm which can be mounted adjacent to the detector or any other convenient location. The 858-2 or 858-3 Remote Alarm/Meter is basically the same as the 858-1 Remote Alarm but also provides a 3½ inch wide meter scale, five decade visual display of the radiation level. The 848-3 Readout Enclosure provides a rugged, attractive enclosure in which to house the readout module when single channels are used. The enclosure can be used as a bench top unit or shelf mounted. The 848-1 chassis provides a convenient means for installing three readout modules in a standard 19-inch relay rack. The 858-4 blank plug-in panel is used when less than three channels of readout are required.

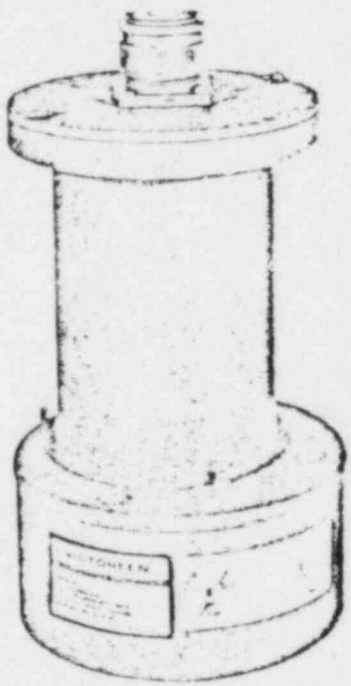
MODEL 858-5 FIELD CALIBRATION KIT

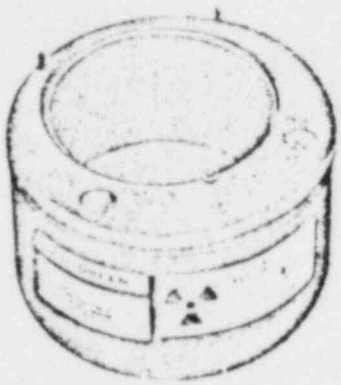
The 858-5 Field Calibration Kit provides a quick means of checking the calibration of the VICTOREEN Model 855 Area Monitoring System.

A sealed radiation source, in conjunction with reproducible geometry, assures constant, accurate results.

The 0.1 mg Radium Source is encapsulated in a Platinum-Irridium capsule and secured inside a steel tube surrounded by a lead shield.

Radiation level one foot from any surface of the unit is less than 1 mR/hr.





Features . . .

Precise, Accurate Calibrations

Safe, Quick Means of Checking System Integrity

Encapsulated ^{226}Ra Source and Highly Reproducible Geometry

Scale Reading Approximately 30 mR/hr

Individual Calibration supplied with Each Calibrator

Specifications . . .

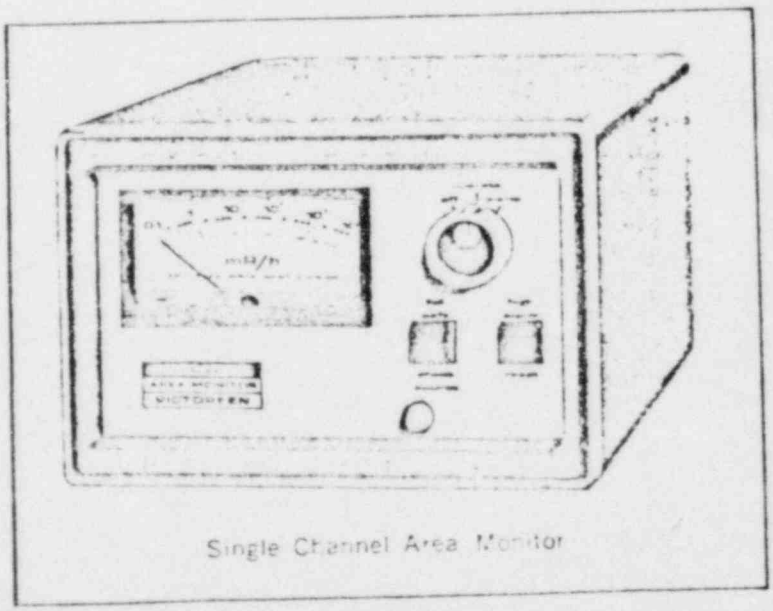
Source Activity: 0.1 mg Radium in a Platinum-Irridium Capsule

Dimensions: 4¾" diameter x 2⅜" high (12.1 cm, 6.04 cm).

Net Weight: 7½ lbs. (3.4 Kg.)

Phenolic Liner for precise positioning of detector.

An A.E.C. license is not required. However, purchasers in agreement states may be subject to licensing or registration requirements.



Single Channel Area Monitor

SPECIFICATIONS

DETECTORS 857-1 or 857-2

Type: G-M tube.

Fill: Argon, halogen quenched.

Range: Model 857-1 Detector: 0.01 to 10^3 mR/hr. Model 857-2 Detector: 0.1 to 10^4 mR/hr.

Energy Dependence: ±15% from 100 Kev to 1.5 Mev.

Radiation Detected: Gamma.

Temperature Limits: —20°F to 140°F (—29°C to 60°C).

Pressure Limits: 30 psig.

Humidity Limits: 0 to 100%.

Connector: AN3102-18-1P.

Detector Element Life: Exceeds 1000 hours at full-scale or over.

Electronic Exposure Life: Approximately 10^8 Rads.

Dimensions: 3" diameter, 7⅛" high (7.63 cm, 18.1 cm).

Weight: Approximately 1 pound (0.45 Kg).

Mounting: Wall bracket.

Remote Capability: Up to 1000 feet.

READOUT MODULES 856-1 or 856-2

Meter Scale Size: 3½" (8.90 cm) taut band.

Alarms:

Fail Alarm: A green pushbutton light is provided on the front panel. This light is ON during operation and goes out if the signal or power fails. This circuit automatically resets when a malfunction is corrected. Depressing this pushbutton will activate the check source in the detector causing an upscale reading proving the channel integrity. The pushbutton is spring loaded and will return the channel to normal operation when released.

High Alarm: A red pushbutton light is provided on the front panel. This light will go ON when the radiation exceeds the preset level. Depressing this spring loaded button will reset the alarm when the radiation has subsided below the preset level. The alarm will not reset while the radiation level is above the alarm set point.

The High Alarm level trip point is adjusted by means of a 15-turn potentiometer, located on the printed circuit board.

Controls:

Rotary Function Switch: "OFF" position shuts off all power to the channel. "OPERATE" position puts channel into normal operation. In "ALARM POINT" position meter needle indicates where the alarm point is set. The alarm circuit is isolated to prevent the alarm from actuating and to prevent a recorder-computer from tracking the alarm point when switch is held in the "Alarm Point" position. This switch is spring loaded to return to the "OPERATE" position when released.

External Alarm Contacts: High and fail: 5 amperes, 120 volts, SPDT.

Recorder Output: 0 to 10 mv. Spans five decades (isolated from computer output).

Computer Output: 0 to 50 mv (isolated).

Connector: Terminal strip for hookup of detector cable, recorder, computer, external alarms and follow meters on back of printed circuit boards. Accessible from front with unit withdrawn from rack.

Temperature Limits: 32°F to 120°F (0°C to 49°C).

Humidity Limits: 0-95%.

Input Power Requirement: 117/234 volts ±15%, 50-60 Hz.

Power Supplied: +600 volts regulated, +22 volts unregulated, +10 volts regulated, —6.8 volts regulated.

Auxiliary Power: 15 to 18 volts d.c. battery (standby), 300 ma maximum.

Meter Response: (Approx.) 2.5 sec. for full scale deflection.

Time Constant: 60, 6, 6 sec. for .01, 1, 1 mR/hr respectively.

Dimensions: 5⅝" wide, 3½" high, 11⅛" deep (14.4 cm, 8.90 cm, 28.3 cm).

Weight: Approximately 3 pounds (1.36 Kg).

REMOTE ALARM 858-1

Visual Alarm: Red light, 1" square, ½" thick (2.54 cm, 1.27 cm).

Audible Alarm: Loud buzzer activates with alarm light.

Logic: Same as the "High Alarm" on the Readout Module.

Temperature Limits: —20°F to 140°F (—29°C to 60°C).

Humidity Limits: 0 to 95% (weatherproof).

Mounting: Heavy duty industrial junction box with flanges for wall mounting.

Dimensions: 7" high, 7" wide, 4" deep (17.8 cm, 17.8 cm, 10.2 cm).

Weight: 4¾ pounds (2.15 Kg).

REMOTE ALARM/METER 858-2 or 858-3

Range: Model 858-2: 0.01 to 10^3 mR/hr. Model 858-3: 0.1 to 10^4 mR/hr.

Visual Alarm: Same as Remote Alarm above.

Audible Alarm: Same as Remote Alarm above.

Logic: Same as Remote Alarm above.

Temperature Limits: Same as Remote Alarm above.

Humidity Limits: Same as Remote Alarm above.

Mounting: Same as Remote Alarm above.

Dimensions: Same as Remote Alarm above.

Weight: 5 pounds (2.26 Kg).

Meter: 3½" wide with 5 decade display (8.90 cm). Remote Alarm/Meter tracks readout module meter within ±2% of fullscale.

SINGLE CHANNEL

Application: Single Channel Area Monitoring Readout Module.

Construction: Wrap-around, welded steel case, with channel guide for module insertion.

Mounting: Rubber pads for bench or shelf mounting.

Dimensions: 4½" high, 6⅛" wide, 12" deep (11.4 cm, 16.5 cm, 30.4 cm).

Weight: 5¾ pounds (2.60 Kg).

RACK CHASSIS (848-1)

Application: Multi-channel Area Monitoring Readout Modules.

Construction: Sheet steel welded to angle steel brackets, with plastic guides for insertion of three readout modules.

Mounting: Designed to fit in standard 19 inch relay rack.

Dimensions: 3½" high, 19" wide, 11⅛" deep (8.90 cm, 48.3 cm, 28.3 cm.).

Weight: 7¾ pounds (3.50 Kg).

BLANK READOUT MODULE PANEL (858-4)

Application: Fill in blank space(s) of the rack chassis.

Construction: Aluminum frame with black finish.

Mounting: Simply slides into the rack chassis.

Dimensions: 3½" high, 5⅝" wide (8.90 cm, 14.4 cm).

Weight: ½ pound (0.23 Kg).

DETECTOR CABLE (848-6)

Type: Multi-conductor, outer insulation waterproof.

Outside Diameter: ½" nominal (1.27 cm).

Temperature Limits: —40°F to 158°F (—40°C to 70°C).

VICTOREEN INSTRUMENT DIV. of VLN
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104
Phone: [216] 795-8700 • TWX [810] 421-8287

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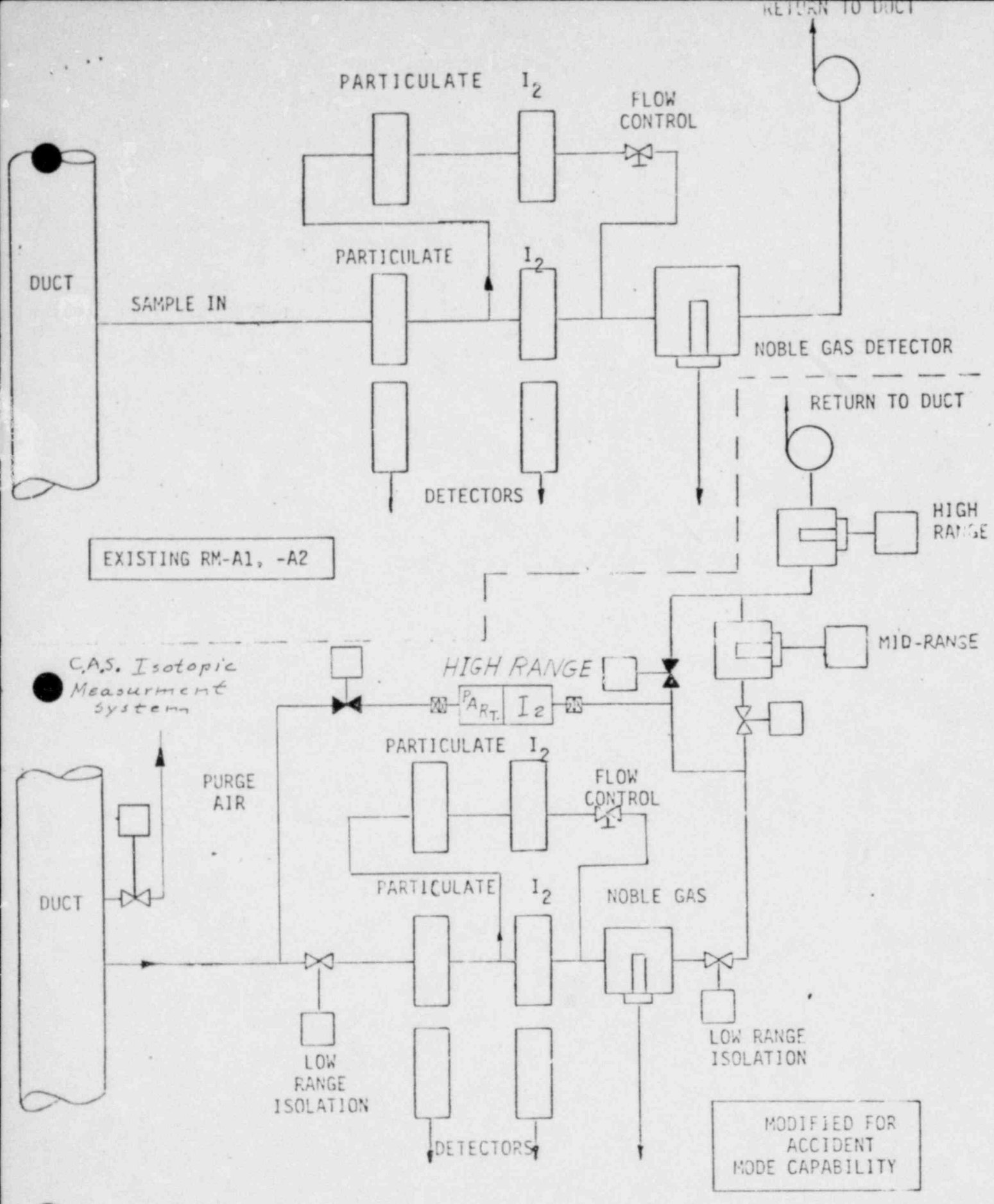

PARTICULATE, IODINE, AND NOBLE GAS MONITORS
FOR
FLORIDA POWER CORPORATION, CRYSTAL RIVER UNIT THREE