RADIATION MONITORING SYSTEMS
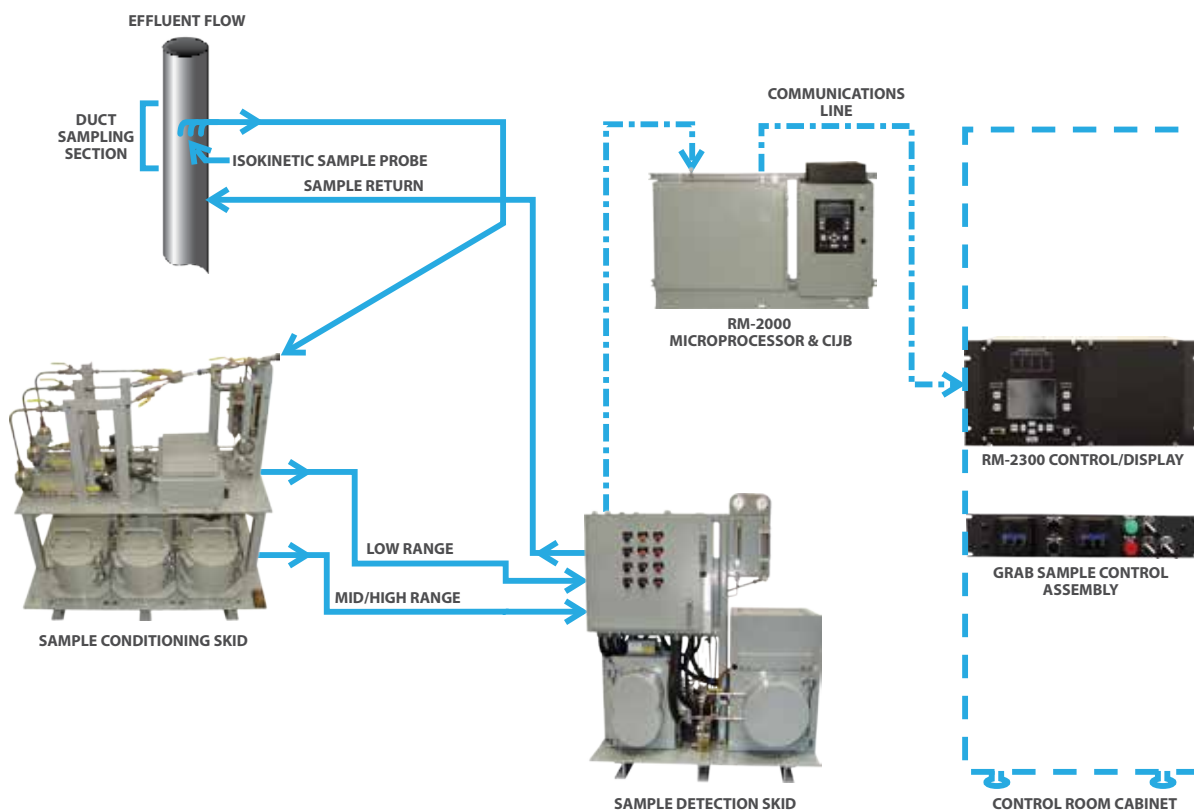
GENERAL ATOMICS
ELECTROMAGNETICS

RADIATION MONITORING SYSTEMS FOR A LIFETIME OF SERVICE

- Area and process monitors

- In-line, adjacent-to-line monitors

- Local/remote processors, data acquisition systems

- NUPIC Certified, NRC Approved Vendor

- LOCA-qualified (Loss of Coolant Accident)

- Wide range sensitivity

GENERAL ATOMICS
ELECTROMAGNETICS

RADIATION MONITORING SYSTEMS

Nuclear power plants worldwide rely on the quality and dependability of General Atomics Electromagnetic Systems (GA-EMS) Radiation Monitoring Systems (RMS). GA-EMS has fielded and continuously supported qualified monitoring and detection systems, providing plant operators with unmatched reliability and performance to ensure safety while minimizing overall plant lifecycle costs. Since the first system installation in 1965, we have provided customers with unwavering support and a commitment to keep our RMS systems running efficiently for the lifetime of the plant.

Designed and manufactured in the U.S.A., our flexible designs are customizable to meet site-specific requirements for new plant builds and for retrofitting existing plant installations. GA-EMS radiation monitors are built with full qualifications and traceability, eliminating additional costs associated with qualification in place. We also provide diagnostic and system health monitoring capabilities to help operators keep system performance optimal.

EFFLUENT FLOW

DUCT SAMPLING SECTION

ISOKINETIC SAMPLE PROBE

SAMPLE RETURN

COMMUNICATIONS LINE

RM-2000 MICROPROCESSOR & CIJB

RM-2300 CONTROL/DISPLAY

LOW RANGE

MID/HIGH RANGE

SAMPLE CONDITIONING SKID

GRAB SAMPLE CONTROL ASSEMBLY

SAMPLE DETECTION SKID

CONTROL ROOM CABINET

COMPLIANCE

GA-EMS leads the industry in meeting safety and non-safety requirements with a Quality Assurance Program that fully complies with:

- 10CFR50, Appendix B
- Reg.Guide 1.97
- NQA-1 (2008) and NQA-1a (2009)
- ANSI N45.2, including applicable daughter standards
- Seismic – IEEE 344
- Environmental – IEEE 323
- ISO 9001-2008

10 CFR 50 APPENDIX B	ISO 9001:2008	NQA-1 QA PROGRAM	NUPIC CERTIFIED	NRC APPROVED VENDOR	REGULATORY GUIDE 1.97	SAFETY RELATED, CLASS 1E

GA-EMS has designed, manufactured, and fielded over 100 unique detectors. This brochure provides information on typical standard systems and parameters. We work closely with our customers to design and manufacture systems customized to suit specific plant requirements. Contact GA-EMS to discuss our range of capabilities to meet your unique specifications.

CUSTOMER SUPPORT SERVICES

We provide outstanding customer support and obsolescence mitigation to ensure each system is sustainable over a plant's entire operating lifecycle. Our support services, access to unmatched technology expertise, and extensive on- and off-site training help plant operators keep systems safely on-line, all the time.

CAPABILITIES

- Complete Field Service
- Engineering Services
- Start-up Service
- Training Courses
- RMS Users' Group Conference

GA-EMS offers a variety of area monitors designed to continuously monitor gamma radiation for areas inside a nuclear power plant. Systems are configured to monitor low radiation ranges for the protection of plant personnel, as well as high radiation ranges to detect breaches in process stream or containment boundaries. GA-EMS area monitors feature Geiger-Mueller (G-M) tubes for low range gamma radiation detection and ionization chambers for high range gamma radiation detection. Extended range configurations are available to monitor ranges which overlap between the G-M tube region and ion-chamber region. GA-EMS microprocessor unit processes the detector signals, calculates activity data, displays data, transmits data to plant computer systems, and activates local and remote audible and visual alarms.

High Range Containment Monitors with RD-23 Detector

RD-14 Detector

RD-2A Detector

MODEL	TYPE	RANGE	DESCRIPTION
RD-2A, RD-2B	Ionization Chamber	10^{-1} to 10^4 R/hr	General high range area detector, or can be used to view a process line for measurement of radioactivity such as a hardened containment vent pipe.
RD-8	Ionization Chamber	10^{-1} to 10^5 R/hr	Energy compensated high range area detector, LOCA qualified.
RD-14 Low Range	G-M Tube	10^{-3} to 10^4 mR/hr	General area monitoring within the plant.
RD-14 High Range	G-M Tube	10^{-2} to 10^5 mR/hr	General area monitoring within the plant or adjacent to line applications.
RD-23	Ionization Chamber	10^0 to 10^8 R/hr	Measures radiation level in the containment. Safety related R.G. 1.97 qualified for use in harsh environments and during a LOCA.

PROCESS MONITORS

GA-EMS process radiation monitoring systems are designed to continuously detect and measure radioactivity in airborne and process gas, liquid and steam lines. Our custom and standard designs can accommodate specific applications and requirements within a nuclear power plant. All GA-EMS monitors are manufactured with the highest standards of quality in the industry, with full qualifications and traceability, eliminating additional costs associated with qualification in place.

GA-EMS radiation monitors include local processors, remote indicators, and integrated systems to perform data acquisition, analysis and display, monitor control functions, alarm relays, analog outputs, and digital communications. System databases contain operation and calibration constants, alarm set-points and history files, and are programmable for specific applications. The Control Room Display assembly provides easy menu-driven access to database items, monitor remote control and display, and continuous polling for radiation level and operation status. Operators can also perform control functions such as purge, checksource and pump functions from the display to verify performance and status.

Heat Traced Particulate, Iodine
and Gas Monitor

Off-Line Liquid Monitor

TYPE	RANGE	DESCRIPTION
Gas Monitors	Xe^{133}: 3.4×10^{-7} to 3.4×10^{-1} µCi/mL	Off-line beta detector assembly designed for detecting activity concentration in a continuous gas sample. Attached to sample flow piping, the sample gas is drawn into the chamber at a set rate.
Liquid Monitors	Cs^{137}: 7.8×10^{-8} to 7.8×10^{-2} µCi/mL	Off-line gamma detector assembly designed for detecting activity concentration in a continuous liquid sample. Attached to sample flow piping, the sample liquid is pumped into the chamber at a set rate.
Wide Range Gas Monitors (WRGM)	Xe^{133}: 10^{-7} to 10^5 µCi/mL	Detects and measures off-line beta-gamma activity concentration levels by drawing a representative sample from the plant vent effluent flow. The sample flow is directed either to the normal or accident sample flow path determined by the sample activity concentration level. Safety related R.G. 1.97 qualified monitor.
Particulate Monitors	Cs^{137}: 2.5×10^{-12} to 2.5×10^{-6} µCi/mL	Off-line particulate detector assembly measures particulate activity concentrations. Samples are drawn continuously through a local particulate filter (fixed or moving filter available).
Particulate and Gas Monitors (PG) (R.G. 1.45)	Particulate: Cs^{137}: 2.5×10^{-12} to 2.5×10^{-6} µCi/mL Gas: Xe^{133}: 5.4×10^{-7} to 5.4×10^{-1} µCi/mL	Off-line PG monitor draws a representative sample from the plant containment atmosphere, provides sample flow through the monitor and measures the sample's radioactive level. Both channels utilize beta detectors to measure the activity concentration.
Particulate and Iodine Monitors (PI)	Particulate: Cs^{137}: 2.5×10^{-12} to 2.5×10^{-6} µCi/mL Iodine: I^{131}: 2.9×10^{-11} to 2.9×10^{-5} µCi/mL	Off-line PI monitor draws a representative sample from process gas or atmosphere, detects and measures process beta and gamma activity concentration.
Particulate, Iodine and Gas Monitors (PIG)	Particulate: Cs^{137}: 2.5×10^{-12} to 2.5×10^{-6} µCi/mL Iodine: I^{131}: 2.9×10^{-11} to 2.9×10^{-5} µCi/mL Gas: Xe^{133}: 5.4×10^{-7} to 5.4×10^{-1} µCi/mL	Designed for sampling and measurement of process gas streams. The off-line PIG monitor draws a representative sample from process gas or atmosphere, detects and measures process beta and gamma activity concentration.

IN-LINE AND ADJACENT-TO-LINE MONITORS

Whether off-line, on-line, in-line or adjacent-to-line, our monitoring systems continuously measure radiation activity in the process gas, liquid or steam lines. Each system provides real-time processing of activity data, and maintains monitor and channel databases and multiple history files. In addition, monitors provide local detection, indicators and alarms. Each system communicates directly with the digital radiation processor to produce measurement data for display and processing, and to transmit status, activity data, alarm status, and receiving status inquiries.
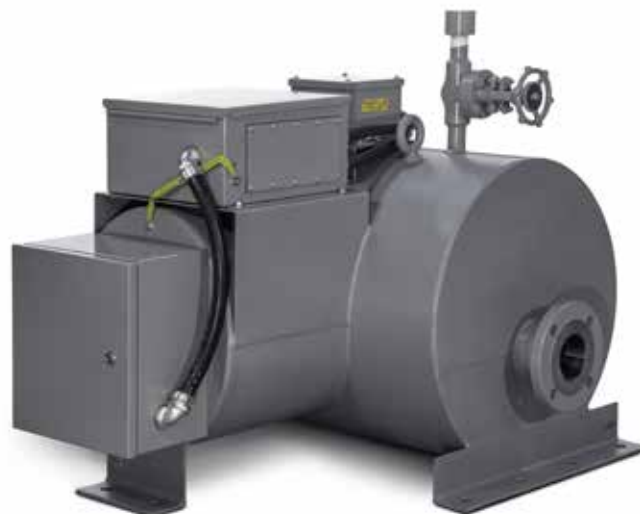
Depending on the system configuration, detectors are protected by a three or six inch lead shield assembly to minimize any background radiation from reaching the detector. A shielded door provides easy access to the detector. GA-EMS monitoring systems are configured to fit most pipe and cable sizes to eliminate the need for additional engineering costs to simplify installation and maintenance.

Adjacent-to-Line Detector in Lead Shield

In-Duct Noble Gas Detector

Stainless Steel In-Line Liquid Monitor

TYPE	RANGE	DESCRIPTION
In-Line Liquid or Gas Monitors	Cs^{137}: 6.7×10^{-8} to 6.7×10^{-2} µCi/mL Xe^{133}: 2.1×10^{-7} to 2.1×10^{-1} µCi/mL	Provides continuous measurement of gamma activity concentration levels in the process lines. Examples of applications include: service water blowdown, steam generator blowdown and condenser off gas.
In-Duct Gas Monitors	Xe^{133}: 1.5×10^{-7} to 1.5×10^{-1} µCi/mL	Continuously measures the level of beta activity concentration by directly interfacing with the air in a duct. Examples include fuel handling area exhaust, auxiliary building exhaust and control room vent.
Adjacent-to-Line Monitors	Cs^{137}: 1.5×10^{-7} to 1.5×10^{-1} µCi/mL Xe^{133}: 5.1×10^{-6} to 5.1×10^{0} µCi/mL	Mounts adjacent to main process lines to measure activity concentration without removing the sample or interrupting the line.
Main Steam Line N16 Primary-to-Secondary Leak Monitors (R.G. 1.97)	N^{16}: 3.7×10^{-7} to 3.7×10^{-1} µCi/mL	An adjacent-to-line monitor that measures activity concentration of the main steam line to support leak rate calculations. Two different regions of interest (ROI) available for display and processing include the fission product and N^{16} ROI.
Main Steam Line Monitors (R.G. 1.97)	Co^{60}: 5.7×10^{-5} to 1.0×10^{2} µCi/mL	Mounted in a lead shield adjacent to the main steam line to measure post-accident concentration of primary coolant in the main steam line. Lead shield minimizes the effect of the background radiation on the detector.

LOCAL/REMOTE PROCESSORS AND DATA ACQUISITION SYSTEMS

GA-EMS local and remote processors and data acquisition systems provide powerful tools and software to capture, relay, analyze and display information to support decision making, and operational status and readiness. Control room processors and indicators offer remote control of the fielded processors and provide convenient, user-friendly interfaces with menu-driven access to database items, numerical and graphical data displays, alarms, and high resolution digital to analog converter outputs to plant interfaces. Each component is designed to suit various mounting configurations, provide ease of accessibility, and is seismically and environmentally qualified to meet safety requirements.

RM-1000

RM-2020

RM-2000

MODEL	TYPE	DESCRIPTION
RM-2000	Local Processor – Multi-channel	Performs data acquisition, analysis and display, monitor control functions, alarm relays, analog outputs, and digital communications. Includes application specific database, multiple history files, menu-driven interface, electronic calibration, automatic diagnostics/continuous self-test, and local status indication.
RM-2020	Local Processor – Single Channel	Provides local and remote activity and alarm status. Generates operate and alert alarms and digital display of dose rate and monitor status. Includes database for configuration, data/alarm setpoints, calibration constants, history files and control functions. Includes checksource operations and communications with external devices.
RM-80	Local Processor – Multi-channel (Legacy)	Performs data collection, data reduction, data analysis, data display, and alarm generation. Controls monitor functions and alarm relays, and maintains monitor and channel database information containing monitor operating parameters.
RM-1000	Remote Indicator – Single Channel	Single channel digital radiation processor/rate meter module for use in various detector systems, both safety-related, Class1E, and non-safety related. Performs processing for both area and process monitor functions. Mounted in standard 19" rackmount NIM bin.
RM-2300	Remote Processor – Multi-channel	Provides database control, display, and inquiry of fielded monitor via communications to the RM-2000. Numerical and graphical display of data. Provides alarm relay outputs. Mounted in standard 19" rackmount NIM bin.
RM-11U	Central Computer System	Monitors and displays data and logs alarm messages from all RM-2000 and RM-2020 in a given network via communication loops. Provides capability for the operator to control the monitor equipment including pumps, checksource, and purge. Provides the operator with display screens showing detector activity levels, status, alarms, trends, database information, and communication statistics. Maintains information for each monitor by polling each RM-2000 and RM-2020 for activities, flow values, alarms, and status.

SPECIAL TOOLS

MODEL	TYPE	DESCRIPTION
RT-10	G-M Tube Transfer Calibration Source	Allows performance of routine transfer calibrations of G-M tube area radiation detectors. Uses a C^{137} source contained in a 4π lead shield for safe handling.
RT-11	Ion Chamber Transfer Calibration Source	Allows performance of routine transfer calibrations of ion chamber area radiation detectors. Uses a C^{137} source contained in a 4π lead shield for safe handling.
Simulator – RM-2000	Simulator Software	PC based software application simulates all features of the RM-2000 microprocessor for use in simulator systems and training systems.
MI-2080	Maintenance Interface Software Kit	PC based remote software interface to RM-80 and RM-2000 monitors. Provides data analysis and maintenance functionality, is capable of querying data from individual monitors and displaying this data to the user as well as downloading data to a monitor in the form of database changes. The software provides a tabular database view, a user-controlled graph display, data-logging capabilities, and the ability to monitor a single radiation monitor. The software can display trends, channel-selection graph, flow graph, checksource trend, K-list display and verification, and communication statistics.