NUCLEAR POWER PLANT PROCESS MONITOR
Model FM-9W-IC-25-HT Ion Chamber System

FEATURES:

- HIGHLY SENSITIVE GAMMA
- MEETS LOCA REQUIREMENTS,
  (Loss of Coolant Accident Prevention)
- ALL PLUG-IN MODULAR
- RACK MOUNTED OR CASE
- SINGLE OR MULTIPLE CHANNEL
- SEALED ION CHAMBER FOR EXCELLENT
  RADIATION RESPONSE
- LOCAL OR REMOTE MONITORING;
  USB/ETHERNET OUTPUT
- SMART ELECTRONICS- ON-BOARD
  MICROPROCESSOR AND DATA-LOGGING; LCD
  COLOR DISPLAY
- USER-SETTABLE ALARMS – AUDIO & VISUAL,
  UNITS OF MEASUREMENT, ETC.
- SAFETY CLASS QUALIFIED FOR NUCLEAR
  POWER PLANT
- DETECTOR: IP67
- ELECTRONICS: IP 63

APPLICATION:
Area monitoring in and around nuclear reactors, reactor pools, hot cells, irradiators and other facilities
handling radioactive materials or x-rays.

DESCRIPTION:

- The FM-9W Series Radiation Monitors incorporate micro-processor driven smart electronics with
  color LCD display.
- On-board data-logging and user-adjustable parameters are featured. The plug-in modular
  construction, allows the addition of channels or functions.
- Ion chamber and circuit design prevent the system readings from falling below full scale during
  an over range condition.
- Both the detector and connecting cables are designed for optimal performance in strenuous
  conditions, such as in containment buildings.
- High level alarm can be set to any value desired. Alarm activation produces red light on front
  panel and piercing audio tone.
- Optional relay is also closed (or opened) for activation of remote alarms. Stand-by battery power
  is optional. Rack or case mounting is supplied.
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GENERAL SPECIFICATIONS:

DETECTOR:
Detector Type: High pressurized ion chamber

Range:
STANDARD: 5 decades 1 µGy/h to 0.1 Gy/h (100 µR/h to 10 R/h)

Range:
OPTIONAL: 6 decades 1 µGy/h to 1 Gy/h (100 µR/h to 100 R/h)

Dose Rate Range: 100 nSv/h – 1 Sv/h (10 mR/h – 100 R/h)

Energy Rejection: Thermal Neutrons, Alphas, Betas

Energy range: 80 KeV to 7 MeV

Response Time: 0.5 to 3 seconds (slower at lower decade, faster at higher decade)

Environment: Temperature: 165° C duration of 12 Hours
Relative Humidity: Up to 95%
Total Integrated Dose: 2 x 10^6 Gy

Accuracy: <± 10%

Temperature Dependence: <.2%/°C

Storage Temperature Range: -40°C to 85°C

ELECTRONICS (LPDU) FM-9W:
Read Out: Alpha-Numeric

Modes (Five):
• Alerts:
  User Settable To Any Trigger Level.

Alarms – Beacon Assembly:
Visual: (High-High) Red Flashing when Radiation Reaches Set Point
Audio: 90 dB at 1 meter

Low Level Alarm: Automatic reset.

High Level Alarm: High level alarm remains activated until ACKNOWLEDGE & RESET button is pushed.

Alarm Clearance: Automatic Reset


Environment:
Temperature: Up to 50°C
Relative Humidity: Up to 95%
Total Integrated Dose: 10 Gy

Weight & Dimensions:
Size: 12” x 12” x 12”
Weight: 26 lbs
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FM-9W SERIES HUB

ELECTRONICS (RDU) FM-9W SERIES HUB:

Display: Color LCD display
Display Read Out: Digital Alpha-Numeric
Read Out Units: Gy/h (User Settable)
Modes (Five): Alert, High, High-High, Operation, Test
Alarms: Green, Yellow, Red
Warning, Equipment Failure, Over-Range, Detector Status
Audio: 90 dB at 1 meter
Visual: Red Flashing when Radiation Reaches Set Point

Alarm Acknowledgement: Silent Mode Push Button
Low Level Alarm: Automatic reset.
High Level Alarm: High level alarm remains activated until ACKNOWLEDGE & RESET button is pushed.
Alarm Clearance: Automatic Reset
Output: USB/Ethernet
Power supply: 120v 60 Hz or 230v 50 Hz or 24 volt DC, 2 Amp
Relay output: 230v, 10 Amp

Outputs:
Buffered isolated 4-20 mA Logarithmic Analog Output Covering the full range of the monitor.

- Stable Within 1% Due to Drift, Temperature, or Line Variations
- Logic Level Signals
- Contact Closure or Opening
- HIGH Radiation Level Relay De-energized When Signal Exceeds Set Point
- Equipment Failure Relay De-energized with Equipment Failure

Weight & Dimensions:
Size: 13.5” W X 11” H X 3.6”
Weight: 8 lbs
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OPTIONAL:
Junction Transfer Box:
- Power Supply Signal
- Detector Signal
- Communication Signal
- Wall or Rack Mount – User Specified.

Weight & Dimensions:
- Size: 8" x 10" x 4"
- Weight: 10 lbs

ADDITIONAL SYSTEM DESCRIPTION:
- Ion chamber is designed and built to withstand maximum temperature of 170°C and total integrated dose of $10^8$ Rads.
- Materials which might be compromised by these conditions are excluded from chamber construction.
- Insulators in ion chamber are specifically mineral or treated glass materials.
- Internal chamber itself is made primarily of stainless steel.
- Cable insulation is mineral
- Length of this cable is determined by user when ordering.
- Electrometer box specially built essentially eliminates possibility of extracameral response.

FM-9W ELECTRONICS MODULE:
- Installation
- Processor:
  FM-9W & FM-9W Series HUB Advanced processor computer
- High Voltage Power Supply:
  FM-9W Separately variable from 0 to 1500v. Extremely stable high voltage.
- Monitor Display
  FM-9W & FM-9W Series HUB Monitor shows both real-time concentration & accumulated dose.
- Read Out:
  FM-9W Data is shown alpha-numerically
  FM-9W Series HUB Data is shown both graphically & alpha-numerically.
IC-25 Sealed Ionization Chamber Detector:

- Sensitivity: \(1.3 \times 10^{-9}\) amps R/hr
- Slope: 0.10% per 100 Volts or less
- Insulation value for inner chamber: >4T ohms
- Capacitance of inner chamber: <15 pF
- Operating Voltage: -200 to -800 V
- Keep Alive Source: 10 µCi Cs-137

PRE-AMPLIFIER:

- The pre-amplifier is a current to voltage amplifier.
- Very high input impedance amplifier with high meg feedback resistors.
- Input current starts from sub-pico amp range.
- Amplified voltage drives a pulse generator feeding into the counter/display module.
- Ultra-quiet high voltage supply delivers a flat VDC as required.
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DETECTOR CABLE:
Mineral Insulated Cable: 2 each (HV and Signal)
Length: 5 to 15 feet; Sheath: 0.250" O.D. (User Specified)
Insulation: High-purity (99.4%) Magnesium Oxide (MgO)
Melting Temp.: 2500°F, 1370°C
Max. Temp. in Air: 1650°F, 900°C

ADDITIONAL CABLE SPECIFICATIONS:
Sheath Diameter: ±0.001 inch (±0.0025mm) or 1% of Nominal diameter, whichever is greater
Wall Thickness: 10% of sheath diameter as a minimum
Thermocouple Wire Calibration: Meets Standard Limits of Error tolerance on calibration per ASTM E-230.
Insulation Resistance At Room Temperature:
Greater than 1000 megohms@50VDC
(sheath diameters of 0.080 inch/ 2.0mm and less),
1000 megohms@500VDC
(sheath diameters of 0.120 inch / 3.0mm and greater).
High Temperature Insulation Resistance:
0.040” diameter at 600°F (316°C) One foot length will be in excess of 10 megohms.
0.62” diameter & larger at 600°F (316°C) One foot length will be in excess of 100 megohms.
Dielectric Strength: These are reference values for application to conductor cable only.

Data is at 60Hz and 70°F (21°C).
Straight: - 100VAC per mil of insulation thickness. Bent: - 45VAC per mil of insulation thickness.
Temperature: Insulation Range:
-450°F (-270°C) to 3000°F (1650°C) without change of phase or chemical reaction with adjacent metals.
Melting Temperature of Insulation: 4800°F (2640°C). Limiting temperature is associated with metals used.
Pressure: Can withstand external pressure up to 50,000psi (3500kg/cm²).
Nuclear: Insulation can be subjected to a mean neutron flux of 2 x 10¹¹n.cm⁻²S⁻¹@100°C and a total peak irradiation of 8 x 10¹⁸n.cm⁻² with no significant change in characteristics.
Formability: Can be bent around a mandrel having a radius equal to twice the sheath diameter without rupturing the sheath or causing loss of insulation resistance.
Fabrication: Sheath can be welded, brazed, and soldered using normal care for the metals and thickness involved without changing insulation resistance.
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POOL SURFACE RADIATION MONITORING SYSTEM

REACTOR POOL

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