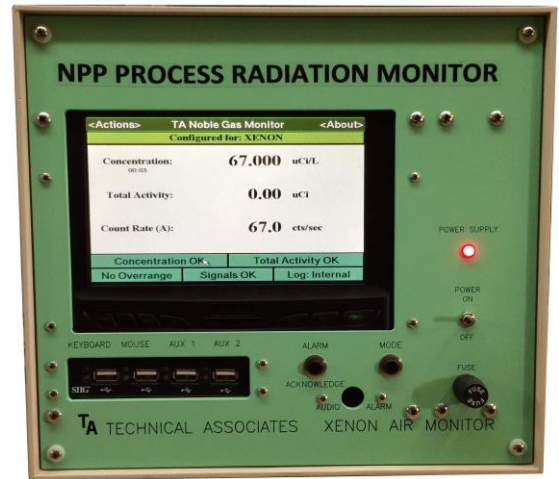


# NUCLEAR POWER PLANT PROCESS MONITOR

## 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**



**FM-9W ELECTRONICS**

### 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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## Model FM-9W-IC-25-HT Ion Chamber System

### GENERAL SPECIFICATIONS:

#### DETECTOR:

<b>Detector Type:</b>	High pressurized ion chamber
<b>Range:</b>	
<b>STANDARD: 5 decades</b>	1 $\mu$ Gy/h to 0.1 Gy/h (100 $\mu$ R/h to 10 R/h)
<b>Range:</b>	
<b>OPTIONAL: 6 decades</b>	1 $\mu$ Gy/h to 1 Gy/h (100 $\mu$ R/h to 100 R/h)
<b>Dose Rate Range:</b>	100 nSv/h – 1 Sv/h (10 mR/h – 100 R/h)
<b>Energy Rejection:</b>	Thermal Neutrons, Alphas, Betas
<b>Energy range:</b>	80 KeV to 7 MeV
<b>Response Time:</b>	0.5 to 3 seconds (slower at lower decade, faster at higher decade)
<b>Environment:</b>	<b>Temperature:</b> 165° C duration of 12 Hours <b>Relative Humidity:</b> Up to 95% <b>Total Integrated Dose:</b> 2 x 10 <sup>6</sup> Gy
<b>Accuracy:</b>	< $\pm$ 10%
<b>Temperature Dependence:</b>	<.2% / °C
<b>Storage Temperature Range:</b>	-40°C to 85°C

#### ELECTRONICS (LPDU) FM-9W:

<b>Read Out:</b>	Alpha-Numeric
<b>Modes (Five):</b>	Alert, High, High-High, Operation, Test
<ul style="list-style-type: none"><li>• <b>Alarms:</b></li></ul>	User Settable To Any Trigger Level.
<b>Alarms – Beacon Assembly:</b>	Green, Yellow, Red
	Visual: (High-High) Red Flashing when Radiation Reaches Set Point
	Audio: 90 dB at 1 meter
<b>Low Level Alarm:</b>	Automatic reset.
<b>High Level Alarm:</b>	High level alarm remains activated until ACKNOWLEDGE & RESET button is pushed.
<b>Alarm Clearance:</b>	Automatic Reset
<b>Visual Alarm:</b>	On-screen alarms and warnings. <b>Red:</b> High level. <b>Amber:</b> Low level
<b>Environment:</b>	<b>Temperature:</b> Up to 50° C <b>Relative Humidity:</b> Up to 95% <b>Total Integrated Dose:</b> 10 Gy
<b>Weight &amp; Dimensions:</b>	
<b>Size:</b>	12" x 12" x 12"
<b>Weight:</b>	26 lbs



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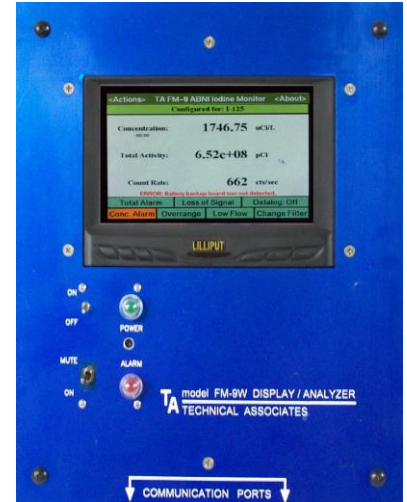
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# NUCLEAR POWER PLANT PROCESS MONITOR

## Model FM-9W-IC-25-HT Ion Chamber System

### FM-9W SERIES HUB

#### ELECTRONICS (RDU) FM-9W SERIES HUB:



<b>Display:</b>	Color LCD display
<b>Display Read Out:</b>	Digital Alpha-Numeric
<b>Read Out Units:</b>	Gy/h (User Settable)
<b>Modes (Five):</b>	Alert, High, High-High, Operation, Test
<b>Alarms:</b>	Green, Yellow, Red Warning, Equipment Failure, Over-Range, Detector Status Audio: 90 dB at 1 meter Visual: Red Flashing when Radiation Reaches Set Point
<b>Alarm Acknowledgement:</b>	Silent Mode Push Button
<b>Low Level Alarm:</b>	Automatic reset.
<b>High Level Alarm:</b>	High level alarm remains activated until ACKNOWLEDGE & RESET button is pushed.
<b>Alarm Clearance:</b>	Automatic Reset
<b>Visual Alarm:</b>	On-screen alarms and warnings. <b>Red:</b> High level. <b>Amber:</b> Low level
<b>Output:</b>	USB/Ethernet
<b>Power supply:</b>	120v 60 hz or 230v 50 hz or 24 volt DC, 2 Amp
<b>Relay output:</b>	230v, 10 Amp
<b>Outputs:</b>	Buffered isolated 4-20 mA Logarithmic Analog Output Covering the full range of the monitor. <ul style="list-style-type: none"><li>• Stable Within 1% Due to Drift, Temperature, or Line Variations</li><li>• Logic Level Signals</li><li>• Contact Closure or Opening</li><li>• HIGH Radiation Level Relay De-energized When Signal Exceeds Set Point</li><li>• Equipment Failure Relay De-energized with Equipment Failure</li></ul>
<b>Weight &amp; Dimensions:</b>	
<b>Size:</b>	13.5" W X 11" H X 3.6"
<b>Weight:</b>	8 lbs



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# NUCLEAR POWER PLANT PROCESS MONITOR

## Model FM-9W-IC-25-HT Ion Chamber System

### 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



### OPTIONAL JUNCTION TRANSFER BOX

### ADDITIONAL SYSTEM DESCRIPTION:

- Ion chamber is designed and built to withstand maximum temperature of 170°C and total integrated dose of 10<sup>8</sup> 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 extracamerual response.

### FM-9W ELECTRONICS MODULE:

- **Installation**  
**FM-9W & FM-9W Series HUB** Wall or Rack Mount – User Specified.
- **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.



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# NUCLEAR POWER PLANT PROCESS MONITOR

## Model FM-9W-IC-25-HT Ion Chamber System

Assembly Procedure: IC-25HT Ion Chambers  
V1.0 20-May-2013

Bottom plate  
Capton Insulator

Window cutout

Probe body



“Shim” with  
outline

End cap

### IC-25 Sealed Ionization Chamber Detector:

<b>Sensitivity:</b>	1.3x10 <sup>-9</sup> amps R/hr
<b>Slope:</b>	0.10% per 100 Volts or less
<b>Insulation value for inner chamber:</b>	>4T ohms
<b>Capacitance of inner chamber:</b>	<15 pF
<b>Operating Voltage:</b>	-200 to -800 V
<b>Keep Alive Source:</b>	10 $\mu$ Ci 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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# NUCLEAR POWER PLANT PROCESS MONITOR

## Model FM-9W-IC-25-HT Ion Chamber System

### 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 <b>ASTM E-230</b> .
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.

<b>Temperature: Insulation Range:</b>	-450°F (-270°C) to 3000°F (1650°C) without change of phase or chemical reaction with adjacent metals.
<b>Melting Temperature of Insulation:</b>	4800°F (2640°C). Limiting temperature is associated with metals used.
<b>Pressure:</b>	Can withstand external pressure up to 50,000psi (3500kg/cm <sup>2</sup> ).
<b>Nuclear:</b>	Insulation can be subjected to a mean neutron flux of $2 \times 10^{11} \text{n.cm}^{-2}\text{S}^{-1}$ @100°C and a total peak irradiation of $8 \times 10^{18} \text{n.cm}^{-2}$ with no significant change in characteristics.
<b>Formability:</b>	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.
<b>Fabrication:</b>	Sheath can be welded, brazed, and soldered using normal care for the metals and thickness involved without changing insulation resistance.



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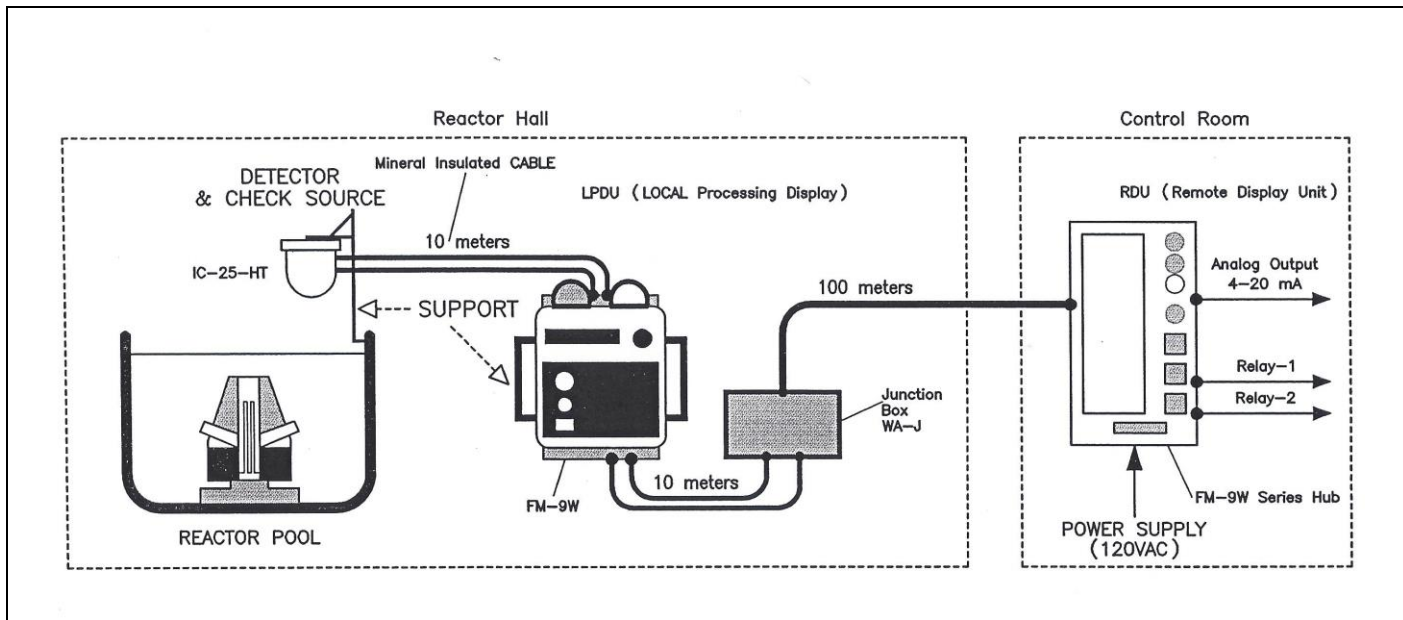
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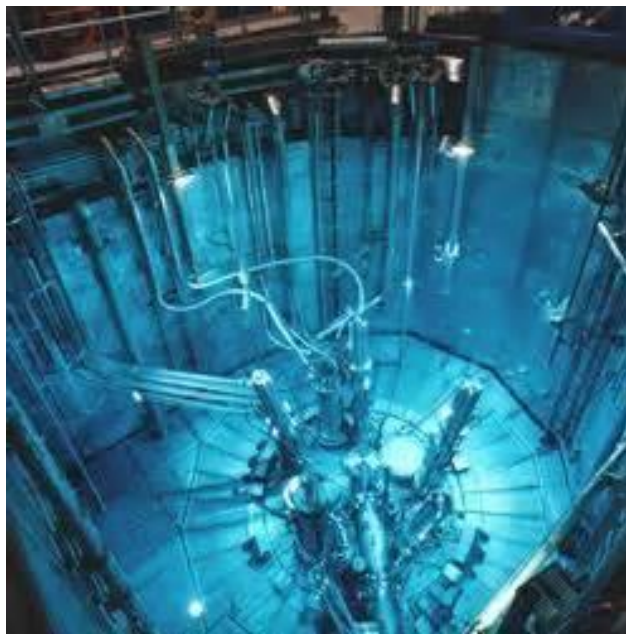
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# NUCLEAR POWER PLANT PROCESS MONITOR

## Model FM-9W-IC-25-HT Ion Chamber System



**POOL SURFACE RADIATION MONITORING SYSTEM**



**REACTOR POOL**



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