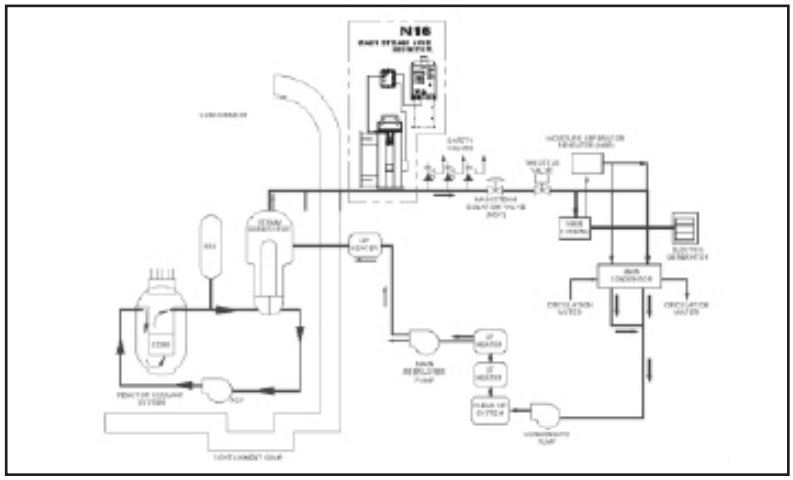
MIRION TECHNOLOGIES

Model NLM100 Main Steam Line and N-16 Steam Generator Leakage

Features

- Optional
  - ADM606 remote display
  - ADM616 digital/analog display and control unit
- Ruggedized gain-stabilized scintillation detectors
- PA300E preamplifier/SCA/ high voltage power supply



Due to regulatory requirements, operating pressurized water reactors (PWR) require monitoring for primary-to-secondary leakage and main steam line activity. Canberra has developed a simple yet technologically advanced monitoring system that can perform both functions using a single set of hardware. Each channel is comprised of a locally mounted lead shielded geometry with a gamma sensitive MD55E scintillation detector, a PA300E preamplifier/SCA, and an ADM616 local Signal Conditioning Unit. A remote signal-conditioning unit Model ADM606 can also be provided for use in the main control room.

For main steam line monitoring applications, Canberra provides a detector that is gain stabilized and designed to operate under the potentially severe environmental conditions associated with such use. The lead shielded geometry is positioned to present the sensitive end of the detector to the main steam line via a collimated opening on the sampler. The range of channel measurement and display is 1E-3 to 1E4 milli Sieverts per hour for gamma energies and is responsive to radiation over an energy range of at least 60 keV to 7 MeV. When it is desirable to also measure levels of N-16 to quantify primary-to-secondary leakage, the same system is expanded to include N-16 measurement. This is accomplished without the use of additional hardware and is implemented by programming the additional analyzer circuits located in the PA300E preamplifier/SCA to window the higher energy gamma associated with the relatively short half-life N-16. Since the PA300E includes three separate SCA circuits, the instrument performs pulse analysis separately for the two different energies from the pulses provided by the MD55E detector. If a reactor power level signal is provided, the system is capable of indicating leakage in the form of gallons per day or gallons per hour. If a dynamic signal is not available, constants are manually entered using the keypad on the instrument or set to a default value in the memory of the ADM606. When operated as an N-16 monitoring channel only, the lead shield is not required. The following paragraphs provide detailed information concerning each design element:

Model NLM100 Main Steam Line and N-16 Steam Generator Leakage Monitor

The display and control device is the Canberra model ADM616 Digital/Analog Ratemeter for local display, and the ADM606 for optional remote display. The ADM616 is a wall-mounted version, while the ADM606 is designed for chassis mounting into a CR600 chassis. Each channel will have a corresponding local ADM616 unit for display and control. The ADM includes visual and audible indication of alarm transition. Each alarm has an associated DPDT relay contact. The following indications will be provided at the local ADM:

CONDITION	VISUAL	AUDIBLE	RELAY
HIGH	Red	Tone	DPDT
ALERT	Amber	Tone	DPDT
FAIL	Amber	Tone	DPDT
NORMAL	Green	None	None
CHECK SOURCE	Digital	None	SPDT
LOW FLOW	Digital	None	SPDT

Each ADM unit also includes a bit mapped digital/analog display, which is used to indicate both the radiation activity and operator messages. Radiation activity is displayed digitally in scientific notation and as an analog bar-graph for trending. The display is autoranging and can be configured via operator input to display process information as either Counts Per Minute (cpm) or engineering units (µCi/cc/GPD leakage, etc.). Operator messages are presented in the digital display to provide information such as alarm setpoints, error messages, alarm conditions and instrument status. Operators interface with the ADM unit via a security keyed keypad switch. By using the MODE, SET and INCREMENT keys, the HIGH and ALERT alarm setpoints can be established at any point in the instrument range. The security keylock switch prevents unauthorized access to the keypad switch and alarm setpoints. Check source activation, lamp test and other diagnostic functions can be performed without the security keylock. In addition to the visual, audible and relay transition outputs previously described, each ADM unit also includes analog and digital signals. Analog 4-20mADC and 0-10 VDC outputs are provided for interfacing with analog devices such as recorders. An RS485 serial communications port is provided for networking the local ADM units with the control room computer system for distributed display and control of the RMS units. In addition, an RS-232C serial communications port is provided for interfacing with a portable laptop computer or diagnostic device.

Each ADM unit is independent from other monitoring channels and includes a power supply for operating the local electronics. A lithium battery backup is maintained for retention of historical information for a period of up to 200 hours after loss of primary battery power.

PA300 PREAMP/SCA

Each channel of the RMS that includes a scintillation detector will also include a locally mounted PA300E Preamp/SCA for conditioning the radiation signal from the detector. The model PA300E is a NEMA enclosed assembly mounted within five feet of the detector.

The PA300E is controlled via the host ADM606 or ADM616 ratemeter using software ‘potentiometers’ to adjust the spectrometer settings such as threshold and window width. PA300E settings are maintained in non-volatile memory to prevent malfunctions due to power disruptions.

Each PA300E will perform the following functions:

a) Provides high voltage for operation of the detector

b) Amplifies the radiation signal for transmission

c) Provides single channel analyzer (SCA) functions including setting the desired energy, window width and threshold. Three separate SCA channels are included.

d) Affords gain stabilization control circuitry for automatic gain control.

e) Provides BNC connector for pulse output to optional multichannel analyzer.

f) Coordinates and controls operation of Canberra extended range scintillation detectors

MD55E Gamma Scintillation Detector

The MD55E detector uses a BGO scintillator optically coupled to a photomultiplier tube/light pipe assembly for detection of gamma emitting radionuclides. The MD55E is a gain stabilized detector and includes an LED and thermistor for gain control and feedback. The MD55E is packaged in a water-resistant O-ring sealed cylinder with a mumetal shield. A multi-conductor cable pigtail with in-line multi-pin circular MS connector interfaces the MD55E with the PA300E preamp/SCA. High temperature versions of the MD55E are provided for Main Steam Line monitoring due to the environmental conditions normally encountered in such locations.

Model NLM100 Main Steam Line and N-16 Steam Generator Leakage Monitor

Specifications

Detector MD55E

TYPE – BGO scintillation crystal, 2 in. x 2 in.

ENVIRONMENT – -10 °F to +200 °F (optional); 0-90% RH Non-condensing.

OPERATING VOLTAGE – Provided by PA-300

DIMENSIONS – 7 in. L x 2.25 in. dia.

Main Steam Line Channel

MDC – Gamma 1E-3 mSv/hr over an energy range of 80 keV to 2.5 MeV.

Sensitivity per RG 1.21, Rev. 1, Appendix A., Section B3 - Sensitivity.

RANGE – 1E-3 to 1E+4 mSv/hr, extended range up to 1E+7 mSv/hr (optional).

ACCURACY – ± 20% (95% confidence level) over the energy range of 80 KeV to 2.5 MeV for a fixed dose rate and normal steam environmental conditions, referenced to ^{137}Cs.

N-16 Channel

MDC – Gamma 5 gallons/day (GPD) leakage at 7 MeV (5E-7 µCi/cc, 18.5 kBq/m^3).

Sensitivity/RG 1.21, Rev. 1, Appendix A., Section B3 Sensitivity.

RANGE – 5 GPD to 50,000 GPD.

ADM616 Display and Control Unit Specifications

DISPLAY – 2 x 20 character alphanumeric, Analog/Digital, Auto ranging and Auto Zeroing LCD, or Thermo.

LUMINESCENT DISPLAY –

Red indicator:	HIGH
Amber indicator:	ALERT
White indicator:	FAIL
Green indicator:	NORMAL

RANGE – 6 decades standard extendable to RG1.97 levels.

OUTPUTS – Digital (2) RS-485 and (1) RS-232C Analog (4) 0-10 V dc, or (4) 4-20 mA dc isolated DPDT contact for FAIL, ALERT and HIGH alarms, contact rating 2A at 115 V ac resistive.

POWER – 115 V ac or 220 V ac single phase, 50/60 Hz, 8 watts.

TEMPERATURE – -10°C to +60°C.

HUMIDITY – 0-95% RH, non-condensing.

Gain Stabilized Scintillation Detection

Canberra scintillation detectors operate with Canberra's unique gain stabilization circuitry for accurate and automatically compensated detection of radiation activity. In brief, imbedded within the detector enclosure, and optically coupled to the light pipe assembly, Canberra has included an LED and thermistor for gain compensation. The LED is pulsed at a known low pulse repetition rate with a known pulse width and amplitude to provide a reference signal to the PA300E preamplifier/SCA. The PA300E contains circuitry, which compares the LED pulses with a reference reading to provide a feedback for automatic gain compensations due to drift and aging. The thermistor within the detector performs a similar function with respect to temperature variations, automatically correcting the detector output for variations in gain due to temperature shifts. This unique Canberra feature extends the calibration cycle of the radiation monitoring channel and improves system accuracy with drift free operation.

Extended Range Scintillation Detectors

Using the characteristics inherent in the scintillation detector operation, Canberra has developed the ability to measure a wide dynamic range using a single scintillation detector system. Traditionally, scintillation based detectors were limited to five or six decades of linear measurement before pulse rates saturated the detection channel. Wide range detection channels for measuring normal and post-accident/high range conditions required two or more detectors to provide nine or more decades of activity. Canberra scintillation detectors are capable of up to nine or more decades of measurement by employing the characteristics of scintillation detectors. As the scintillation detector approaches the upper range of pulse counting capabilities, the amount of current generated by the detector system (crystal and photomultiplier tube) becomes a statistically reliable amount suitable for measurement. Since the current output is proportional to the activity detected, this type of measurement provides a linear and reliable measurement of gross activity. Canberra extended range scintillation detectors include automatic switchover from pulse counting to current measurement as the activity increases. On decreasing activity levels, the detectors automatically switch back into pulse counting mode. Using this methodology, Canberra scintillation based extended range detection systems are capable of measuring nine or more decades of linear activity (from environmental effluent release levels up to high range activity monitoring levels) using a single detector.

CANBERRA

C9786 – 07/02