

Previous model number: 4200-600

N2240 Series Active-Passive Drum Monitor (Differential Die Away)

Introduction

The ANTECH N2240 Series are enhanced efficiency active-passive neutron counters for the measurement of plutonium and uranium in nuclear waste.

The neutron detection system consists of 90 ^3He tubes embedded in a cadmium clad polyethylene moderator and arranged in 18 fast detector packages (three per side). Each package is connected to a high voltage junction box containing an Amptek charge sensitive amplifier/discriminator circuit and connections for high voltage, low voltage and signal cables. Polyethylene back shielding is provided to reduce the effects of ambient background. The outer surface is covered in stainless steel cladding and the graphite liner is clad in aluminium. The N2240 Series can be operated in conventional totals active mode or the more advanced Fission Fission passive neutron correlation coincidence counting (reals) mode. This latter mode reduces the amount of effort required to calibrate the measurement system.

In conventional active totals mode, pulses of neutrons are used to interrogate a waste drum placed in the measurement chamber. A neutron generator is pulsed at 100 Hz producing 14-MeV neutrons. The neutrons are slowed down in graphite providing a source of thermal neutrons that cause induced fission in the ^{235}U and ^{239}Pu in the waste. Each pulse generates approximately 1×10^6 neutrons. Cadmium shielded detector packages are used to measure the prompt fission neutrons (from induced fission) in a time period (after a delay of 500 μs) when neutrons from the initial generator burst have been cleared from the fast detector packages. At a generator frequency of 100 Hz, each measurement period is $\sim 10\text{ms}$. Neutrons are counted in an early gate (0.8 ms to 3.0 ms) and a late gate (6 ms to 9.5 ms). The measurement result is the separate sum of many early and late gates as the overall measurement time is typically 5 minutes or more. Additional ^3He flux monitors are placed in the measurement chamber and provide a measure of the interrogating neutron intensity and its die-away characteristics. A later time period is used to determine the background due to delayed neutron production from fission products and from any spontaneous fission nuclides present. The fissile mass is proportional to the net fissile signal normalised to the interrogating flux. The system is calibrated for uranium and plutonium mass using representative matrices.

Passive mode operation uses conventional neutron counting of the correlated neutrons arising from spontaneous fission of the even plutonium nuclides, principally ^{240}Pu . Plant measured isotopic ratios (from high resolution gamma-ray spectrometry) can be used by the software in order to convert $^{240}\text{Pu}_{\text{effective}}$ mass to total plutonium mass.



Model N2240-440

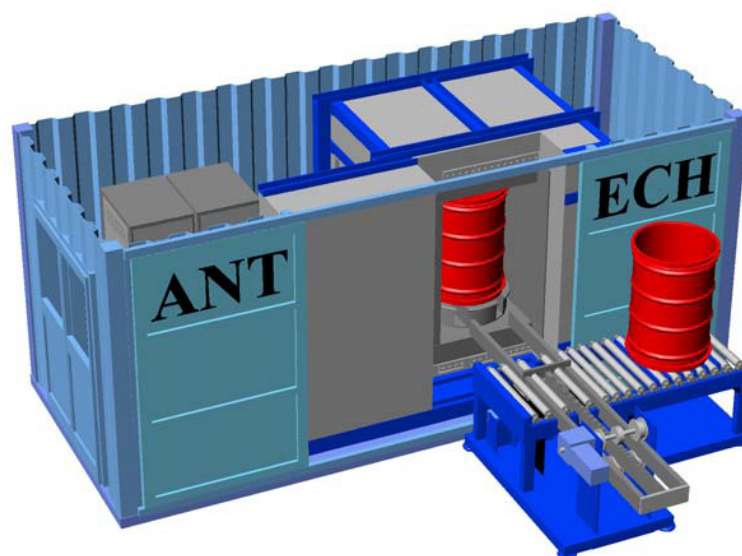


Illustration of the Active-Passive Drum Monitor (Differential Die Away) housed in a transportable ISO container. In this configuration it is model N6241-2240-220 (for 220L drums) or N6241-2240-440 (for 440L drums).

Features

- Semi-automatic drum loading capability
- Thermo Scientific (MF Physics) zetatron neutron (D-T) generator of proven high reliability
- 18 x fast neutron detector packages
- State of the art multi-channel scaler and time correlation analyser
- Operation in conventional active totals neutron mode or in coincidence counting mode using the Fission Fission neutron Correlation method

Benefits

- Capable of the measurement of low levels of fissile and fertile material in waste
- Capable of both 'active' and 'passive' operation for the measurement of fissile and fertile nuclides
- Long die-away time (>1 ms) and high neutron detection efficiency
- Aimed at European and USA low level waste consignment limits and LLW/TRU segregation in the USA

Specification

	4200-200	4200-440
Measurement chamber dimensions (H x W x D)	1060 mm x 760 mm x 760 mm (41.7 in x 30 in x 30 in)	1250 mm x 850 mm x 850 mm (49.2 in x 33.4 in x 33.4 in)
External dimensions (H x W x D) (excluding conveyer and loading platform)	2600 mm x 2500 mm x 2500 mm (102.5 in x 98.5 in x 98.5 in)	
Weight (approx.)	11,500 kg	
Maximum drum size	200 L	440 L
Detector tubes	90 x ³ He detector tubes	
Detector tube dimensions (diameter)	25.4 mm at 4 atm pressure (1 in)	
Die-away time fast detector packages	~40 μs	
Die-away time (chamber)	~1-1.5 ms	
Active mode Lower Limit of Detection (LLD)	0.61 mg ²³⁹ Pu and 0.91 mg ²³⁵ U (approx.)	
Passive mode detection efficiency	11.4% in empty chamber (approx.)	
Services	Electrical 240 v or 110 v AC	
Typical measurement time	Active 5 minutes	
	Passive 20 minutes	