

Previous model number: 5100

Passive Neutron Crate Counter

N2920-2550

Introduction

The N2920-2550 Passive Neutron Crate Counter is used for the determination of the ^{240}Pu mass in transuranic (TRU) waste transport containers. It can be configured to the customer's requirements to measure a variety of waste boxes including B25 Crate or the Standard Waste Box (SWB). The instrument performs passive neutron counting of the correlated neutrons arising from the spontaneous fission of even plutonium nuclides, principally ^{240}Pu .

The neutron detection system consists of polyethylene modules. Each of these modules contains eight ^3He tubes connected to a junction box. The junction boxes are hermetically sealed and contain not only the high voltage distribution and charge collection circuitry, but also Amptek model A-111 charge sensitive amplifiers. The detector modules are housed inside a 270 mm (10.63 in) thick polyethylene outer shield.

A cadmium liner on the internal face of the modules can be removed to change the drum monitor to a higher efficiency unfiltered configuration. The N2920-2550 has a typical detection efficiency of ~20% with the cadmium liners deployed and ~30% with the cadmium liners removed.

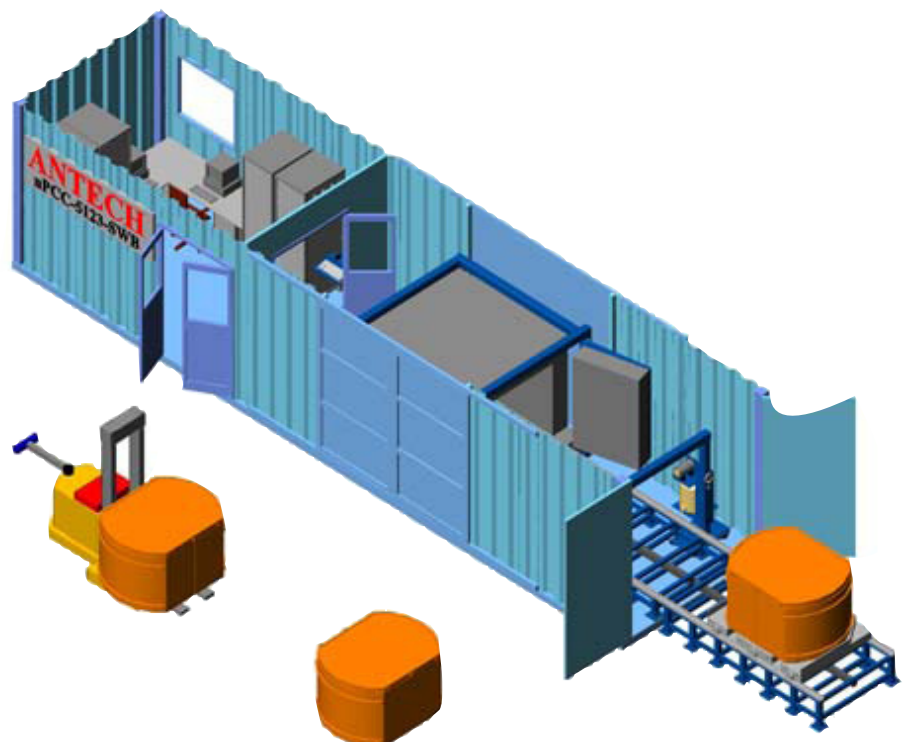
The N2920-2550 is coupled with a Multiplicity Shift Register that uses an optimised version of the Los Alamos National Laboratory (LANL) INCC code based on super-HENC technology for cosmic-ray reduction. This involves multiplicity distribution truncation and veto counting of adjacent detectors to reduce the cosmic-ray generated coincidence background.

The N2920-2550 is available with an optional 'Add-a-Source' ^{252}Cf based matrix correction capability. This is a well established technique for matrix correction and is appropriate when low count rates and small quantities of material are present in the measurement chamber. 'Add-a-Source' complements matrix correction by neutron multiplicity counting. The system typically consists of an 80 μCi ^{252}Cf source deployed on a 'Teleflex' cable with associated shielding, motor drive and control.

The N2920-2550 can be operated in conventional shift register coincidence counting (reals) mode with a calibration function, the absolute multiplicity counting mode (histogram function), or totals counting mode. Plant measured isotopic ratios can be used by the software to convert $^{240}\text{Pu}_{\text{effective}}$ mass to total plutonium mass.

Features

- Removable internal cadmium filters allow detection efficiency to be varied in accordance with the measurement requirement
- Optional 'Add-a-Source' ^{252}Cf available for matrix correction that complements the matrix correction by neutron multiplicity counting
- Optional High Purity Germanium (HPGe) gamma-ray spectrometry system available for determining plutonium isotopic ratios; the combined instrument reports total plutonium mass



Benefits

- Can be operated in conventional coincidence mode to eliminate the (α ,n) neutron signal, and in multiplicity mode to achieve matrix correction (when larger quantities of plutonium are present)
- Crate counter can be placed in a building or operated from a remote location within a transportable ISO container (as illustrated above)
- Multiple neutron measurement methods include: neutron totals counting, neutron coincidence counting and neutron multiplicity counting
- System can also be operated as an absolute neutron multiplicity system, independent of calibration for TRU waste
- Avoidance of high Z structural materials in the construction of the counter to reduce cosmic-ray background

Specification

Approximate external dimensions (H x W x D)	2100 mm x 2400 mm x 3500 mm (82.68 in x 94.49 in x 137.8 in)
Weight (approx.)	400 kg (881.85 lb)
Detector tubes	272 x ^3He detector tubes deployed around the crate or box
Detector dimensions	25.4 mm at 6.5 atm pressure (1 in)
Detection efficiency	~20% with Cd liners deployed and ~30% with the Cd liners removed (typically)
Operating voltage	~1650 v
Detector module die-away time	< 40 μs
Minimum detection limit	92 mg $^{240}\text{Pu}_{\text{effective}}$ in coincidence (reals) mode equivalent to between ~1.54 g total Pu (military grade)