MIRION TECHNOLOGIES

Radiation Safety. **Amplified.**

Model WM3210 Passive/Active

Neutron Cf-252 Shuffler System

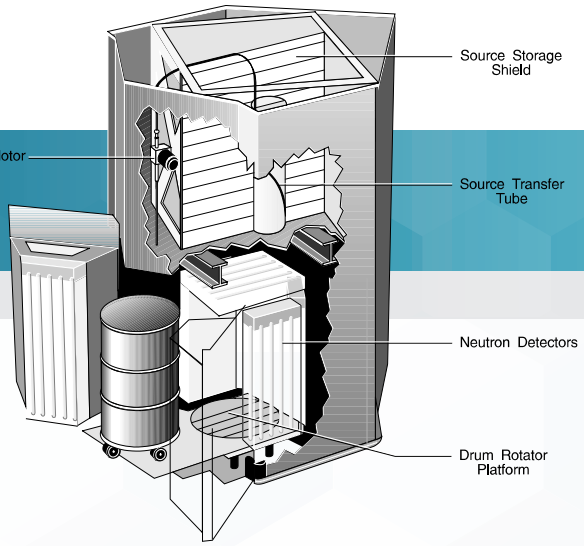

Figure 1
The WM3210 PAN Counter and Shuffler[1].

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KEY FEATURES

- Unique ^{252}Cf Shuffler mechanism for both Active and Passive neutro coincidence counting of 200 L drums
- Active mode sensitivity[1], 1000 second count time:
  - Fast neutrons: 300 mg ^{235}U
  - Thermal neutrons: 3 mg ^{235}U
- Passive mode sensitivity[1], 1000 second count time: 4 mg ^{240}Pu
- Rugged mechanical design for in-plant use
- Fast Teleflex source shuffling mechanism with 400 ms transfer time
- Three rpm turntable for barrel rotation
- Sixty-four ^{3}He tubes for 17.5% detection efficiency
- PC-based control and analysis system

DESCRIPTION

The WM3210 is based upon a design by Los Alamos National Laboratory[1], and is available commercially from CANBERRA's Applied Systems Division through a technology transfer agreement with LANL. The Model WM3210 Passive/Active Neutron (PAN) Shuffler uses a high speed transfer mechanism to shuffle a ^{252}Cf interrogation source between a source shield assembly and the counting chamber, giving it the ability to be used for both passive and active neutron coincidence counting of fissionable materials.

Because shuffler-type instruments can be used for the non-destructive assay (NDA) of small amounts of both uranium and plutonium in a wide variety of forms and matrix materials, they are ideal for analyzing waste materials produced by facilities which handle fissile material and for safeguards accountability measurements. In addition, the design of the WM3210 allows it to also be used for samples as large as spent fuel assemblies, where the presence of large amounts of activation products make gamma assay impractical.

THE COUNTING CHAMBER

The counting chamber, shown in Figure 1, has an interior cavity large enough to comfortably contain a 200 L (55 gal) drum. The drum sits on a turntable, which rotates at 3 rpm while the count is in progress. When the door to the counting chamber is closed the drum is surrounded by a shield of tungsten, high-density polyethylene, and boron-loaded polyethylene weighing approximately 3600 kg (8000 lb). Imbedded in the shielding are 64 ^{3}He tubes, giving the system a high counting efficiency.

THE SOURCE AND SHUFFLER

The ^{252}Cf interrogation source, which nominally provides 8 x 10^{8} n/s, is housed in its own 1800 kg (4000 lb) shield located above the counting chamber. A Teleflex cable, which is driven by a computer-controlled stepper motor, is used to rapidly transfer the source between its shielded housing and the counting chamber.

Less than 400 ms are required to insert or remove the source, and safety interlocks insure that the counting chamber door is closed before the source is transferred into its sample interrogation position.

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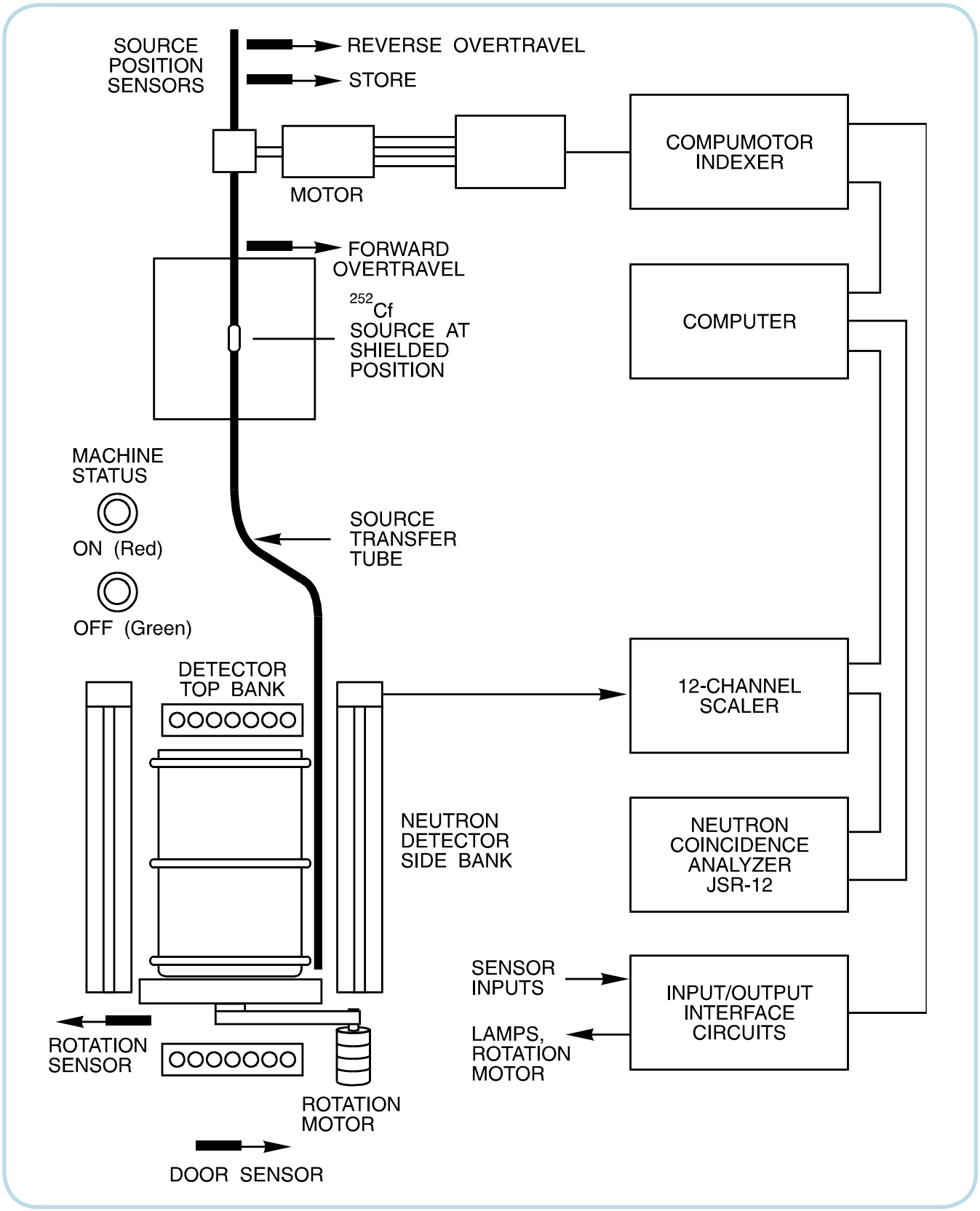

Figure 2
System Block Diagram[1].

THE SHUFFLER COUNTING METHOD

When the WM3210 is used as an active counter, the shuffler mechanism is typically used as follows to count a sample:

1. The source is sent to the counting chamber, where it spends 11 seconds irradiating the sample.
2. The source is removed, and a delay of approximately 3.5 seconds is allowed to elapse.
3. A 7 second count cycle is then initiated to count the delayed neutrons from the sample.

This irradiation/delay/count process is then continuously repeated until sufficiently good counting statistics have been achieved.

When the WM3210 is used as a passive counter, the ^{252}Cf source remains in its shield. In this mode the WM3210 operates in a manner similar to the WM3100 Series.

TYPICAL RESULTS

While the nature of the sample and exact shuffle/count times used will impact the results, 1000 second measurement times have yielded sensitivities (at 3 s above background) of 300 mg of ^{235}U contained within a 200 L drum. By removing the cadmium liner from the counting chamber and counting the thermal neutrons which are produced, sensitivities down to 20 mg of ^{235}U have been obtained. When operated in areas with lower ambient backgrounds or with a larger ^{252}Cf source, the sensitivity levels improve.

When used as a passive counter for the even isotopes of plutonium, results of 4 mg ^{240}Pu-eff are typical of what can be expected.

THE ELECTRONICS SUBSYSTEM

A block diagram of the control and analysis system required to perform the shuffle counting and analysis is shown in Figure 2. Overall supervision and data analysis is performed via an industry PC. A JSR-12 Neutron Coincidence Counter is used for data acquisition, and the remaining components for motion control and safety interlocks.

SPECIFICATIONS

^{252}CF SOURCE AND SHIELD

- Source Strength – 8 x 10^8 n/s.
- Source Half Life – 2.6 years.
- Radiation Shielding – 1800 kg (4000 lb).
- Radiation Level – 1 mR/h at 1 m from the shield.

COUNTING CHAMBER

- ^{3}He Tubes – 64 each.
- Detector Efficiency – 17.5%.
- Radiation Shielding – 3600 kg (8000 lb).
- Liner – Cadmium.
- Inside Diameter – 76 cm (30 in.).
- Barrel Rotation – 3 rpm.

PERFORMANCE

- Active mode sensitivity – 1000 second count time:
  - Fast Neutrons – 300 mg ^{235}U.
  - Thermal Neutrons – 3 mg ^{235}U.
- Passive mode sensitivity – 1000 second count time: 4 mg ^{240}Pu-eff.
- Accuracy – 15% for waste barrels.

REFERENCE

1. Los Alamos National Laboratory Application Note *The ^{252}Californium Shuffler*, March, 1990.

ISO 9001 SYSTEM CERTIFIED

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