cavendish nuclear

Fast neutron detectors configured for glovebox measurements (image courtesy Jordans of Yate, Bristol).

PRODUCTS AND SERVICES:

Plutonium Hold-Up Measurement System

OVERVIEW

Cavendish Nuclear's fast neutron detector based Plutonium Hold-Up Measurement System (PHUMS) is a lightweight, compact and portable assay system with the flexibility to measure the nuclear material content of a wide range of objects including process cells, facilities, gloveboxes, pipes and drums to inform Post Operation Clean Out strategies.

AT A GLANCE

- The ultimate tool for informing Post Operation Clean Out strategy, decommissioning, waste management and security applications
- Unique, modular, mobile design for the in-situ assay of a wide range of object sizes and shapes
- Calculates both plutonium mass and distribution
- Determines information for use in pre-commencement safety cases
- State of the art fast neutron counting technology
- Novel analytical methods including likelihood expectation and clustering techniques
- Optional High Resolution Gamma Spectrometry system for Pu isotopics analysis

THE BENEFITS OF OUR APPROACH

PIN-POINT ACCURACY

0% ZERO ERROR RATE

SIMPLE, RELIABLE DESIGN

THE PRODUCT IN DETAIL

The PHUMS is an innovative and novel analysis method that combines the latest in fast neutron detection technology with advanced analysis techniques to allow characterisation of extended environments such as a process cell or facility, or glovebox line, as well as discrete objects such as individual gloveboxes or drums.

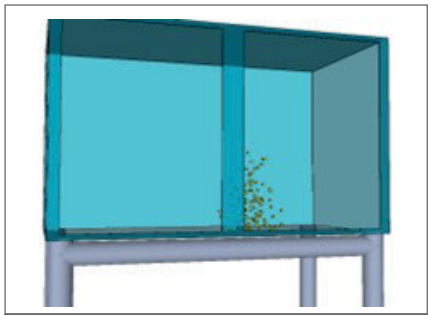
Fast neutron measurements can be conducted quickly and easily with minimal disruption to the environment within which the detectors are deployed.

The number of detectors and the duration and number of measurements taken can be tailored to suit the object under investigation and its environment to ensure optimum measurement coverage. Using the Cavendish Nuclear developed fast neutron detection system it is possible to determine both the mass and distribution of nuclear material within the item being measured.

Each fast neutron detector is pre-calibrated prior to deployment to ensure that it is operating optimally and the response of the detector is fully determined before deployment.

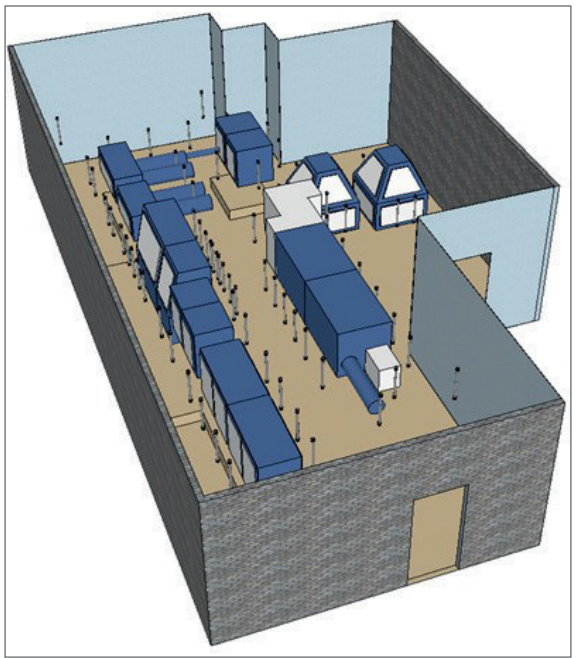
Multiple detectors can be deployed to minimise measurement times and thereby reduce operator dose uptake whilst still ensuring adequate coverage of the item being investigated.

The measurement data available for analysis is extensive, enabling neutron energy spectrum information, total fast neutron count rates, fast to thermal neutron ratio, and the ratio of spontaneous fission neutrons to (a,n) neutrons to be determined. This extensive dataset makes Cavendish Nuclear's fast neutron detection capability unique and an ideal way to inform Post Operation Clean Out (POCO) strategy.



PHUMS Pu mass distribution within a glovebox

Most characterisation methodologies do not allow for robust uncertainties to be fully determined as, typically, only one of the many valid solutions is calculated. However, by combining "likelihood expectation" strategies with novel clustering methods a near complete set of solutions is found. This permits a best estimate plutonium mass to be determined with much more robust uncertainties.



Model showing detector position around gloveboxes within a process cell.

As PHUMS does not rely on background shielding of the detectors, the analytical modelling can be set up so that the detectors are thought of as being within the environment and not just around an object. This approach makes the PHUMS ideal for characterisation of entire cells or facilities

The analysis consists of three phases:

1) Measurement Phase

- Measurements taken throughout cell for > 5 minutes. The duration and number of measurements is chosen to give optimum coverage.
- Typically takes between 1 and 5 days dependent upon cell / facility size.

2) Modelling Phase

- MCNP model created for scene / environment.
- Generate point set.
- Determine build up and transmission factors.
- Time depends on complexity of model but does not need repeating for subsequent deployments in same location.

3) Solution Phase

- Construct response matrix.
- Subdivide point set
- Perform likelihood expectation.
- Generate neutron emission.
- Generate plutonium mass and uncertainty
- Typically takes between 10 minutes and several hours dependent upon complexity.

An optional high resolution gamma spectrometry (HRGS) system may be deployed to supplement the fast neutron measurements in order to determine plutonium isotopic composition.

PHUMS trials have been successfully undertaken in a range of different environments validating the suitability of the system as a plutonium hold-up characterisation method suitable for use in POCO strategy development. In a number of cases it has been possible to verify results by comparison with deployments of existing well proven hold-up characterisation methods such as Cavendish Nuclear's DISPIM (Decommissioning In-Situ Plutonium Imaging Monitor) system.

cavendish nuclear

FOR MORE INFORMATION, CONTACT:

Jonathan Britton - Product & Services Manager, Cavendish Nuclear,
106 Dalton Avenue, Birchwood, Warrington, Cheshire WA3 6YD
+44 (0)1925 377800 *instrumentservices@cavendishnuclear.com*