

Method Development for Characterisation of Uranium in UF₆ Cylinders

Scope:

This project was to carry out a feasibility study and radiometric method development (with consideration of the physics methodology, measurement geometries and scanning methodology and identification of key indicator nuclides) for discrimination between standard storage cylinders containing UF₆ which is of virgin origin and that which has arisen from reprocessing operations. A High Resolution Gamma ray Spectrometry (HRGS) survey was conducted for 4 type 48Y UF₆ cylinders whose UF₆ inventory has already been sampled and chemically analysed, in order to test the technique. Our standard In-Situ Object Counting System (ISOCS) which is an established flexible tool for quantifying the β/γ activity content, was employed for these test measurements. This technique is based on computer modelling of the item under interrogation, in order to represent the counting geometry, with no requirement for radioisotope calibration sources. Measurements were performed at the Sellafield Ltd (Capenhurst) site in Cheshire, UK.

Key Drivers:

Sellafield Ltd required development of a non destructive technique to distinguish between cylinders containing virgin and used UF₆. This data is ultimately required to provide Sellafield Ltd with essential characterisation knowledge to assist in the planning of future operations with regard to potential storage or re-use of the UF₆ material.



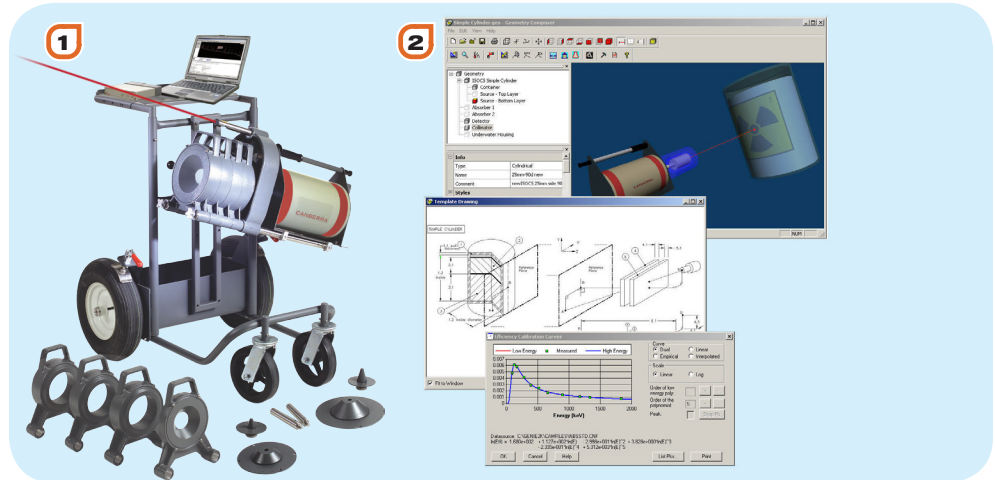
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MIRION
TECHNOLOGIES

Instruments & Techniques Used:

- 1 Instruments:**
 - ISOCS
- 2 Software**
 - ISOCS modelling



CANBERRA Solution:

CANBERRA's solution to Sellafield Ltd's challenge included:

- A thorough review of the reactor physics governing the isotope production routes in irradiated uranium, leading to identification of candidate gamma emissions from a gamma spectroscopy technique.
- Development of a cylinder survey approach and procedures for the 4 test cylinders.
- Development of complete step by step procedures including assessment of the required count time and measurement geometry.
- ISOCS modelling of the UF₆ cylinders for calibration.
- Mobilisation of ISOCS equipment and deployment at the Capenhurst site.
- Performing a non-destructive measurement of the entire item volume of the test cylinders to identify the nuclides responsible for the gamma emissions.
- Measuring the activity for each identified nuclide in the bulk UF₆ inventory.
- Initial assessment as to the irradiation origin of the uranium within each cylinder.
- Consolidation of analysis results in the light of known characterisation data (isotopics data for various U isotopes) to test the assessment technique.
- Production of a complete technical report detailing the physics method development, assumptions, test measurements and conclusions.

ACHIEVEMENTS

The UK measurements team has developed a robust physics technique for discrimination between virgin and reprocessed uranium in UF₆ storage cylinders, based on identification and quantification of an unambiguous characteristic gamma ray signature. This method has been validated with reference to the test cylinder measurements, and provides a platform for future development of a routine high throughput system for stored cylinders.

