The Sellafield Ltd. Muon Tomography Project

This multi-million pound industrial collaboration (funded by Sellafield Ltd. on behalf of the UK Nuclear Decommissioning Authority) between the Nuclear Physics group at the University of Glasgow and National Nuclear Laboratory is developing a cosmic-ray Muon Tomography (MT) system to non-destructively and non-invasively assay the contents of legacy nuclear waste containers at Sellafield.

Fig. 1: The Intermediate Level Waste (ILW) encapsulation process showing the Magnox fuel rods and intermediate swarf removal and grouting stages (all images courtesy of Sellafield Ltd. and the UK NDA).

Detector Technology & Imaging Principles

A small-scale prototype detector system (Fig. 2) has been constructed in Glasgow using plastic scintillating fibre and photomultiplier tube technologies. Two tracking modules above, and two below, measure the incoming and Coulomb-scattered trajectories of the muon as it passes through the volume of interest. Determination of the scattering position and angle (dependent on the atomic number Z of the material) allows the constituent materials to be identified.

The prototype system has been successfully demonstrated using experimental data collected with a small industrial test barrel. These images are shown in Fig. 3. A high-Z uranium cylinder is clearly visible within this steel-shielded, concrete-filled container with millimetre precision. Full details on the project and these results can be found here.

Fig. 3: Horizontal and vertical slices through a steel, concrete-filled barrel in the region of a small uranium cylinder. The colour scale represents the Z-dependent scattering density.

http://nuclear.gla.ac.uk/MuonProject

Project Contacts:
Dr. Craig Shearer
Craig.Shearer@nnl.co.uk

Prof. David Ireland
David.Ireland@Glasgow.ac.uk

Mr. Mark Dowson
Mark.Dowson@sellafieldsites.com