

Activity Depth Profiling of HIFAR Reactor at ANSTO, Lucas Heights, Australia

Scope:

- HIFAR was Australia's first multi-purpose research nuclear reactor, a pressurized heavy water reactor that operated from 1958 to 2007
- Depth profiling of the reactor shell was performed to support future dismantling and disposal of the activated components
- The *TruPro*[®] patented technology was selected by ANSTO to avoid cross-contamination as drilling is less invasive and contaminating than the standard coring method
- The goal of this project for ANSTO was to perform the facility characterization using *New Millennium Nuclear Technologies International, Inc's (NMNTI) TruPro*[®] patented technology coupled with the *CANBERRA*[™] alpha/beta/gamma analytical capabilities to assess the levels of material activation while still maintaining the integrity of the building

Key Drivers:

- To maintain ALARA principles, the reactor shell had to be characterized to understand levels of activation in different materials and to generate activity depth profiles prior to dismantlement
- Three locations were used to sample different zones of the reactor shell
- The duration of the work was four weeks, with 100 samples collected and analyzed
- Sampling of several different materials including steel, lead, graphite, concrete, lead-shot concrete, aluminum and boral, was required
- Same-day analytical results were required
- Specific radionuclides of concern included Ba-133, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, and Zn-65
- Gamma detection limits of <0.1 Bq/g were to be maintained for all radionuclides of concern
- Working space for drilling was very limited within the HIFAR building



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Activity Depth Profiling at ANSTO

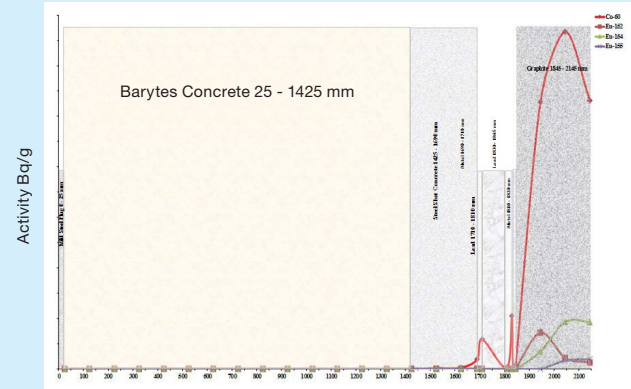
Case Study

Instruments & Techniques Used:

- 1 iSolo® for alpha/beta counts
- 2 ISOCS™ with GC5020 HPGe, Big MAC, InSpector™ 2000
- 3 ISOCS characterization software
- 4 Genie™ 2000 analysis software



GRAPH SHOWING GAMMA ACTIVITY FOR DEPTH OF 0 - 2145 mm HIFAR CENTRELINE



CANBERRA Solution:

- A temporary on-site analytical lab was set up in an adjacent building for sample analysis. The required measurements included gamma spectroscopy, gross alpha, and gross beta counts
- *NMNTI's TruPro®* patented technology collected powdered samples into 250 ml sample jars
- The *TruPro®* technology is capable of sampling a wide range of materials, including concrete, lead, graphite, and steel
- The sampling depth was recorded for each sample
- The CANBERRA ISOCS system was the appropriate choice for gamma measurements
- A separate ISOCS efficiency model that accounted for the sample material type and density, the sample geometry, and the intrinsic detector efficiency, were generated for each sample collected
- The complete gamma system included two ISOCS HPGe detectors, 25 mm lead shielding, InSpector 2000 MCA's, and ISOCS and Genie 2000 analysis software
- Typical gamma count times were 20 minutes per sample
- Same-day gamma analyses were performed
- Gross alpha/beta counts were performed on subsamples using the CANBERRA iSolo instrument

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ACHIEVEMENTS

- ➔ All layers of the HIFAR reactor shield were successfully sampled
- ➔ Three different locations were drilled. Depth profiles of detected activation products were generated for all three locations. All of the relevant radionuclides were detected and quantified
- ➔ Distinct material layers were sampled with no cross contamination
- ➔ 100 samples were measured over 20 working days
- ➔ Throughputs were up to 20 samples per day
- ➔ Gamma detection limits were maintained below 0.1Bq/g for all radionuclides of concern and for all samples
- ➔ All gamma analyses were completed and reported to the customer on the same day as sample measurement
- ➔ Gross alpha/beta counts were performed for all samples
- ➔ The *TruPro®* patented technology approach was faster, cheaper, and safer than traditional core drilling
- ➔ The successful joint effort demonstrated that the CANBERRA solutions are well suited for analysis of samples obtained with *TruPro®*
- ➔ Personnel doses were maintained ALARA. Control of radioactive material was maintained throughout the project