

# 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*<sup>®</sup> 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*<sup>®</sup> patented technology coupled with the *CANBERRA*<sup>™</sup> 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



Visit our Measurement and Expertise (M&E) page.



**MIRION**  
TECHNOLOGIES

# Activity Depth Profiling at ANSTO

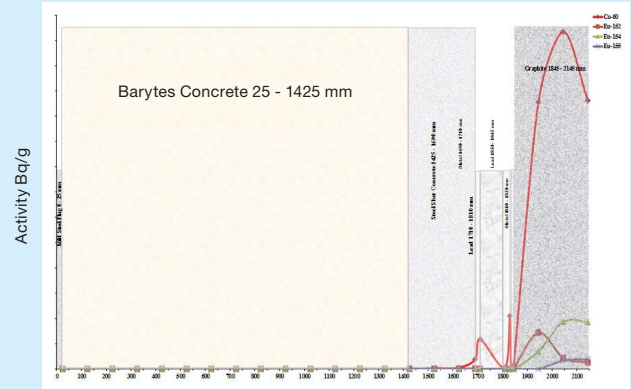
## Case Study

### Instruments & Techniques Used:

- 1 iSolo<sup>®</sup> for alpha/beta counts
- 2 ISOCS<sup>™</sup> with GC5020 HPGe, Big MAC, InSpector<sup>™</sup> 2000
- 3 ISOCS characterization software
- 4 Genie<sup>™</sup> 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<sup>®</sup>* patented technology collected powdered samples into 250 ml sample jars
- The *TruPro<sup>®</sup>* 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

Copyright ©2017 Mirion Technologies, Inc. or its affiliates. All rights reserved. Mirion, the Mirion logo, CANBERRA, iSolo, ISOCS, InSpector, Genie and other trade names of Mirion products listed herein are trademarks and/or registered trademarks of Mirion Technologies, Inc. and/or its affiliates in the United States and/or other countries.

TruPro is a registered trademark of New Millennium Nuclear Technologies International, Inc. in the United States and/or other countries.

Third party trademarks mentioned are the property of their respective owners.

### 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<sup>®</sup>* 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<sup>®</sup>*
- ➔ Personnel doses were maintained ALARA. Control of radioactive material was maintained throughout the project