Supporting nuclear non-proliferation: Ghana converts research reactor from HEU to LEU fuel

Ghana has successfully completed the conversion of its only research reactor from the use of high enriched uranium (HEU) fuel to low enriched uranium (LEU) fuel, in an international project supported by the IAEA to help decrease the proliferation risks associated with HEU fuel.

HEU is an ingredient that can be used to create a nuclear device intended for malicious use, and since 1978 various national and international activities have been underway to convert research and test reactors from the use of HEU to LEU fuel, with the aim of minimizing and eventually eliminating the civilian use of HEU.

The HEU fuel was repatriated to China

The three-year project, which was a joint undertaking of the Ghana Atomic Energy Commission (GAEC), the China Atomic Energy Authority (CAEA), the US Department of Energy's National Nuclear Security Administration (DOE/NNSA) and the IAEA, was completed last week. Ghana has become the first of the five countries operating a Chinese-supplied Miniature Neutron Source Reactor (MNSR) to successfully convert and repatriate its irradiated HEU core to China.

"With this pioneer engagement Ghana demonstrated the feasibility of the MNSR conversion outside China," said Kwame I. J. Aboh, Project Manager at GAEC. "We hope our model of conversion and repatriation can be applied in similar operations in other countries operating such facilities."

The conversion from HEU to LEU reduces the enrichment level from over 90 percent uranium to below 20 percent, without affecting the reactor's research capabilities. Therefore, GAEC is still able to maintain its scientific research, education, training and industrial applications based on nuclear facilities following the conversion.

"Ensuring the sustainability of MNSR operation with a LEU core was a key success factor of this project," said Christophe Xerri, Director of the IAEA Division of Nuclear Fuel Cycle and Waste Technology. "This experience offers a good example of international cooperation to foster nuclear science and practical training while addressing non-proliferation concerns and delivering capacity building."

To ensure successful knowledge transfer for future conversion projects, a mock-up MNSR vessel was built for operator training at the GHARR-1 facility. This has since been further developed into a full-scale MNSR Core Removal Training Centre (CRTC), available for training operators from other MNSR countries. "The National Nuclear Security Administration is a strong supporter of the CRTC concept," said Dave Huizenga, Acting Deputy Administrator of Defense Nuclear Non-proliferation at NNSA. "This helps harness experience gained from the pilot project in Ghana and offers full-scale training possibilities for the MNSR operators facing similar challenges in the future."

Two meetings were held in the summer of 2017 to capture lessons learned from the implementation of the project – which could benefit other reactors looking to convert to LEU fuel. "Outcomes of these meetings will build up the Ghana model and support similar operations in the future," said Lixin Shen, Deputy Director General of China Atomic Energy Authority.

Chinese-designed MNSRs

MNSR type research reactors were designed and manufactured by the China Institute of Atomic Energy, and the original design had a compact core with 30 kW thermal powers, containing about 1 kg of 90 percent enriched HEU.

Nine Chinese-designed MNSR facilities exist: four in China – one of which has been converted to LEU fuel – and one each in Ghana, Iran, Nigeria, Pakistan and Syria. They are used primarily for education and training purposes.

Upon the commitment of the Chinese Government, the China Atomic Energy Authority undertook the responsibility of MNSR conversion first for the prototype MNSR in China, and then worked with GAEC to complete the conversion of GHARR-1 and take back the HEU.

IAEA assistance

The IAEA's cooperation with the MNSR community began in 2006 with a coordinated research project to determine the technical feasibility of converting them to LEU fuel.

Upon request from Ghana in 2014 for assistance in securing a LEU core for the country's GHARR-1 facility, the IAEA's Research Reactor Section provided support for the conversion and removal, carried out review missions at the GHARR-1 research reactor focusing on safety, offered regulator training on cask licencing and held workshops on transport security.

Nigeria and Syria have also requested IAEA assistance for conversion and HEU core removal. The Nigerian project is scheduled to be accomplished in 2018.

In Beijing, where the HEU fuel has just arrived, Mary-Alice Hayward, IAEA Deputy Director General, head of the Management Department, represented the Agency at HEU return event that the Chinese authorities organised today. She stated that "The IAEA was pleased to support our Member States with the conversion of Ghana's MNSR and the return of its HEU fuel to China. This project represents a significant milestone in the broader endeavour to minimize the use of HEU in civilian facilities while ensuring continued access to nuclear research and training capabilities."

— By Sandor Tozser