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Report on GHARR-1 MNSR Core Removal

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ABSTRACT

The Ghana Research Reactor-1 was earmarked for Core Conversion following the completion of the feasibility studies which indicated that changing of the Reactor Core from Highly Enriched Uranium to Lowly Enriched Uranium is highly likely bring no new potential accidents or incidents. Several Consultancy meetings were held at different countries to pave way for the reactor core removal. The core have been removed from the Reactor Vessel, awaiting shipment to China. The paper gives a brief report on the reactor core removal.

1. Introduction

Several Trainings and Workshops have been organized to support the Removal and Transportation of the HEU fuel. The most recent are those organized by the Regulatory Body of Ghana: National Workshop on Material Transport, June 14 - 16, 2016; National Transport and Security Planning Workshop, May 23 - 27, 2016 and that by SOSNY Research and Development on the operation of the Technical Equipment Set (TES) used for the removal of the HEU from the reactor vessel. Besides, numerous Consultancy Meeting have been held at various places as collaborations towards the completion of the Reactor Core Conversion Project (i.e. Removal of HEU and refueling with LEU).

There have also been some Observations and Dry Runs at various Institution. Staff of the National Nuclear Research Institute of the Ghana Atomic Energy Commission were at China Institute of Atomic Energy to observe the HEU Fuel Removal in September, 2015. Some observed the Shipment of Fuel from Uzbekistan in September, 2016. Another notable event is the participation of staff at Facility Acceptance Test for the TES and a Radioactive Resistant Underwater Camera used during the HEU Fuel removal. The Institute were also invited to CIAE for the Zero Power Test of the Fresh Fuel which is yet to be shipped to Ghana.

2. Milestones

Some of the milestones accomplished for the Core Conversion Project are:

- i. Project and Supply Agreement (GOV/2014/17) – this came into force on February 28, 2014.

- ii. Shutdown of Research Reactor – July 1, 2016.
- iii. Zero Power Test – July 24 to August 5, 2016.
- iv. Authorizations, Licensing and Approval for Imports and Uses of Equipment and Tools – August 24, 2016.
- v. Removal of irradiated fuel from Reactor Vessel – August 28, 2016.
- vi. Temporary storage of irradiated fuel at Waste Management Facility – August 28 to October 13, 2016
- vii. Packing of irradiated fuel into TUK SKODA MNSR Cask – October 13 to 16, 2016

The following are yet to be accomplished:

- i. Shipment of Fresh Fuel from China (TBD)
- ii. Shipment of Irradiated Fuel to China (TBD)
- iii. Loading of Fresh Fuel (TBD)
- iv. Commission (TBD)

It is worth mentioning that Operation Organization (NNRI/GAEC) did submit a number of documents to the Nuclear Regulatory Authority of Ghana. These include the documents for the licensing of the TES, that for ES-3100 (the cask for the fresh fuel), and TUK SKODA MNSR Cask (Cask for the irradiated fuel). The Procedures for the removal of fuel and packaging, qualification of associated tools and training of personnel were also submitted to the NRA among others. Furthermore, the Institute did respond to Request for Additional Information from the NRA.

3. Chronology of Activities undertaken for Fuel Removal

Day 1

- i. A meeting was held to brief the participants on the task ahead.
- ii. The technical equipment set (TES) which includes the ITC was transferred from the stores to the working platform at the GHARR-1 premises and subsequently inspected by the SOSNY R&D Company – the designer and manufacturer of the TES.

Day 2 and 3

- i. The TES was installed at the dry-run facility.
- ii. The SOSNY R&D Company tested the ITC and it proved functional after a couple of maintenance works.

Day 4, 5 and 6

- i. The SOSNY R&D Company organized a classroom and hands-on training on the ITC for the Ghanaian team.
- ii. After the training, SOSNY R&D Company certified the Ghanaian team for operation of the ITC.

Day 7

- i. Demonstration of ITC operation to IAEA and Nuclear Regulatory Authority of Ghana (NRA).

Day 8

- i. Dismantling of TES from the dry-run facility.
- ii. The IAEA seal on the reactor was broken by the IAEA safeguard inspectors that were present.
- iii. The metal barricade around the reactor pool was cut off.
- iv. The Chinese installed helium detector and ionization chamber in the inner irradiation tubes together with cadmium absorbers.

Day 9

- i. The control rod, drive mechanism and the beryllium shim tray were removed from the reactor vessel.
- ii. The control rod and the beryllium shim tray were placed in the reactor pool. Installation of TES in the reactor hall.
- iii. The under-water cameras were installed in the reactor vessel and signal projected on a TV screen in the control room

Day 10

- i. The HEU core was removed from the reactor vessel by using the ITC. The Core while inside the ITC was left on top of the reactor vessel to allow water to drain off it for one hour.
- ii. The ITC was then closed at the bottom with the Core inside.
- iii. The crane in the reactor hall was used to lift the ITC onto the dolly which was positioned at the entrance of the reactor hall
- iv. HEU fuel was placed under temporary storage at a Waste Management Facility at GAEC after it has been sealed by IAEA Safeguards' Team

The following pictures were captured during some of the above stated activities.



Fig. 1: Training of NNRI Staff by SOSNY R & D



Fig. 2: Hands-on at the Training Facility



Fig. 3: Certificate for Trainees

After the fuel had been removed, the pool and vessel were inspected. It was concluded at the end that all seem to be well with the components. This is based on visual images captured with the radioactive resistant underwater camera and associated monitors (laptops and TV). It was also concluded that there will be no need for an external neutron source for startup after fresh core is loaded. This was based on neutron counts measurements undertaken with a He-3 detector at the center of beryllium reflector. Apparently there is enough neutron production from gamma interaction with beryllium.



Fig. 4: Neutron Count Measurement

4. References

- [1] A. Minutes on Core Removal Meeting – August 20, 2016.
- [2] Inspection Report for Ghana MNSR – September 23, 2016.