

DOWNBLENDING OF HEU GRAPHITE FUEL IN KAZAKHSTAN

The National Nuclear Center of Kazakhstan (NNC) operates an Impulse Graphite Reactor (IGR) with a homogeneous uranium-graphite core. Graphite blocks in the reactor core are impregnated with a water solution of uranyl nitrite with a concentration of ~3.1 grams of uranium per one kilogram of graphite. The enrichment of uranium by the isotope U-235 is 90%. The reactor core consists of immovable and movable parts surrounded by graphite reflectors. The physical start-up of the IGR reactor took place in June 1960, and the energy start-up was in August 1961. In 1967, the IGR reactor was upgraded –the uranium mass in the core was increased from 7.46 kg to 9.0 kg and the diameter of the central experimental channel was enlarged. Since reactor modernization about 2.5 kg of HEU fuel from the first reactor core that was never used in the reactor has been stored at the reactor site. Last year the government of Kazakhstan made the decision to down-blend fresh HEU graphite fuel from the IGR reactor, which is located at the Ulba Metallurgical Plant (UMP) in Ust-Kamenogorsk, Kazakhstan.

The UMP developed a special technology to down-blend the IGR graphite fuel which includes fuel crushing, graphite oxidation, dissolution of uranium oxides, U-235 based correction using depleted or natural uranium, uranium extraction, precipitation, and calcination to oxides. The final product will have an enrichment of about 19.7%. The UMP facility preparations for graphite fuel down-blending should be completed in July or August 2019 and the down-blending process - which may take up to 1 year - will start in October or November 2019. The down-blending will be conducted under the supervision of IAEA safeguards.

The first, irradiated HEU core from the IGR reactor was discharged in 1967 and is currently located in dry storage at the reactor site. The total core weight is about 2,600 kg, and the total mass of uranium (including uranium 235 and 238) is about 7.46 kg. The radionuclide composition is as following: 137Cs, 90Sr, 151Sm, 99Tc, 155Eu, 93Zr, 135 Cs. Since this material was irradiated in a reactor its down-blending at the UMP is not allowed under the current UMP license.

In 2018-2019 NNC conducted a feasibility study for down-blending and final disposition of the irradiated IGR graphite fuel at the NNC site. Based on preliminary results of the feasibility study the dry mixing technology using natural uranium has been proposed as a prospective method for down-blending of the irradiated HEU graphite fuel with the following cementation of the down-blended material for permanent disposition.

This paper will outline the down-blending and disposition plans for both the unirradiated and irradiated HEU located outside the IGR reactor core.

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Track Classification: PP: Minimization, on a voluntary basis, of high enriched uranium within civilian stocks and where technically and economically feasible