What is the nuclear fuel cycle?

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The nuclear fuel cycle (NFC) is a complex of devices, production facilities and technologies, covering the entire chain of handling nuclear fuel - from mining to disposal of irradiated nuclear fuel. The term "fuel cycle" refers to the fact that the spent or irradiated nuclear fuel (SNF) after special processing can be reused.

In a simplified sense NFC can be divided into three stages. The first stage covers operations from mining uranium ore to the delivery of fuel assemblies to an NPP site. Next the fuel is utilized in the reactor to generate electricity. The final stage involves the transportation of the spent fuel to a special storage or processing plant.

In principle, there are many NFC options – depending on the type (or types) of reactor, the

technological links, the character and importance of the internal and external material and energy flows and so on. To a certain extent planning the NFC structure resembles a "Lego" game – combining the position of certain elements in the scheme it is possible to achieve a configuration with specified functional properties.

Generally speaking, a type of NFC is determined entirely by the principle approach to the management of spent nuclear fuel. The simple version of the NFC does not envisage the continued use of spent nuclear fuel after its removal from the reactor: it is sent for long-term storage and in the future – for the final ("eternal") RW dumping. This cycle is called "open" or "open circuit", and it prevails in the modern nuclear power industry. Its advantage is in its relative simplicity and low cost. The drawback is an underutilization of natural uranium.

However, spent fuel can be recycled at a radiochemical plant to re-use unburned uranium-235 as nuclear fuel, and plutonium produced in reactor fuel through irradiation. This option of NFC is called "closed" (in respect to uranium or uranium and plutonium).

Currently, in most countries storage of spent nuclear fuel is accumulating, as the rate of SNF production exceeds the capacity for recycling. Therefore, most of the spent nuclear fuel after removal from the reactor and short-term near-station storage is sent for a long-term (ten years or more) storage for subsequent processing.