Sustainable nuclear energy moves a step closer

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In future a new generation of nuclear reactors will create energy, while producing virtually no long-lasting nuclear waste, according to research conducted by Wilfred van Rooijen, who will receive his Delft University of Technology (Netherlands) PhD degree based on this research subject on Tuesday, 12 December.

Wilfred van Rooijen's research, conducted at the Reactor Institute Delft, focused on the nuclear fuel cycle and safety features of a Gas-cooled Fast Reactor (GFR), one of the so-called 'fourth generation' nuclear reactor designs. These designs have a sustainable character: they are economical in their use of nuclear fuel and are capable of rendering a great deal of their own nuclear waste harmless. The ability to actually build such reactors is however still in the very distant future.

The fourth generation GFR uses helium as a coolant at high temperatures. GFR's ultimate objective is to create a closed nuclear fuel cycle, in which only natural uranium is used as a raw material and in which the resulting waste consists of only nuclear fission products. Uranium and heavier isotopes, such as plutonium and americum, are recycled in the reactor and ultimately burned up (fissioned). In the reactors in use today, these heavy isotopes determine the long-term radioactivity of the nuclear waste. A closed nuclear fuel cycle therefore allows for maximum use of the raw materials, while at the same time substantially reducing the life-span of the waste.

This PhD research showed that it is possible to obtain a closed nuclear

fuel cycle with a GFR. It also revealed that the GFR could use the waste materials of other light water reactors (LWR). The Gas-cooled Fast Reactor can therefore serve as an 'incinerator' of nuclear waste.

To increase the GFR's safety, special elements have been designed to automatically shut down the reactor during incidents. Van Rooijen's research has shown that with these elements the reactor is capable of withstanding incidents without damage to the nuclear fuel.

Source: Delft University of Technology