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The Dual Fluid Reactor - a new concept for nuclear power

Abstract

The Dual Fluid Reactor, DFR[1-3], is a patented novel concept of a nuclear reactor based on liquid fuel. Its key feature is - different from other liquid fuel based concepts like the molten salt reactor MSR - the use of two separate cycles, one for fuel and one for coolant. Both cycles can be optimized for their respective purpose.

The advantage of this concept is an extremely high economic efficiency in terms of the EROI (energy return on invested) with a very compact design at a high operating tempereature of 1000 °C. This makes not only an efficient power production but also high-temperature process chemistry economically feasible, including the production of automotive fuel.

The DFR's liquid fuel is composed of actinide compounds that can be a molten salt or molten metal eutecticum. It can be processed on-line in a small internal pyro-processing unit, the PPU, utilizing fractionated distillation/rectification. Liquid Lead as a coolant yields a very hard neutron spectrum providing a very good neutron economy. This makes the DFR also an effective waste burner and breeder reactor with a closed fuel cycle and no need for geological waste storage.

The DFR is self-regulating by a strong negative temperature reactivity - there is no need for active power control or any mechanical parts in the core. The DFR also adopts the feature of a melting fuse plug from the MSR design, providing passive and inherent safety.

[1] A. Huke, G. Ruprecht, D. Weißbach; S. Gottlieb; A. Hussein, K. Czerski, "The Dual Fluid Reactor – a novel concept for a fast nuclear reactor of high efficiency", Annals of Nuclear Energy, Volume 80, June 2015, pp. 225- 235.

[2] A. Huke, G. Ruprecht, D. Weißbach; S. Gottlieb; A. Hussein, K. Czerski, F. Herrmann, "Dual-fluid Reactor", Molten Salt Reactors and Thorium Energy, Edt. Thomas J. Dolan, pp. 619-632 (2017).

[3] Wang, X., "Analysis and Evaluation of the Dual Fluid Reactor Concept", Technical University of Munich, PhD Thesis (2017).

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