FLOW-SHEETING STUDIES OF THE FLUORIDE MSR TH-BREEDER AND MSR AN-BURNER

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Abstract

In addition to the experimental research and development of separation technologies suitable for the MSR fuel cycle, the ÚJV Řež and later also the Research Centre Řež (CVŘ) were devoted to conceptual designs of the MSR fuel cycle.

Designs of individual flow-sheets were developed for two basic types of MSR with fluoride salt.

These were both MSRs operating in the fast neutron spectrum and serving to burn plutonium and other transuranic elements - the so-called MSR An-burner. The design of its simplified scheme is shown in FIG. 1. This scheme was designed primarily for the combustion of plutonium and minor actinides from MOX-type spent fuel.[1]

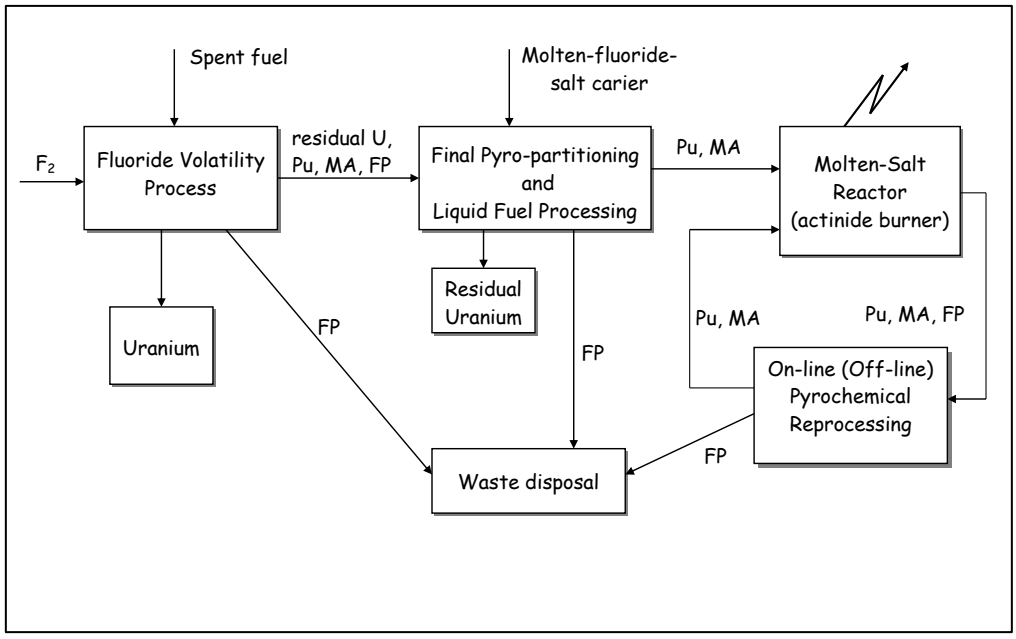

FIG. 1. Simplified scheme of MSR An-burner.

The second proposal was a MSR operating in the thermal neutron spectrum and the thorium-uranium fuel cycle - the MSR Th-breeder. This reactor is designed primarily as a power system with its own production of U-233 fissile material. One of the main advantages of this system would also be that it would produce virtually no transplutonium elements. A simplified scheme of the MSR Th-breeder is shown in FIG 2.[1]

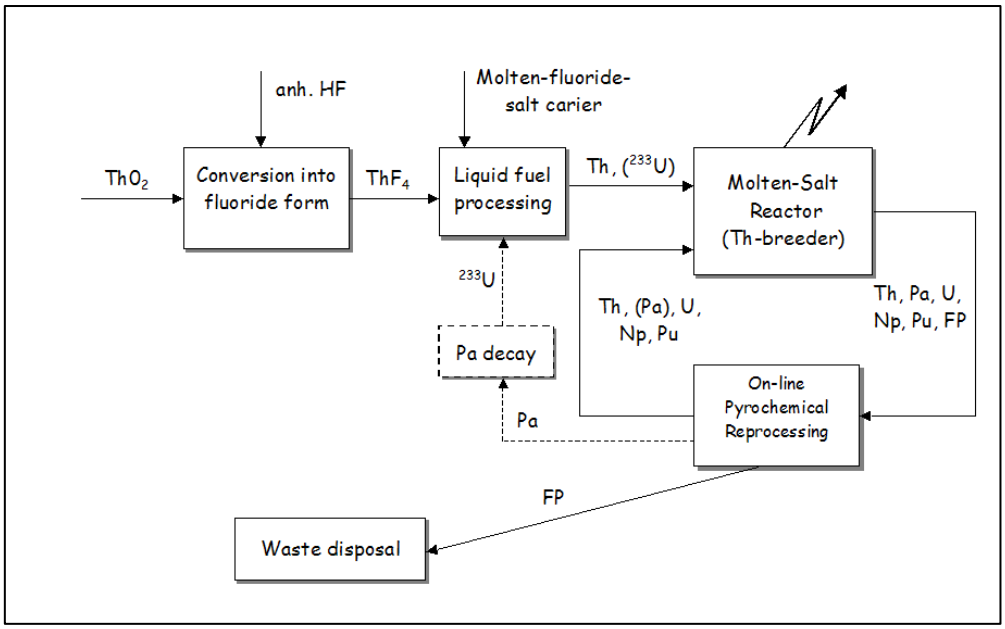

FIG. 2: Simplified scheme of MSR Th-breeder.

The basic differences in the approach to the fuel cycle of these two types of MSRs are in their front-end, where the An-burner requires the preparation of liquid transuranic fuel, while the Th-breeder involves the relatively simple preparation of fresh thorium-uranium fuel.

A combination of the "Fluoride volatility method" and electrochemical separation of Pu, Am and Cm in fluoride molten salt media has been proposed for the preparation of transuranic fluoride liquid fresh fuel from light water reactor spent fuel [2, 3]. This combination allows both the conversion of the oxide form of the spent fuel to fluorides and, most importantly, the removal of uranium from the prepared transuranic liquid fuel and finally the processing of liquid fluoride transuranic fuel.

The MSR Th-breeder flow-sheet studies were focused on the design of a conceptual flow-sheet for MSR Th-breeder on-line fuel reprocessing that would make maximum use of the capabilities of electrochemical separation methods from fluoride melt environments. Within the on-line reprocessing design, special attention was paid to the separation of protactinium and in this context also to non-proliferation and physical protection aspects. The design of the individual steps of the on-line reprocessing was adapted to meet the basic criteria of Proliferation Resistance and Physical Protection (PRPP) but at the same time not to reduce the breeding capabilities of the MSR Th-breeder system [4].

REFERENCES

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