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A Demand Driven Way of Thinking Nuclear Development –Neutron Physical Feasibility of a Reactor Directly Operating SNF from LWR

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Invention and innovation with regards to nuclear reactor development can be described with the concept of developments in s-curves. This view is taken to identify the problems of nuclear development. Following this, the request are formed for the definition of demand driven objectives. The future objectives should follow the UN sustainable development goals. The key words to form the vision of electric energy production are: very limited request for resources and production of waste, affordable economics and safe, secure and reliable operation which can be assembled to the dream solution –the perpetuum mobile. It is concluded that a reactor operating in closed fuel cycle using spent nuclear fuel from Light Water reactors would come close to this vision. Additionally, the technology fully fulfils the UN sustainability request of using technologies which provide future generation with solutions to increase the amount of available resources.
Following this demand driven theoretical discussion of objectives, a new innovative proposal is presented. A proposed reactor which is operated directly on SNF from LWRs as main fuel resource. The simulation tools and the limitation of the simulation are discussed. A proof of feasibility is given from neutron physical point of view. The major challenge is to establish a breeding process which provides enough new fissile material from the inserted SNF. For the start-up of the system a support of fissile material in the initial core and the transition phase is required. The feasibility of sufficient breeding is demonstrated, a first estimation of the resources in a possible fuel cycle is given, and the consequences on the back end of the fuel cycle are discussed. Finally, the challenges of the proposed technology are highlighted to stimulated future R&D to make a sustainable innovative nuclear reactor possible. This could form attractive major innovation challenge for a wide variety of engineers to form the basis for the long term success of nuclear reactors as a major carbon free, sustainable, and applied highly reliable energy source.

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