

# International Conference on Fast Reactors and Related Fuel Cycles: Next Generation Nuclear Systems for Sustainable Development (FR17)



Contribution ID: 188

Type: ORAL

## Analysis of the Characteristics of the Fast Breeder Reactor with Metallic Fuel

Monday, June 26, 2017 4:30 PM (20 minutes)

A lot of approaches are considered to increase a marketability of fast breeder reactors producing two products – electricity and exceeding nuclear fuel. To increase a production of exceeding nuclear fuel it is proposed to switch from widely used oxide fuel to carbide, nitride and the densest metallic uranium fuel. In a fabrication chain of the exceeding nuclear fuel a cost of spent nuclear fuel refabrication is also important. From all kinds of nuclear fuel, considered worldwide at the fast breeder reactors' area, the metallic fuel provide the highest values of the exceeding nuclear fuel production i.e. the highest value of the breeding rate (BR) and the lowest refabrication cost for spent nuclear fuel due to melting technology.

But the reactors with metallic fuel have issues which lead to the absence of completed projects and their realizations. The main problem of the safety assurance of such reactors is related to a weak reactivity feedback by fuel temperature. To solve this problem an approach with heterogeneous placement of the fuel at the axial direction is suggested. Layout of the depleted metallic fuel is proposed at the bottom blanket region and at the top blanket region above the sodium cavity to receive high breeding rate. In addition, placement of the oxide fuel with central thin layer made of metallic fuel in the core is proposed to provide sufficient level of temperature feedback. An improvement of this approach with replacement of the oxide fuel from the bottom part of the core by a metallic plutonium fuel is considered at the paper.

It is shown by calculations that the suggested approach together with the replacement of the oxide fuel by the metallic depleted uranium fuel at the assemblies of a radial blanket region ensures the high reactor BR with sufficient level of the temperature feedback. The high BR value is provided by using of the metallic fuel in the majority of reactor's volume. Substantial feedbacks are provided by the utilizing of the oxide fuel at the area of high coolant, fuel and cladding temperatures. At the same time the metallic plutonium fuel is placed at the area of high power density and low temperature of the core components.

### Country/Int. Organization

Russian Federation/JSC ("VNIIAES JSC")

**Primary author:** Mr DROBYSHEV, IURII (VNIIAES JSC)

**Co-author:** Mr SELEZNEV, Evgeny (NUCLEAR SAFETY INSTITUTE OF RUSSIAN ACADEMY OF SCIENCES)

**Presenter:** Mr DROBYSHEV, IURII (VNIIAES JSC)

**Session Classification:** 1.2 SFR DESIGN & DEVELOPMENT - 2

**Track Classification:** Track 1. Innovative Fast Reactor Designs