BREST-OD-300 (RDIPE, Russian Federation)

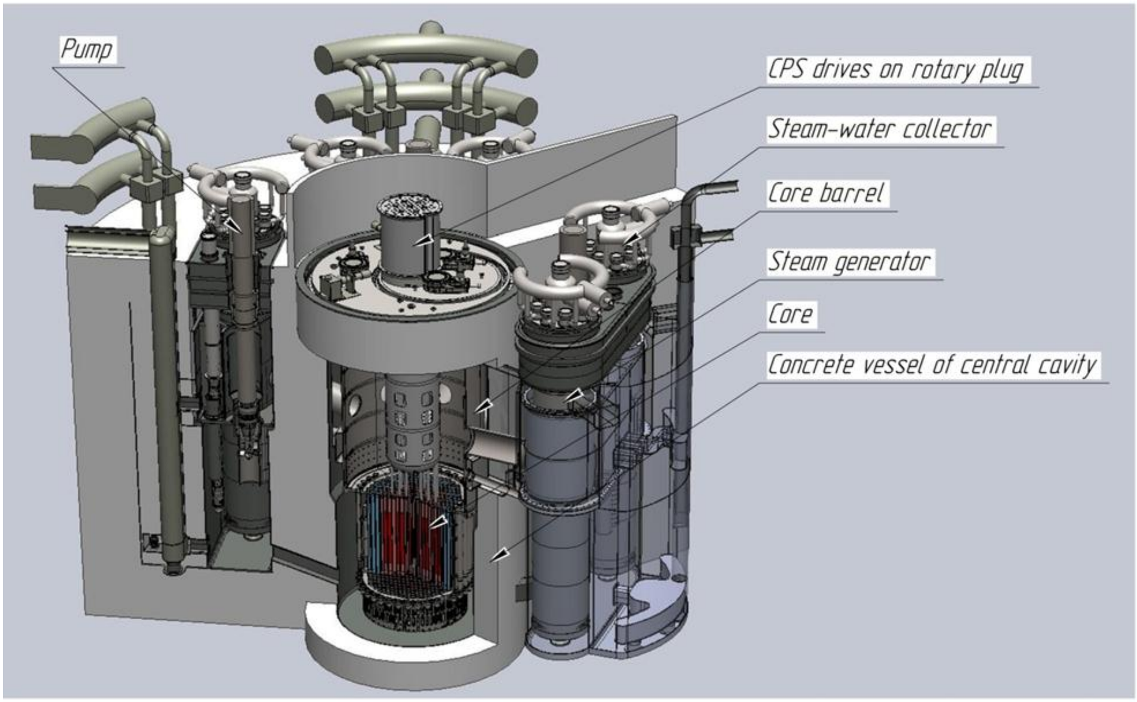

FIG. 21. Schematic representation of BREST-OD-300

Reactor type:	*Liquid metal cooled fast reactor*
Electrical capacity:	*300 MW(e)*
Thermal capacity:	*700 MW(th)*
Coolant:	*Lead*
Primary circulation:	*Forced circulation*
System pressure:	*Low pressure operation*
Core inlet/outlet temperature:	*420 / 540°C*
Thermodynamic cycle:	*Indirect Rankine cycle*
Fuel material:	*PuN–UN*
Fuel enrichment:	*~13,5%*
Fuel cycle:	*5-6 years, partial refuelling – 1/year*
Reactivity control:	*Shim and automatic control rods* ($\Delta\rho \approx 14 \cdot \beta_{eff}$)
Emergency safety systems:	*Emergency protection rods* ($\Delta\rho \approx 6 \cdot \beta_{eff}$)
Residual heat removal systems:	*Passive and time-unlimited direct residual heat removal from the lead circuit system via natural air circulation with heat discharge in the atmosphere*
Design life:	*30 years*
Design status:	*Detailed design*
Seismic design:	*VII–MSK 64*
Planned deployment:	*Unit startup – 2020 year*
Distinguishing features:	*High level of inherent safety due to natural properties of the lead, fuel, core and cooling design*

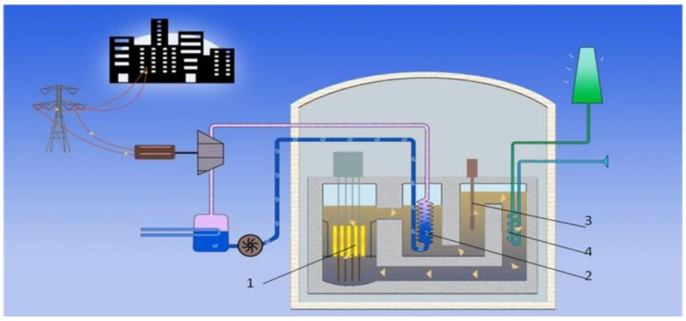

FIG. 22. BREST-OD-300 coolant circulation circuit

1–core; 2–steam generator; 3–reactor coolant pump (RCP); 4–emergency cooling system channel

Introduction

BREST is a lead cooled fast reactor fuelled with uranium plutonium mononitride (PuN–UN) that uses a two circuit heat transport system to deliver heat to a steam turbine.

Description of the nuclear systems

The adopted fuel exhibits high density and high heat conductivity, and is compatible with lead and the fuel cladding of chromium ferritic martensitic steel. To provide a significant coolant flow area, the level of power removed by natural lead circulation is increased, the coolant preheating temperature is reduced and cooling losses in the damaged FAs are primarily excluded in the case of local flow rate blockage; no core FAs have shrouds. The FA design allows radial coolant overflow in the core that prevents overheating of the damaged FA.

The reactor of a pool-type design has an integral lead circuit accommodated in one central and 4 peripheral cavities of the concrete steel-lined vessel.

The central cavity houses the core barrel together with the side reflector, the CPS rods, the SFA storage and the shell that partitions the hot and the cold lead flows. Four peripheral cavities (according to the loop number) accommodate the SG-RCP units, heat exchangers of the emergency and normal cooldown systems, filters and auxiliary components. The cavities have hydraulic interconnection.

Better radial uniformity of fuel assembly power levels and coolant heating is ensured by regionalized fuelling and lead flow rates by placing assemblies with smaller-diameter rods in central regions, and larger-diameter in peripheral regions.

Description of the safety concept

The use in integral design of the BREST reactor of a high-boiling (~2000 K), radiation-resistant, low-activated lead coolant, which is inert when contacting water and air, does not require high pressure in the primary circuit, and excludes the potentiality of accidents with a loss of coolant and heat removal, fires and explosions in a contact with the environment. In a combination the properties of the lead coolant and a dense, heat-conducting nitride fuel provide conditions for complete plutonium breeding in the core (CBR≥1). That results in a small operating reactivity margin ($\Delta\rho<\beta_{eff}$) and enables power operation without prompt-neutron reactor power excursions

The safety analysis has shown that none of the considered initial events involving a fast introduction of reactivity up to its full margin and interruption of the forced coolant circulation lead to accidents with fuel damage and inadmissible radioactive or toxic releases, even in the case of a failure of the reactor's active safety systems. So no population evacuation or resettlement is required.

Deployment status

The BREST-OD-300 power unit is designed as a pilot and demonstration unit intended for studying the reactor facility operation in different modes and optimizing all processes and systems that support reactor operation. Furthermore, BREST-OD-300 is also considered the prototype of a fleet of medium sized power reactors.