SVBR-100 (AKME Engineering, Russian Federation)

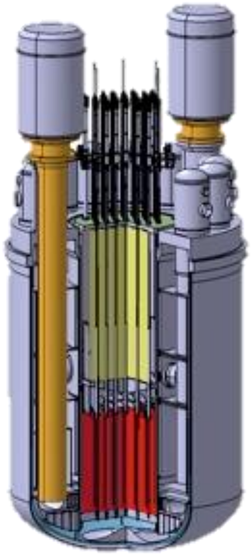

FIG. 23. Schematic View of SVBR-100

Reactor type:	*Liquid metal cooled fast reactor*
Electrical capacity:	*101 MW(e)*
Thermal capacity:	*280 MW(th)*
Coolant:	*Lead–bismuth eutectic alloy*
Primary circulation:	*Forced circulation*
System pressure:	*6.7 MPa*
Core outlet temperature:	*490°C*
Thermodynamic cycle:	*Indirect Rankine cycle*
Fuel material:	UO_2
Fuel enrichment:	*16,5%*
Fuel cycle:	*7–8 years*
Reactivity control:	*Control rod mechanism*
No. of safety trains:	*N/A*
Emergency safety systems:	*Passive and active*
Residual heat removal systems:	*Passive*
Design life:	*60 years*
Design status:	*Complete reactor and power plant design expected by 2014*
Seismic design:	*For structures and pipelines: horizontal PGA=0,12 g (7-point on MSK scale), for reactor module equipment: horizontal PGA=0,25 g (8-point on MSK scale)*
Predicted CDF:	*<1E-7/reactor year*
Distinguishing features:	*Closed nuclear fuel cycle with mixed oxide uranium plutonium fuel; operation in a fuel self-sufficient mode* **) figures shown above are targeted parameters for SVBR-100*

Introduction

The SVBR-100 is an innovative, small, modular fast reactor with lead–bismuth coolant (LBC). In the Russian Federation, lead–bismuth cooled reactor technology relies on the unique experience gained due to development and operation of reactors with HLMC for propulsion installations (15 reactors, 80 reactor years) and FRs with sodium coolant. It has provided knowledge and skills in such issues as: ensuring the corrosion resistance of structural materials, controlling the LBC quality and the mass transfer processes in the reactor circuit, ensuring the radiation safety of the personnel carrying out work with equipment contaminated with the ^{210}Po radionuclide, and multiple LBC freezing and unfreezing in the reactor facility.

Fuel cycle option

The SVBR-100's reactor core operates without any partial refuelling. The fresh fuel is loaded as a single cartridge while the spent nuclear fuel is unloaded cassette by cassette. This design has the capability to utilize various fuel cycles. The first stage will be typical uranium oxide fuel, leading to a core breeding ratio (CBR) of 0.84; mixed oxide fuel can also be used, leading to a CBR just near one. Using UO_2 as the starting fuel, the closed fuel cycle can be realized in 15 years. Nitride uranium and uranium plutonium fuel can also be used to improve safety and fuel cycle characteristics. The SVBR-100 reactor pursues resistance to nuclear fissile material proliferation by using uranium with enrichment below 20%, while using uranium oxide fuel in the initial core. The reactor is designed to operate for eight years without core refuelling.

Reactor coolant system

The entire primary equipment circuit of SVBR-100 is contained within a robust single reactor vessel; LBC valves and pipelines are eliminated. A protective enclosure surrounds the single unit reactor vessel. The reactor passes heat to a two circuit heat removal system and steam generator with a multiple circulation, secondary coolant system. Natural circulation of coolant in the reactor heat removal circuits is sufficient to passively cool down the reactor and prevent hazardous superheating of the core.

Description of the safety concept

The combination of a fast reactor design, HLMC and integral reactor layout aim to ensure that the SVBR-100 reactor system meets IAEA international project safety levels for prevention of severe accidents and inherent safety, according to analysis and studies. The SVBR-100 design pursues a high level of safety with inherent self-protection and passive safety by use of chemically inert LBC and integral arrangement of the primary circuit equipment in a single vessel, operating at approximately atmospheric pressure, NSSS being free of materials releasing hydrogen as a result of thermal and radiation impacts and chemical reactions with the coolant, water, and air. This combination of features excludes the loss of coolant accident (LOCA) type accidents, the possibility of chemical explosions and fires and high-pressure radioactive releases like Fukushima. This will possibly allow the reactor design to exclude many safety systems required for traditional type reactors and to simplify and reduce the cost of the power plant. Safety systems in the reactor facility include fusible locks of additional safety rods to provide passive shutdown, bursting disc membrane to prevent overpressurization and passive removal of residual heat in the event of a blackout by evaporation of water.

Deployment status and planned schedule

On June, 15th 2006 The Rosatom Scientific and Technical Council has approved the development of the technical design of the experimental industrial power unit based on SVBR-100. A complete reactor and power plant design are expected to be completed by 2014, along with a preliminary safety report. Siting licence works are underway. Construction licence is expected to be obtained in 2014. Meanwhile, the first SVBR-100 training simulator for personnel was developed, education course should start till the end of 2013. The first trial 100 MW(e) unit planned to be constructed by 2017 at Dimitrovgrad, Ulyanovsk region near the Russian State Atomic Reactor Research Institute.