BN-1200 (JSC “Afrikantov OKBM”, Russian Federation)

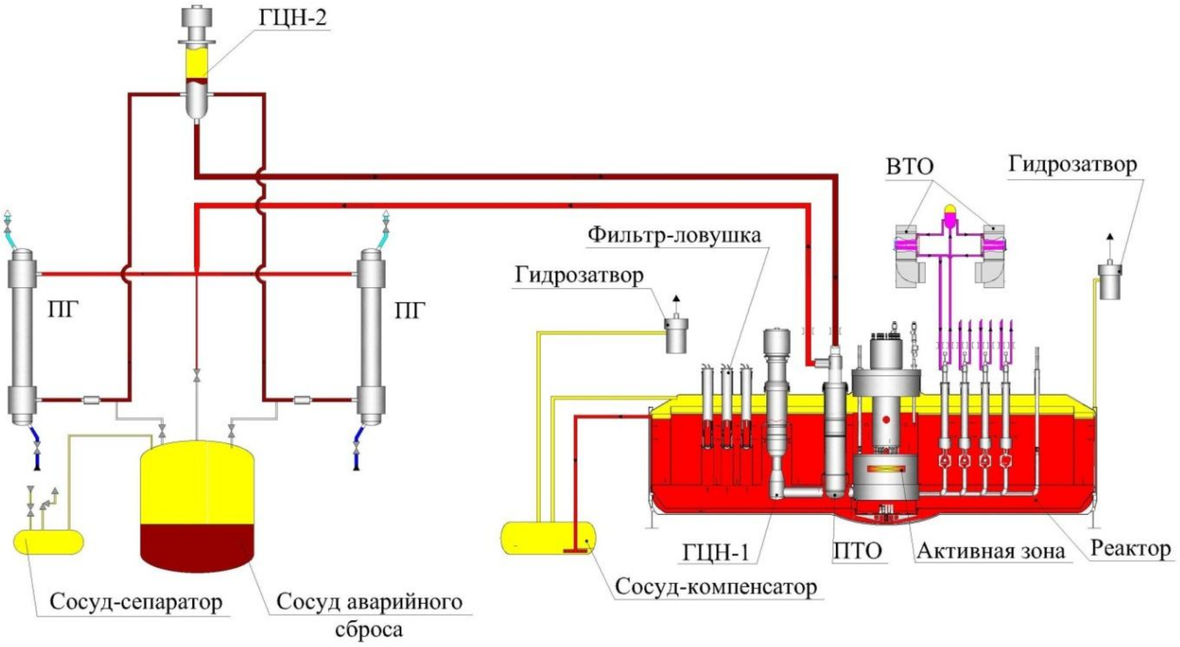

FIG. 10. Schematic view of BN-1200

Full name:	*BN-1200*
Designer:	*JSC “Afrikantov OKBM”*
Reactor type:	*Sodium-cooled Reactor*
Electrical capacity:	*1220 MWe*
Thermal capacity:	*2800 MWth*
Primary circuit configuration	*Loop*
Primary Circulation	*Forced*
System Pressure:	*0.54 MPa*
System Temperature:	*410 °C*
Fuel Material:	*Nitride or MOX*
Emergency safety systems:	*Hybrid*
Residual heat removal systems:	*Hybrid*
Design Life:	*60 Years*
Design status:	*Final design completion in 2015*
Planned deployment/1st date of completion:	*Final decision has not been taken yet*
New/Distinguishing Features:	*Integral layout of primary circuit*

Introduction

BN-1200 is a new sodium-cooled fast reactor for serial construction. The succession of fundamental engineering solutions proved to be positive for BN-600 and BN-800 and has been preserved in the process of BN-1200 reactor development. Monoblock principle has been used in BN-1200 power design, i.e. one reactor and one turbine. The reactor design provides for integral layout of primary circuit equipment (reactor core, MCP-1, IHX, autonomous heat exchangers and cold trap filters). The reactor vessel is supported at its lower part and enclosed in a guard vessel.

Description of the Nuclear System

The reactor core comprises assemblies of different types [fuel subassemblies (FSA), boron shield assemblies and absorber rods]. The central part of the core consists of FSA with fuel of similar enrichment and cells with absorber rods. The adopted tank designed for in-reactor storage reduces residual heat release to the safe level for refueling activities and FSA washing and it was selected taking into account the possible elimination of the spent FSA cask. Rows of assemblies with natural boron carbide are arranged behind in-reactor storage to form additional side shielding of in-reactor equipment. The structure of the core FSA represents a hexagonal wrapper tube with a top nozzle attached to one end and a bottom nozzle to the other one. Inside the hexagonal wrapper tube there are bundles of absorber elements and fuel pins arranged one beneath the another forming a 'sodium' cavity between each other providing Sodium Void Reactivity Effect.

MCP-1 is an impeller submersible pump including a check valve and variable-frequency electric drive with a stepless control of speed.

The reactor plant has three circuits. The primary and secondary circuits are sodium-cooled and the third circuit coolant is water/steam. Each of the three circuits is divided into four parallel flows (loops) equally participating in heat transfer from reactor to turbine plant of power unit. Each loop of the secondary circuit consists of an MCP-2 and a steam generator (SG) connected by pipelines. Temperature transfers at the secondary circuit pipelines are compensated via bellows compensators.

The MCP-2 is a single-stage vertical centrifugal pump with free level of sodium in it. The SG is a block-type once-through heat exchanger consisting of two modules with straight heat exchanging pipes. The SG is fitted with automatic protection system in case of inter-circuit leaks.

Description of the Safety Concept

BN-1200 reactor plant design utilizes a number of new engineering solutions compared to BN-600 and BN-800:

– primary circuit sodium systems and equipment are completely integrated in the reactor tank which eliminates radioactive sodium leaks,

– emergency heat removal system (EHRS) is applied providing natural circulation through all EHRS circuits, including circulation immediately through FSA thereby increasing the level of power output under allowable temperature conditions in the reactor core,

– passive shutdown system comprising hydraulically suspended absorber rods and a system of rods responding to sodium temperature variations in the core is used,

– a special containment is provided in the reactor compartment to confine accidental releases from the reactor under beyond design-basis accidents.

Due to adopted solutions it is expected to achieve better safety indicators:

- possibility of severe damage (10^{-6}) to the reactor core is an order of magnitude less than the one required by regulatory documentation,
- target criterion has been specified, i.e. the boundary of protective action zone has to coincide with the boundary of production site for severe beyond design-basis accidents with their probability not exceeding 10^{-7} over reactor/year.

Deployment Status and Planned Schedule

Not specified yet.