MBIR (NIKIET, Russian Federation)

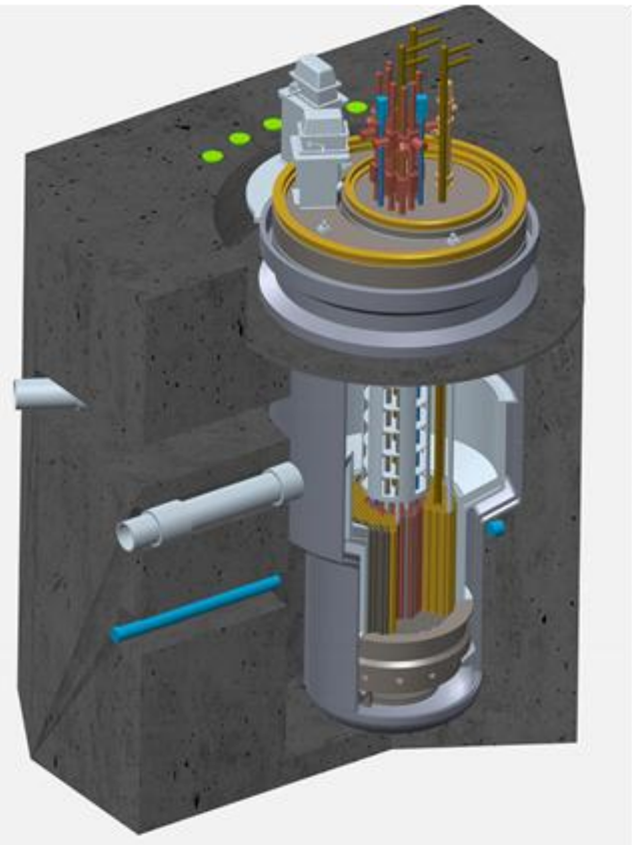

FIG. 11. Schematic view of MBIR

Name:	*Multipurpose fast-neutron research reactor (MBIR)*
General Designer:	*NIKIET*
Reactor type:	*Sodium-cooled fast-neutron reactor*
Electrical capacity:	*up to 60 MW*
Thermal capacity:	*up to 150 MW*
Coolant:	*Sodium*
Primary Circulation:	*Forced*
System Pressure:	*up to 0.6 MPa*
System Temperature:	*330-512 ºC*
Fuel Material:	*MOX*
Fuel Cycle:	*15 weeks*
No. of safety trains:	*2*
Emergency safety systems:	*Active/hybrid*
Design Life:	*50 years*
Planned deployment/1st date of completion:	*2020*
Distinguishing Features:	*Reactor equipped with in-vessel and ex-vessel experimental facilities and devices for a broad range of in-pile research activities and experiments, high fast neutron flux (up to* $5 \cdot 10^{15}$ $cm^{-2} \cdot s^{-1}$*)*

Introduction

The MBIR is a nuclear research facility with a multipurpose sodium-cooled fast-neutron reactor of the thermal power 150 MW, designed for a broad range of in-pile research activities and experiments. The MBIR is developed for various research activities including advanced nuclear fuel and absorber materials, cyclic and emergency modes of operation, studies into the problems of closed fuel cycle, radiation tests of advanced structural materials, study of new and modified liquid-metal coolants, validation of new equipment, production of radioisotopes, and use of neutron beams for medical applications.

Description of the Nuclear Systems

The MBIR includes a number of experimental devices to be accommodated within the core. The maximum in-core neutron flux is not less than $5{\cdot}10^{15}$ $cm^{-2}s^{-1}$. Regarding the facility's purposes, the core should contain three loop channels, independent instrumented experimental channels and more than ten material test and isotope production assemblies, with vertical and experimental channels to be arranged outside the reactor vessel. The core is composed of 94 hexagonal FAs with the width across flats of 72.2 mm and 91 MOX fuel elements of the diameter 6.0 mm. The FA spacing is 75 mm. The refueling interval is not less than 100 days. The core has a negative temperature and power reactivity effects. The reactor vessel has the vertical dimension of about 11.6 m and the diameter of 2.5 m in the core accommodation area. The austenitic-steel reactor vessel is enclosed within a safeguard vessel to exclude the sodium loss. The reactor vessel has two inlet and two outlet nozzles. The core components are contained in a barrel intended to separate the coolant flows that enter and leave the reactor, arrange for the reactor vessel and core cooling (through the pressure header), and provide thermal and radiation protection for the barrel and reactor vessel walls. There are 8 CPS members in the core.

There are two reactor heat removal loops. The heat transfer from the reactor core to the ultimate heat sink (a turbine generating up to 60 MWe) uses a three-circuit sodium-sodium-water layout.

Description of the Safety Concept

In the event of anticipated operational occurrences and emergences, the maximum values of the MBIR parameters are limited by the inherent safety features. The MBIR is equipped with active safety systems based on a passive principle of action ensuring the regulatory safety requirements are met in full. The actuators for the scram system and the normal operation system have different designs. The primary circuit will include a system for the passive removal of decay heat by natural circulation. The circuit structure basis makes it impossible for the primary circuit's radioactive sodium to enter the secondary circuit. The secondary circuit includes a steam generator emergency protection system and discharge tanks in case of emergencies with a sodium-water contact within the steam generator. The design approaches exclude severe damage to the core and release of radioactive contamination to beyond the safety barriers. The fuel melt catcher is located beneath the core inside the reactor vessel. The MBIR implements the single-failure, safe-failure, redundancy, independence, separation and diversity principles; the technical concepts adopted in the automated process control system (APCS) exclude or mitigate operator errors and reduce the operator load. The control interface supports a graphic representation of the holistic picture of the facility status via displays (video walls). The hardware of the integrated control and protection systems is based on modern components.

Deployment Status and Planned Schedule

At present, MBIR is at detailed design stage. A preliminary safety case study and a probabilistic safety analysis are conducted. The completion of the design activities and obtaining the construction license are scheduled for 2014. It is planned that the construction, commissioning and commencement of the experimental works will be completed by 2020.