Abstract

The sodium cooled fast reactors are one of the most developed and advanced directions of future nuclear engineering. Russia is the first among other countries in field of fast reactor development.

The idea of fast reactor designing was proposed in the former Soviet Union by Dr. A.I. Leipunski at the end of 40th. The successful operation of Russian fast reactors (BOR-60, BN-350 and BN-600) and the world experience proved the feasibility, reliability and safety of this direction of nuclear engineering and allowed to begin the development of the BN-800 reactor project as the commercial fast reactor.

In 1992 Russian Government confirmed the construction of BN-800 reactors on South Ural NPP in Chelyabinsk region and on Beloyarskaya NPP.

History of BN-800 design

The first design of BN-800 reactor was developed and was undergone an examination in 1985. It fulfilled the demands made of the reactors in that time.

But last time (after the serious accidents on Chernobyl NPP and Three Mile Island NPP) the aspects of safety increase of NPP play a leading role when designing the new reactors serving the economic competitiveness.

All these aspects were introduced into the new Nuclear Safety Rules, adopted in our country in 1989. These Rules include the requirement of guaranteeing of negative reactivity coefficients on reactor power and coolant temperature.

After having adopted the new Safety Rules the commission of Russian Academy of Science headed by Dr. V. Subbotin made new examination of BN-800 reactor project. The commission noted the large positive value of sodium void reactivity effect (SVRE) as a main disadvantage of this project. The recommendation was to develop a new reactor core design with negative value of SVRE.

The first investigations in the end of 80th showed the principal possibility to achieve zero (or negative) SVRE value in the reactor core by introduction of sodium plenum above the core.

The analysis of the numerous ways to reduce the SVRE value allowed to choose the most optimal core design.

The design project of BN-800 core we developed in 1992. During next 5 years the complex justification of reactor physics was carried out base on calculational analysis and experiments investigations at the MFS facility critical assembly and based on results of international benchmark analysis of BN-800 reactor core with sodium plenum.

At the end of 1998 we got the license for reactor construction.

BN-800 Reactor designs for nuclear wastes utilization

During last five years the numerous investigations were carried out on possibility to use the different core modifications based on BN-800 reactor project for effective utilization of plutonium (including weapon grade plutonium) and minor actinides.

The main directions of the core modifications are as follows:
- abandonment of fertile blankets;
- use of MOX-fuel of increased enrichment;
- use of uranium-free fuel;
- use of special devices for long-lived nuclear wastes transmutation;
- closed fuel cycle organization with thermal reactors.

Conclusion

Thus on the basis of BN-800 reactor project it is possible to design the universal fast reactor permitting to solve rather effectively the different problems of nuclear fuel cycle: from high breeding of secondary nuclear fuel to the effective transmutation of long-lived nuclear wastes depending on state of nuclear market.