# The synergy between the approaches to safety regulation of advanced nuclear reactors and fusion facilities

S.V. SINEGRIBOV

Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS)

Moscow, Russian Federation

Email: sinegribov@secnrs.ru

A.V. KURYNDIN

Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS)

Moscow, Russian Federation

A.M. KIRKIN

Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS)

Moscow, Russian Federation

A.V. SIMONOVA

Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS)

Moscow, Russian Federation

Currently, there is a growing interest in the use of innovative technologies in the field of nuclear energy use all over the world. The main advantages of the innovative technologies are inherent safety features, using of passive safety systems, heat removal mainly due to natural coolant circulation. Moreover, some of the technologies have improved confinement features, increased efficiency of the nuclear materials use and the possibility of spent nuclear fuel reuse. In the Russian Federation in the frames of state programs the implementation of innovative projects in the field of nuclear energy use is provided. In particular, developing small modular reactors (SMR), liquid metal fast reactors, molten salt reactors and others is also planned.

In order to provide scientific and technical support to Rostechnadzor in terms of effective safety regulation of Russian advanced nuclear reactors SEC NRS conducts large amount of researches. Thus, preliminary analysis of advanced reactor safety features and analysis of the applicability of current requirements of legal and regulatory framework in the field of nuclear energy use to the advanced reactors are carried out in SEC NRS. Besides, SEC NRS analyzes the international practice of regulating safety of advanced nuclear fission reactors. Special requirements of laws and regulations are being developed based on the results of the conducted work and taking into account specific aspects of innovative technologies.

One example is experience of developing a regulatory framework for regulating the safety of floating power units (FPU) with SMRs. To take into account the specific features of FPU with SMR, amendments have been made to a number of federal rules and regulations in the field of nuclear energy use, including the " General safety provisions for vessels and other floating craft with nuclear reactors" (NP-022-17), "Nuclear safety rules for vessels and other floating craft with nuclear reactors" (NP-029-17), "Requirements to planning of measures for actions and protection of personnel at nuclear and radiological accidents on vessels and other floating craft with nuclear reactors" (NP-079-18), "Requirements for the security of ships with nuclear reactors, nuclear technology service vessels, ships transporting nuclear materials, and floating nuclear power plants" (NP-085-19). The developed requirements were subsequently applied in the development and construction of the FPU "Akademik Lomonosov", which was successfully commissioned in 2020 and became the world's first small nuclear power plant with SMR and the world's first floating nuclear power plant.

It is worth mentioning that the requirements of some federal rules and regulations are indifferent (neutral) in relation to the types of nuclear facilities and do not require changes to regulate the safety of advanced reactors. Such requirements, for instance, include a series of documents that establish safety requirements for radioactive waste management, requirements for accounting external hazards and safety provisions during the transportation of radioactive materials.

It should be noted that fusion facilities have hazardous factors similar to nuclear installations and radiation sources (ionizing radiation, activation of structural elements, formation of radioactive waste, release of radioactive substances into the environment). Some radiation-related risks of such facilities may be commensurate or even exceed similar characteristics at operating high-capacity nuclear power plants. At the same time, the fusion facilities are characterized by numerous hazard factors caused by the implementation of fusion reactions which are not specific for nuclear fission reactors.

Nevertheless, the approach used in the development of a regulatory framework for regulating the safety of advanced nuclear fission reactors can be applied in the development of a regulatory framework for regulating the safety of fusion facilities. Therefore, new regulatory documents should be developed and/or amendments should be made to existing regulatory documents in the field of nuclear energy use in order to effectively regulate the safety of fusion facilities, based on the results of the analysis of the applicability of existing regulatory requirements and the analysis of international practices. Moreover, amendments to legislative acts may be required depending on the current regulatory system.