



Federal Environmental, Industrial and Nuclear Supervision Service



Scientific and Engineering Centre for Nuclear and Radiation Safety

ETSON

EUROPEAN
TECHNICAL SAFETY
ORGANISATIONS
NETWORK

Safety Regulation of Fusion Facilities in the Russian Federation

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30th IAEA Fusion Energy Conference (FEC-2025), 13-18 October, 2025
Chengdu, People's Republic of China

Bodies of the State Regulation of Safety in the Use of Atomic Energy



Rostekhnadzor

Technical aspects of nuclear and radiation safety
National regulatory authority

Ministry of Emergency
Situations

Fire safety

Federal Medical-Biological
Agency

Sanitary and hygienic aspects of radiation
protection of personnel

Rospotrebnadzor

Sanitary and hygienic aspects of radiation
protection of the population

Ministry of Natural Resources
and Environment

Environmental protection

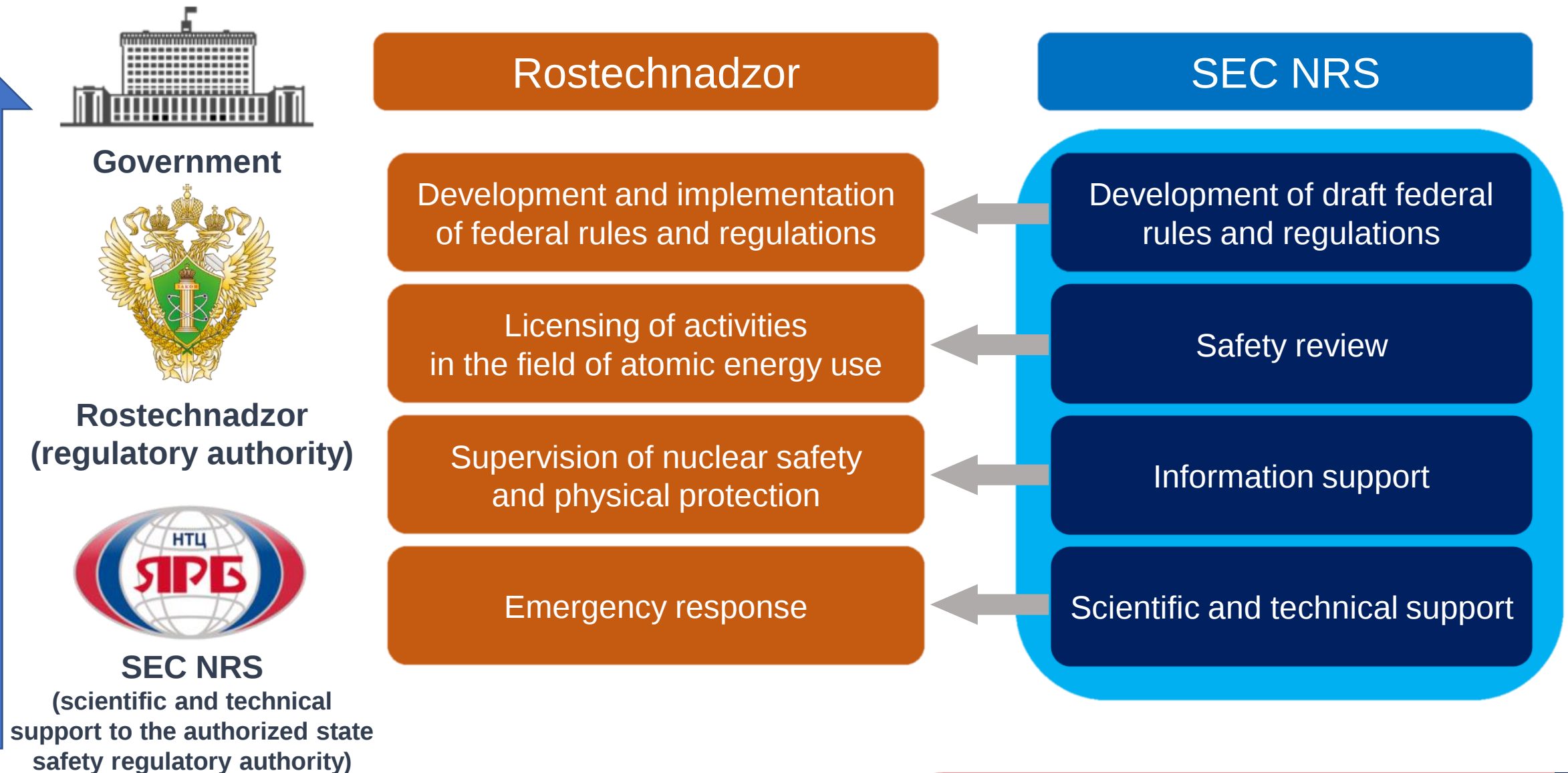
Rosprirodnadzor



RF Government
Decree of 03.07.2006
№ 412



The activities of SEC NRS



Development of Fusion Facilities in Russia

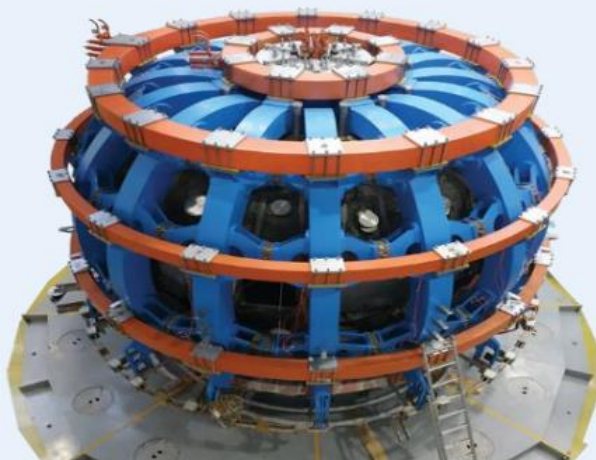


[\(http://government.ru/rugovclassifier/929/\)](http://government.ru/rugovclassifier/929/)



Federal project «Fusion Energy Technologies»

**Upgraded tokamak
T-15MD – a platform for advanced
experimental research
of high-temperature plasma**



Physical start-up – 2021 г.
Commissioning – 2023 г.
Max. parameters – 2030 г.

- Pulse duration over 30 s
- Heating capacity not lower than 20 MW
- Advanced diagnostic systems

Tokamak with Reactor Technologies (TRT)

Based on a high-temperature
superconductor with a set of innovative
technological solutions



Conceptual design – 2024
Engineering design – 2025-2029
Construction – after 2030

- Magnetic field ~ 8 T
- D-D plasma heating capacity up to 40 MW
- Pulse duration over 100 s

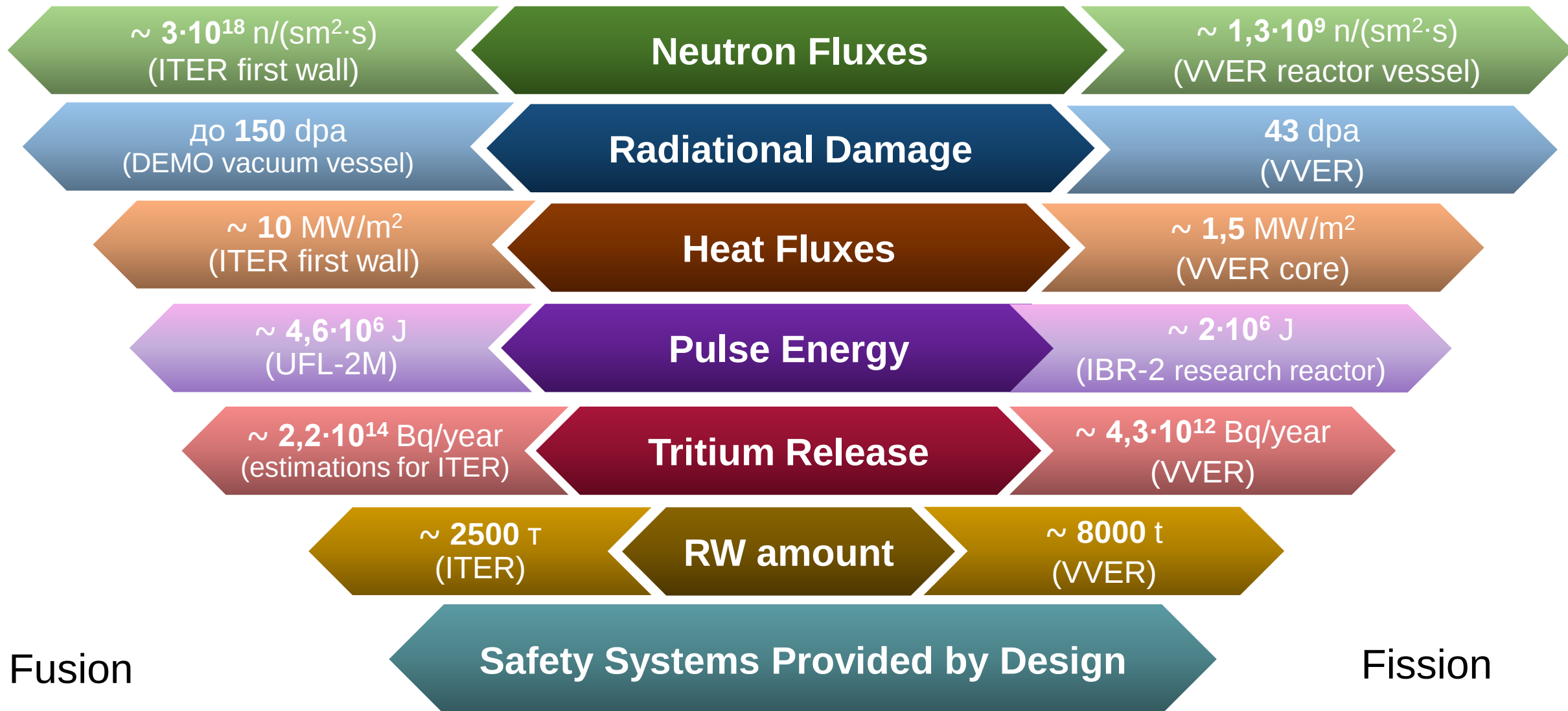
Spherical tokamak Globus-M2



Laser fusion facility UFL-2M



Hazard Factors Comparison



Basic terms and definitions



The Glossary «**Fusion Facilities**» was published in 2023

- **Fusion Machine** – machine, designed to realize the nuclear fusion reaction of light nuclei due to magnetic or inertial plasma confinement
- **Fusion Installation** – Fusion Machine, which is not containing or capable of generating (fissionable) nuclear materials
- **Fusion Reactor** – Fusion Machine, which uses nuclear materials and neutrons formed as a result of the nuclear fusion reaction of light atoms, initiate the nuclear fission reaction of heavy nuclei in nuclear materials in a subcritical core (blanket)
- **Fusion Facility (FF)** – structures and facilities with fusion reactors or installations, designed to generate ionizing radiation and (or) energy



Classification of Fusion Facilities (FFs) in the Russian Federation



Nuclear installations

Nuclear facilities

Radiation sources

Federal Law dated November, 21, 1995 № 170-FZ
(ed. Federal Law dated July 31, 2025 № 342-FZ)



NPPs

NRIs

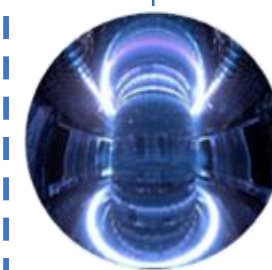
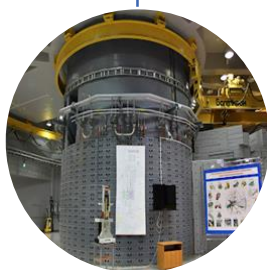
Ships with NRs

FFs

URS

SRS

FFs

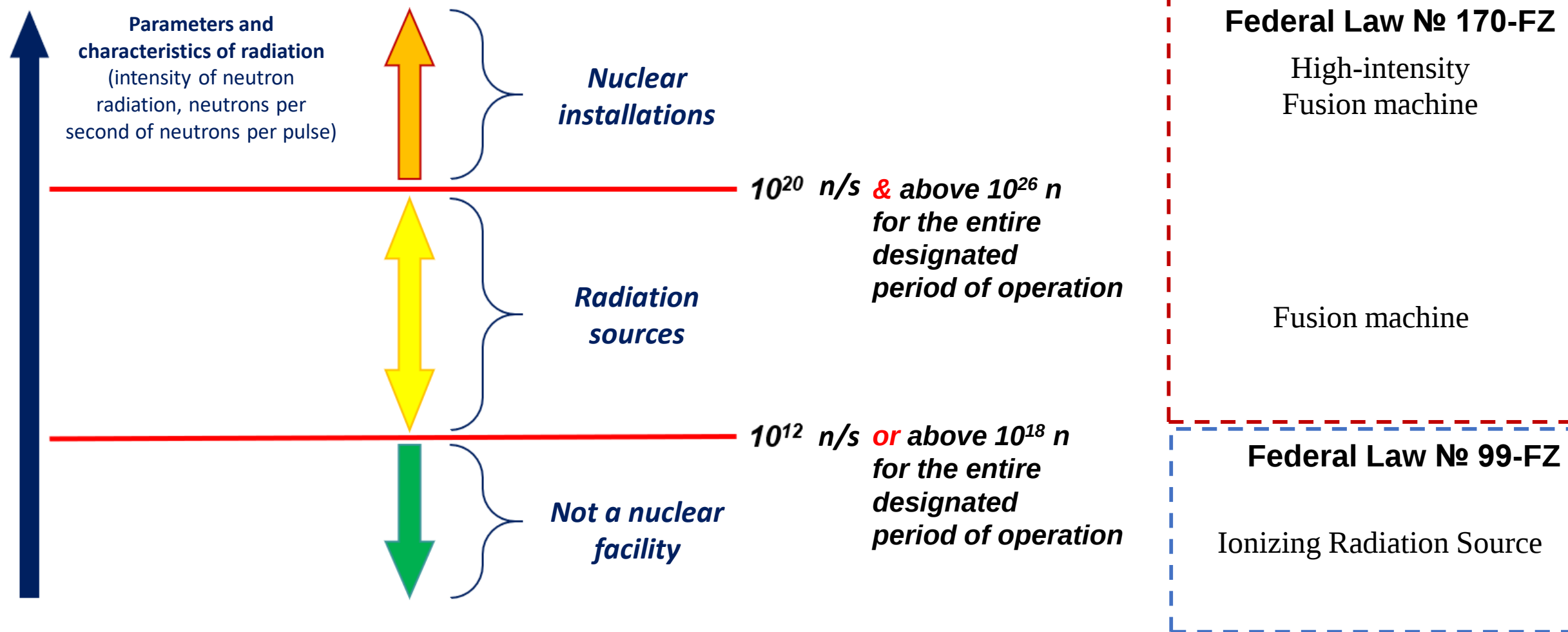


Fusion Facility will not be classified as a nuclear facility if the neutron intensity is less than the criterion, which will be set in **FRR “General Provisions for Fusion Facilities Safety Assurance”**

Regulation and licensing of such installations is carried out by Rospotrebnadzor as **ionizing radiation sources (generating)** in accordance with:
Federal Law № 99-FZ of May 4, 2011 “On Licensing of Certain Types of Activity”,
Federal Law № 52-FZ of March 30, 1999 “On the Sanitary and Epidemiological Welfare of the Population”

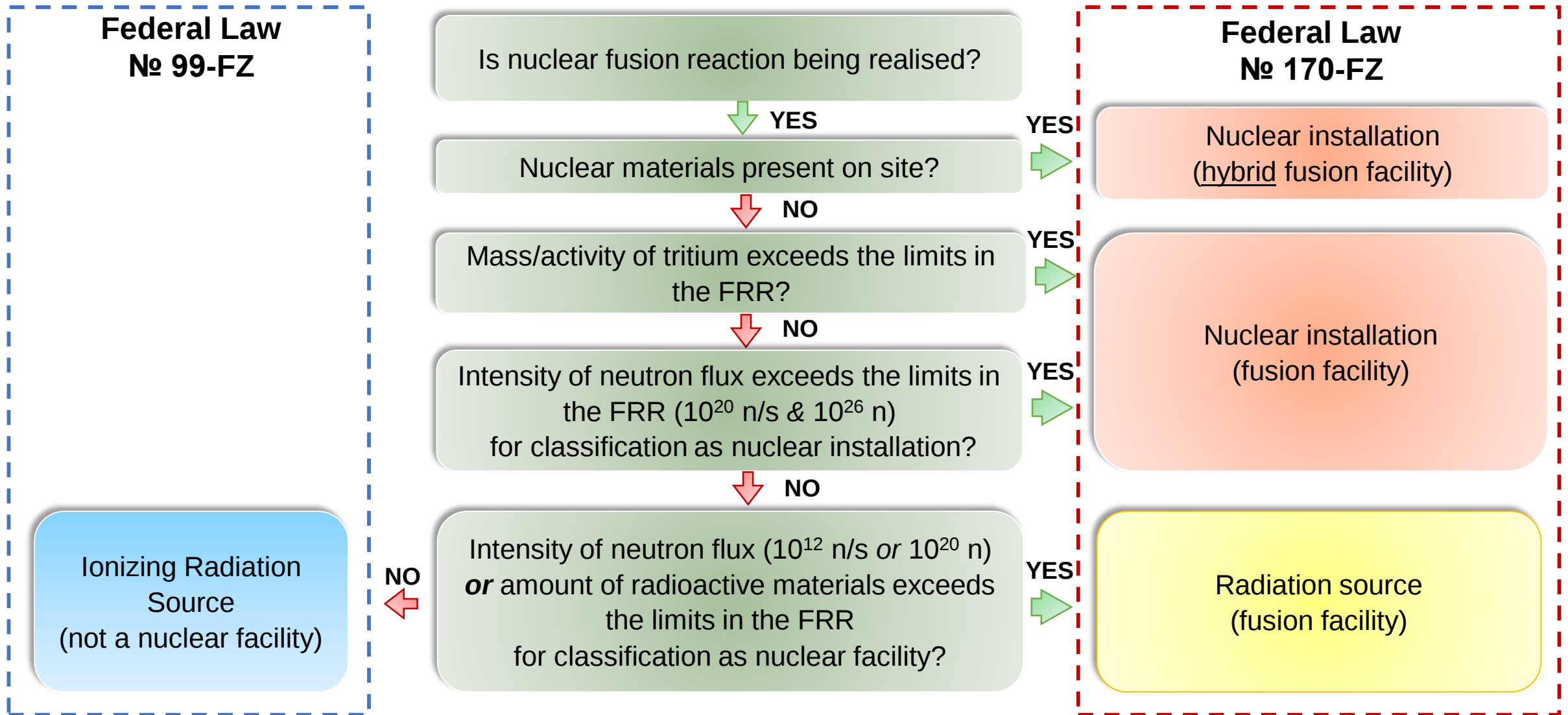


Criteria on Neutron Intensity



In accordance with the Explanatory Note to Federal Law of July 31, 2025 No. 342-FZ
<https://sozd.duma.gov.ru/bill/835243-8>

Classification scheme of Fusion Facilities



General Provisions (GP) for Fusion Facilities (FFs) Safety Assurance



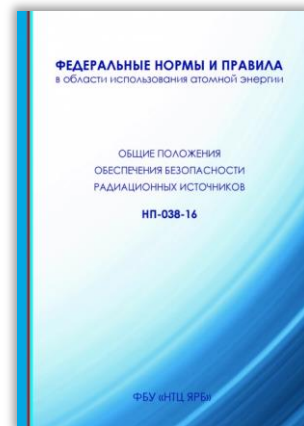
- Establishment of safety requirements for FFs at all stages of the life cycle, taking into account the specific hazard factors of fusion technologies
- Consideration of the specifics, physical features, technologies, and principles of operation of individual systems and components specific to FFs
- Accounting for foreign documents and regulatory approaches
- Taking into account the experience of developing and applying General Provisions for:
 - nuclear power plants
 - nuclear research installations
 - radiation sources



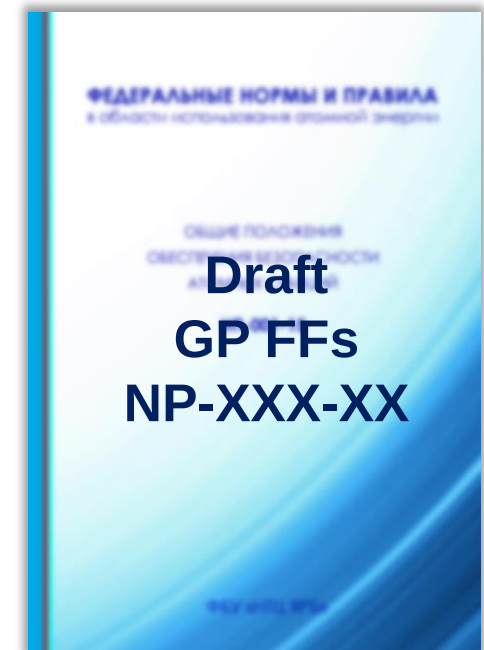
NP-001-15



NP-033-11



NP-038-16



Basic requirements of the General Safety Provisions for FFs



The general safety provisions establish requirements for:

- **compliance with established radiation dose limits** for personnel and the public, standards for release and discharges of radioactive substances during normal operation and normal operation malfunctions, including design basis accidents
- **limitation of radiation exposure** to the personnel, the public and the environment in a beyond design basis accident
- ensuring the required **quality** of systems (components) and works performed
- the main **criteria and principles of ensuring safety** implemented in the FF design and its systems
- **safety analysis**
- supporting and operational **documentation**
- **action plans** for protection of the personnel and the public in case of accidents
- **commissioning and decommissioning** of FF
- **process control**



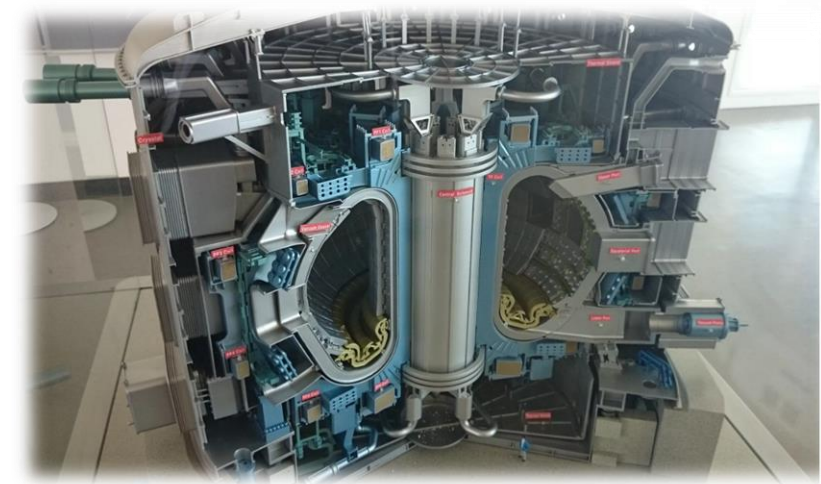
Physical barriers

The FF design shall provide a system of physical barriers on the way of propagation of ionizing radiation and radioactive substances to the environment

- *The number and purpose of barriers shall be determined in the FF design*
- *The FF design shall provide measures to protect and preserve the efficiency of the barriers*
- *Sufficiency of barriers and measures to protect them shall be justified in the FF design*

For FF physical barriers can be:

- *vacuum vessel*
- *blanket with nuclear materials (for hybrid installations)*
- *boundaries of equipment for handling tritium and other radioactive substances*
- *boundaries of the rooms / building where the FF is located*
- *biological protection*



Graded Approach in the Application of the Safety Requirements



Criteria for classification as nuclear installation

Additional requirements

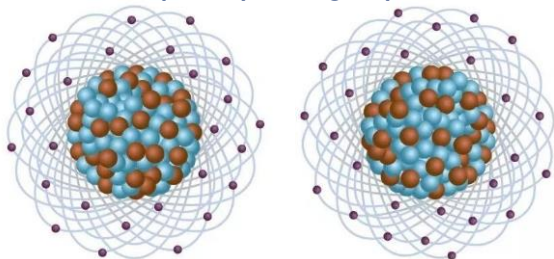
(depending on the factors and degree of danger associated with the characteristics of the FFs, as well as with the use of various technologies, materials, substances)

Tritium usage



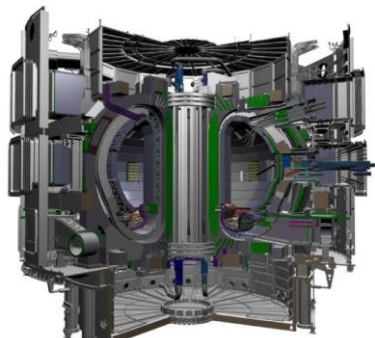
- for tritium-containing systems and components in the rooms where they are located
- for the control of discharges of radioactive substances
- for minimizing the accumulation of tritium in materials
- to limit the release of radioactive substances, including in case of accidents
- for accounting and control of Special Non-Nuclear Materials (including ^3H , ^6Li) in the State System for Accounting and Control of NMs

Nuclear materials (NMs) usage (^{238}U , ^{232}Th , ...)



- for systems and components, including for the containment of NMs within established boundaries
- for the exclusion of criticality
- for heat removal from blankets with NMs
- for neutron flux density control in the blankets with NMs
- for accounting and control of NMs
- for the storage of NMs, the handling of NMs

High-intensity Fusion machine



- for control of the fusion reaction
- for protection safety systems
- for probabilistic safety analysis, reliability analysis
- for chemistry regimes of the media in the FFs systems and components
- for development of action plans for protection of the personnel and the public in case of accidents
- for accident management
- for the personnel training

Conclusions



- Currently, alongside advancements in fusion technology, significant efforts are underway to expand the atomic energy safety regulatory framework, integrating FF into Russian legislation. The primary objectives for FF safety regulation in the Russian Federation include legislative updates and development of FRRs defining safety requirements for fusion and hybrid systems. (Federal Law of November 21, 1995 No. 170-FZ “On the Use of Atomic Energy”)
- Federal Law of July 31, 2025 No. 342-FZ (effective January 1, 2027) was developed with the direct participation of the SEC NRS, and the requirements of FRRs in the field of atomic energy use of for FFs are being developed.
- When developing approaches to safety regulation, international approaches and accumulated experience in regulating the safety of NPPs are taken into account, as well as interaction with organizations involved in the development and further operation of fusion facilities.





FEDERAL ENVIRONMENTAL, INDUSTRIAL AND NUCLEAR
SUPERVISION SERVICE



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谢谢聆听！

THANK YOU FOR YOUR ATTENTION!