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1. Introduction

Russia is one of a few nuclear power states obtaining the whole number of nuclear fuel cycle (NFC) components – from mining of uranium and on-site electricity production, from NPP spent nuclear fuel processing and extracted fissile materials and radionuclides, which are available in industry, in medicine and in other relevant areas, to radioactive waste processing and disposal. For this reason it is very important to solve the problem of nuclear fuel cycle safety as it is a single system task with an adequate approach for all cycle components.

The problem is that NFC facilities are technologically various and refer to different industries (mining, machinery engineering, power engineering, chemistry, etc.). Besides, the above facilities need the development of various scientific bases. The most NFC facilities is directly connected with peaceful use of nuclear energy and with military nuclear industry, as the defense orders stimulated the development of NFC.

The specific attention to safety problems at the beginning of nuclear complex foundation adversely affected the state attitude towards the risk in nuclear industry, it has left the traces at present. In our paper we touch upon the problems of risk and the liability for nuclear damage for the third persons. The problems of nuclear damage compensation for nuclear facilities personnel and for the owners (operating organizations) are beyond our subject.

2. Risk Classification

The meaning of “risk” has been widely spread for the last two decades in various fields of science and technology, in legal and regulatory documents of different levels, in commercial and financial practice. Each side has its own understanding of
this meaning while using the above term, its specific components and risk management. The generalized classification of the tasks of risk determination may be as follows:

2.1 Task 1

There are one or several initial events which may lead to an accident, the consequences of which are considered a priori as severe ones. The assessment of its consequences in natural or in money equivalents may be either obvious, or significantly difficult, but it is not determined as it is not the purpose. Here the “risk” is “the probability” of the realization of such event and all efforts are directed to the decrease of this probability (i.e. practically exclude the event).

According to this scheme of “risk” the risk analysis of strength and integrity of the equipment and constructions of potentially dangerous facilities is performed, when the rupture of the equipment and constructions operated under pressure is the most undesirable event. According to the same scheme the “risk” problems of aircraft falls, train collisions, shipwrecks, etc. are solved.

2.2 Task 2

The determined one or several initial events which may lead to some consequences are being postulated. The problem of a concrete event consequences decrease is being solved without the determination of the event probability. The indicator of “risk” is the scale of “consequences” for the concrete event. The problem of “risk” assessment from ionizing radiation refers to this problem as the irradiation dose is being postulated and the effect on human health is being identified.

The scheme of the “risk” decrease is applied in the solution of the problem of a driver and passengers life preservation in case of a car accident with frontal blow, of a submarine crew survival in case of a flood, i.e. of all problems of human survival in extreme situations.

2.3 Task 3

The reviewed facility or process has definite number of events with corresponding consequences. Various events occur with various probability (frequency) and the corresponding consequences differ by range (in natural or in money equivalents). In the properly organized society it is important to consider as frequent, so as rare events. In this case “risk” is determined as average value of consequences in discrete or continuous conception.

It is possible to consider more delicate nuances of the established task with more detailed information of probabilistic “risk” indicators and with a specific attitude towards frequent and rare events. Such risk must be assessed for the third persons
insurance from large-scale accidents at nuclear facilities. To solve this problem in practice is most difficult for nuclear damage insurers and for insurables.

3. Risk Assessment in Nuclear Industry

Severe accidents at nuclear facilities, including large-scale Kyshtym (USSR), Three-Mile-Island (USA) and Chernobyl (USSR) accidents, demonstrated the need of the probabilistic safety analysis (PSA).

Since the eighties the works of NPP probabilistic safety analysis (PSA) mastering have been initiated in the former USSR and then in Russia. At present the requirement of 1-st level PSA for newly constructed NPP units is obligatory. There are regulated values of probability for core damage ($10^{-5}$ per year) and large-scale radioactive material release ($10^{-7}$ per year).

At present practically all operating NPP units in Russia to some extent have carried out probabilistic safety analyses as the obligatory condition for the confirmation of operation license issued by a regulatory authority (Gosatomnadzor RF). Now we do not touch upon the discussion of PSA results for operating nuclear units as their various generations significantly differ by safety systems availability.

We may only note the fact that the obtained results and relevant weak points form the base for nuclear units modernization and licensing condition for operation in the next time period. The operating NPP units with VVER-1000 reactor type according to the obtained results have the core damage probability of $10^{-5} - 10^{-4}$ per year.

Since the nineties PSA introduction to the various NFC facilities has been accomplished: transportation of spent fuel and radioactive materials, radiochemical plants, etc. But we can not analyze nuclear complex as a whole from the obtained positions.

Unfortunately, the PSA development level in Russia and all over the world is not still sufficient for acceptable exact determination of nuclear accident probability (frequency) and its scale. In particular, practically all large-scale accidents at nuclear facilities are the consequences of actions defined by “human factor”.

Recently the works on comprehensive investigation of nuclear facility accident risk and damage from its consequences have been initiated in Russia. It was necessary for nuclear damage insurance. Different approaches to nuclear facility insurance have been proposed [1].
4. Legal Aspects of the Third Person Insurance from Nuclear Risk in Russia


Partial or complete damage from radiation accident was previously completely compensated by the state. It was so after the well-known Kyshtym, Chazhmyn and Chernobyl accidents, e.g. by resettling of the inhabitants from the radionuclide-contaminated areas to other regions, treatment, payment of compensations for “clean” food purchasing and so on.

The basis of liability for nuclear damage was legally formulated when the Federal Law “On the Use of Nuclear Energy” was adopted in 1995. Different aspects of nuclear damage insurance are presented in the Law (Articles 15, 53-60). Liability for damage and injury of juridical and physical persons due to radiation during the works in the use of nuclear energy is carried upon an operating organization.

The kinds and limits of operating organization liability for damage and injury of physical and juridical persons according to the type of nuclear facility are determined by relevant legislation.

Financing provision of the liability limit of an operating organization for damage includes the state guarantee or other guarantee, own financing and insurance policy availability.

The Government of the Russian Federation provides the financial compensation for damage, which exceeds the operating organization responsibility limit.

The license for a nuclear facility operation is given by a regulatory authority to an operating organization only if it is able to confirm its possibility to compensate nuclear damage.

4.2 The basic Legal Documents of Nuclear Damage Liability

The basic legal document of the considered problem will be the federal law “On Guaranteeing the Financing of Liability of the Operating Organization for Damage and Injury due to Radiation”. The State Duma has given the bill to the first reading of the Law. At present it is under consideration in the State Duma.

Some principal provisions of this draft law are as follows:

- Definitions are given to such specific terms as “nuclear damage”, “nuclear insurance” and “nuclear facility”. Under “nuclear damage” along with radiation impact we mean accompanying chemical, toxic, explosive and other impacts.
• Compensation for damage to the nuclear facility itself and its personnel is not touched upon.
• Maximum damage liability of the operating organization per an incident at nuclear facility is fixed in the amount of 15 million of minimal labor remuneration in Russia (2001) or approximately 50 mln US dollars.
• The same for a nuclear incident in transportation of nuclear materials, radioactive substances and radioactive waste is fixed in the amount of 5 million of minimal labor remuneration or approximately 17 mln US dollars.
• Damage compensation expenditures are ascribed to the cost of products and services.

This Law must be the direct action law. A delay in the Law implementation is explained, in particular, by the need to develop approximately twenty regulatory documents of the legitimate level.

At the same time a Decree of the Government of the Russian Federation in being prepared for establishing of the insurance system. The main objective of the document is to designate the limits of financial liability of the operating organization and kinds of financial guarantees depending on the type of nuclear facility and on its operating conditions.

According to the draft, four types of insured nuclear facilities are defined:

• Nuclear reactors of various thermal power;
• Nuclear facilities with irradiated nuclear fuel, depending on the quantity, presence of Pu, $^{235}\text{U}$ of various enrichment;
• Nuclear facilities with non-irradiated nuclear fuel, depending on the number of isotopes of Pu, $^{235}\text{U}$;
• Radiation-dangerous nuclear facilities depending on activity.

5. Economic Aspects of Insurance of Nuclear Damage Liability

It is proposed, that the Federal insurance supervisory authority will establish a procedure for nuclear insurers to form special insurance reserves, which are required to cover long-term liability on nuclear damage compensation.

Insurers may establish partnerships of nuclear insurers (nuclear insurance pool) on the grounds of cooperation agreement.

Operating organizations may establish reciprocal nuclear insurance society on the basis of appropriate regulatory document on reciprocal insurance.
For complete compensation of nuclear damage above the limits of liability of the operating organization, a federal fund could be established for nuclear damage compensation.

Insurance reserves of Russian insurance companies included into the Russian insurance pool are significantly limited, so at present they cannot provide financial guarantees of the international level. Risk reduction through reinsurance of nuclear facilities by foreign insurance pools, which own significant insurance reserves, is still problematic for Russian insurers due to delay of the Vienna Convention ratification and to the lack of the Federal law on nuclear insurance.

In this situation the insurance rate for Russian operating facilities is defined by two main factors:
- need to ensure rather quick accumulation of insurance reserves;
- terms of nuclear risk re-insurance including international re-insurance and not probabilistic actuarial calculations being very inexact at present.

Russian nuclear complex includes belonging-to-the-state hundreds of nuclear-dangerous facilities, such as NPP units, research and industrial-type reactors, transport nuclear power installations and others.

Difficult situation of Russian economy leads to the problems of nuclear facility insurance. Thus, the liability limit of NPP unit insurance in 2001-2002 is 100 mln rubles or approximately 3.5 mln US dollars. Taking into account the acting rate in the amount of 0.5% to 1.5% of the insurance sum per ensured unit, it makes up 0.9 mln US dollars. This fact does not contribute to attraction of significant number of Russian and foreign insurers in the conditions of nuclear risk uncertainty.

At present the state, as an owner of such facilities, is the dominating factor guaranteeing nuclear damage compensation.

The state share in financial guarantees of nuclear damage compensation could be reduced in case of significant extension of potentials of Russian nuclear insurance community and also for the account of involvement of foreign insurance organizations.

In condition of extra-budgetary guarantying by the Russian state or by any concerned state of the insurance reserves of the companies, participating in nuclear insurance, a variant, which could be attractive for Russia, seems to be investment of insurance funds into the equipment and services on extension of the operating NPP service life and on commissioning of the units owning large reserves with definite benefit level of such investment.

Approximately 350 mln US dollars are needed for commissioning of two most complete Russian NPP units. At present more than 90% of investments for
completion are comprised from the NPP funds: amortization charged to operation and target investment assets included in the electricity rate bonus.

Moreover, spare assets of the insurers and their profits could be increased due to the growth of the absolute values of insurance parameters and also by broadening of the insurance field. Reliability of the nuclear facility insurance will be qualitatively increased [1].

It should be specially underlined, that introduction of the feedback “insurance rate - target investment assets” makes it possible for the Russian insurers to speed up accumulation of asset for real guarantees of nuclear damage compensation and it will be more attractive for Russian insurance organizations and Russian representatives of foreign insurance organizations to participate in nuclear insurance.

It is not less important, that such insurance scheme is beneficial not only for the state, but also for insurance companies, both national and private.

References