# Implementation of the risk informed approach for the development of requirements to the physical protection of radioactive material and associated facilities

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**Abstract**

Radioactive sources and associated facilities are used in the world widely – in medicine, industry, agriculture, geological exploration etc. Depending on the type of their application, the characteristics of radioactive sources are also different - it could be a high activity radioactive source for radiotherapy treatment or a very low activity source in a chromatograph device. Conditions of the use of radioactive sources are specific either – an associated facility can be located in a populous district or in sparsely one, a number of people who can access to the radioactive sources are not fixed. Territorial location defines possible groups of potential adversaries that could be considered like the threat.

In accordance with the Essential element 9 “Use of risk informed approaches” from IAEA Nuclear Security Series publication No 20, all of these mentioned factors should be taken into account by a regulatory body when requirements to nuclear security systems and nuclear security measures for radioactive sources and associated facilities are established. But how the regulatory body can implement this Essential element in practice? The paper will provide an answer to this question based on the experience of Rostechnadzor - the Russian regulatory body for safety and security in the use of atomic energy.

In the paper the elements of the risk informed approach, that applied by Rostechndazor, will be described: the graded approach for physical protection requirements based on “security levels” concept, defence in depth principle for different security layers, categorization of radioactive material and associated facilities for security purposes, use of an adversaries model (threat assessment concept) to define a set of adequate physical protection measures. The paper will also provide information about special approaches that were implemented to establish requirements to the physical protection of sealed radioactive sources categories 4 and 5, radioactive sources located at nuclear sites.

## INTRODUCTION

Sustainability of a State nuclear security regime depends on a regulatory body’s activity effectiveness. This activity includes three elements of the State regulation – licensing procedures, establishment of physical protection requirements and inspections.

The greatest difficulty for the regulatory body is the choice of regulatory approach and the establishment of requirements to ensure security of radioactive sources and associated facilities. While there are three types of regulatory approaches (prescriptive, risk-informed, combined), the regulatory body should choose the most appropriate one to provide protection at the state level. At the same time, the requirements for physical protection of radioactive sources and associated facilities should be feasible by the operator and take into account the "effectiveness-cost" approach. Each approach has its advantages and disadvantages. For example, the prescriptive approach is convenient for both the operator and the regulator because it is based on a fixed (limited) number of requirements. It is sufficient for the operator to comply with these requirements to ensure protection of radioactive sources and associated facilities. It is also convenient for the regulator to verify compliance with prescriptive requirements. For example, the regulatory body requires the installation of a CCTV camera in a room with a category 2 radioactive source. The operator understands this requirement. By installing the camera in such a room, it will comply the requirement of the regulator. The regulator will also easily check whether the camera is installed in the room with the source. However, this approach cannot quickly adapt to changing threats. The risk-based approach is more flexible. It allows the operator to independently determine the list of physical protection measures that will protect the radioactive source. The task of the regulator in using this approach is to determine the target level of protection to be achieved by the operator. The main problem in the application of the risk-based approach is the assessment of the adequacy of the applied physical protection measures. For this reason, a combined approach is popular among regulators. It incorporates the advantages of the other two approaches and minimizes their disadvantages.

Further, the paper will present the evolution of Russian requirements for the physical protection of radioactive sources and associated facilities and demonstrate elements of risk-informed approach included in national legislative and regulatory framework.

Ensuring of the physical protection of radioactive material, radiation sources in the Russian Federation is an essential condition for their use established in the Federal Law «On the use of atomic energy» № 170-FZ dated November 21, 1995. The operation of storage facilities without compliance with requirements for their physical protection is also prohibited. Requirements for the physical protection of radioactive substances, radiation sources and storage facilities are established in Federal rules and regulations in the field of nuclear energy. As a regulatory body, the Federal Environmental, Industrial and Nuclear Supervision Service (Rostechnadzor), has developed of the Federal rules and regulations “Regulations on physical protection of radioactive substances, radiation sources and storage facilities” (NP-034-15) that provides requirements to the physical protection of radioactive sources (sealed and unsealed) and associated facilities.

## IMPLEMENTATION OF THE RISK INFORMED APPROACH FOR THE DEVELOPMENT OF REQUIREMENTS TO THE PHYSICAL PROTECTION

The first edition of the “Regulations...” was approved in 2002 and was designated as NP 034 01. In contrast to the draft of publication of the IAEA Nuclear Security Series NST048 “Security of radioactive material in use and storage and of associated facilities (Revision of NSS No. 11)”, in which the scope of the document covers the radioactive material and associated facilities only now, the NP-034-01 had already contained the requirements to the physical protection of radioactive substances, radiation sources and storage facilities.

The graded approach was used in NP-034-01. It meant that the number of requirements for the physical protection of targets was increased with increasing of radiological consequences scope resulted from adversaries’ unauthorized activity. Categorization of targets was taking into account the impact on personnel, population and the environment. Four categories were defined: the smallest category (category 4) was applied for the targets for which the radioactive impact of unauthorized actions was limited to areas in which radiation sources and radioactive substances are located, as well as to rooms of storage facilities; the highest category (category 1) was applied to the targets for which the unauthorized actions could lead to radiation exposure of the population. Requirements for organizational procedures and technical means were given in the table. That's why the implementation of NP-034-01 was convenient for the license holders and the inspectors of Rostechnadzor.

Since 2002 much had been done by the IAEA to strengthen security of radioactive sources: in 2004 the Code of Conduct on the Safety and Security of Radioactive Sources was prepared, in 2005 a new categorization of radioactive sources (based on using of ratio A/D where “A” is an activity of radionuclide and “D” is “dangerous” quantity of radioactive material) appeared in IAEA RS-G-1.9 publication “Categorization of Radioactive Sources”, in 2011 the Implementing Guide NSS 9 on security of radioactive sources was published.

In the Russian regulations, governing the safety and the security of the use of nuclear energy, it's necessary to take into account IAEA recommendations. That’s why the Rostechnadzor initiated a review of NP-034-01 to harmonize Russian requirements for the physical protection of radioactive material and associated facilities with IAEA approaches and to apply the accumulated experience of physical protection supervision. This process took more than two years. It included developing of several revisions of the document draft, conducting of consultancy and technical meetings with representatives of the organizations that use radioactive material and associated facilities, with Rostechnadzor inspectors, the official publication of the final version of the document draft and discussion of comments and suggestions to it. Finally, revised “Regulations on physical protection of radioactive substances, radiation sources and storage facilities” (NP-034-15) (hereinafter – Regulations) was adopted by Rostechnadzor’s Order № 280 dated July 21, 2015. After registration of the Rostechnadzor’s Order by the Ministry of Justice of the Russia Federation and official publication of the decree, the new Regulations entered into force.

The Regulations is based on using of prescriptive approach for establishment graded requirements for physical protection of radioactive material and associated facilities. Furthermore, the elements of risk-informed approach were added in the Regulations requirements for physical protection had been established taking into account potential dangerous of both unauthorized actions: theft (unauthorized removal of radioactive material) and sabotage.

Following IAEA recommendations the term “physical protection level of radiation facility” is used in the Regulations. Whereas three security levels (A, B, C) are applied in IAEA publications, the Regulations define four levels (A, B, C, D). Each level has its own set of requirements for physical protection. The term “radiation facility” in the Regulations was added to establish comprehensive and universal requirements for physical protection of different objects which are located and used by the license holders – radioactive material (sealed and unsealed radioactive sources), radioactive devices (any equipment which contains radioactive sources), storage facilities with radioactive material (except facilities with nuclear material), storage facilities with radioactive waste. The term “radiation facility” means facility (room, group of rooms, building), where radioactive material are used or located and (or) where radioactive devices, radioactive waste are used or located. The List of radiation facilities must be approved by the head of company (factory, medical facility, etc.).

The physical protection level has been defined and established to each radiation facility of the company. For that purpose, the head of the company organizes an activity of a special committee. The committee includes workers of the physical protection personnel, workers from a number of experts, whose duties include ensuring the safe operation of the radiation facility, its hazards and critical elements. Specialists from other companies which are competent in matters of physical protection could also be included in the committee structure.

Establishing of the physical protection level is based on the following criteria:

category of sabotage consequences at a radiation facility;

category on potential radiation hazard of sealed radioactive sources which are used at the radiation facility;

a reasonable conclusion of the possibility or impossibility of the radioactive sources theft.

There are four categories of sabotage consequences at a radiation facility in the Regulations (it’s similar with categories in the previous version of the Regulations). To take into account a risk of radioactive sources theft the additional criteria «possibility or impossibility of radioactive sources theft» was added in the Regulations. It allows to use graded approach, based on risk analysis of unauthorized actions against radioactive sources, and apply more strengthen physical protection measures to categories 1-3 sealed radioactive sources in case of their theft possibility. Risk assessment is organized according to adversaries' actions, mentioned in the adversaries model. The Regulations defines “adversaries model” as a set of information about numbers, equipment, training, awareness, and tactics of adversaries, their motivations and goals which are used to develop adequate requirements for physical protection system. The adversaries model is developed for each license holder. It’s based on the national list of general threats to nuclear and radiation sites and typical adversaries models and it is coordinated with the regional offices of security services.

To take into account different risks for different types of radioactive sources and to establish adequate requirements for its physical protection the Regulations prescripts to fix the physical protection “D” (with minimum of requirements) for categories 4-5 sealed radioactive sources. The Regulations also contains special requirements for physical protection of portable radioactive devices.

Another new requirement in the Regulations, harmonized with IAEA recommendations is a development of “Physical protection plan” as a universal site document, including comprehensive information about physical protection measures implemented by operators.

## Recommendations on security of Radioactive material and associated facilities

There are two parties that use the Regulations in practice. One of them is Rostechnadzor’s inspectors (they inspect the Regulations requirements implementation). The second one is the license holders (operators) (they implement the Regulations requirements). The Rostechnadzor develops special supporting methodological documents in order to facilitate the usage of the Regulations by each party. For example, to use the risk-informed approach while an organization and implementation of inspections, a standard inspection program was developed. Using this document inspectors define a number and types of checked questions according with features of operators’ radiation facilities (type of company activity, existing results of the previous inspections, established physical protection levels). For license holders, the Rostechnadzor publishes recommendations on implementation of Federal rules and regulations in the field of nuclear energy in special series, called “Safety recommendations in the field of nuclear energy”. To facilitate an implementation of Regulations requirements Safety recommendations (Recommendations on the structure and content of documents developed at a site for physical protection of radioactive sources, radioactive devices and storage facilities, Assessment of the physical protection system at a site with radiation facilities, Recommendations on the security measures for portable radioactive devices) were adopted by the Rostechnadzor and some others are currently being developed.