



Hungarian Atomic Energy Authority

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Guideline PP-7

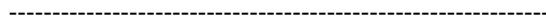
**Design of the physical protection system of
nuclear materials, radioactive sources and
radioactive wastes in use or store against
unauthorized removal and sabotage**

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FOREWORD FROM THE DIRECTOR GENERAL

The Hungarian Atomic Energy Authority (hereinafter referred to as HAEA) is a central state administration organ (a so-called government office) having nationwide competence in the field of peaceful use of atomic energy; it operates under the direction of the Government, it has independent tasks and scope of authority. The HAEA was established in 1990 by the Government of the Republic of Hungary with Govt. decree 104/1990. (XII. 15.) Korm. on the scope of tasks and competence of the Hungarian Atomic Energy Commission and the OAH.

The public service of the HAEA as defined in law is to perform and coordinate, independently of organizations having interest in the application of atomic energy, the regulatory tasks in relation to the peaceful and safe use of atomic energy, including the safety of nuclear facilities and materials, nuclear emergency response and nuclear security, and the corresponding public information activity, and to make proposal to develop and amend, and to offer an opinion on proposed legislations corresponding to the use of atomic energy.

The fundamental nuclear safety objective is to ensure the protection of individuals and groups of the population and of the environment against the hazards of ionising radiation. This is ensured with effective safety measures implemented and adequately maintained in the nuclear facility.

The radiation protection objective is to keep the radiation exposure of the operating personnel and the public all times below the prescribed limits and as low as reasonable achievable. This shall be ensured in the case of radiation exposures occurring during design basis accidents, and as far as reasonably possible during beyond design basis accidents and severe accidents.

The technical safety objective is to prevent or avoid the occurrence of accidents with high confidence, and the potential consequences occurring in the case of every postulated initiating event taken into account in the design of the nuclear facility shall remain within acceptable extent, and the probability of severe accidents shall be adequately low.

The HAEA determines the way how the regulations should be implemented in guidelines containing clear, unambiguous recommendations in agreement with the users of atomic energy. These guidelines are published and accessible to every members of the public. The guidelines regarding the implementation of nuclear safety, security and non-proliferation requirements for the use of atomic energy are published by the director general of the HAEA.

FOREWORD

The internationally accepted bases of physical protection are represented by the Law Order 8 of 1987 on the promulgation of the International Convention on the Physical Protection of Nuclear Materials, the Act LXII of 2008 on the promulgation of the Amendment to the Convention on Physical Protection of Nuclear Materials approved in the frame of the International Atomic Energy Agency and promulgated by Law-decree 8 of 1987 amended by a Diplomatic Conference organized by the IAEA signed on July 8, 2005, and the Act XX of 2007 on the promulgation of the International Convention for the Suppression of Acts of Nuclear Terrorism.

The realization of the stipulations undertaken by Hungary, at the highest level, is represented by the Act CXVI of 1996 (hereinafter referred to as Atomic Act), which includes the fundamental security principles and establishes the frame of the detailed physical protection regulations.

The Govt. decree 190/2011. (IX. 19.) Korm. published based on the authorization of the Act (hereinafter referred to as Government Decree) establishes the legal requirements for the physical protection of the use of atomic energy and for the connecting licensing, reporting and inspection system.

The HAEA is authorized to develop recommendations regarding the implementation of requirements established in laws, which are published in the form of guidelines and made accessible on the website of the HAEA.

For the fast and smooth conduct of licensing and inspection procedures connecting to the regulatory oversight activity, the Authority encourages the licensees to take into account the recommendations of the guidelines to the extent possible.

If methods different from those laid down in the regulatory guidelines are applied, then the Authority shall conduct an in-depth examination to determine if the applied method is correct, adequate and full scope, which may entail a longer regulatory procedure, involvement of external experts and extra costs.

The guidelines are revised regularly as specified by the HAEA or out of turn if initiated by a licensee.

The regulations listed are supplemented by the internal regulations of the licensees and other organizations contributing to the use of atomic energy (designers, manufacturers etc.), which shall be developed and maintained according to their quality management systems.

Before applying a given guideline, always make sure whether the newest, effective version is considered. The valid guidelines can be downloaded from the HAEA's website: <http://www.oah.hu>.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

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1. INTRODUCTION

1.1. Scope and objective of the guideline

The guideline contains recommendations on how to comply with the regulations established in the Decree.

It provides detailed guidance and practical examples for complying with the requirements and criteria for the physical protection of nuclear materials, radioactive sources and radioactive wastes in use or storage against their unauthorized removal and sabotage thereto.

Guidance on the physical protection plan for the transport of nuclear and other radioactive materials is provided in Guideline PP-15.

Guidance on the design of the physical protection of nuclear facilities (with the exemption of reactors having less than 1 MW thermal power), and interim storage and final disposal radioactive repositories is provided in Guideline PP-8.

1.2. Relevant laws and regulations

Legal background of nuclear security requirements are provided by the Atomic Act and the Decree and the following provisions:

- a) Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, IAEA, CPPNM/AC/L.1/1, 2005.
- b) Preventive and Protective Measures Against Insider Threats, IAEA Nuclear Security Series No. 8, IAEA, 2008.
- c) Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, 2009
- d) Nuclear security recommendations on the physical protection of nuclear material and nuclear facilities (INFCIRC/225/Rev5), IAEA Nuclear Security Series No. 13, IAEA, 2011.
- e) Nuclear Security Recommendations on Radioactive material and associated facilities, IAEA Nuclear Security Series No. 14, IAEA, 2011.

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2. DEFINITIONS

In addition to the definitions in Section 2 of the Atomic Act and Section 2 of the Decree, this guideline uses the following definitions:

Intrusion detection system: such an electronic system, which can automatically sense the existence of any intruder in rooms or areas being under surveillance, as well as the intrusion or its attempt, receive manual signaling, and display such signals.

Access point: where the access/regress is controlled. The equipment controlling the access/regress can be doors, turnstiles, barriers, etc.

Access control system: it supervises the access to a location. It can be operated autonomously or in a controlled manner.

Biometric identifier: identifies a person based on his/her individual biological characteristics (fingerprint, hand geometry, iris, face, etc).

Unacceptable radiological consequence: a consequence of sabotage directed against a nuclear facility, nuclear material, a radioactive source or radioactive waste is unacceptable if it cause or might cause nuclear emergency. Furthermore, if the sabotage causes substantial exceedance of the dose limits for individuals or group of individuals in a short period or it is suitable to cause such extra radiation exposure.

Surface protection: it is also known as shell protection; it basically includes means providing the protection of the fence, boundary walls, ceilings, doors and windows.

Authority: Hungarian Atomic Energy Authority and National Police Headquarters.

Minimum (intrusion) detection system: the surface protection covers doors and windows below 3 meters, area protection is trap-like, object and person protection do not exist.

Partial (intrusion) detection system: the surface protection is overall (the detection system supervises every door, window, gate, as well as those walls, ceilings and floors that are not in compliance with the requirements of the overall mechanical physical protection; it provides alarm if intrusion is attempted), the area protection is trap-like (the detection system supervises the access routes of the threatened objects and important areas), and the alarm goes off locally (alarming the direct environment).

Object protection: it provides direct protection of objects located in rooms.

Overall (intrusion) detection system: it is an integrated surface, area, object and person protection system. As a part of surface protection the detection system

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supervises every door, window, gate, as well as those walls, ceilings and floors that are not in compliance with the requirements of the overall mechanical physical protection; it provides alarm if intrusion is attempted. As a part of area protection the detection system supervises the internal area, provides alarm if any unauthorized human action is taken, as well as supervises the access routes at least trap-like. As a part of object protection the detection system supervises every threatened object. As a part of person protection the detection system provides the opportunity for every potentially threatened person to indicate any attack; in addition to local alarming provided by the intrusion or attack detection system it directly notifies the security personnel.

Area protection: it provides protection for internal areas.

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3. RECOMMENDATIONS OF THE GUIDELINE

3.1. Basic requirements

Section 18 of the Govt. decree regulates how to design a physical protection system, as follows:

Section 18

(1) The obligant shall develop a physical protection plan to describe the structure and operation of the physical protection system according to the specifications of Annex 4.

(2) The obligant, as part of the physical protection plan, shall prepare a contingency plan, which specifies the scope of possible events, including also the events that may cause inappropriate operation of the physical protection system, as well as the procedure of necessary measures and interventions.

(3) The obligant shall prepare for the measures to introduce advanced level physical protection if ordered for according to point subpoint da) of point d) of paragraph (1) of Section 3.

(4) The obligant shall harmonize the management of nuclear and non-nuclear emergencies with the operation of the physical protection system.

(5) If nuclear emergency occurs due to sabotage or other reason, the physical protection system shall not hinder the implementation of the emergency response plan.

In the case of use and storage of materials, the below requirements of Annex 4 of the Govt. decree shall be complied with:

Content requirements for physical protection plans

1. The physical protection plan of a nuclear facility, a radioactive waste storage or disposal facility, nuclear material, radioactive source or radioactive waste shall contain:

1.1. General data:

1.1.1. administrative data: name, address and contact details of the obligant, contact persons, copy of the ownership registry of the real estate, or if the real estate is rented then the contribution declaration of the renter;

1.1.2. identification of the activity;

1.1.3. description of the close environment of a nuclear facility, and a radioactive waste storage and disposal facility: site with coordinates, scaled map with the

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indication of physical protection important buildings, access routes, routes, rails and waterways in the vicinity;

1.1.4. description of nuclear material, radioactive source and radioactive waste: its type, quantity, activity, physical state, category, use;

1.1.5. description of the management and storage rules of keys for storage equipment and rooms;

1.1.6. identification of technology systems, structures and components that are significant to radiological consequences;

1.1.7. detailed layout with the indication of the artificial barriers, physical protection zones, nuclear and radioactive materials to be protected, physical protection systems, structures and components, guards points, patrol routes, central alarm station; layout of the storage room and rooms of application;

1.1.8. identification of potential adversary pathways; and

1.1.9. description of insider tactics;

1.2. data on the organization sub-system of physical protection:

1.2.1. organizational structure of physical protection;

1.2.2. physical protection roles and responsibilities within the organization (managers, assigned contact person);

1.2.3. description of the rule of guarding, and the applied mechanical and electronic asset protection system;

1.2.4. category, organization structure, tasks and rules of operation of armed security guards (if appropriate), number and date of the ordering resolution;

1.2.5. selection of the members of the internal response force; conditions for them;

1.2.6. physical protection training of the members of the internal response force and the entire organization;

1.2.7. preparation, conduct and evaluation of physical protection exercises; and

1.2.8. arms, tools and vehicle (number, type and description) of the internal response forces;

1.3. rules of access and regress;

1.4. physical protection procedures, quality management data:

1.4.1. documentation system (policy, instructions, procedures); and

1.4.2. accountancy for nuclear materials, radioactive sources and radioactive wastes; description of the rules of use;

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- 1.4.3. rules of access, access rights and the recording of access time points;*
- 1.4.4. protection plan of programmable systems;*
- 1.4.5. reporting procedure of events in relation to the operation of the physical protection system;*
- 1.4.6. procedure of investigation of reportable events;*
- 1.4.7. verification of the effectiveness of the physical protection system (exercise programme); and*
- 1.4.8. method, regularity, approval of the revision of the physical protection plan, its storage, name and positions of those having access to the physical protection plan;*
- 1.5. data on the technical sub-system of physical protection:*
 - 1.5.1. design and operational specification,, components and their functions;*
 - 1.5.2. description of deterrence, detection, delay and response tools; and*
 - 1.5.3. maintenance and testing programme;*
- 1.6. external response forces, cooperation with the external response forces;*
- 1.7. comprehensive evaluation of the physical protection system in reflect to the potential adversary pathways and adversary tactics;*
- 1.8. harmony with plans identified in Section 6 (6);*
- 1.9. plans and procedures of response actions (contingency plan);*
- 1.10. presentation of measures to be implemented if elevated level of physical protection is ordered; and*
- 1.11. special rules with regard to regulatory inspections.*

Annex 4 of the Govt. decree determines the mandatory elements of a physical protection plan. This guideline facilitates the technical design process of a physical protection system.

3.2. Design process

The design process is composed of the following major steps:

- a) Designation of the organization/person responsible for physical protection
- b) Comprehensive assessment of legal obligations
- c) Technical design of the physical protection system
- d) Specification of administration regulations for physical protection
- e) Preparation of the physical protection plan

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3.2.1. Designation of the organization/person responsible for physical protection

The persons and the organizational unit responsible for physical protection shall be clearly defined within the organization of the obligant in its organizational rules and procedures, as well as the obligations of the employees to be taken in order to comply with the physical protection regulations. It is reasonable to designate the safeguards officer in the case of nuclear materials, or the radiation protection officer in the case of other radioactive materials.

3.2.2. Comprehensive assessment of legal obligations

It is essential to take full account of the legal requirements to be complied with during the activity of the obligant in the first phase of the design process. The individual requirements, as well as their correlations should be considered; their compliance in the mirror of the local specialties should be in the focus.

3.2.3. Technical design of the physical protection system

The Govt. decree defines the steps of the technical design process of the physical protection system of nuclear and other radioactive materials in use, storage and transport, as follows:

Section 29

(1) To design the physical protection system the obligant shall:

a) identify the type, amount and activity of the used, stored or transported nuclear material, radioactive source, or of the processed, stored or transported radioactive waste, as well as the systems and components important from the point of view of radiological consequences;

b) determine the respective categories based on Section 4;

c) determine the minimum level of protection based on Section 7;

d) survey the potential adversary pathways, and the potential tactics of insiders; and

e) meet all the requirements determined in Annex 2 and 3 for each potential intrusion routes in relation to all of the physical protection functions specified in Sections 9–12.

(2) The obligant may apply higher level physical protection solutions compared to the minimum required protection, may meet higher level requirements or may apply different physical protection solutions in addition to that required in Annex 2 and 3. The physical protection solutions pertaining to higher level physical protection, or using more than minimum required additional different solutions can be regarded as part of the elevated level physical protection.

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Accordingly, the most important steps are as follows:

Categorization

The security (threat) related categorization of nuclear materials, radioactive sources and radioactive wastes shall be conducted on the basis of their type, quantity and activity. The principles of categorization and additional practical guidance can be found in Guideline PP-1 "*Categorization of nuclear materials, radioactive sources and radioactive wastes*".

Specification of the minimum requires physical protection levels

The Govt. decree associates the threat categories with the minimum required level of the related physical protection system, and defines their fundamental objectives.

Section 7

(1) During the use, storage and transport of nuclear materials, radioactive sources, and processing, storage and transport of radioactive wastes four levels of physical protection shall be developed according to sections (2)–(5) by ensuring:

- a) on physical protection level A: prevention of sabotage and unauthorized removal,*
- b) on physical protection level B: reducing the opportunity of sabotage and unauthorized removal,*
- c) on physical protection level C: reducing the opportunity of unauthorized removal, and*
- d) on physical protection level D: application of basic protection measures (i.e. prudent management).*

(2) Level A physical protection shall be ensured in the case of use, storage and transport of Category I nuclear material.

(3) Level B physical protection shall be ensured in the case of:

- a) use, storage and transport of Category II nuclear material,*
- b) use, storage and transport Category 1 radioactive source,*
- c) processing, storage and transport of Category 1 radioactive waste, and*
- d) transport of Category III nuclear material.*

(4) Level C physical protection shall be ensured in the case of:

- a) use, storage of Category III nuclear material,*

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b) use, storage and transport of Category 2 and 3 radioactive source, with the exemption of sealed radioactive sources within portable equipment, when used outside of an examination laboratory, and

c) processing, storage and transport of Category 2 and 3 radioactive waste.

(5) Level D physical protection shall be ensured in the case of:

a) use, storage and transport of Category 4–5 radioactive source, with the exemption of sealed radioactive sources within portable equipment, when used outside of an examination laboratory,

b) use, storage and transport of non-categorized nuclear materials, and

c) processing, storage and transport of Category 4 radioactive waste.

(6) Concerning systems, structures and components significant to radiological consequences the level of physical protection shall be identical to that of the used or stored nuclear material and radioactive source, or processed, disposed radioactive waste, determined according to Sections (1)–(5).

(7) Concerning the physical protection during processing and transport of the radioactive source that was re-qualified to radioactive waste the requirements of the protection level of the radioactive source shall apply.

The minimum required physical protection levels belonging to certain categories of materials are summarized in Table 1. The table indicates the minimum required level of the physical protection system and its objective (against what the protection shall be provided) that are dependent on the type of activity (i.e. use, storage or transport) as well.

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Table 1 Minimum physical protection level belonging to certain material categories

Material	Activity	Against what	Minimum required level
Category I nuclear material	US	ST	A
Category I nuclear material	T	T	A
Category II nuclear material	US	ST	B
Category II nuclear material	T	T	B
Category III nuclear material	US	T	C
Category III nuclear material	T	T	B
Category 1 radioactive source*	US	ST	B
Category 1 radioactive source*	T	T	B
Category 2 radioactive source*	UST	T	C
Category 3 radioactive source*	UST	T	C
Category 4 radioactive source*	UST	T	D
Category 5 radioactive source*	UST	T	D
Category 1 radioactive waste	UST	ST	B
Category 2 radioactive waste	UST	T	C
Category 3 radioactive waste	UST	T	C
Category 4 radioactive waste	UST	T	D
Non-categorized nuclear material	UST	T	D

U-use or processing, S-storage, T-transport, S-sabotage, Th-theft and unauthorized removal

*in the case of use sealed radioactive sources within portable equipment, when used outside of an examination laboratory is exemption.

Establishment of the required physical protection system

The Govt. decree requires that the physical protection system shall be established in such a way that the physical protection functions are complied with in each adversary pathways with the requirements established in Annex 2 of the Govt. decree.

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Pursuant to Section 8 of the Govt. decree, the physical protection system shall have the following functions:

Section 8

The physical protection shall ensure that the:

- a) deterrence,*
- b) detection,*
- c) delay, and*
- d) response*

functions cooperate effectively according to the requirement of Annex 2 and 3.

The objectives of each function of the physical protection system are described below.

1. Deterrence

The deterrence function aims at frightening the adversary having malicious objective (sabotage or unauthorized removal), in ideal case at preventing its intentions. This can be reached by the announcement and visibility of a high level of physical protection.

2. Detection

The detection function aims at sensing and alarming the adversary action as early as possible. Depending on the required level of physical protection, this aim can be fulfilled by several possible solutions. These solutions may support the deterrence function as well.

3. Delay

The delay function aims at holding up the adversary in the successful realization of its intention. Primarily, this can be reached by technical barriers. The delay time measured subsequent to detection also depends on the required level of protection. Well visible technical barriers (fence, wall, etc.) strengthen the deterrence function.

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4. Response

The response function aims at preventing the adversary action or mitigating the potential consequences. This function performed by guards and armed guards, internal and external response forces, who are to detain or to catch the adversary in order to prevent its access to the material or equipment.

The potential solutions for different functions are discussed in details in guidelines listed below.

Guideline	Title
PP-2	Detailed requirement levels for the systems and components of deterrence physical protection function
PP -3	Detailed requirement levels for the systems and components of detection physical protection function
PP -4	Detailed requirement levels for the systems and components of delay physical protection function
PP-16	Detailed requirement levels for response physical protection function

The Govt. decree requires the designation of a physical protection zone or zones within the protected zone established for the physical protection of the nuclear material, radioactive source and radioactive waste, as follows:

Section 14

(1) Following the concept of protection-in-depth, physical protection zone or zones shall be developed within the area established for the physical protection of the nuclear facility, interim store and final repository of radioactive waste, nuclear material, radioactive source and for radioactive waste.

(2) The physical protection zones are as follows:

- a) limited access area;*
- b) protected area;*
- c) vital area; and*

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d) inner area.

(3) Protected area shall be designated inside the limited access area; vital area shall be designated inside the protected area; while inner area shall be designated inside vital area.

(4) The physical protection areas shall conform to the physical protection levels determined in Section 7 as specified in paragraphs (5)–(8).

(5) As minimum, level D protection shall be ensured within limited access area. Nuclear material, radioactive source, radioactive waste requiring level D physical protection shall be located within limited access area.

(6) As minimum, level C protection shall be ensured within protected area. Nuclear material, radioactive source, radioactive waste that requires level C physical protection and such systems, structures and components, which are significant to radiological consequences and so require level C protection, shall be located within protected area.

(7) As minimum, level B protection shall be ensured within vital area. Nuclear material, radioactive source, radioactive waste that requires level C physical protection and such systems, structures and components, which are significant from the point of view of radiological consequences and so require level C protection, shall be located within vital area.

(8) Level A protection shall be ensured within inner area. Nuclear material requiring level A physical protection shall be located within inner area.

(9) Movement between two physical protection zones shall be possible only via access points in a controlled manner.

The way how the physical protection zones should be designated is discussed in Guideline PP-5 "Designation of physical protection zones".

3.2.4. Determination of the administrative measures of physical protection

The content elements and particular prescriptions of internal documents regulating the operation of the facility should be elaborated. Among them, the most important ones are: the access/regress rules, the rules of asset protection, guarding, transportation, accountancy of materials and protection of information.

3.2.5. Preparation of the physical protection plan

Guidance on the elaboration of the physical protection plan is provided in Guideline PP-11 "Preparation and submittal of physical protection plans".

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3.3. Establishment of the physical protection system

3.3.1. Reason for physical protection levels

In line with the international recommendations, the nuclear materials and radioactive sources entailing different threats should be protected by different (more or less strong) physical protection systems, depending on the potential consequences of the sabotage against them or their unauthorized removal and malicious use. Level A physical protection provides the strongest protection, while Levels B, C and D provide proportionally lower capabilities. Each physical protection level serves for a given goal, which means the outcome to be ensured by the given physical protection system. The Govt. decree defines the goals of the various physical protection levels as follows.

Section 7

(1) During the use, storage and transport of nuclear materials, radioactive sources, and processing, storage and transport of radioactive wastes four levels of physical protection shall be developed according to sections (2)–(5) by ensuring:

- a) on physical protection level A: prevention of sabotage and unauthorized removal,*
- b) on physical protection level B: reducing the opportunity of sabotage and unauthorized removal,*
- c) on physical protection level C: reducing the opportunity of unauthorized removal, and*
- d) on physical protection level D: application of basic protection measures (i.e. prudent management).*

The above defined goals can be met by the appropriate combination of physical protection functions. The combination of functions being in compliance with Level A requirements is summarized in Section 3.3.2 and 3.3.3 below.

3.3.2. Protection against sabotage

A possible solution for the realization of Level A physical protection against sabotage is described below. Physical protection systems established according to lower levels can be established based on Level A by adequate adjustment of the goals and solutions.

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Regarding sabotage, the basic objective of Level A physical protection is to prevent any access to the object to be protected. In order to meet this objective, the physical protection functions should operate as indicated in the table. The table includes the proposed administrative, technical and response personnel solutions as well.

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Table 2. Realization of Level A physical protection against sabotage to a facility

Function	Goal	Potential solution	Mean category/group
I. Detection	I.1. Immediate detection of any access to limited access area	I.1.a. Intrusion detection system or I.1.b. Continuous surveillance	Technical (electronic) or Human
	I.2. Monitoring of access to limited access area (insiders!)	I.2.a. Permanent metal detection I.2. b Occasional explosive detection I.2.c. Continuous surveillance	Technical (electronic) or Human
	I.3. Immediate assessment of detection	I.3.a. CCTV or I.3.b. Human based assessment	Technical or Human
	I.4. Immediate communication to response forces	I.4. Rapid, reliable and alternative communication channels (phone, mobile, radio, etc.)	Technical
II. Delay	II.1. Provision of delay after detection sufficient for the response forces to prevent sabotage	II.1. Provision of delay at least on two levels (e.g. fence, building having reinforced walls, doors and windows, etc.)	Doubled technical (Engineering barrier)
III. Response	III.1. Provision of timely response to a confirmed alarm with sufficient resources to deny the adversary action	III.1. Provision of response personnel in sufficient number, with sufficient resources and qualification	Administrative and Human
IV. Management	IV.1. Only authorized persons may access to limited access area	IV.1. Appropriate access control system (ID card system or verified key management)	Technical or Administrative
	IV.2. Ensure trustworthiness of	IV.2. Vetting	Administrative

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	authorized individuals		
	IV.3. Identification and protection of sensitive information	IV.3. Classification procedures	Administrative
	IV.4. Existence and awareness of security procedure	IV.4. Preparation and practice of security procedures	Administrative

3.3.3. Protection against unauthorized removal

A potential solution for the establishment of Level A physical protection against unauthorized removal is shown below. The other physical protection levels can be established based on this solution by elimination of certain elements according to the objective of the given physical protection level.

The basic goal of Level A physical protection is to prevent the removal of the source. In order to meet this goal, the functions of the physical protection system should perform as described in Table 3.

Table 3. Establishment of Level A physical protection against theft from a facility

Function	Goal	Potential solution	Mean category/group
I. Detection	I.1. Immediate detection of intrusion to limited access area or the store	I.1.a. Intrusion detection system or I.1.b. Continuous surveillance	Technical (electronic) or Human
	I.2. Immediate detection of any attempted unauthorized removal of the source	I.2.a. Theft alarm system or I.2.b. Continuous surveillance	Technical (electronic) or Human
	I.3. Immediate assessment of detection	I.3.a. CCTV or I.3.b. Human made assessment	Technical or Human
	I.4. Immediate communication to response forces	I.4. Rapid, reliable and alternative communication	Technical

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		channels (phone, mobile, radio, etc.)	
	I.5. Provision of means to detect any loss	I.5. Daily verification (physical, CCTV, signal of loss detector, etc.)	Technical and/or Human
	I.6. Monitoring the regress from limited access area	I.2.a. Permanent metal detection I.2. b Radiation detection I.2.c. Continuous surveillance	Technical (electronic) and Human
II. Delay	II.1. Provision of delay after detection sufficient for the response forces to prevent unauthorized removal	II.1. Provision of delay at least in two steps (e.g. closed fixed container or source holder and lockable room)	Doubled technical (Engineering barrier)
III. Response	III.1. Provision of timely response to a confirmed alarm with sufficient resources to deny the adversary action	III.1. Provision of response personnel in sufficient number, with sufficient resources and qualification	Administrative and Human
IV. Management	IV.1. Only authorized persons may access to area containing the source	IV.1. Appropriate access control system (ID card system or verified key management)	Technical or Administrative
	IV.2. Ensure trustworthiness of authorized individuals	IV.2. Vetting	Administrative
	IV.3. Identification and protection of sensitive information	IV.3. Classification procedures	Administrative
	IV.4. Existence and awareness of security procedure	IV.4. Preparation and practice of security procedures	Administrative

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

3.4. Case studies for the establishment of physical protection systems

The below described case studies are presented to provide concrete examples regarding the establishment of physical protection systems, and to support the elaboration of certain sections of physical protection plans. The paragraphs prescribed as obligatory in Annex 4 of the Govt. decree are interpreted through the presentation of the Level D physical protection plan. Only those paragraphs are discussed in detail in Level C and Level B model plans, regarding which the Authority seems the detailed presentation necessary.

3.4.1. Level D physical protection model plan for the protection of radioactive sources during use and storage

The below chapter provides a complete physical protection model plan for the use and storage of radioactive sources requiring Level D physical protection.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

**PHYSICAL PROTECTION PLAN of
University Laboratory**

pursuant to Section 18 of Govt. decree 190/2011. (IX.19.) Korm.

Level D physical protection for use and storage

Prepared by: XY, radiation protection officer

Approved by: XYZ, director

unique identifier/version number

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

day.month.year

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

The physical protection plan was prepared pursuant to Para 1 of Annex 4 of the Govt. decree.

1.1. General data

1.1.1 Administrative data

The most important administrative data of the obligant should be presented in this section:

Obligant's name:	University Laboratory (hereinafter: Institute)
Address:	postal code, town, street, house number, building XX
Responsible leader:	XYZ, director
Liaison person:	XY, radiation protection officer
Phone number:	wired and mobile number
Alternate liaison person:	XY, deputy radiation protection officer
Phone number:	wired and mobile number
Fax:	fax number
Extract from property register:	see Annex 9

1.1.2 Activity

The University Laboratory applies its nuclear and other radioactive materials for research and practical training of university students.

1.1.3 Description of the site

The map of the university campus and the layout of Building XX are attached to the Physical protection plan as Annex 1 and 2. The map indicates the two main entrances of Building XX, the main gate of the university campus, as well as two other gates.

The GPS coordinates of the University are (Building XX): N/S

1.1.4 Applied radioactive materials

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

I. 1 pc Pu-239-Be radioactive source

Certificate number: cc00000 (Annex 3)

Batch number: cccccc

Use

Pu-239 mass: 1.6 g

Original activity: 37 MBq (1968. 01. 01.)

Category of the source according to its D value:

D-value: $6 \cdot 10^{-2}$ TBq

R-value: $0.000037/6 \cdot 10^{-2} = 0.0006167 \rightarrow 0.01 > 0.0006167$

Category: 5

Categorization of the source according to its nuclear material content: the mass of the source is less than 15 g, thus it cannot be categorized as nuclear material.

II.1 pc Cs-137 radioactive source

Certificate number: cc00000 (Annex 4)

Use: ...

Original activity: 1 GBq (1980. 01. 01.)

D-value: $1 \cdot 10^{-1}$ TBq

R-value: $0.001/1 \cdot 10^{-1} = 0.01$

Category: 4

Accordingly, the required physical protection level is D.

1.1.5 Description of the management and storage rules of keys of storage cabinet and rooms

The sealed sources are stored in the basement of Building XX, in Room No.23 (so called laboratory), in a special storage cabinet providing sufficient radiation shielding. This room is the only controlled zone of the Institute. The storage cabinet is equipped with a security padlock. The storage cabinet is always locked; it is opened only if experiments or student practices are in progress in order to

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

take radioactive sources in or out. Room No.23 is a laboratory equipped with security lock. The layout of Room No.23 can be seen in Annex 5.

The keys of both the storage cabinet and Room No.23 is stored in the room of the radiation protection officer and his deputy (i.e. Room No.128), on the first floor, in a lockable plate safe used exclusively for this purpose. The key of the plate safe can be handled by the above mentioned two officers only.

The reserve key of Room No.23 is stored at the security service of the university campus (main gate, Building I), together with the actual contact details of the radiation protection officer and his deputy.

A specific register is maintained in Room No.23 on actions when radioactive sources are taken in to and out from the storage cabinet; the register provides information on:

- a) who,
- b) when,
- c) with what purpose, and
- d) for what type of activity
 - a. used the sources.

Access to the large laboratory is permitted in writing by the director; other people may enter with the permission of the radiation protection officer or his deputy, or the teacher holding the lecture.

1.1.6 Identification of technology systems, structures and components that are significant to radiological consequences

Only the radioactive source means radiological risk. There is no any such system or component that may entail radiological risk.

Room No. 23 is neither equipped with a separate video nor with an alarm system. The laboratory only has an entrance door, it has no other door or window, the air conditioning system provides the necessary conditions for working.

1.1.7 Detailed layout

Room No.23 is located in Building XX of the university campus, which is the closest to the western gate. The university campus has three entrances (in addition to the north gate which is the main entrance, the south and west gates); the area is enclosed by a stone fence, which (together with the forged iron ornaments) reaches the height of 2 m. The south and west gates are open between 7 a.m. and 8 p.m. during working days. The entrance centre is operated around the clock at

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

the main gate; night entrance can be performed after presentation of identification card to and registration by the security service. The surveillance is supported by 25 cameras located at various locations of the campus (the positions of the cameras are indicated in Annex 6).

Both entrances of Building XX (on the ground floor) are open between 7 a.m. and 8 p.m. Night work has to be declared in advance in writing to the security service.

1.1.8 Identification of potential adversary pathways

Both entrances of Building XX are near the west gate; the distance between these two points is about 80 meters. The north gate is located 200 meters, while the south gate from 100 meters from the entrances of the building.

Entering and leaving by vehicles are only possible through the main gate, with special permission.

After entering the building two stairs lead to the basement, both ends of which are closed by two-wing doors. These doors are locked by the security service for night. If work is not planned for the night, then the security service locks the building and sets the alarm system. The only access route to the large laboratory is through its entrance door; artificial venting system provides the work conditions.

1.1.9 Description of insider tactics

The following measures were introduced by the Institute in order to prevent malevolent acts by insiders:

e.g.:

- a) Control of personal identification
- b) Truthworthiness assessment
- c) Accompany and supervision of visitors
- d) etc.

(The potential solutions for protecting against insiders are discussed in detail in Guideline PP-13 "Protection against insiders".)

1.2. Data on the organization sub-system of physical protection

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.2.1. Organizational structure of physical protection

The security service of the campus is provided by: SDFG Kft.

Its address: postal code, town, street, house number, building

Responsible leader: ZY, managing director

His phone number: wired and mobile numbers

Commander: YX

His phone number: wired and mobile numbers

1.2.2. Physical protection roles and responsibilities

Designated liaison person: XY, radiation protection officer

His phone number: wired and mobile numbers

Alternate liaison officer: XY, deputy radiation protection officer

His phone number: wired and mobile numbers

1.2.3. Description of the rule of guarding, and the applied mechanical and electronic asset protection system

The guarding rules and the description of the applied physical protection system are described in Annex 7, in which the following are detailed:

- a) Technical description of the video surveillance system of the campus;
- b) Technical description of the alarm system of building XX;
- c) Operation of the reception service;
- d) Guard instructions of the security service.

1.2.4. and 1.2.8. These requirements are not relevant, because armed security guards shall not be applied See Section 13 of the Govt. decree.

1.2.5. – 1.2.7. Training of response forces insider

The employees of the Institute, the reception and the security services have learnt the content of this physical protection plan in the frame of internal training.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.3 Rules of access and regress

The south and the west entrances are open between 7 a.m. and 8 p.m. on working days only. The entrance service at the main gate is available around the clock; however it requires presentation of identification card and registration by the security service between 8 p.m. and 7 a.m. Both entrance gates of Building XX (on the basement) are open between 7 a.m. and 8 p.m. If work out of office hours is planned, then the security service shall be notified in writing in advance.

1.4. Physical protection procedures, quality management data

1.4.1. Documentation system

A procedure was prepared to describe the work in the large laboratory (see Annex 8).

1.4.2. Accountancy for nuclear materials, radioactive sources and radioactive wastes; description of the rules of use

The radioactive sources are registered by the Radium 1.42 software that was provided by HAEA.

1.4.3. Rules of access, access rights and the recording of access time points

Access to the large laboratory is permitted in writing by the director; other people may enter with the permission of the radiation protection officer or his deputy, or the teacher holding the lecture.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.4.4. Protection plan of programmable systems

This requirement should not be applied based on Section 20 of the Govt. decree. Further information can be found in *Guideline-18 Protection requirements for computer systems*

1.4.5. Reporting procedure of events in relation to the operation of the physical protection system

The designated liaison person notifies the responsible leader and the security commander, and then records the events in writing. Subsequently, the security commander notifies the Authorities.

1.4.6. Procedure of investigation of reportable events

Reporting obligations for reportable events should be performed:

- a) An immediate reportable event should be immediately reported by phone but not later than 2 hours from its occurrence (detection).
- b) In addition to the oral notification of an immediate reportable event a written confirmation should be made during the next working day.
- c) The non-immediate reportable events should be notified of during the next working day in writing.

The scope of reportable events in Level D protection:

- a) Unauthorized removal of nuclear or other radioactive material, its attempt or a deficit in the inventory.
- b) Causing public danger and damaging to the environment with the use of nuclear and other radioactive material.

Content of oral notification:

- a) short description of the event (especially the exact time and location)
- b) taken or planned actions

Content of the written notification:

- a) short description of the event
- b) taken or planned actions and description of their expected effect and effectiveness.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

(The elaboration of the procedure of the investigation of reportable events is supported by Guideline PP-12 "Reporting system of physical protection related events".)

1.4.7. Verification of the effectiveness of the physical protection system

The verification of system effectiveness includes the verification how the guards are aware of the procedures (made by the guard commander) and the periodic maintenance (see also Section 1.5.3).

1.4.8. Method, regularity, approval of the revision of the physical protection plan, its storage, name and positions of those having access to the physical protection plan

The plan is to be reviewed if any change in the described human or technical conditions is expected. The plan does not include classified information; it can be accessed both by the members of the security service and the staff of the laboratory.

1.5. Data on the technical sub-system of physical protection

1.5.1. Design and operational specification, components and their functions

The following zone is designated in line with Section 14 of the Govt. decree, the following zone is designated:

- Limited access zone: Room 23 of Building XX (large laboratory)

1.5.2. Description of deterrence, detection, delay and response tools

Deterrence

1. Warning signs

A warning signs on radiation hazard are placed on the doors of Room No.23 and the storage cabinet; the operational rules of the large laboratory are hanged on the wall of the room. Signs placed on double-wing doors at both ends of the corridor warn people on ionizing radiation related activities.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Other signs used:

- a) name of the facility,
- b) warning on vehicle entrance rules,
- c) warning on unpermitted tools and activities,
- d) warning on radiation, and
- e) warning on entrance hazards and conditions.

2. Artificial barriers

On physical protection level D, the checked entering to the protected facility shall be assured by road signs, if it consists of more than one physical protection zone; otherwise artificial barriers shall not be applied. In the case of the Institute a barrier at the main gate limits unauthorized access.

3. Accountancy and control

The physical existence of the radioactive sources is verified in a documented manner by the radiation protection officer and its deputy at least once every six months; such proofing documents are presented to the director of the Institute.

Detection

Access control system

Its elements are the lockable doors and the limitation of access rights.

Delay

The delay within the physical protection system is provided by the boundary fence and gates, as well as by distances between gates and the building hosting the large laboratory, and the doors of the corridor and the room. The doors of Room No.23 are reinforced with iron bands, the opening of which by common tools needs more than 3 minutes. The cabinet providing storage place for the radioactive sources is equipped with a security bolt.

Response

The local security service starts to provide response to security events within 5 minutes, while the external response force (police) will arrive at the site within 20 minutes.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.5.3. *Maintenance and testing programme*

The technical part of the physical protection system was installed by XY Kft; a three year contract was concluded with this company for the maintenance and testing of the system elements.

1.6. External response forces, cooperation with the external response forces

In case of unauthorized removal or any other offence the security service immediately notifies the police.

1.7. Comprehensive evaluation of the physical protection system

The physical protection system of the Institute/laboratory complies with the requirements for level D system, since:

See Sections 1.5.2 and 1.2.3.

1.8. Harmony with the plans determined in Subsection 6 (6)

The operation of the established physical protection system is in compliance with the radiation protection and fire protection rules of the laboratory.

1.9. Plans and procedures of response actions

Out of office hours the security service regularly checks the entrance door of the large laboratory; in the case of any unauthorized access or removal it notifies the police. Such events are always recorded that contains the methods of elimination of potential protection failures.

In working hours the laboratory is in use, the missing sources can be detected at this time and should then proceed according to Section 1.4.5.

In case of a potential technical failure the Maintenance Sections should be notified (phone number: XXX)

1.10. Measures to be implemented if elevated level of physical protection is ordered

If the implementation of elevated level of physical protection is ordered by the Authority, then the security service will increase its checking frequency.

1.11. Special rules with regard to regulatory inspections

There are no specific rules to be complies with by inspectors during regulatory inspections.

Annexes

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Annex 1: Map of the university campus

Annex 2: Layout of Building XX

Annex 3: Certificate of the radioactive source

Annex 4: Certificate of the radioactive source

Annex 5: Layout of Room 23

Annex 6: Map of cameras

Annex 7: Description on the guarding rules and the applied asset protection system

Operation rules of the laboratory

Copy of the extract from the land register

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Level C physical protection model plan

**PHYSICAL PROTECTION PLAN
of an industrial radiography site**

pursuant to Section 18 of Govt. decree 190/2011. (IX.19.) Korm.

Level C physical protection for use and storage

Prepared by:

Approved by:

unique identifier/version number

year. month. day

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

The physical protection plan was prepared pursuant to Para 1 of Annex 4 of the Govt. decree on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection.

1.1. General data

1.1.1 Administrative data

The most important administrative data of the obligant should be presented in this section:

Obligant's name:

Address:

Responsible leader:

Liaison person:

Phone number:

Alternate liaison person:

Phone number:

Fax:

1.1.2 Activity

The company applies its radioactive materials for radiography examinations; exclusively on its site.

1.1.3 Description of the site

The layout of the site is attached as Annex 1.

GPS coordinates of the site:.....

1.1.4 Applied radioactive materials

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

2 pc Ir-192 radioactive source

Certificate number cc00000 (see Annex2)

Original activity: 3.7 TBq (date)

Category of the source according to its D value:

D-value: 0.08 TBq

Categorization pursuant to Table 2 of Annex 1 is:

$$R = \sum_i \frac{A_i}{D_i}$$

in this case:

$$R = 2 \times \frac{A_{Ir-192}}{D_{Ir-192}} = 2 \times \frac{3.7TBq}{0.08TBq} = 92.5$$

Since the R value is between 1000 and 10, therefore the applied radioactive sources belong to Category 2; thus (according to Section 7 (4) b of the Govt. decree) Level C physical protection shall be provided. Pursuant to Section 5 (1) a) of the Govt. decree the radioactive sources shall be protected against unauthorized removal.

1.1.5 Description of the management and storage rules of keys of storage cabinet and rooms

It should be assured that the room keys can be accessed by those only who have proper authorization. It is recommended to store the keys in separate lockable cabinet. The physical protection level is improved, if two persons should be present to open the storage rooms.

1.1.6 Identification of technology systems, structures and components that are significant to radiological consequences

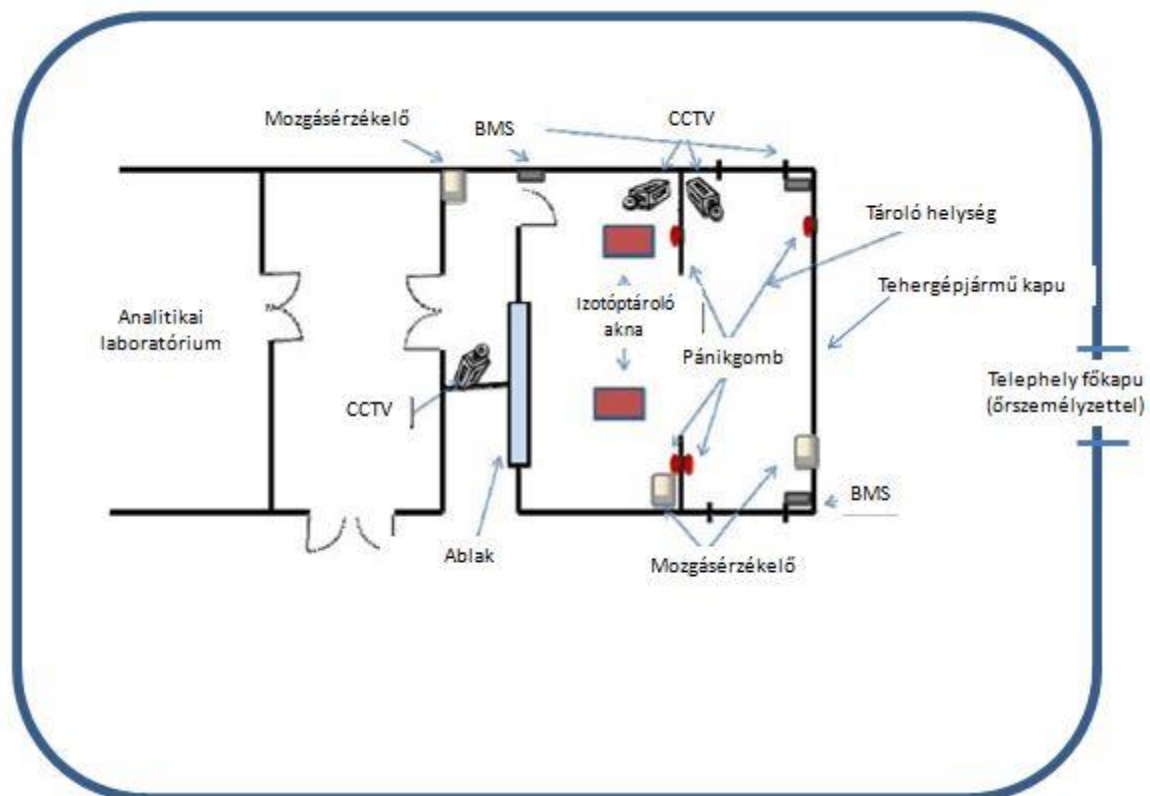
Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

In this case only the radiography sources exhibit potential radiological threat. There is no such system or component, which may entail significant radiological risk.

1.1.7 Detailed layout

The building where the radiography examinations are performed is located on the site; the site is surrounded by fence. The entrance is controlled, it is possible through the entrance gate, which is supervised 24/7. The site has no other entry point. The radiation source can be found in a brick building built in the 80's, which can be approached from only one direction.

The layout of the site and the radiography examination room can be seen in the figure below:



1.1.8 Identification of potential adversary pathways

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Since the radioactive source shall be protected against unauthorized removal, thus the external adversaries need longer time to perform the theft; they have to reach and remove the radioactive source and then leave the site with it. Accordingly, the response forces have longer time to respond, since they have to prevent the radioactive source to leave the site. All possible access routes have to be considered and the shortest route has to be chosen as a basis of design.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Route		Protective		Time need [s]
Stage	Description	element/tool	function	
1	Getting through fence	fence/gate	delay	5
2	Running to building (50 m)	distance + load	delay	30
3	Approach to radiography room	distance + load	delay	30
4	Entering storage room	door/wall motion sensor camera	delay detection alert	600 - 10
5	Removal of source from equipment	complicacy radiation meter	delay alert	600
6	Leaving the building	distance + load	delay	60
7	Approach to fence (50 m)	distance + load	delay	60
8	Getting through the fence	fence/gate	delay	10
Total duration after alarming (unauthorized removal)				1320

Consequently, the response forces have 1,320 seconds to prevent the attempt of unauthorized removal.

1.1.9 Description of insider tactics

The potential solutions for protecting against insiders are discussed in detail in Guideline PP-13 "Protection against insider threats".

1.2. Data on the organization sub-system of physical protection

1.2.1. Organizational structure of physical protection

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

The security service of the campus is provided by: SDFG Kft.

Its address: postal code, town, street, house number, building

Responsible leader: ZY, managing director

His phone number: wired and mobile numbers

Commander: YX

His phone number: wired and mobile numbers

1.2.2. *Physical protection roles and responsibilities*

Designated liaison person: XY, radiation protection officer

His phone number: wired and mobile numbers

Alternate liaison officer: XY, deputy radiation protection officer

His phone number: wired and mobile numbers

1.3 Rules of access and regress

The site can be accessed by those having authorization only. The gates shall be kept closed; they may be opened at the presence of guards. The entrance control system elements are reading-verifying units, person identification elements, and access/regress points.

1.4. Physical protection procedures, quality management data

1.4.1. *Documentation system*

If the obligant operates a quality management system, then the physical protection related policies, procedures, instructions should be attached.

1.4.2. *Accountancy for nuclear materials, radioactive sources and radioactive wastes; description of the rules of use*

The accountancy for and registration of nuclear and other radioactive materials are in compliance with the relevant laws. The existence of materials requiring Level C physical protection shall be verified in a documented manner at least once every three months.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.4.3. Rules of access, access rights and the recording of access time points

The detailed rules of entrance, the rights established for the relevant rooms and the documentation rules of access should be discussed here in details.

1.4.4. Protection plan of programmable systems

This should not apply according to Section 20 of the Govt. Decree.

Further information can be found in the Guideline PP-18, Protection requirements for computer systems.

1.4.5. Reporting procedure of events in relation to the operation of the physical protection system

The procedure of reporting events is guided by Guideline PP-12 "Reporting system of physical protection related events".

1.4.6. Procedure of investigation of reportable events

The elaboration of the procedure of the investigation of reportable events is guided by Guideline PP-12 "Reporting system of physical protection related events".

1.4.7. Verification of the effectiveness of the physical protection system

The Level C physical protection plan should be evaluated whether the deterrence, detection, delay and response functions can fully meet their goals and able to reduce the possibility of unauthorized source removal (Section 7 (1) c) of the Govt. decree).

1.4.8. Method, regularity, approval of the revision of the physical protection plan, its storage, name and positions of those having access to the physical protection plan

The obligants should make revision of the plan, if any element of the physical protection system is intended to be changed; the revised physical protection plan may require re-licensing.

1.5. Data on the technical sub-system of physical protection

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.5.1. Design and operational specification, components and their functions

The following zones are designated in line with Section 14 of the Govt. decree:

- a) Limited access area: site boundary (within the fence)
- b) Protected area: the radiography examination room

1.5.2. Description of deterrence, detection, delay and response tools

Deterrence

1. Warning signs

Among the warning signs listed in Annex 2 of the Govt. decree, the below listed ones are applied.

At the entrance of the site:

- name of the facility,
- warning on entrance rules,
- warning on forbidden tools and activities,

At the entrance of the radiography examination room:

- warning of entrance rights,
- warning on entrance hazards, indication of entrance conditions,
- warning on radiation hazards.

2. Artificial barriers

On physical protection level C, the protection against unauthorized penetration as well as the checked entrance to the protected facility shall be assured by mobile barriers and road dividers.

3. Accountancy and control

On physical protection level C, the physical inventory of nuclear and other radioactive materials shall be verified in a documented manner at least once every three months.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Detection

According to Annex 2 of the Govt. decree, on Level C physical protection, the detection function shall meet the following requirements:

Element	Requirement	Solution/mean
5. Intrusion detection and attack signaling system	14.1. overall surface protection	Surface protection on the radiography room: opening sensor on the entrance door (15.1.1. – e.g. balanced magnetic switch - BMS) Opening sensor on the load vehicle gate (15.1.1. – e.g. balanced magnetic switch - BMS)
	14.2. trap-like area protection	In the lobby of the radiography room the area protection is provided by 1 dual motion sensor . In the lobby of the radiography room the area protection is provided by 2 dual motion sensors .
6. Video surveillance and assessment system	18. video surveillance system for Level C physical protection	Digital camera according to Level C in the lobby of the radiography room. 2 digital cameras according to Level C in the radiography room. One out of two watches the entrance of the lobby, while the other watches the load vehicle gate. The images are transmitted through bunched conductor pair .
		The images of the cameras are displayed on monitors installed at the entrance reception.
7. Access control system	23.1. reader-verification units, 23.2. person identification elements, and 23.3. access/regress points.	Proximity card is needed for opening of the safety door of the radiography room by using the sabotage protected reader terminal with a personal identification code ; the opening needs two independent cards and codes .
8. Alarm station	26. 1. the alarm station should be located within the protected area or its boundary	The alarm station (guard center) is placed in the reception building at the entrance due to practical reasons. Since this is a limited access zone, therefore external response forces should be used in order to strengthen the response function (see below). The data of the surveillance and assessment system, in case of an alarm, is transmitted to the external response forces as well.

Delay

The delay, within the physical protection system, is provided by the fence/gate on the boundary (limited access area - Level D requirements), the distance to the building accommodating the radiography room, the wall/door of the radiography room (protected area - Level C requirements).

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

According to Annex 2 of the Govt. decree, the means of delay should comply with the following requirements:

Element	Requirement	Solution/mean
9. Passive mechanical barriers	40. Level D: fence	The area of the hospital is protected by a fence having height of 2 m, made of plastic wire stretched between concrete columns that are located on the boundary of the area (limited access area, where Level D is required). Its delay time: 5 sec.
	41. Level D: gates on the fence	The 2.5 m high gate is made of steel that is stronger than the material of the fence. If the gate is open, then the entrance is controlled by a barrier. If the gate is closed, then it can be opened at the presence of guards.
	39. Level C: wall ...exhibits minimum 5 minutes breakage resistance, equivalent to dense brick wall having 6 cm width ... 46.1. ... the door exhibits five minutes breakage time.. 46.4. ... the locks ... security locks exhibit 5 minutes breakage resistance	The wall of the radiography room is made of small bricks. The radiography room has a security door having 5 min breakage time (Category III security door) and a security lock having 5 min resistance. The load vehicle gate exhibits the same delay capability.

Response

The response is provided by the guarding personnel or the external response forces who shall arrive within 15 minutes to the scene.

1.5.3. *Maintenance and testing programme*

The technical part of the physical protection system was installed by XY Kft; a three year contact was concluded with this company for the maintenance and testing of the system elements. The maintenance and testing is performed every three month.

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

1.6. External response forces, cooperation with the external response forces

The site concluded an agreement with the local police for the provision of external response forces. On contractual basis the images of the CCTV cameras of the physical protection system, in case of alarm, are automatically transmitted to the police. The external response forces will arrive at the site within 15 minutes after the alarm goes off. The local response forces are in contact with the external forces through the phone.

1.7. Comprehensive evaluation of the physical protection system

The Level C physical protection plan should be evaluated in the mirror if the deterrence, detection, delay and response functions can fully meet their objectives, and thus able to reduce any potential attempt of unauthorized removal pursuant to Section 7 (1) c) of the Govt. decree.

1.8. Harmony with other plans determined in Subsection 6 (6) of the Govt. decree

In accordance with Section 6 (6) of the Govt. decree:

The physical protection system shall be operated effectively in cooperation with the requirements for and technical solutions of nuclear safety, industrial safety, accountancy and control, radiation protection, management of abnormal situations and nuclear and conventional emergency management of the nuclear facility, interim storage and final repository of radioactive wastes, nuclear materials, radioactive sources and radioactive wastes.

This section should justify that the above referred systems do not hinder the effective operation of each other; they are able to perform their tasks in harmony.

1.10. Measures to be implemented if elevated level of physical protection is ordered

The measures to be implemented if elevated level of physical protection is ordered should be presented in this section. E.g. if the panic button is pushed in the radiography room, then it immediately alarms the internal and external response forces.

Annexes

Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage

Annex 10: Map of the site

Annex 11: Certificate of the radioactive source

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Level B physical protection model plan

The model plan relates to a radiation therapy units of a hospital operating a Category 1 radioactive source. Since the radiation unit is in use during working hours, thus its surveillance is continuously assured. As a consequence of the practice how the unit is used, a part of the detection function of the physical protection system can be performed only out of working hours. Accordingly, it is reasonable to design the physical protection system for this period.

1.1. General data

1.1.4. Description of nuclear material, radioactive source and radioactive waste: its type, quantity, activity, physical state, category, use

The material to be protected:

- Co-60 radioactive source installed in a teletherapy head.
- Instrument type: Terathron X
- Original activity of the source (on January 1, 2011): 200 TBq
- D-value: $3 \cdot 10^{-2}$ TBq
- R-value = $200 / 3 \cdot 10^{-2} = 6666.7 > 1000$
- Category: 1

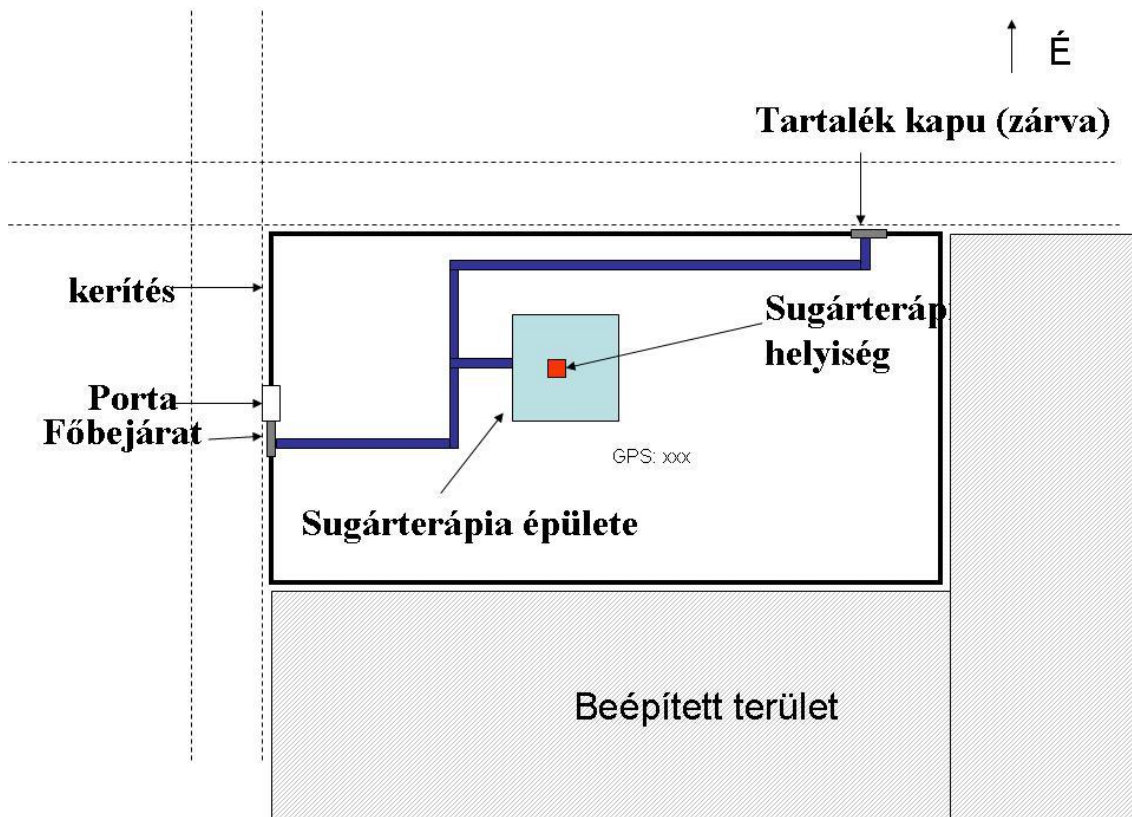
The radioactive source belongs to Category 1, thus Level B physical protection is required. Consequently, the source shall be protected against sabotage as well as unauthorized removal.

1.1.7. Detailed layout with the indication of the artificial barriers, physical protection zones, nuclear and radioactive materials to be protected, physical protection systems, structures and components, guards points, patrol routes, central alarm station; layout of the storage room and rooms of application

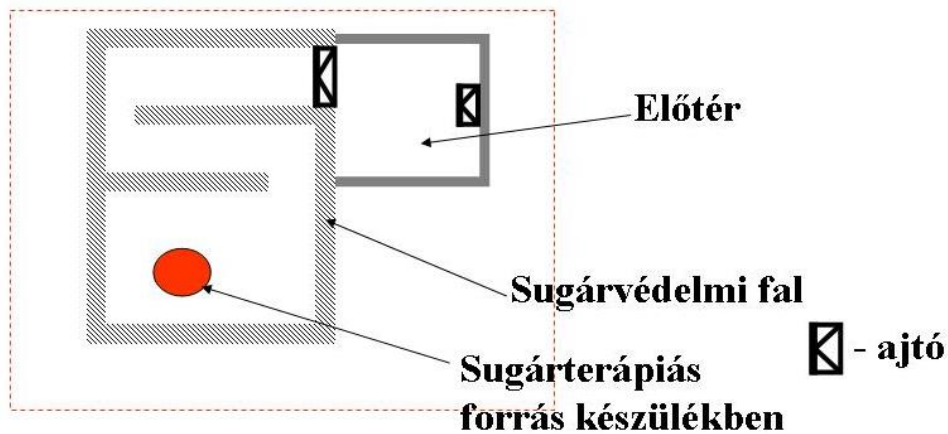
The hospital site is bordered by fence and an entrance gate, where 24/7 supervision and patrolling with a dog are applied. The building locating the teletherapy unit is made of brick in the 1960'; it can be accessed from two independent directions.

The layout of the site is as follows:

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The layout of the radiation therapy room is as follows:



1.1.8. Identification of potential adversary pathways

The sabotage pathway is always shorter, since it is sufficient for the adversary to access the radioactive source, it should not remove from the unit and from the area of the hospital. Every pathway should be taken into account, and then the fastest pathway should be used as a basis for designing the physical protection

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system. Those delay times should be considered only, which are subsequent to the detection/alarm.

The characteristics of the pathway identified as the shortest one for an unauthorized removal by an outsider and the physical protection elements/means to be applied are summarized in the below table.

Pathway		Physical protection		Time needed [s]
Section	Description	element/mean	function	
1	Penetration through fence	fence/gate	delay	5
2	Running to building (50 m)	distance + load	delay	30
3	Approach to therapy room	distance + load	delay	60
4	Access to lobby	door/wall motion sensor camera	delay detection alarm	5 x 60 = 300 - 10
5	Access to therapy room	door/wall motion sensor camera	delay detection alarm	10 x 60 = 600 - -
Total period subsequent to alarm needed for accessing the radioactive source (sabotage) [s]:				600 ~ 10 min
6	Disassembly of the radioactive source	complication radiation meter	delay alarm	10 x 60 = 600
7	Get out of the building	distance + load	delay	60
8	Approach to fence (50 m)	distance + load	delay	60
Total period subsequent to alarm needed for removing the radioactive source from the hospital site [s]:				1320 ~ 22 min

The disassembly of the radioactive source from the unit requires professional knowledge; based on conservative judgment the removal of the source requires 10 minutes as minimum. Without suffering from deterministic effects a radioactive source belonging to Category 1 must be transported in a proper container, which should be taken from outside and thus this slows down the adversarie(s).

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The minimum required time for accessing the radioactive source is 10 minutes (sabotage); the successful removal of the source from the hospital site requires 22 minutes as minimum.

1.1.9. Description of insider tactics

The act can be performed or supported by an insider, which shall be considered during the design of the physical protection system. The protection principles regarding insiders are discussed in PP-13 Guideline PP-13 "Protection against insider threats".

1.1.10. Protection plan of programmable systems

This should not apply according to Section 20 of the Govt. Decree.

Further information can be found in the Guideline PP-18, Protection requirements for computer systems.

1.5. Data on the technical sub-system of physical protection

1.5.1. Design and operational specification, components and their functions

Establishment of physical protection zones

Pursuant to Section 14 of the Govt. decree, the following zones are designated:

- a) Limited access area: hospital site bordered by fence
- b) Protected area: lobby of the radiation therapy room together with the radiotherapy room itself
- c) Vital area: radiation therapy room

1.5.2. Description of deterrence, detection, delay and response tools

Deterrence

1. Warning signs

The following warning signs are applied among those listed in Annex 2 of the Govt. decree for Level B physical protection.

At the gate to the hospital:

- 1.1. name of the facility,
- 1.2. warning on vehicle entrance rules,
- 1.3. warning on unpermitted tools and activities,

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At the entrance of the lobby of the radiation therapy room:

- 1.4. warning on entrance rights,
- 1.8. warning on radiation hazard,
- 1.9. indication of video surveillance area,
- 1.10. indication of physical protection covered area, and

At the entrance of the radiation therapy room:

- 1.4. warning on entrance rights,
- 1.8. warning on radiation hazard,

2. Artificial barriers

Based on the Level B requirements for controller entrance of the load vehicle traffic in Annex 2 of the Govt. decree a barrier shall be established on the road leading to the main entrance.

3. Accountancy verification

On physical protection level B, the physical inventory of nuclear and other radioactive materials shall be verified in a documented manner at least once every two weeks. The use of the teletherapy unit complies with this requirement, since the radiation therapy treatments are document.

If the teletherapy unit is not in use during a period longer than two weeks, then the existence of the source has to be verified by dose rate measurement; the measurement has to be recorded.

Detection

In accordance with Annex 2 of the Govt. decree, in the case of Level B physical protection the detection function shall meet the following requirements:

Element	Requirement	Solution/mean
5. Intrusion detection and attack signaling system	14.1. overall surface protection	Surface protection of the teletherapy room: opening sensor on the entrance door (15.1.1. – e.g. balanced magnetic switch - BMS) Surface protection of the lobby of the teletherapy the radiography room: opening sensor on the entrance door (15.1.1. – e.g. balanced magnetic switch - BMS)
	14.2. trap-like area protection	In the lobby of the teletherapy room the 100% area protection is provided by 2 dual motion sensor .

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		In the teletherapy room the area protection is provided by 1 dual motion sensor .
6.Video surveillance and assessment system	18. video surveillance system for Level C physical protection	2 digital camera according to Level B in the lobby of the teletherapy room. One out of two watches the entrance of the lobby, while the other watches the entrance of the teletherapy room. The images are transmitted through bunched conductor pair . The images of the cameras, with the exemption of the periods of treatments, are displayed on monitors installed at the entrance reception.
7. Access control system	23.1. reader-verification units, 23.2. person identification elements, and 23.3. access/regress points.	Proximity card is needed for the opening of the safety door of the lobby of the teletherapy room by using the sabotage protected reader terminal and the personal identification code ; Similar system is applied at the door of the teletherapy room, but the opening needs two independent cards and codes .
8. Alarm station	26. 1. the alarm station should be located within the protected area or its boundary	The alarm station (guard center) is placed in the reception building at the entrance due to practical reasons. Since this is a limited access zone, therefore external response forces should be used in order to strengthen the response function (see below). The data of the surveillance and assessment system, in case of an alarm, is transmitted to the external response forces as well.

Delay

The delay, within the physical protection system, is provided by the fence/gate on the boundary (limited access area - Level D requirements), the distance to the building accommodating the teletherapy room, the wall/door of the lobby of the teletherapy room (protected area - Level C requirements), and the wall/door of the teletherapy room (vital area – Level B requirements).

According to Annex 2 of the Govt. decree, the means of delay should comply with the following requirements:

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Element	Requirement	Solution/mean
9. Passive mechanical barriers	40. Level D: fence	The area of the hospital is protected by a fence having height of 2 m, made of plastic wire stretched between concrete columns that are located on the boundary of the area (limited access area, where Level D is required). Its delay time: 5 sec.
	41. Level D: gates on the fence	The 2.5 m high gate is made of steel that is stronger than the material of the fence. If the gate is open, then the entrance is controlled by a barrier. If the gate is closed, then it can be opened at the presence of guards.
	39. Level C: wall ...exhibits minimum 5 minutes breakage resistance, equivalent to dense brick wall having 6 cm width ... 46.1. ... the door exhibits five minutes breakage time.. 46.4. ... the locks ... security locks exhibit 5 minutes breakage resistance	The wall of the teletherapy room is made of small bricks. The lobby of the teletherapy room has a security door having 5 min breakage time (Category III security door) and a security lock having 5 min resistance.
	35. Level C: wall ...exhibits minimum 10 minutes breakage resistance, equivalent to dense brick wall having 15 cm width ... 45.1. ... the door exhibits ten minutes breakage time.. 45.4. ... the locks ... security locks exhibit 10 minutes breakage resistance	The teletherapy room has a thick concrete wall (50 cm) performing radiation protection function as well; it complies with the requirements. Its door is a Cat III security door that is filled with lead for radiation protection; thus it exhibits 10 minutes delay time. The security lock exhibits 10 minutes delay.

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Response

Chapter IV of Annex 2 of the Govt. decree establishes the following requirements against internal response forces and on-call police forces.

Element	Requirement	Solution/mean
13. Internal response forces and on-call forces	57. On physical protection level B: 57.1. the response shall be performed by internal response forces having the same number of persons as the number of independent adversary pathways, and by external response forces arriving within 10 minutes, and 57.2. the internal response forces shall perform patrolling on the site and provide 24 hours guard service.	There are two independent adversary pathways (from the fence at the main gate and from the north side). In addition to the 24/7 reception service, 2 guards are on duty. Out of office hours, two guards provide patrolling every two hours. They are in permanent phone contact with each other and the center. In the frame of a contract, the local police provides external response; maximum three persons can arrive the site at any time.

1.5.3. Maintenance and testing programme

The technical part of the physical protection system was installed by XY Kft; a three year contact was concluded with this company for the maintenance and testing of the system elements. The maintenance and testing is performed every three month; records are made on the spot.

1.6. Internal response forces, cooperation with the external response forces

The hospital concluded an agreement with the local police for the provision of external response forces. On contractual basis the images of the CCTV cameras of the physical protection system, in case of alarm, are automatically transmitted to the police. The external response forces will arrive at the site within 10 minutes after the alarm goes off. The local response forces are in contact with the external forces through the phone.

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1.7. Comprehensive evaluation of the physical protection system in reflect to the potential adversary pathways and adversary tactics

Based on that written in Section 1.1.8, the minimum period needed for accessing the radioactive source is 10 minutes (sabotage), while the removal of the radioactive source from the hospital needs 22 minutes (unauthorized removal).

The guard with dog being on duty can reach the teletherapy room within 3 minutes; he disturbs the activity of the adversary, thus the delay time calculated in Section 1.1.8 will increase. The external response forces can arrive to the teletherapy room within 10 minutes, thus the chance of a successful sabotage is significantly decreased, while the unauthorized removal is prevented with high probability.

1.10. Presentation of measures to be implemented if elevated level of physical protection is ordered

Panic buttons are installed both at the teletherapy unit and in the control room, which immediately alarms the internal and external response forces.

The internal response forces are equipped with attach signal, which immediately alarms the internal and external response forces.

If needed, then the internal response force can be strengthened by one additional person, as well as the patrolling by two persons with a dog can be conducted hourly.