STUK

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SECURITY ARRANGEMENTS OF RADIATION SOURCES

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Authorization

The Radiation Act stipulates that the party running a radiation practice is responsible for the safety of the operations. The responsible party is obliged to ensure that the level of safety specified in the ST Guides is attained and maintained.

Under section 70, paragraph 2, of the Radiation Act (592/1991), STUK – Radiation and Nuclear Safety Authority (Finland) issues general instructions, known as Radiation Safety Guides (ST Guides), concerning the use of radiation and operations involving radiation.

Translation. In the event of any differences in interpretation of this guide, the Finnish and Swedish versions shall take precedence over this translation.

1 General

Radiation safety measures relating to the use of radiation do not always pay sufficient attention to the fact that radiation sources may be subjected to illegal activities; for example, radiation sources may be wilfully harmed or used for harming something else. To cover such cases, radiation safety measures need to be supplemented by special arrangements called security arrangements.

This Guide presents the requirements for the security arrangements that must be applied in all uses of radiation subject to a safety license. This Guide shall apply to radioactive substances and radiation appliances that contain such substances as well as to mobile devices that produce radiation electrically. Where applicable, this Guide may be used to construct the basis of the security arrangements for other radiation appliances.

This Guide does not cover security in the transport of radioactive substances, but the Guide may be applied in transport cases involving storage of radioactive substances in transport terminals.

This Guide shall not apply to the use of nuclear energy and nuclear materials.

The definitions relating to this Guide are presented in Appendix A.

The use of radiation is governed by the Radiation Act (592/1991) and the statutes issued pursuant thereto. Instructions relating to the radiation safety measures that must be applied in the use of radiation are given in the Radiation and Nuclear Safety Authority's (STUK's) ST Guides.

Requirements for the practices referred to in the Nuclear Energy Act (990/1987) are presented in YVL Guides, also issued by STUK.

Shipments of radioactive substances are governed by the Act on Transport of Dangerous Goods (719/1994) and the statutes issued pursuant thereto.

2 The party running the radiation practice shall be responsible for security arrangements

The party running a radiation practice (hereafter the responsible party) shall ensure the safety of the use of radiation, implementing radiation safety and security measures that are sufficient with respect to the nature and extent of the operations. These measures shall cover the possibility that a radiation source is subjected to illegal activities, is lost, or is damaged. These procedures, i.e. the security arrangements, shall be proportionate to the outcomes and the likelihood of the illegal activities and the loss and damage to which the radiation source may be subjected.

Cooperating with other public authorities, STUK has assessed threats to which radiation sources might be exposed and has also considered the respective outcomes. This Guide presents the requirements concerning security arrangements in such a way that their implementation will provide sufficient protection against these threats. Security arrangements and radiation safety measures shall be implemented in conjunction so that the best solution, covering both aspects, is reached. STUK may impose licence conditions that deviate from this Guide for specific reasons.

Provisions are laid down in Section 14 of the Radiation Act concerning the responsible party's general duty of care in ensuring radiation safety.

The responsible party's duty to protect high-activity sealed sources from illegal activities, loss and damage is laid down in Section 31 c of the Radiation Act.

3 Places of use and storages of radiation sources shall be classified

Security arrangements shall be applied in all uses of radiation that require a safety licence. These arrangements shall be proportionate to the potential hazard caused by the relevant sources and the nature of the operations.

The extents and coverages of the required security arrangements are determined in accordance with the radiation sources used or stored in the place of use of radiation or radiation source storage. The terms place of use of radiation and radiation source storage refer to individual rooms or other similar, limited spaces. One building may contain several separate places of use of radiation or radiation source storages.

Places of use of radiation and radiation source storages in which radiation sources are used or stored shall meet security arrangement level C, B or A requirements depending on the radiation sources:

Level C security arrangements

- sealed or unsealed sources with activity exceeding the exemption values presented in Guide ST 1.5
- mobile X-ray appliances.

Level B security arrangements

- sealed or unsealed sources with activity exceeding or equal to the value presented in Appendix B, column "Level B security arrangements"
- other sealed or unsealed sources with total activity exceeding or equal to the value presented in Appendix B, column "Level B security arrangements" (in the case of several different radionuclides, the security arrangement level shall be determined using the formula given in Appendix B)
- mobile industrial radiography appliances that produce radiation electrically.

Level A security arrangements

- sealed or unsealed sources with activity exceeding or equal to the value presented in Appendix B, column "Level A security arrangements"
- other sealed or unsealed sources with total activity exceeding or equal to the value presented in Appendix B, column "Level A security arrangements" (in the case of several different radionuclides, the security arrangement level shall be determined using the formula given in Appendix B).

The exemption values for radiation sources are presented in Guide ST 1.5. The classification of radionuclide laboratories is presented in Guide ST 6.1. The classification of areas in workplaces (controlled and supervised areas) is presented in Guide ST 1.6. Different types of mobile X-ray appliances are discussed in Guides ST 3.1, 3.3, 5.2 and 5.6. Industrial radiography is discussed in Guide ST 5.6.

4 Security arrangements in practice

4.1 Level C security arrangements

Usually, no special security arrangements are needed if the normal radiation safety measures specified for the use of radiation are appropriately implemented. The responsible party shall ensure that at least the following arrangements, which are required for the safety of the use of radiation in any case, are implemented.

Inspections, receipts, transfers and records of radiation sources and appliances

Radiation sources must be recorded. The records must be kept up to date at all times.

Procedures shall be specified for the orders, receipts, hand-overs and transfers of radiation sources to ensure the conduct of these activities under the supervision of the radiation safety officer.

It is not allowed to unnecessarily store radiation sources in places of use of radiation if these sources are no longer used. A radiation source that is decommissioned shall be transferred to a radiation source storage.

Radioactive substances as well as appliances containing radioactive substances shall not be

stored unnecessarily if they no longer have uses.*) Decommissioned sealed sources may be returned to the suppliers of the respective radiation sources or to recognized installations that render radioactive waste harmless.

The responsible party shall verify at least once per year that all the radiation sources in its care are appropriately stored and in safe condition. The implementation of such verifications shall be documented.

The duty of accounting in relation to radiation sources is laid down in Section 14 b of the Radiation Act.

Structural barriers

Radiation sources shall be protected with

- at least one structural barrier in the place of use or storage or
- a structural barrier in the radiation appliance itself and a structural barrier external to the place of use.

Structural barriers are described in more detail in Appendix C.

When an appliance is being used, the presence of operating personnel can count as a structural barrier.

During storage, a mobile appliance that produces radiation electrically shall be kept in a state that prevents its easy activation without specialized skills. Such an appliance must not be connected to an electrical outlet during storage unless the appliance is battery-powered and requires recharging during storage.

Access control

Access to a radiation source storage shall be made possible only to those persons who are tasked with taking care of the storage. Usually, such persons comprise the radiation safety officer or the person nominated in the organization description to be in charge of the storage.

Access control is described in more detail in Appendix C.

*) Storage may be required in some cases. The decreasing of activity of short-lived unsealed sources, in particular, through storage, may form a planned part of systematic waste management.

Other issues

Places of use of radiation and radiation source storages shall carry appropriate signs calling attention to a radiation hazard. The positions of these signs should, when such a choice exists without compromise to radiation safety, be selected so that they do not unnecessarily draw the attention of occasional passers-by and other outsiders.

Guide ST 1.3 discusses warning signs for radiation sources.

4.2 Level B security arrangements

The responsible party shall ensure that the arrangements presented in Item 4.1 (Level C security arrangements) are implemented and that they are supplemented as follows:

Security arrangement plan

The responsible party shall draft a security arrangement plan which describes the procedures, responsibilities and duties involved in arranging security. The plan shall be kept up-to-date. Contents guidelines for security arrangement plans are presented in Appendix C.

Information security

All information concerning radiation sources and their security arrangements must be kept in a secure manner. Plans concerning security arrangements, procedural instructions and other similar information shall be handled and stored in a manner that prevents persons from obtaining them except those who need such documents to conduct their duties.

Inspections and accounting concerning radiation sources and appliances

The responsible party shall verify at least once per month that all the sealed sources in its care with activity exceeding or equal to the value presented in Appendix B, column “Level B security arrangements” are appropriately in their places. The implementation of such verifications shall be documented.

Structural barriers

Radiation sources shall be protected with at least two structural barriers. At least one of

these structural barriers shall be in the radiation appliance itself or immediately next to the appliance.

When an appliance is being used, the presence of operating personnel can count as a structural barrier. If structural barriers are replaced with the presence of personnel, the personnel must be able to report on any illegal activity or suspicion thereof immediately.

A radiation source storage shall not have windows large enough to allow entry, or the windows shall be fortified to prevent break-ins (bars, bulletproof glass, or similar).

Items other than those relating to radiation sources must not be stored in radiation source storages, and such storage rooms must not be used for any other purposes.

Structural barriers are described in more detail in Appendix C.

Access control
Access to a place of use of radiation or a radiation source storage shall be made possible only to those persons who, in view of the type and nature of the work, have been given sufficient instructions and guidance concerning the manner in which they should attend to the current security arrangements.

Access to a place of use of radiation and to a radiation source storage shall be controlled. Practical implementations of access control are described in Appendix C.

Alarm systems
A place of use or a radiation source storage in which a radiation source may stay unsupervised when not used (at night, for example) must have a remotely controlled alarm system. Alarms must be automatically routed to a location in which the confirmation of an event can be initiated immediately, such as a private security agency or a manned control centre.

4.3 Level A security arrangements

The responsible party shall ensure that the arrangements presented in Item 4.2 (Level B security arrangements) are implemented and that they are supplemented as follows:

Security arrangement plan
When the security arrangement plan is being drafted, discussions must be conducted with the local police and procedures must be agreed on for various types of occurrences. The procedures agreed on shall be described in the security arrangement plan. The security arrangement plan must be checked regularly, e.g. once per year, to ensure that it is up-to-date.

Structural barriers
All structural barriers cannot be replaced with the presence of personel.

Alarm confirmation
A place of use of radiation or a radiation source storage shall be remotely monitored by a camera or a similar device so that any event causing an alarm can be immediately confirmed from e.g. a private security agency or a manned control centre. Procedures shall be agreed on with the local police to ensure that the police are immediately notified of detected events.

5 Abnormal events shall be reported

The police shall be immediately notified if

- a radiation source is stolen
- a sealed or unsealed source is subjected to intentional damage
- a sealed or unsealed source with activity exceeding or equal to the value presented in Appendix B, column ”Level B security arrangements”, is suspected of having been lost.

All events of the kind mentioned above shall be reported without delay to STUK as well. In addition, STUK must be informed without delay if any radiation source is suspected of having been lost.

Provisions concerning notifications to STUK concerning abnormal events are given in Sections 13 a and 17 of the Radiation Decree. Additional instructions concerning abnormal events relating to radiation safety and the reporting of such events are available in Guide ST 1.6.

Bibliography

1. International Atomic Energy Agency. Nuclear security recommendations on radioactive material and associated facilities. Recommendations. IAEA Nuclear Security Series No 14, Vienna: IAEA, 2011.
2. International Atomic Energy Agency. Security of radioactive sources. Implementing Guide. IAEA Nuclear Security Series No 11, Vienna: IAEA, 2009.
3. International Atomic Energy Agency. Categorization of radioactive sources. Safety Guide RS-G-1.9. IAEA Safety Standards Series. Vienna: IAEA, 2005.
4. International Atomic Energy Agency. Dangerous quantities of radioactive material (D-values). Emergency Preparedness and Response Series. Vienna: IAEA; 2006.

APPENDIX A

Definitions

Radiation safety measures

Procedures to prevent and decrease radiation doses and detrimental effects of radiation to humans, and to ensure the safety of the responsible party's own workers, students and apprentices as well as the safety of the members of the public and outside workers working for the responsible party. These procedures also include the measures which aim to prevent accidents and mitigate their results.

Security arrangements (Security measures)

Measures to detect and prevent illegal activities against radiation sources (e.g. theft, sabotage or unlawful transfer of a radiation source, or unlawful entry into an institution or facility which contains these sources). These measures also include the counter-measures after the unlawful act.

Further information:

Security arrangements include administrative arrangements (organization, management system, safety culture), technical arrangements (structural barriers, security surveillance, alarm systems, other equipment), functional arrangements (surveillance by a security organization, response to a threatening event, the responsible party's arrangements to ensure response from public authorities), and information security.

Security consists of the deterrence, detection and delay of illegal activities as well as the response to them. Responses consist of terminating the illegal activities, taking control of the situation, and preventing and limiting the consequences.

Security arrangements also protect parties from the consequences of careless or thoughtless actions (such as the loss of or damage to a source).

Illegal activities

Wilful activities or measures that are intended to endanger the safety of the use of radiation or the integrity of a radiation source, or to cause a direct or indirect threat to radiation safety, or to cause damage to a radiation source due to negligence.

Radiation source

A radiation appliance or radioactive substance.

Radiation appliance

An appliance which produces radiation electrically or contains any radioactive substance.

Mobile radiation appliance

A radiation appliance intended to be transferred from one place of use to another as required, either by carrying it or moving it on its wheels or e.g. on a cart.

Sealed source

A radioactive source wherein the radioactive substance is permanently enclosed inside a capsule or in a solid form; the purpose is to prevent the spreading of radioactive material under normal conditions of use.

Unsealed source

A radioactive substance that is not a sealed source.

APPENDIX B

Determination of security arrangement levels according to the activity of the sealed or unsealed source

The values of quantity D for the radionuclides not present in the table below are available in the IAEA publication RS-G-1.9 "Categorization of Radioactive Sources" and "Dangerous Quantities of Radioactive Material". (Level A security arrangements: activity as in Category 1; Level B security arrangement : activity as in Category 3.

Determination of the security arrangement level in the case of several different radionuclides

The security arrangement level shall be A if the following equation is true:

$$\sum_n \frac{\sum_i A_{i,n}}{D_n} \geq 1,$$

where

$A_{i,n}$ is the activity of the single sealed source i of the radionuclide n. In the case of unsealed sources the value of $\sum_i A_{i,n}$ is the maximum activity of the radionuclide n to be used.

D_n is the activity of radionuclide n as presented in the table below in column "Level A security arrangements".

The security arrangement level shall be B if the above equation is true when D_n is the activity of radionuclide n as presented in the table below in column "Level B security arrangements".

The security arrangement level shall be C if the above equation is not true with the values of security arrangement level A or B or equivalent.

Radio-nuclide	Level A security arrangements Activity (Bq)	Level B security arrangements Activity (Bq)
H-3	$2 \cdot 10^{18}$	$2 \cdot 10^{15}$
C-11	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
N-13	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
C-14	$5 \cdot 10^{16}$	$5 \cdot 10^{13}$
F-18	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
Na-22	$3 \cdot 10^{13}$	$3 \cdot 10^{10}$
P-32	$1 \cdot 10^{16}$	$1 \cdot 10^{13}$
P-33	$2 \cdot 10^{17}$	$2 \cdot 10^{14}$
S-35	$6 \cdot 10^{16}$	$6 \cdot 10^{13}$
Ca-45	$1 \cdot 10^{17}$	$1 \cdot 10^{14}$
Cr-51	$2 \cdot 10^{15}$	$2 \cdot 10^{12}$
Fe-55	$8 \cdot 10^{17}$	$8 \cdot 10^{14}$
Co-57	$7 \cdot 10^{14}$	$7 \cdot 10^{11}$
Co-60	$3 \cdot 10^{13}$	$3 \cdot 10^{10}$
Cu-64	$3 \cdot 10^{14}$	$3 \cdot 10^{11}$
Ga-67	$5 \cdot 10^{14}$	$5 \cdot 10^{11}$
Ga-68	$7 \cdot 10^{13}$	$7 \cdot 10^{10}$
Ge-68	$7 \cdot 10^{13}$	$7 \cdot 10^{10}$
Se-75	$2 \cdot 10^{14}$	$2 \cdot 10^{11}$
Br-82	$3 \cdot 10^{13}$	$3 \cdot 10^{10}$
Kr-85	$3 \cdot 10^{16}$	$3 \cdot 10^{13}$
Rb-86	$7 \cdot 10^{14}$	$7 \cdot 10^{11}$
Y-90	$5 \cdot 10^{15}$	$5 \cdot 10^{12}$
Sr-90	$1 \cdot 10^{15}$	$1 \cdot 10^{12}$

Radio-nuclide	Level A security arrangements Activity (Bq)	Level B security arrangements Activity (Bq)
Tc-99m	$7 \cdot 10^{14}$	$7 \cdot 10^{11}$
Mo-99	$3 \cdot 10^{14}$	$3 \cdot 10^{11}$
Pd-103	$9 \cdot 10^{16}$	$9 \cdot 10^{13}$
In-111	$2 \cdot 10^{14}$	$2 \cdot 10^{11}$
I-123	$5 \cdot 10^{14}$	$5 \cdot 10^{11}$
I-124	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
I-125	$2 \cdot 10^{14}$	$2 \cdot 10^{11}$
I-131	$2 \cdot 10^{14}$	$2 \cdot 10^{11}$
Cs-134	$4 \cdot 10^{13}$	$4 \cdot 10^{10}$
Cs-137	$1 \cdot 10^{14}$	$1 \cdot 10^{11}$
Pm-147	$4 \cdot 10^{16}$	$4 \cdot 10^{13}$
Sm-153	$2 \cdot 10^{15}$	$2 \cdot 10^{12}$
Gd-153	$1 \cdot 10^{15}$	$1 \cdot 10^{12}$
Tm-170	$2 \cdot 10^{16}$	$2 \cdot 10^{13}$
Lu-177	$2 \cdot 10^{15}$	$2 \cdot 10^{12}$
Ir-192	$8 \cdot 10^{13}$	$8 \cdot 10^{10}$
Tl-201	$1 \cdot 10^{15}$	$1 \cdot 10^{12}$
Tl-204	$2 \cdot 10^{16}$	$2 \cdot 10^{13}$
Ra-223	$1 \cdot 10^{14}$	$1 \cdot 10^{11}$
Ra-226	$4 \cdot 10^{13}$	$4 \cdot 10^{10}$
Pu-238	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
Am-241	$6 \cdot 10^{13}$	$6 \cdot 10^{10}$
Cf-252	$2 \cdot 10^{13}$	$2 \cdot 10^{10}$

APPENDIX C

Practical guidelines relating to security arrangements

Security arrangement plan

The extent and level of detail in a security arrangement plan shall be proportionate to the potential hazards caused by the relevant sources as well as to the nature of the operations. STUK approves security arrangement plans when granting the safety licence or when conducting an inspection. Typically, a security arrangement plan is expected to include:

1. A description of the security arrangement organization
   - division of responsibilities among the various parties, the line of command (including organization-internal and external parties)
   - persons in charge, their duties, their training requirements and other requirements pertaining to them
2. Information concerning sources
   - purpose of use of a source, the radionuclide, the activity
   - the number of the safety licence pertaining to a source, the number of the relevant appliance given in the licence
3. Information concerning a place of use/a radiation source storage
   - the layout picture of the area and/or the building with the locations of radiation sources marked, also showing the places of use and/or the radiation source storages and their security arrangement levels (only security arrangement levels A and B)
   - description of the structural barriers
   - description of the technical systems applied in access control
   - description of the technical alarm systems

The layout picture shall also show the locations of the structural barriers and the technical systems.

4. Procedural instructions relating to
   - receipts, hand-overs and accounting relating to sources
   - regular inspections of sources
   - arrangements relating to access control
   - actions and communication when any sort of deviations are observed
   - regular inspections and service of technical systems used for surveillance and alarms
   - notifications of abnormal events to the police and to STUK
   - providing the staff with instructions and guidance relating to security arrangements
   - regular updates of the security arrangement plan and the handling and confidentiality of documents.

Structural barrier

Structural barriers are used to make access to radiation sources more difficult and slower, thereby preventing any unauthorized seizure or any wilful damage that the source might be subjected to. Structural barriers include

- structures associated with the shield of the radiation appliance itself, or with its operation; such appliances include e.g.
  - fixed–mount radiometric measuring devices in industrial institutions
  - devices such that moving them would require transportation equipment difficult to use in the particular location, significantly slowing down and encumbering the seizing of the source
  - devices that produce radiation electrically, equipped with keys or codes to start them, or otherwise rendered such that only operating personnel are able to start them
- barriers in the immediate vicinity of radiation sources, for example:
  - locking of doors to the place of use or radiation source storage
  - radiation sources kept in separate, locked cabinets
- barriers outside places of use or storages of radiation sources, such as locating the place of use or storage in a building that has its outdoors locked or in a locked, fenced area.

The security level of locks, cabinets, fences, windows, doors and structures relating to walls, roofs/ceilings and floors shall be designed according to the object that is being protected. The KATAKRI criteria*) may be used for design guidelines when applicable (e.g. sections F).

STUK assesses the sufficiency of the design when granting the safety licence and in connection with inspections.

Access control

Access control is used for limiting access to a certain area or room. The objectives of access control include

- surveillance of the people in the area
- prevention of the entry of unauthorized persons into the area or room (e.g. general access control at the entrance to a building)
- allowing access to the restricted area or room only to those members of the organization that must have access due to their duties.

Access control may include e.g. electronic locks in doors, worker-specific definition of access rights and the identification of the individuals (code, key, biometric identification or similar).

If there is no electronic access control available, access control can, for example, be arranged so that the key to a certain place may be signed out by nominated persons only, and only for the time required for the conduct of their duties.

When radiation sources are being used, access control can be managed so that the operating personnel are constantly present, ensuring that the objectives of access control, listed above, are actualized.

*) Katakri 2015 – Tietoturvallisuuden auditointityökalu viranomaisille ("A tool for information security auditing for authorities"), Ministry of Defenue 2015.