

RADIATION SAFETY OF SEALED SOURCES AND EQUIPMENT CONTAINING THEM

1	GENERAL	3
2	GENERAL REQUIREMENTS	3
2.1	Safety licence	3
2.2	Record keeping for sources and associated notifications	4
2.3	Protection of workers	4
3	GENERAL REQUIREMENTS CONCERNING SEALED SOURCES	5
4	REQUIREMENTS DURING THE USE FOR EQUIPMENT CONTAINING SEALED SOURCES	6
4.1	Structure of the appliance	6
4.2	Shutter	7
4.3	Labels and markings	7
5	LIFECYCLE MANAGEMENT FOR SEALED SOURCES AND DEVICES CONTAINING THEM	7
5.1	Reception	8
5.2	Commissioning	8
5.3	Regular inspections and servicing	8
5.4	Decommissioning	8
5.4.1	Detachment and storage of radiation sources	8
5.4.2	Assignment to another user	9
5.4.3	Assignment to the manufacturer, supplier or recognized installation	9
5.4.4	Clearance from regulatory control for sealed sources	10
6	TRANSPORT OF RADIOACTIVE MATERIALS	10
6.1	Transport preparations and reception of radiation sources	10
6.2	Transporting radiation sources by road	11

This Guide is valid as of 1 October 2016 until further notice.

It replaces Guide ST 5.1, Radiation safety of sealed sources and equipment containing them, issued on 17 November 2007.

Helsinki 2017

ISBN 978-952-309-382-9 (pdf)

ISSN 0789-4619

ISBN 978-952-309-383-6 (html)

7	ABNORMAL EVENTS	11
7.1	Preparation for abnormal events	11
7.2	Procedures in case of an abnormal event	11
7.3	Reporting of abnormal events	11
APPENDIX A	DEFINITIONS	
APPENDIX B	ACTIVITY LEVELS OF HIGH ACTIVITY SEALED SOURCES	
APPENDIX C	RECORDING FORM FOR HIGH ACTIVITY SEALED SOURCES	

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

Sealed sources are used in many applications in health care and industry, such as radiometric devices, radiotherapy apparatus and irradiation appliances, and as calibration sources.

This guide presents radiation safety requirements for the operation and lifecycle management of sealed sources and devices that contain them. When sealed sources or devices that contain them are used, security arrangements for radiation sources must also be in place in addition to the radiation safety arrangements. This guide also discusses the transportation of radioactive substances and the preparation thereof.

This guide also sets out the additional requirements that only concern high activity sealed sources. These requirements have been highlighted under the sub-heading *High activity sealed sources*. The activity levels for high activity sealed sources are set forth in Appendix B.

The definitions concerning this guide are provided in Appendix A.

The use of sealed sources in industrial radiography is also governed by Guide ST 5.6, their use in radiotherapy is governed by Guide ST 2.1 and their shielding requirements are governed by Guide ST 1.10. The exemption values for radioactive substances are provided in Guide ST 1.5.

Guide ST 5.8 concerns the installation, repair and servicing of radiation appliances. Requirements concerning security arrangements for radiation sources are set out in Guide ST 1.11.

2 General requirements

2.1 Safety licence

A safety licence is required for the use and possession of sealed sources and devices containing them, unless the activity has been exempted from a safety licence by virtue of the Radiation Act. A party running a radiation practice (hereinafter referred to as the “responsible party”) that uses radioactive substances or devices containing them in its operations or possesses them is obliged to apply for a safety licence. A safety licence must also be requested by any enterprise or individual that

installs, repairs or services radiation sources as an independent sole trader. The responsible party shall be required to ensure that it possesses the expertise required as regards the safety of operations.

An application for a safety licence must include a description of the organization that lists the operating personnel for the use of radiation. Appointment of a radiation safety officer responsible for the safe use of radiation generally suffices as a description of the organization in simple cases. The licence application must also present the purpose of radiation use, the place of use of radiation and the information concerning radiation sources. Furthermore, the application must present the servicing arrangement for the devices containing radiation sources. A safety licence must be applied for in good time before the intended start of the activities, since a radiation source cannot be taken into possession before the licence has been granted.

An amendment to the safety licence shall be requested before starting the commissioning or operations if a new type of radiation source is to be taken into use or the activities otherwise change in a substantial manner. STUK shall be notified within two weeks if the radiation source is later handed over or a new source of the same type is taken into use.

High activity sealed sources

An amendment to the safety licence shall be applied for in advance for the use of each new high activity sealed source.

However, it is not necessary to apply for an amendment in advance if the high activity sealed source has a half-life less than 150 days and if the sealed source is replaced in an existing device governed by the safety licence. Nevertheless in this case, an application concerning a new high activity sealed source must be submitted to STUK as soon as possible, however no later than two weeks after the acquisition of the sealed source.

The responsible party shall impose a financial security on a high activity sealed source in preparation for any costs that may be incurred by the source. The financial security is needed, for example, in cases where the radiation source needs to be rendered harmless or the

environment needs to be cleaned.

No such security need be imposed, however, if

- the activity of the source is lower than one hundred times the level of activity presented in Appendix B
- the half-life of the source is less than 150 days
- the responsible party is the State, local authority, local authority federation or a comparable corporation or independent institution of public law character.

As regards high activity sealed sources, the application must include information concerning the quality system for the use and maintenance of the radiation sources, the practices followed in quality management and preparations for abnormal events.

Furthermore, an application for a safety licence for a high activity sealed source must include an agreement by a manufacturer, foreign supplier or recognized installation to take custody of the radiation source after it is decommissioned.

Sections 16 and 17 of the Radiation Act (592/1991) contain provisions concerning the safety licence, the granting thereof and the operations that are exempt from safety licence. Sections 19 and 31 f of the Radiation Act contain provisions concerning the imposing of a security. Determining the size of the security is governed by Section 22 d of the Radiation Decree.

Guide ST 1.5 discusses operations that are exempted from safety licence. Guide ST 1.4 covers the duties of the responsible party, the organization description and the tasks of the radiation safety officer. Appendix B to that Guide describes in more detail the categories for radiation practices. The required qualifications of a radiation safety officer are set out in Guide ST 1.8.

2.2 Record keeping for sources and associated notifications

The responsible party must maintain up to date records of the radiation sources, for which the said party is responsible, and their receipt and assignment for transfer. The records must also cover radiation sources whose activity is below the exemption value. The records concerning

radiation sources must be sufficient in order to allow a recorded radiation source to be identified on their basis.

To ensure up to date records and notifications to STUK, the radiation safety officer must supervise all reception and outgoing transfers of radiation sources.

High activity sealed sources

The records of high activity sealed sources must at least include the details shown in Appendix C.

The responsible party must submit a copy of its records concerning high activity sealed sources to STUK

- when acquiring a high activity sealed source
- annually by the last day of January
- if the record details presented in Appendix C change.

2.3 Protection of workers

All persons involved in handling radiation sources must be familiar with the radiation protection regulations and workplace-specific instructions that pertain to their own work. These instructions must set out the health precautions to be considered when using the radiation sources and when performing servicing and repair work in the vicinity of a radiation source. Written instructions must also be provided on how to proceed in the event of an abnormal incident (see chapter 7).

Practices shall be planned and executed in such a manner that the radiation exposure caused by the use of radiation is as low as reasonably achievable (principle of optimization). However, the plan that is selected for execution on the basis of the optimization study shall be such that the effective dose caused on persons other than those engaged in radiation work is not expected to exceed 0.3 mSv per year (dose constraint). If the operations are appropriately optimized, the doses are usually clearly lower than the dose constraint. Ensuring the following matters will help to achieve optimized practices:

- Persons other than radiation workers are not allowed to stay for over one hour per day on average in areas where the dose rate arising from a radiation source is over 1.5 $\mu\text{Sv/h}$ (corresponds to an annual dose of 0.3 mSv).

- If operating or servicing work must be done in an area where the dose rate arising from a radiation source is greater than 5 $\mu\text{Sv/h}$, then separate instructions must be prepared for the work.

A suitable radiation meter shall be available for use at the place of use of the radiation sources if this is required for monitoring of working conditions or other methods of ensuring safety. These activities include the following:

- use of high activity sealed sources
- servicing work in the vicinity of radiation sources
- use of calibration sources and other loose sealed sources
- use of transportable radiometric devices containing sealed sources.

Workers will not generally need to be classified as occupationally exposed workers, nor will any individual monitoring or classification of work areas be required, if the use of appliances containing sealed sources has been arranged according to the requirements provided in this ST Guide.

Workers shall be classified as occupationally exposed workers if during the use, installation or maintenance of sealed sources

- the effective dose may exceed 1 mSv
- the equivalent dose in the lens of the eye may exceed 15 mSv
- the equivalent dose at any point on the skin may exceed 50 mSv.

This work may include replacing sealed sources inside equipment, for example.

Guide ST 1.6 concerns the classification of work areas and workers. Monitoring of radiation exposure is discussed in Guide ST 7.1, Guide ST 7.2 discusses dose limits and Guide ST 7.5 contains provisions for medical surveillance. Guide ST 5.8 concerns the installation, repair and servicing work of radiation appliances. Guide ST 1.9 discusses radiation meters and measurements.

3 General requirements concerning sealed sources

The radionuclide used in a sealed source must be suitable for its purpose in respect of activity, radiation type, radiation energy and half-life. The activity of a sealed source may not exceed the value that is necessary for the reliable operation, purpose, measurement requirements and designed service life of the device.

As a general rule, the capsule of a sealed source must have the following information on a permanent label:

- the word “radioactive” or, whenever it is not possible, the symbol for ionizing radiation according to standard ISO 361
- the name or symbol of the manufacturer
- the manufacturing number
- the radionuclide.

The capsule of the sealed source must be marked before the leak-tightness of the sealed source is ensured.

The sealed source must satisfy the requirements of standard ISO 9978 for leak-tightness and purity, and the requirements of standard ISO 2919 for strength. The sealed source must always be supplied with a certificate of compliance with the standard issued by its manufacturer or by a recognised testing institute.

A wipe test in accordance with standard ISO 9978 or another type of applicable wipe test shall be performed on the sealed source when

- the sealed source or parts in its immediate vicinity (such as the shutter) are detached for servicing or for some other reason
- the sealed source is replaced
- the sealed source is handed over to another responsible party and over one year has passed since the last wipe test
- environmental conditions (e.g. corrosive substances, moisture, temperature, vibration) or other causes may have had a detrimental effect on the leak-tightness of the sealed source

- a fixed sealed source is removed from its place of use (e.g. stored, handed over for transport or decommissioned).

Furthermore, a wipe test in accordance with standard ISO 9978 or another type of applicable wipe test shall be performed at least once every five years if the sealed source is transportable.

Pursuant to standard ISO 9978, the highest allowed observed contamination in a wipe sample is 200 Bq.

Where necessary, wipe tests shall be performed regularly. When considering the introduction of regular wipe tests, exceeding the manufacturer's recommended working life and the operating conditions shall be considered.

A record shall be kept of the wipe tests.

The wipe sample should be taken on the surface of the sealed source or in the immediately surrounding area. Should an additional radiation dose be possible when taking the sample, then the sample must be taken on the nearest accessible parts that could suffer radioactive contamination in the event of a leak from the sealed source. No wipe test need to be performed on a radiation source containing radioactive gas. Alternatively, another leak test method may be performed in accordance with standard ISO 9978.

STUK must be notified without delay if a sealed source is found to be leaking. Care must then be taken at the place of use of the sealed source to ensure that no health hazard arises from the leaking radiation source or possible contamination.

High activity sealed sources

The radiation source must have a unique identification number for sealed sources issued by the manufacturer. This identifier must be permanently marked on the radiation source itself and engraved or stamped on the source shield. If engraving or other marking of the source or shield is not possible in practice, then the details of the source must be stated in documents and on the transportation container where necessary. The importing or transferring from another EU country of a radiation source for which the manufacturer has not issued an individual identifier is prohibited.

A wipe test pursuant to chapter 3 must

be performed on high activity sealed sources regularly, at least once per year.

Standards ISO 2919 and ISO 9978 have been considered when setting the requirements stated in this chapter.

4 Requirements during the use for equipment containing sealed sources

4.1 Structure of the appliance

The principal requirements during the use are as follows:

- The structure of the radiation device must minimise the radiation dose that the employee sustains while operating and servicing the equipment.
- The device must withstand the environmental conditions and the effects of radiation.
- The device must be designed to ensure that the radiation source remains in its shield even during a fire. The protective ability of the shield may not be substantially impaired in a fire.
- The attachment of the sealed source to the device must be ensured with a seal or lock.
- The source shield must be selected to minimize the size of the radiation beam.
- The radiation detector utilised in the device must be selected to enable the use of a radiation source of the lowest possible activity.
- It must be possible to safely transport the device.
- If working near the device is required during servicing, for example, the device must be equipped with finger guards that prevent the entry of body parts into the primary beam of the radiation source.
- The dose rates in the vicinity of radiometric measuring devices containing sealed sources (other than in the radiation beam) may not exceed the following values under standard ISO 62598 for equipment classification xx 3434xx x x:
 - 500 µSv/h
 at a distance of 5 cm from the surface of the equipment

- 7.5 $\mu\text{Sv/h}$ at a distance of 1 m from the surface of the equipment.

If commissioning of radiation equipment in some other classification is desired, then the radiation safety requirements for its use shall be specified as necessary when issuing the safety licence.

4.2 Shutter

The source shield shall have a shutter enabling the sealed source to be fully shielded when necessary. In special cases a device with no shutter may be approved for use if its structure and shielding prevent the radiation beam from leaving the device, or if the properties and manner of operation of the device achieve the same safety standard as a device that is fitted with a shutter.

The shutter must function reliably under all operating conditions. To ensure that the operation of the shutter is not hampered by the malleability of lead, the surface layer of the shutter and its associated components may not be made of lead.

The design of the shutter must prevent it from opening accidentally. It must be possible to close the shutter without using tools.

The source shield must include a lock enabling the shutter to be locked in the closed position. It must not be possible to open the lock using a substitute for the key. The shutter must not be locked in the open position, and it must be possible to close the shutter without a key.

The radiation device must include texts indicating the shutter positions or other clear markings. If the device has several shutters, then each shutter shall have a position indicator of its own.

Electrically or pneumatically controlled shutters must close automatically in the event of a power failure or loss of air pressure. No separate shutter lock is required in such cases.

Devices with a remote-controlled shutter must include shutter position indicator lights. These lights must be directly controlled by movements of the shutter. The closed indicator light must only show when the shutter is completely closed. The indicator lights must indicate an open position if the shutter is partly open.

The responsible party must ensure that all persons who may operate device are familiar with the shutter's operation.

4.3 Labels and markings

The radiation source part of a device that contains a sealed source must contain a warning sign for ionizing radiation and a signboard that indicates the manufacturer, type, manufacturing number, radionuclide, its activity and the determination time of the activity. Furthermore, a signboard manufactured from a material that can withstand the operating conditions must be permanently fastened to the radiation source part of the device. The signboard must contain the source number or another type of identifier that has been used to uniquely identify the radiation source in the records. The markings must be renewed if new sealed sources are installed in the device.

A prominent radiation hazard warning sign must also be placed in the vicinity of a fixed radiation device.

If it is possible to access the radiation beam of a device, for example through a manhole or service hatch, then a sign must be placed in the passageway to the beam specifying that the radiation source shutter must be closed before entering the area.

High activity sealed sources

If a radiation source has to be changed repeatedly (e.g. Ir-192 sources), then details of the type of source may be engraved or stamped, and the serial number of the source may be marked on the shield in some other suitable manner.

The structural requirements and classification for radiometric measuring devices which this Guide refers to are presented in standard IEC 62598. Guide ST 1.3 discusses warning signs.

5 Lifecycle management for sealed sources and devices containing them

The responsible party must ensure the management of sealed sources and devices

containing them from the reception of the radiation source until its decommissioning.

The risk of losing a radiation source is generally greatest during transfers and decommissioning. To avoid such loss it is essential for decommissioning to take place under the supervision of the radiation safety officer appointed in the safety licence. To be able to satisfy the recording and notification requirements of item 2.2, the radiation safety officer must be aware of the reception of the radiation sources, of the locations of radiation sources and of sources to be decommissioned.

5.1 Reception

Responsible parties who have no previous safety licences must not accept the radiation source before the safety licence has been granted.

If the responsible party has been granted a safety licence for the use of radiation sources, STUK must be notified of a new radiation source within two weeks of its reception at the latest.

High activity sealed sources

An amendment to the safety licence shall be applied for the use of each new high activity sealed source in accordance with item 2.1.

5.2 Commissioning

Devices containing sealed sources may be installed and removed only by a person who has been adequately trained for such work. Whenever possible the shutter must be locked in the closed position during the work. The person performing the installation work must have use of a radiation meter suitable for the purpose. Any demanding service work on the sealed source may only be performed by the device manufacturer or by an enterprise with an appropriate safety licence for such service work.

The requirements during the use for the radiation device are set forth in chapter 4, and they must be observed when radiation devices are being commissioned.

The requirements concerning the installation, repair and servicing of radiation sources are set forth in Guide ST 5.8.

5.3 Regular inspections and servicing

Equipment containing sealed sources must be inspected regularly, once per year at a minimum. The inspection must consider the following:

- condition and fastening of shields
- fastening of the sealed source device
- functioning of the shutter
- radiation source information
- warning signs.

A wipe test pursuant to chapter 3 must also be performed on the sealed source in the cases presented in chapter 3.

The operating condition of the electrically or pneumatically actuated shutters of the source shield and the shutter position indicator lights must be inspected at regular intervals. Any detected faults must be rectified without delay. When performing inspections or service work, care must be taken to ensure that the text of signboards attached to the equipment is appropriate and readily legible. The signboards must be replaced when necessary.

A device containing a sealed source must be inspected if there is any cause to suspect that the device may have been damaged as a result of fire or another type of incident. A wipe test in accordance with chapter 3 must be performed on the sealed source in this case.

A record must be kept of the responsible party's own inspections.

Sealed sources whose use requires level A or B security arrangements must be inspected once per month.

The levels of security arrangements are set forth in Guide ST 1.11.

5.4 Decommissioning

5.4.1 Detachment and storage of radiation sources

Special attention must be paid to the following points when decommissioning a device containing a sealed source:

- The source shutter must be locked in the closed position before the work begins. If the shutter cannot be closed, for example, due to

damage or because the shutter is jammed, then a temporary shutter of equivalent shielding capacity must be placed in the radiation beam. This temporary shutter shall be fastened to the equipment in a manner that keeps it firmly in place when the equipment is moved.

- The radiation source must be kept in its shield inside a locked storage.
- The radiation source and storage must display the appropriate warning signs.
- The radiation shielding in the storage must be of a kind that keeps the radiation dose of persons remaining in the vicinity of the storage, other than workers engaged in radiation work, as low as reasonably achievable, and ensures that their annual dose does not exceed 0.3 mSv. Furthermore, the aim shall be to maintain a dose rate outside of the storage that does not exceed 2.5 µSv/h.
- No other dangerous goods or chemicals are allowed inside the radiation source storage. These include: explosives, flammable liquids, gases or solids, materials that become dangerous when wet, corrosive materials and self-combustible materials.
- Redundant radiation sources must not be stored needlessly.

The requirements concerning security arrangements that are presented in Guide ST 1.11 also apply to the radiation source storage.

5.4.2 Assignment to another user

Radiation sources that have become redundant to a licensee and are still in working order may be assigned to another licensee. The reassignment and recommissioning of a radiation source is subject to the same safety requirements as new radiation sources that contain a comparable amount of activity. The assignment of a decommissioned sealed source for reuse requires that the following safety requirements are met:

- The recipient has an appropriate safety licence for the possession and use of the radiation source.
- A certificate from the manufacturer is available for the radiation source.

- If the certificate mentions a recommended working life stated by the manufacturer, this time must not be exceeded.
- The source has a packaging that corresponds with the transportation requirements.

In exceptional cases, STUK may approve exceeding the manufacturer's recommended working life if the responsible party can ensure the leak-tightness of the source and its usability at the new location and demonstrate these facts to STUK. If necessary, STUK will impose additional conditions on the use of the radiation source at the new location.

Together with the equipment and sealed source, the assignor must supply sufficient information on their structure, leak-tightness and on properties that affect their safety. Before the transfer it must also be verified that the identifying details of the equipment and source are correct and that their labels and the radiation hazard warning signs on the source shield are appropriate and in good condition.

STUK must be notified of the transfer of a radiation source within two weeks.

Section 15 of the Radiation Act contains provisions on the assigner's obligation to provide information. Section 21 contains provisions concerning the conformity of products to requirements. Section 56 contains provisions regarding STUK's right to prohibit the sale and assignment of a product that does not meet the safety requirements. The transfer of radioactive materials between Member States of the European Union, their exportation to other countries, and their importation from other countries are described in greater detail in Guide ST 5.4.

5.4.3 Assignment to the manufacturer, supplier or recognized installation

Decommissioned sealed sources must primarily be returned to the manufacturer or supplier of the source. If the supplier does not accept radiation sources, they may be delivered to a recognized installation that attends to the safe disposal of radioactive waste. Radioactive waste comprises radioactive substances, and equipment and goods that have been contaminated with radioactive substances, for which there is no use.

The recipient of a radiation source must provide the assigner with a certificate of reception that identifies the assigner, assignee, date of transfer and the information concerning the radiation source.

STUK must be notified of the transfer of a radiation source within two weeks.

High activity sealed sources

A decommissioned high activity sealed source must be primarily returned to the provider of the reception agreement discussed in item 2.1. STUK will release the financial security set by the responsible party once a certificate from the recipient has been used to demonstrate that the used radiation source has been appropriately attended to.

5.4.4 Clearance from regulatory control for sealed sources

If the activity of a sealed source other than a high-activity sealed source decreases below the exemption value during use, the responsible party may seek exemption from safety licence for the radiation source from STUK. The procedure described under item 5.4.3 is always recommended for sealed sources whose activity falls below the exemption value. However, such sealed sources may also be delivered as regular waste to incineration plants or landfills, for example, if the following conditions are met:

- The activity of the sealed source is below the exemption value.
- The activity in a single waste package is at most equal to the exemption value set for each radionuclide.
- The activity delivered to a waste incineration plant or landfill from one place of use of radiation over the course of one month may be at most 10 times the exemption value set for each radionuclide.

The labels indicating radiation and radioactivity must be removed from sealed sources and their shields before they are disposed of in this way.

The exemption values for radioactive substances are provided in Guide ST 1.5.

6 Transport of radioactive materials

The transport of radioactive materials has been exempted from the need for a safety licence by virtue of the Radiation Act. However, the Radiation Act lays down general obligations for a safety licence holder who commissions the transport of radioactive materials or imports such materials. The transport of sealed sources and equipment containing sealed sources must comply with the legislation on the transport of dangerous goods. Furthermore, the obligation to provide information discussed in item 5.4.2 must be taken into account.

6.1 Transport preparations and reception of radiation sources

The consignor of a radioactive material is responsible for the appropriate preparation of the transport. The consignor may be the safety licence holder or a party authorized by the safety licence holder. When consigning radioactive materials for transport, the consignor is responsible for ensuring the following, among other things:

- The radioactive material is correctly classified (UN number and title).
- The transport package and its markings meet the set requirements.
- The mode of transport is appropriate from a safety perspective.
- The carrier has all the documents and instructions required by the regulations (consignment note, any additional instructions).

If radioactive materials are sent by air, the qualifications of the consignor and packer must be approved by the Finnish Transport Safety Agency.

The responsible party must ensure that employees receiving radioactive materials have been sufficiently trained and instructed for their task. Transport packaging containing radioactive materials must not be unnecessarily stored in the reception facilities.

6.2 Transporting radiation sources by road

A safety licence holder may transport their own radiation sources by road. In such cases, the licence holder must meet the obligations of the carrier and driver, including the following:

- The driver has the necessary qualifications for the transport of dangerous goods (a valid ADR certificate or awareness training, if necessary).
- The vehicle has the markings for the transport of radioactive materials, if necessary.
- The vehicle has the equipment and safety instructions required by the regulations.
- The shipments are loaded safely.
- The damage, loss and unauthorized seizure of sealed sources have been effectively prevented throughout the transport.

For more information about the transport of radioactive materials, see the guides *Radioaktiivisten aineiden kuljetus (Transport of radioactive materials)* [7] and *Turvajärjestelyt radioaktiivisten aineiden tiekuljetuksissa (Security arrangements in the road transport of radioactive materials)* [8], published by STUK.

The transport of dangerous materials is regulated by the Act on the Transport of Dangerous Goods (719/1994) and regulations issued by virtue of the Act. Detailed requirements for transport by road are specified in the Finnish Transport Safety Agency's order TRAFI/4541/03.04.03.00/2015. By virtue of Section 11 of the Radiation Act, the transport of radioactive substances constitutes use of radiation. The transport of radioactive materials has been exempted from the need for a safety licence by virtue of Section 17 of the Radiation Act. The safety licence holder's liability for transport and damage in transport are regulated by Sections 29–30 of the Radiation Act. The ADR certificate is regulated by the Government Decree on the Driving Authorization of the Drivers of Dangerous Goods (401/2011). Awareness training is regulated by a Finnish Transport Safety Agency's order, Annex A, Special regulation S12.

7 Abnormal events

7.1 Preparation for abnormal events

The responsible party must identify the possible hazardous abnormal events associated with the use of radiation equipment in advance. Examples of possible abnormal incidents occurring during the use of sealed sources include the disappearance of a radiation source or the suspected or discovered abnormal exposure of an employee. Abnormal events may also include malicious damage to or theft of the sealed source or radioactive material.

The responsible party must plan and implement the operations in a manner that minimizes the likelihood of abnormal events. The responsible party shall also ensure that the information concerning the abnormal event is relayed within the organization, allowing it to reach the responsible party and the responsible individuals.

Steps shall be taken to prepare for potential abnormal events by such means as issuing written instructions on how to act in case of abnormal events to workers engaged in duties involving radiation sources, and by reserving sufficient equipment for the isolation of an area, for example.

7.2 Procedures in case of an abnormal event

In case of an abnormal event, all feasible measures shall be taken to limit the radiation exposure and to restore radiation safety. The causes of the abnormal event shall be identified. Actions shall be taken in order to prevent the occurrence of similar events.

The causes of the event shall also be analysed for near misses that involve a substantial potential risk, and the implementation of corrective actions shall be considered.

7.3 Reporting of abnormal events

Abnormal events must be reported to STUK without delay. The report shall indicate the following:

- the responsible party (safety licence holder) and the radiation safety officer
- the name and contact details of the person submitting the report
- the time and place of the event
- description of the event
- information on persons exposed to danger and an estimate of their possible radiation exposure
- estimate of any possible discharges of radioactive substances
- immediate actions taken due to the event.

If necessary, a written report concerning the abnormal event shall be submitted to STUK. In addition to the foregoing details, the written report must also give an account of the causes and consequences of the abnormal event (particularly of possible radiation exposure) and of the measures taken to prevent similar events in the future.

Reporting of abnormal events to STUK is regulated by Section 17 of the Radiation Decree (1512/91). Further details concerning the procedure in case of abnormal events and the reporting of such events to STUK are set out in Guide ST 1.6. Additionally, Guide ST 1.11 discusses malicious damage to or theft of radioactive substances and the required reports.

Bibliography

1. EN ISO 2919: 2014. Radiological protection – Sealed radioactive sources – General requirements and classification. Geneva: International Organization for Standardization.
2. ISO 9978: 1992. (E). Radiation protection – Sealed radioactive sources – Leakage test methods. Geneva: International Organization for Standardization.
3. IEC 62598: 2011. Nuclear instrumentation – Constructional requirements and classification of radiometric gauges. Geneva: International Electrotechnical Commission.
4. IAEA Safety Standards: Safety of Radiation Generators and Sealed Radioactive Sources. Safety Guide No. RS-G-1.10. Vienna: International Atomic Energy Agency; 2012.
5. ISO 361:1975. Basic ionizing radiation symbol. Geneva: International Organization for Standardization.
6. IAEA Nuclear Energy Series: Management of Disused Sealed Radioactive Sources (No. NW-T-1.4). Vienna: International Atomic Energy Agency; 2014.
7. Radiation and Nuclear Safety Authority of Finland. Radioaktiivisten aineiden kuljetus. STUK opastaa/Syyskuu 2012. (Transport of radioactive materials. Advice from STUK/ September 2012.) 2. revised edition. Helsinki: STUK; 2013.
8. Radiation and Nuclear Safety Authority of Finland. Turvajärjestelyt radioaktiivisten aineiden tiekuljetuksissa. STUK opastaa / Kesäkuu 2015. (Security arrangements for road transport of radioactive materials. Advice from STUK / June 2015.) Helsinki: STUK; 2015.

APPENDIX A

DEFINITIONS

High activity sealed source

A sealed source containing a radionuclide of activity that was equal to or exceeded the activity level set per nuclide when the source was manufactured or, if the activity at this time is not known, at the time when the source was first placed on the market.

NOTE! Activity levels for different radionuclides are presented in Guide ST 5.1, Appendix B.

Radioactive waste

Radioactive substances and equipment, goods and materials contaminated by radioactive substances that have no use and must be rendered harmless due to their radioactivity. Radioactive substances and radiation appliances containing radioactive substance, the owner of which cannot be found, shall also be regarded as radioactive waste.

Radiometric device

A measuring device comprising a sealed source housed in a radiation shield, a radiation detector and measurement electronics.

Recommended working life

A recommended working life determined by the manufacturer of a radiation source; during this time, the characteristics (e.g. leak-tightness) of the sealed source can be expected to remain unchanged.

Radiation appliance

An appliance which produces radiation electrically or contains any radioactive substance

Radiation source

A radiation appliance or radioactive substance.

Use of radiation

Use of radiation sources in medicine, industry, research and education, and manufacture of and

trade in radiation sources, and related activities such as possession, safekeeping, servicing, repair, installation, import, export, storage, transport, and rendering radioactive waste harmless.

Radiation practices

The use of radiation, operations or circumstances in which human exposure to natural radiation causes or may cause a health hazard.

Additional information: If necessary, STUK shall decide in individual cases whether an operation is to be considered a radiation practice.

Party running a radiation practice (the responsible party)

The holder of a safety licence, any business or sole trader, enterprise, corporation, foundation or institution which uses radiation sources in its operations, or any employer or self-employed person engaged in radiation practices.

Additional information: When the responsible party is not a physical person (but is e.g. a limited liability company, foundation or municipality), the party responsible for the operation as a whole is the party with the highest authority in the organization.

Recognized installation

An enterprise registered in Finland or another responsible party operating in an industrial sector that includes rendering radioactive waste harmless, and that has a safety licence for this operation.

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.

APPENDIX B**ACTIVITY LEVELS OF HIGH ACTIVITY SEALED SOURCES**

For radionuclides not listed in the table below, the relevant activity level is one hundredth of the corresponding A_1 value. A_1 value is given in the IAEA Regulations for the safe transport of radioactive materials*).

Radionuclide	Activity (GBq) A radiation source with a higher activity level is classified as a high activity sealed source
Fe-55	400
Co-60	4
Se-75	30
Kr-85	100
Sr-90 ^(a)	3
Pd-103 ^(a)	400
I-125	200
Cs-137 ^(a)	20
Pm-147	400
Gd-153	100
Tm-170	30
Ir-192	10
Tl-204	100
Ra-226 ^(b)	2
Pu-238 ^(a)	100
Am-241 ^(b)	100
Cf-252	0.5
^(a) The activity level includes contributions from daughter nuclides with half-lives less than 10 days.	
^(b) Includes neutron sources with beryllium.	

*) Regulations for the Safe Transport of Radioactive Material, SRR-6 – International Atomic Energy Agency, Vienna.

APPENDIX C**RECORDING FORM FOR HIGH ACTIVITY SEALED SOURCES**

Recording information for high activity sealed sources in accordance with the standard record sheet annexed to the HASS Directive (2003/233/Euratom). The numbering of the main headings is the same as in the Directive.

Main heading	Detailed information	
1. Source identification number	Manufacturing number of source capsule	
2. Details of licensee	Name of licensee	
	Address	
	Type of user (manufacturer, supplier or user)	
3. Location of device/ source	Location of device. Depot or storage place of mobile device.	
	Address of device location (where different from item 2). Address of depot or storage place of mobile device.	
	Mode of installation (fixed or mobile)	
4. Records	Date when recording of this source began	
	Date of last entry in records (date of transfer of source and termination of active record keeping)	
5. Safety licence	Safety licence number	
	Date of issue of licence	
	Date of expiry of licence	
6. Supervision measures by custodian	Dates of equipment/source inventory *)	
	Dates of wipe tests *)	
7. Details of radiation device and radiation source	Purpose of equipment	
	Manufacturer of equipment	
	Type of source shield	
	In use or in storage	
	Radionuclide	
	Activity on date of manufacture **)	
	Date of manufacturing ***)	
	Name of manufacturer ****)	
	Address of manufacturer ****)	
	Chemical form of radioactive material in the source	
	Physical properties of source capsule	
	Issuer of certificate and date of issue	
8. Receipt of source	Date of receipt	
	Received from	
	Address of foregoing	

9. Transfer of source	Date of transfer	
	Transferred to	
	Address of foregoing	
10. Further details	Details of abnormal events	
	Other information	
<p>*) Inventory of sources and wipe tests of high activity sources performed at intervals not exceeding one year.</p> <p>**) If the date of manufacture is not known, then this entry shall state the activity at the time when the source was placed on the market.</p> <p>***) If the date of manufacture is not known, then this entry shall state the date when the source was placed on the market.</p> <p>****) If the sealed source was manufactured outside of the European Union, then the name and address of the importer may be entered here.</p>		