

TRANSPORT OF NUCLEAR MATERIAL AND NUCLEAR WASTE

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Authorisation

By virtue of the below acts and regulations, the Radiation and Nuclear Safety Authority (STUK) issues detailed regulations that apply to the safe use of nuclear energy and to physical protection, emergency preparedness and safeguards:

- Section 55, paragraph 2, point 3 of the Nuclear Energy Act (990/1987)
- Section 29 of the Government Resolution (395/1991) on the Safety of Nuclear Power Plants
- Section 13 of the Government Resolution (396/1991) on the Physical Protection of Nuclear Power Plants
- Section 11 of the Government Resolution (397/1991) on the Emergency Preparedness of Nuclear Power Plants
- Section 8 of the Government Resolution (398/1991) on the Safety of a Disposal Facility for Reactor Waste
- Section 30 of the Government Resolution (478/1999) on the Safety of Disposal of Spent Nuclear Fuel.

In the Act on Transport of Dangerous Goods (719/1994, Section 6), the Radiation and Nuclear Safety Authority has been appointed to supervise compliance with the said Act and with the regulations issued on its basis as specified in the Act and the Government Decree. The Radiation and Nuclear Safety Authority issues instructions for transports of nuclear materials and nuclear waste on the basis of the following acts and regulations:

- Section 38 of the Government Decree on the Transport of Dangerous Goods by Road (194/2002).
- Section 37 of the Government Decree on the Transport of Dangerous Goods by Rail (195/2002).
- Section 18 of the Decree on the Transport of Dangerous Goods in Packaged Form by Sea (666/1998).
- Section 21 of the Decree on the Transport of Dangerous Goods by Air (210/1997).

Rules for application

The publication of a YVL guide does not, as such, alter any previous decisions made by STUK. After having heard those concerned, STUK makes a separate decision on how a new or revised YVL guide applies to operating nuclear power plants, or to those under construction, and to licensees' operational activities. The guides apply as such to new nuclear facilities.

When considering how new safety requirements presented in YVL guides apply to operating nuclear power plants, or to those under construction, STUK takes into account section 27 of the Government Resolution (395/1991), which prescribes that *for further safety enhancement, action shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology.*

If deviations are made from the requirements of the YVL guides, STUK shall be presented with some other acceptable procedure or solution by which the safety level set forth in the YVL guides is achieved.

1 General

In transports of nuclear materials and nuclear waste, the fundamental safety principle is to protect the transport staff, other people and the environment from the radiation emitted by the radioactive material. The radiation safety and the criticality safety shall be maintained even in an accident.

The transports of nuclear materials and nuclear waste are susceptible to illegal acts. Provision shall be made for the disturbance of transports, and efforts shall be made to prevent wilful damage. Should nuclear materials fall into the wrong hands, it may contribute to the spread of nuclear weapons, which would be extremely serious in terms of general safety and contrary to the international agreements Finland has signed. It is important that the organizations responsible for the transports are reliable and that they have adequate competence and resources to carry out their tasks.

The Radiation and Nuclear Safety Authority (STUK) is the authority that controls the transport of nuclear materials and nuclear waste as prescribed in the Nuclear Energy Act and Decree and in the decrees and decisions concerning the different modes of transport of dangerous goods. This Guide deals with the general requirements set for these transports, their approval procedures and the supervision of transports. Guide YVL 6.4 defines the requirements for transport packagings. Guide YVL 6.21 gives the requirements for the physical protection of transports. Guide YVL 1.16 deals with the nuclear liability and Guide YVL 6.9 with the control of nuclear material related to the transfer and reception of nuclear materials.

This Guide does not include, for instance, issues concerning the classification of packagings, markings of packagings and transport documents, which may differ for the various modes of transport. Detailed regulations have been issued in the transport mode-specific regulations [6–12].

2 Definitions

A₁ and A₂ values

A₁ and A₂ values are material-specific activity values given in the standard of the International Atomic Energy Agency, IAEA Safety Standard Series, Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised) No TS-R-1 (ST-1, Revised), (Chapter IV, Table I), which describe the hazardness of the radionuclide concerned.

Special form

Radioactive material in a special form refers either to solid radioactive material that cannot disperse, or to a sealed capsule containing radioactive material that can be opened only by breaking. Radioactive material in a special form shall be tested in accordance with specific standards. A certificate issued by an authority acts as proof of the special form.

Fissile material

In accordance with the regulations concerning the transport of dangerous goods, fissile materials mean uranium-233, uranium-235, plutonium-239, plutonium-241 and all materials that contain even one of these. However, unirradiated natural uranium or natural uranium irradiated only in a thermal reactor or depleted uranium is not considered to be fissile material.

Low dispersible material, LDM

Low dispersible (radioactive) material refers either to such solid radioactive material or radioactive material contained in a sealed capsule whose dispersion is only limited and which is not in a powder form.

Package

In connection with radioactive materials, package refers to the packaging with its radioactive contents prepared for transport.

Criticality safety index

The criticality safety index is a number related to the design of a fissile material package, which limits the number of packages in one transport unit.

Transport index

The transport index is a number marked on the labels and transport documents of a package, which indicates the dose rate of radiation emitted from the package.

Packaging

Packaging refers to the set of containers and equipment necessary for completely enclosing the radioactive contents. The packaging may include one or several containers, absorbent, equipment to maintain the safety distance, a radiation shield, filling and emptying devices, cooling devices, shock dampers, handling and fastening equipment, etc.

Radioactive material

In this Guide, radioactive material refers to such material (including fissile material, other nuclear material and nuclear waste) whose activity concentration and total activity in the consignment exceed the limits defined in the regulations concerning the transport of dangerous goods.

Design

Design refers to such description of radioactive material in a special form, low dispersible radioactive material, a package or the packaging that enables it to be identified accurately. The description may include technical specifications, engineering drawings, reports and other relevant material.

Nuclear material

In the Nuclear Energy Act and this Guide, nuclear material refers to special fissionable materials and source materials, such as uranium, thorium and plutonium, which are suitable for producing nuclear energy. (In the Nuclear Liability Act, nuclear material has been defined differently.)

Nuclear waste

Nuclear waste refers to radioactive waste in the form of spent nuclear fuel or in some other form generated during or as a result of the use of nuclear energy. Nuclear waste also refers to materials, objects and structures, which having become radioactive during the use of nuclear energy and having been removed from use, require special measures owing to the danger posed by their radioactivity.

3 Regulations and responsibilities concerning transports

3.1 General transport regulations for dangerous goods

The regulations pertaining to the transport of radioactive materials included in the transport mode-specific regulations for dangerous goods shall be complied with in transporting nuclear materials and nuclear waste. As far as domestic transports by sea and by air and all international transports are concerned, international transport regulations for dangerous goods shall be applied. When a transport by road or by rail begins and ends in Finland, decrees issued by the Ministry of Transport and Communications [6], [7] shall be applied.

Transport mode-specific regulations for dangerous goods include the following:

- Government Decree on the Transport of Dangerous Goods by Road (194/2002);
- Government Decree on the Transport of Dangerous Goods by Rail (195/2002);
- Decree on the Transport of Dangerous Goods in Packaged Form by Sea (666/1998);
- Decree on the Transport of Dangerous Goods by Air (210/1997);
- Decree of the Ministry of Transport and Communications on the Transport of Dangerous Goods by Road (277/2002);
- Decree of the Ministry of Transport and Communications on the Transport of Dangerous Goods by Rail (278/2002);
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR);

- Convention concerning International Carriage by Rail (COTIF), RID regulations in Annex I to Appendix B (CIM);
- International Maritime Dangerous Goods Code (IMDG);
- The International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code);
- Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO-TI).

The transport mode-specific regulations concern all dangerous goods, according to which radioactive materials constitute class 7. The regulations concerning the transport of radioactive materials are based on the standard [13] published by the IAEA "IAEA Safety Standard Series, Regulations for the Safe Transport of Radioactive Material," 1996 Edition (Revised) No TS-R-1 (ST-1, Revised). This Guide refers directly to the relevant sections in the publication concerned. The standard is being updated regularly. In assessing the safety of transports, the Radiation and Nuclear Safety Authority takes account of the amendments made to the latest version of the standard concerning safety.

Finnish regulations concerning land transports have been issued as decrees of the Ministry of Transport and Communications [6, 7]. International regulations [10, 11, 12, 8, 9] are applied to sea and air transports and to international land transports. These regulations have not been translated into Finnish.

3.2 Regulations related to the use of nuclear energy

Section 2 of the Nuclear Energy Act (990/1987) defines the transport of nuclear materials and nuclear waste as the use of nuclear energy, thus constituting operations subject to licence. Furthermore, the requirements for export and import licences laid down in the Nuclear Energy Act shall be taken into consideration in international transports. The Nuclear Liability Act (484/1972) is also applied to the transport of nuclear materials and nuclear waste.

Council Directive 92/3/Euratom contains regulations for transports of radioactive waste (including nuclear waste) between the Member

States of the EU and across the EU borders. Council Regulation 1493/93/Euratom contains regulations for transports of radioactive materials between the Member States of the EU. Guide ST 5.4 deals with the advance description, notification and approval procedures required by the above regulations.

Guide YVL 6.21 issued by the Radiation and Nuclear Safety Authority deals with the physical protection of the transports of nuclear fuel. An international agreement named "The Convention on the Physical Protection of Nuclear Material (IAEA INFCIRC/274)" has been concluded to protect nuclear materials from illegal acts. The IAEA has issued a recommendation for the security arrangements of nuclear facilities named "The Physical Protection of Nuclear Material (INFCIRC/225)", and it is applied to transports as well.

3.3 Responsibilities for the transports of nuclear materials and nuclear waste

In accordance with Section 9 of the Act on Transport of Dangerous Goods (719/1994), the carrier shall ensure that the vehicle used for the transport can be used for this purpose, the vehicle is appropriately manned and the driver is sufficiently familiar with the rules and regulations pertaining to the transport. The driver, for his/her part, shall ensure that the transport is carried out in accordance with the relevant rules and regulations. For instance, he/she shall ensure before the beginning of the journey that the vehicle is suitable for the transport concerned and the vehicle is appropriately manned and loaded. In accordance with the transport regulations for dangerous goods, the consignor is responsible for ensuring that all transport preparations are made appropriately. The responsibility of the consignor extends to all transit countries.

The Nuclear Energy Act (990/1987) and Decree (161/1988) require that the holder of the transport licence has at its disposal the sufficient expertise and the necessary opportunities to carry out the transports safely and in compliance with international treaties. The licence-holder is also in charge of the necessary security and emergency arrangements. If the consignor is not the same as the holder of the transport licence, the sharing of responsibility in the area of

Finland shall be defined clearly in the transport documents.

The licence-holder is responsible for compensating for any damage caused during the transport of radioactive material, if the damage results from the licence-holder's negligence. The Nuclear Liability Act (484/1972) requires that, in the cases defined by law, the transports of nuclear materials and nuclear waste shall be insured such that any damage caused to third parties in the event of an accident can be covered. Guide YVL 1.16 issued by the Radiation and Nuclear Safety Authority deals with nuclear liability.

4 Approval procedure

4.1 Application of the transport regulations for nuclear materials and nuclear waste

Limit values ([13] Table I) have been defined for the nuclide-specific activity and activity concentration of radioactive materials, below which the transport regulations for radioactive materials will not be applied. The Nuclear Energy Decree (161/1988) exempts certain small amounts of nuclear material and nuclear waste either from all regulations imposed by the Nuclear Energy Act (Sections 10, 10 a and 10 b) or from a licence for the transport (Section 17).

If a transport does not fulfil all the safety requirements laid down in the transport regulations, or if the fulfilment of these regulations causes unreasonable harm, the Radiation and Nuclear Safety Authority may approve, on application, the transport with special arrangements (e.g. Decree 277/2002, Appendix A, Point 1.7.4). In this case, the operator or the licence-holder shall specify, case by case, the substitutive measures that help achieve at least as good a safety level as in a transport that fulfils the requirements set in the relevant regulations. The Radiation and Nuclear Safety Authority issues an approval certificate about the special arrangements.

4.2 Requirements for the transport of nuclear material and nuclear waste

The regulations concerning the transport of dangerous goods require that the following requirements be fulfilled:

- The competence of the transport staff and the transport equipment meet the requirements laid down in the regulations for the transport of dangerous goods.
- The transport documents have been drawn up and the radioactive material has been packed in accordance with the transport mode-specific regulations for dangerous goods.
- The package used for transport has been fitted with labels, and the package design is approved (when this is required) by the Radiation and Nuclear Safety Authority or another authority that complies with the same regulations.
- The advance notification to be supplied to the Radiation and Nuclear Safety Authority has been given. (The regulations require an advance notification when the activity of the transported material exceeds the value of 3000 A₁ or the value of 3000 A₂ and whenever the activity exceeds 1000 TBq.)

Furthermore, the rules and regulations concerning the use of nuclear energy or radiation require the following:

- a licence approved by the Radiation and Nuclear Safety Authority for the transport of nuclear material or nuclear waste;
- sufficient security and emergency arrangements;
- arrangement of the liability for nuclear damage;
- an import and/or export licence for nuclear material or nuclear waste for transports across Finnish borders (including transit);
- an advance description from the authority of the receiving country for transports of radioactive material within the EU;
- for transports of radioactive waste, an approval by the competent authorities of the country of origin and the receiving country of the waste as well as of the transit countries.

4.3 Transport licence and responsible manager

Except for the cases defined in Section 4.1 above, the Nuclear Energy Act requires a licence for the transport of nuclear materials and nuclear waste. If no licence is required, an advance no-

tification of the transport shall be given to the Radiation and Nuclear Safety Authority. Sections 56–60 of the Nuclear Energy Decree define the requirements for the licence and its application. In handling the licence application, the studies pertain to the applicant's reliability and expertise in the transport of the materials referred to in the application, to the security and emergency arrangements linked with the transport in outline, and to the arrangement of the liability for nuclear damage. In addition, a manager responsible for the transport of nuclear materials and nuclear waste, who is approved by the Radiation and Nuclear Safety Authority, shall be appointed, if a separate licence is required for the transport (Nuclear Energy Decree 161/1988, Section 123).

A transport licence can also be granted on a long-term basis, for instance for the period of the licence granted for the operation of a nuclear facility. A transport licence shall be applied for no later than three months before the transports begin.

4.4 Transport plan

The transport of nuclear material or nuclear waste shall not begin without a transport plan approved by the Radiation and Nuclear Safety Authority. However, a transport plan is not required for such nuclear materials or nuclear wastes that have been exempted from a licence for the transport.

In the transport plan, the licence-holder shall explain in which way the requirements stated in Section 4.2 above are fulfilled. The plan consists of a report to be submitted to the Radiation and Nuclear Safety Authority for approval together with appendices to be included for information. The documentation supplied for information includes, for instance, frequently changing data such as schedules and contact information on the persons involved in the transport.

The decision of approval for the transport plan may include conditions, which may relate, for instance, to the transport routes or to the handling of packagings. Outside nuclear facilities, the packages of nuclear materials and nuclear waste can be handled in the same way as normal goods, unless otherwise required by the licences and approvals for the transport. The equipment used

for handling packages shall be overhauled and inspected appropriately.

The application for the approval of a transport plan shall contain the following information:

- the name and address of the consignor and the consignee;
- general information on the package, the number and issuer of the approval certificate, description of the packaging and contents, the permitted number of packages, the estimated transport index and the criticality safety index, and the estimated class;
- general information on the transport, such as the transport mode, the means of transport, alternative routes, the carrier, and potential stops and temporary storages;
- a list of the documents accompanying the transport;
- information on potential exclusive use of the means of transport;
- special safety measures (speed limits, restrictions on other traffic, special equipment);
- a reference to a separately approved physical protection plan for the transport and, if necessary, an emergency plan in case of an accident;
- a description of any necessary special arrangements (or a reference to a separate approval certificate concerning them);
- a description of the nuclear liability insurance;
- transport equipment and special equipment used for the transport, also including communication and radiation control equipment.

The following information shall be given on the staff:

- the organizational units involved in the design, loading, transport and unloading, and the distribution of their tasks and responsibilities;
- maintenance of the staff's competence.

The following instructions shall be attached to the transport plan:

- safety instructions for the carrier (separate instructions are not needed, if an emergency plan has been drawn up for the transport);
- instructions for the dose rate and contamination measurements before and during the transport;

- instructions for handling the package, for using the equipment and for inspecting and measuring the consignment during the transport (the instructions shall include the requirements set in Point 501 of Standard TS-R-1 for inspections before the first transport of a package and the requirements set in Point 502 for inspections before every transport);
- instructions for temporary storage during the transport;
- instructions for the reception or handover of the transport.

The transport plan shall be submitted to the Radiation and Nuclear Safety Authority for approval no later than three months before the planned transport and the changes to the plan no later than one month before the planned transport.

4.5 Physical protection plan

The physical protection plan for the transports of nuclear materials is a separate confidential document. It describes the measures taken to prevent illegal acts aimed at the transported material. Guide YVL 6.21 deals with the physical protection plan in more detail. The physical protection plan shall be submitted to the Radiation and Nuclear Safety Authority for approval no later than three months before the planned transport.

4.6 Emergency plan

If the activity of the transported spent nuclear fuel or other nuclear waste exceeds 1000 TBq, an emergency plan, which describes the measures in emergency situations and transients, shall be provided. In the transports of fresh fuel or in the cases when the activity is less than 1000 TBq, the emergency plan can be replaced by safety instructions that describe the operations in an emergency. The safety instructions shall form a part of the transport plan. As far as other nuclear materials and nuclear wastes are concerned, the Radiation and Nuclear Safety Authority takes decisions on the necessary scope of advance planning for emergency preparedness in each case.

For the purpose of designing the measures to be described in the emergency plan, the applicant shall draw up a background report, which examines the possibilities of an accident, and assesses

the probabilities of accidents and potential radiation exposures.

The following information shall be given in the emergency plan:

- potential accidents related to the transport and a reference to the background report;
- the emergency organization;
- the alarm and communication arrangements;
- the emergency operations carried out to limit the consequences of an accident;
- the instructions for operations of the transport staff during an accident;
- a description of the emergency equipment;
- training and accident drills of the staff.

The emergency preparedness shall be planned in such a manner that it is closely linked with the planning of rescue operations of the authorities. The licence-holder shall submit the emergency plan approved by the Radiation and Nuclear Safety Authority for information to the Ministry of the Interior, as well as to the county administrative boards along the transport route and to the rescue directors of the rescue operation areas concerned.

The emergency plan shall be submitted to the Radiation and Nuclear Safety Authority for approval no later than three months before the planned transport.

4.7 Notification of transport

A notification of transport shall be submitted to the Radiation and Nuclear Safety Authority no later than one month before the date of transport or in accordance with the licence specifications. The notification shall include information on the date of transport, and it thus fulfils the requirement set in the transport regulations for an advance notification to be given seven days beforehand. If the date of transport stated in the notification changes, the Radiation and Nuclear Safety Authority shall be informed of the new date no later than 24 hours before the transport begins.

The notification of transport specifies the matters stated in the transport plan. The notification shall include a list of the following information:

- the consignor and the consignee, as well as the nuclear facility whose nuclear material or nuclear waste is meant to be transported;

- the transport licence and the manager responsible for the transport and his/her deputy in accordance with the Nuclear Energy Act, and the insurance in accordance with the Nuclear Liability Act;
 - the material to be transported, its amount (e.g. weight and number of nuclear fuel assemblies) and quality (physical and chemical form, isotopic enrichment), as well as potential identification data, such as the number of the nuclear fuel batch;
 - in the case of spent nuclear fuel, the average burn-up, the residual heat and the date of removal from the reactor;
 - the packaging to be used, the number of the approval certificate of the package design, and the permitted number of packages;
 - the total activity and the estimated dose rate on the external surface of the package and the means of transport, and at a distance of 1 m from the surface, as well as the estimated transport index, the criticality safety index and the class;
 - references to the approved transport plan and physical protection plan (and to the emergency plan, if this is required) and to the approval certificate for potential special arrangements;
 - a description of potential special arrangements;
 - the transport events, the route and the carriers;
 - the estimated date of the transport or transports;
 - the contact person of the applicant.
- instructions for the handling, loading and unloading operations to be carried out during the transport, as well as for the temporary storage and measurements during the transport;
 - other documents specified in the transport mode-specific regulations.

5.2 Deviations and reporting

Deviation from the approved transport plan, emergency plan and physical protection plan during the transport is allowed only for unanticipated, compelling reasons.

The Radiation and Nuclear Safety Authority shall be informed of special situations occurring during the transport without delay.

6 References

1. Act on Transport of Dangerous Goods (719/1994).
2. Government Decree on the Transport of Dangerous Goods by Road (194/2002).
3. Government Decree on the Transport of Dangerous Goods by Rail (195/2002).
4. Decree on the Transport of Dangerous Goods in Packaged Form by Sea (666/1998).
5. Decree on the Transport of Dangerous Goods by Air (210/1997).
6. Decree of the Ministry of Transport and Communications on the Transport of Dangerous Goods by Road (277/2002).
7. Decree of the Ministry of Transport and Communications on the Transport of Dangerous Goods by Rail (278/2002).
8. European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Finnish Treaty Series (23/1979).
9. Convention concerning International Carriage by Rail (COTIF), Appendix B (CIM), Annex I, RID regulations, Finnish Treaty Series (5/1985).
10. The International Maritime Dangerous Goods Code (IMDG) defined in the supplement to the International Convention for the Safety of Life at Sea (SOLAS), Chapter VII, Part A, Rule 1 and the valid decision of the Finnish Maritime Administration.

5 Transportation

5.1 Transport documents

In transporting nuclear materials and nuclear wastes, the approved plans shall be complied with. At least the following documents shall accompany the transport:

- the consignment note(s) completed in accordance with the transport mode-specific requirements;
- the approval certificates for the transport and the package;
- the written safety instructions or the emergency plan;

11. The INF Code defined in the supplement to the International Convention for the Safety of Life at Sea (SOLAS), Chapter VII, Part D, Rule 14, which includes requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships.
12. Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO-TI) issued by the International Civil Aviation Organization (ICAO) and aviation regulation OPS M1-18 (5.5.2003).
13. IAEA Safety Standard Series, Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised) No TS-R-1 (ST-1, Revised).
14. Nuclear Energy Act (990/1987).
15. Nuclear Energy Decree (161/1988).
16. Nuclear Liability Act (484/1972).
17. IAEA: INFCIRC/225 "The Physical Protection of Nuclear Material".
18. IAEA: INFCIRC/274 "The Convention on the Physical Protection of Nuclear Material".
19. Council Regulation concerning transports of radioactive materials between the Member States of the EU (1493/93/Euratom).
20. Council Directive on the supervision and control of transports of radioactive waste between the Member States of the EU and into and out of the Community (92/3/Euratom).