

Guidance on maritime transport of radioactive materials (IMDG class 7)

Introduction

This guidance aims to describe the requirements for maritime transport of radioactive material set by the Danish Maritime Authority (DMA), the Danish Institute for Radiation Protection (SIS) and the Danish Emergency Management Agency respectively (BRS). The guidance must also clarify the division of responsibilities between the three authorities involved.

The guide is primarily aimed at shippers/companies and shipping companies.

Preface

Radioactive material is goods that emit ionizing radiation and require radiation protection measures during transport. Certain types of radioactive material are also nuclear material, and for this type of material, in addition to the requirements for radiation protection, there are requirements for the prevention of criticality, for security measures and for security plans.

In case of sea transport of radioactive material, the requirements on the companies depend on, among other things, of the type of material being transported. The requirements thus depend on whether non-nuclear radioactive material, nuclear material or irradiated nuclear fuel, plutonium and highly radioactive waste (INF code-goods) are being transported. When the term "radioactive material" is used in this guidance, this covers both non-nuclear material, nuclear material and INF code-goods.

Legal basis and division of responsibilities

Sea transport of radioactive material is subject to maritime legislation - the SOLAS convention¹ and the IMDG code², as well as order no. 993 of 5 December 2001 on the transport of radioactive substances issued by the Danish Health Authority. For nuclear material Executive Order No. 1762 of 27 December 2016 on security measures for nuclear material and nuclear facilities and the preparation of security plans issued by The Danish Ministry of Defence also apply. Furthermore, the INF code³ apply for goods subject to the code.

The Danish Maritime Authority, the Danish Institute for Radiation Protection and the Danish Emergency Management Agency are the three authorities involved. The DMA is the competent authority as regards sea transport in Denmark, the DMA supervises and certifies Danish-flagged ships. The Danish Institute for Radiation Protection is the competent authority as regards radiation and radiation protection in Denmark, including Danish-flagged ships. The Danish Emergency Management Agency is the authority responsible for security measures and preparation of security plans in connection with nuclear material, sea transport included.

Overview of class 7

Dangerous goods are divided into different classes¹, class 7 covers radioactive material.

Products with hazardous properties are identified through an international classification, the so-called UN numbers. Table 2.7.2.1.1 of the IMDG Code contains an overview of all the UN numbers and official goods designations that fall under class 7. The table is divided by package type, and the packages are typically listed with increasing risk.

Generally, it is possible to distinguish between non-nuclear and nuclear material based on the proper shipping name. Non-nuclear material typically has the text "non-fissile or except fissile" in the proper shipping

name, whereas nuclear material has the text "fissile". However, it is not possible to distinguish between nuclear material and INF code goods on the basis of the proper shipping name.

There is no lower limit for the classification of INF code goods, however, these are typically high-level radioactive products, including:

- Irradiated nuclear fuel; i.e. materials containing uranium, thorium and/or plutonium isotopes that have been used to maintain a self-sustaining nuclear chain reaction, and
 - plutonium (plutonium isotopes) extracted from irradiated nuclear fuel by means of reprocessing, and
 - high-level radioactive solid or liquid waste extracted in a system for reprocessing irradiated fuel. Typically, carriages of INF Code products in large quantities will, however, take place under the following UN numbers/official goods designations:
- UN-3327 Radioactive material, Type A package, fissile (typically rather small quantities).
 - UN-3328, Radioactive material, Type B(U) package, fissile.
 - UN-3329, Radioactive material, Type B(M) package, fissile.
 - UN-3331, Radioactive material, Transported under special arrangement, fissile (which occurs only exceptionally).

Requirements related to the ships

In terms of construction and equipment, a ship is approved to transport dangerous goods class 7, when this class appears from the ship's *Document of Compliance on Special Requirements for Ships Carrying Dangerous Goods*. It is stated in this document that relevant requirements in the IMDG Code must be complied with.

In addition to the requirements of the IMDG code for the transport of class 7 goods, ships that transport INF code goods must comply with the INF code and hold a certificate to that effect: "International Certificate of Fitness for the Carriage of INF Cargo". The INF code sets special requirements i.a. for the ship's survivability (damage stability and fire safety), temperature control in the cargo holds, securing of the cargo, electrical supplies and irradiation protection equipment. To this should be added a number of operational conditions such as safety management, training, contingency plans, including for informing the company, flag State, coastal State, etc. in case of an accident with INF Code materials.

The requirements for each individual ship are established in relation to the irradiation activity that the INF Code goods to be carried liberates. For this purpose, the requirements for the ships are divided into 3 classes:

- "Class INF 1 ship". Ships which are certified to carry INF cargo with an aggregate activity less than 4,000 TBq.
- "Class INF 2 ship". Ships which are certified to carry INF cargo with an aggregate activity less than 2×10^6 TBq.
- "Class INF 3 ship". As stated under a "Class INF 2 ship", but without any limitations in the aggregate activity.

Requirements related to shipping companies

Companies that transport radioactive material must notify or obtain permission from the Danish Institute for Radiation Protection for their transport activities.¹

A notification is to be understood as the level of authority control, which comes before a permit, where the company notifies the Danish Health Authority about its transport activities in Denmark, including Danish-flagged ships and Danish-registered aircrafts. A notification is not to be confused with an advance notification about the individual transport.

A description of when notification or permission is required can be found on the webpage of the Danish Institute for Radiation Protection (www.sis.dk) on the page "Transport". On the webpage one will also find an overview of the information that must be sent to the Danish Institute for Radiation Protection in connection with notification of or application for permission to transport radioactive material. The webpage contains a list of the companies that have notified the Danish Institute for Radiation Protection about or have permission from the Danish Institute for Radiation Protection to transport radioactive material (only companies that have consented to publication appear on the list).

In case of transport of radioactive material the IMDG code and order no. 993 of 5 December 2001 on the transport of radioactive substances issued by the Danish Health Authority requires, amongst others, that the transport takes place in accordance with a comprehensive radiation protection program and quality management system^{2,3}. A radiation protection program must describe the risks of radiation exposure associated with the transport of radioactive material and the measures implemented to address these risks and to optimize the radiation protection. The requirements for a radiation protection program are described in more detail in the guidance on radiation protection program for the transport of radioactive material (2021)⁴ issued by the Danish Health Authority. The quality management system must ensure and document compliance with the relevant regulations in the relevant regulations. On request, the company must present its radiation protection program and relevant parts of the quality management system to the Danish Health Authority⁵. The quality management system can be part of the ship's Safety Management system required by the ISM code. A Safety Management certificate issued by the Danish Maritime Authority is not an obstacle for the Danish Health Authority to make demands on the quality management system in accordance with the Danish Health Authority's orders.

Furthermore, the Danish Institute for Radiation Protection requires that companies that carry out the transport of radioactive material have a radiation protection coordinator approved by the Danish Health Authority². In order to be approved as a radiation protection coordinator qualifications in radiation protection are required. Qualifications in radiation protection can be obtained on the course on basic radiation protection by the Danish Institute for Radiation Protection or an equivalent course.

Approval of security plans in case of transport of nuclear material

The Danish Emergency Management Agency (BRS) must ensure that the provisions of the IAEA Convention on the Physical Protection of Nuclear Material² are complied with in connection with transport in Danish territorial waters including ships flying the Danish flag.

¹ Order 993/2001, §§ 7-8.

² The Convention on the Physical Protection of Nuclear Material

Danish ships carrying fissile/nuclear/fissionable material, respectively foreign ships intending to call at Danish ports or Danish territorial waters with such cargoes must have notified the Danish Emergency Management Agency (BRS) about the transport and acquired its approval.

The BRS makes an independent validation of the plan for physical protection made by the shipper and/or the carrier. The BRS is not responsible for planning the physical protection, but must in connection with each individual transport secure that such physical protection is available, issue an approval of the plan as well as verify that it is complied with. Physical protection includes, inter alia, appropriate locking mechanisms, alarms and communication systems.

The control/survey of the BRS can either be carried out administratively in the form of a review of the plans or as a physical inspection.

Beredskabsstyrelsens døgnvagt følger skibe, der transporterer INF-kode gods, under transporten, bl.a. ved indmelding om position og status efter en fastsat plan.

The 24-hour watch of the Danish Emergency Management Agency follows ships that transport INF code goods during the transport, i.a. by reportings of position and status according to a set plan.

Approval of packages

Where the IMDG code requires an approval certificate from a competent authority for the construction of a package, this is issued by the Danish Institute for Radiation Protection².

In connection with requirements for approval of package construction, a distinction is made between unilateral approval and multilateral approval. With unilateral approval, approval is only required from the competent authority in the package's country of origin, while with multilateral approval, approval is required from the competent authorities in all countries affected by the transport.

Multilateral approval is required for type B(M) packages as well as for all packages used for the transport of nuclear material or material with a low proliferation risk. For type B(U) and type C, which are not used for the transport of the aforementioned material, only unilateral approval is required.

Companies that intend to apply for approval of a package design can request a checklist with items that must be covered when applying to the Danish Health Authority.

Approval of shipments

Where the IMDG-code requires an approval certificate from a Danish competent authority for a carriage of radioactive material, an application to this effect must be forwarded to the Danish Institute for Radiation Protection².

An approval certificate is required for transport of:²

- Type B(M), that deviates from the requirements to type B
- Type B, with an activity greater than 1000 TBq, 3000 x A1 or 3000 x A2 (A1 and A2 refer to table 2.7.2.2.1 in the IMDG-code)
- Packages containing fissile materials if the sum of the criticality safety indexes of the packages in a single freight container or in a single conveyance exceeds 50
- Shipment of SCO-III
- Special arrangement

² IMDG-code, 5.1.5.1.2.

Applications for approval of shipments must contain the following information:³

- The time period for the transport
- The radioactive content
- The expected means of transport
- The type of vessel
- The transport route
- Detailed information on how any special precautions and special administrative or operational control measures required by the approval certificate for the package construction will be implemented

In case of application for approval of a transport as a special arrangement, the application must also contain the following:

- A statement on the particulars where the transport does not comply the relevant requirements and the reasons for this
- A statement on the special precautions, including administrative and operational measures, that must be applied during transport in order to be equivalent to the relevant requirements.

Companies that apply for approval of a transport as a special arrangement can request a checklist with items that must be covered in connection with the application from the Danish Institute for Radiation Protection.

INF-code goods

All transports of INF Code products must be approved by both the ship's flag State and the countries that the ship is to call at (host States)⁴. In this connection, it should be noted that the provisions on innocent passage in United Nations' Convention on the Law of the Seas stipulate that a coastal State cannot require foreign ships undertaking an international transit passage of, for example, Danish waters to be approved.

When Danish ships are to perform INF Code transport, the ship, the carrier, the cargo and the transport packages intended to be used must be approved in each individual case as described in the previous sections. This applies irrespective of whether the ship calls at Danish ports in connection with the carriage.

Notifications

Where, in accordance with section 5.1.5.1.4 of the IMDG Code, advance notification to the Danish competent authority is required, this must be sent to the Danish Institute for Radiation Protection⁵.

The advance notification must be in the hands of the Danish Institute for Radiation Protection at least 5 working days before the transport is initiated, and must contain:

- Sufficient information to enable the identification of the package or packages, including all applicable certificate numbers and identification marks

³ Order 993/2001, § 11, stk. 3.

⁴ Calls mean transports to and from the ports of the host State, respectively transports where the voyage is interrupted with a view to stays in the territorial waters of the host State, for example for bunkering, the receipt of stores, etc.

⁵ Order 993/2001, § 14, stk. 2.

- Information on the date of shipment, the expected date of arrival and proposed routing
- The names and a description of the radioactive material
- Descriptions of the physical and chemical forms of the radioactive material, or whether it is special form radioactive material
- The maximum activity of the radioactive contents during transport. For fissile material, the mass of fissile material (or of each fissile nuclide for mixtures when appropriate) in units of grams (g), or multiples thereof, may be used in place of activity

Education and training of the ship's crew and shore based personnel

The international regulations on education and training⁴ stipulate that ship's crew who handle radioactive products must be educated and trained in this.

Employers, e.g. the shipping company, the shipper etc., must ensure that personnel involved in the transport of radioactive substances have been instructed in all relevant transport provisions as regards, for example, loading, transit storage, separation from workplaces, separation from other dangerous goods, as well as having knowledge of all relevant information from the sender. The workers must also be instructed in measures to be taken in case of accidents, as well as in how the provisions for the individual transport are fulfilled⁵

The Danish Institute for Radiation Protection can, in each individual case make special requirements for the education and training as well as the protection of the crews as well as for the possibilities for measuring the radiation, etc. from the cargo.

For INF-code goods, the INF Code stipulates that – depending on the activity level of the substances carried and the ship's design – it may be necessary with additional arrangements or equipment for protection against radiation.

Emergency preparedness

The emergency tactics to be used in connection with accidents when transporting radioactive substances are described in the guidelines "Handling accidents with radioactive substances" (Håndtering af uheld med radioaktive stoffer, 2001), which has been drawn up in cooperation between the Danish Emergency Management Agency, the Association of Municipal Emergency Managers, the Commissioner of Police and the Danish Health Authority (the Danish Institute for Radiation Protection). The guidelines are available from the webpage of the Danish Health Authority in Danish (www.sst.dk) under "Udgivelser" (Publications) in 2001.

Safety of navigation

United Nations' International Maritime Organization (IMO) recommends, in resolution MSC.138(76), that ships navigating Route T (from the Skaw to Gedser via the Great Belt) and the Sound with INF Code cargoes take a pilot.

Annual report

Every year, the Danish Institute for Radiation Protection publishes an annual report for the entire radiation protection area, in which the most important details regarding the year's transports of radioactive material are described. The annual report states i.a. the number of carriers who have notified of or obtained permission for the transport of radioactive material in Denmark and on Danish-registered ships and aircraft, as well as the number of issued approvals regarding package construction and specific transports.

Furthermore, the annual report states the number of inspections that have been carried out and describes the typical observations associated with these. Special focal points for the year, including development and cooperation nationally and internationally, are also described.

The annual report is available from the webpage of The Danish Institute for Radiation Protection (www.sis.dk) (Publications).

From 1993 to 2018 The Danish Institute for Radiation Protection drew up an annual briefing on the carriage of radioactive substances. In addition to the information that has been transferred to the annual report the annual brief covered general conditions related to the transport. Previous briefings is available from the webpage of The Danish Institute for Radiation Protection (www.sis.dk) (Publications).

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