

IMPLEMENTATION OF THE 1996 EDITION OF THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL

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SUMMARY

The International Atomic Energy Agency (IAEA) completed a 10 year review and revision of its «Regulations for the Safe Transport of Radioactive Material»[1] with approval of the amendments by its Board of Governors in September 1996. The revised edition contains some important changes in the regulations, including:

- Type C package requirements;
- provisions for low dispersible material;
- uranium hexafluoride packaging;
- exemption value specifications; and,
- operational requirements, including the creation of a criticality safety index and new proper shipping names/UN numbers.

The 1996 edition of the IAEA regulations has been published and corresponding revisions are now being considered by the international transport safety organizations and Member States. In particular, the United Nations Committee of Experts on the Transport of Dangerous Goods, International Civil Aviation Organization and International Maritime Organization are preparing revisions to take into account the revised Class 7 requirements. An effective date of 1 January 2001 has been recommended so that international and domestic requirements might come into force simultaneously, thereby avoiding disruptive out-of-phase implementation.

This paper provides information on the history of the international regulations regulating Class 7 transport, highlights major changes in the IAEA regulations and provides information on the status and plans of the international organizations with respect to their revisions.

DANGEROUS GOODS TRANSPORT REGULATIONS IN THE 1950'S

At the beginning of the 1950's, the international regulations governing the transport of dangerous goods by various modes were fragmentary and those applied in different parts of the world lacked uniformity. International rail transport of dangerous goods was regulated by the Regulations Concerning the International Transport of Dangerous Goods by Rail (RID) in Western Europe and the «Special conditions for the transport of dangerous goods in international traffic by rail" (Annex 4 to the Agreement on international traffic in goods by rail) for the USSR and several of its trading partners. Canada, Mexico and the United States

applied the rail regulations prescribed for the United States by the Interstate Commerce Commission, which were notably different from European regulations.

The International Convention Concerning the Transport of Combustible Liquids in Inland Navigation (The Hague, 1939) was applied by all riparian States of the Rhine and by Belgium and the Inland Transport Committee of the United Nations Economic Commission for Europe had in preparation two European agreements concerning the international transport of dangerous goods by road (ADR, signed in 1957) and by navigable waterways (ADN).

For sea and air transport, only general basic requirements were contained in chapter VI of the International Convention for the Safety of Life at Sea (London, 1948) and in article 35 of the Convention on International Civil Aviation (Chicago, 1944) and its Annex 6. In addition, the «Regulations Relating to the Carriage of Restricted Articles» of the International Air Transport Association (IATA) became effective on a world-wide basis on 1 January 1956.

With regard to postal traffic, Article 59 of the Universal Postal Convention (Brussels, 1952) and Article 6 of the Agreement concerning Postal Parcels included dangerous substances among those articles for which forwarding was prohibited with the possibility of exceptions for postal parcels subject to agreement between the postal Administrations concerned.

COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

In 1953, the United Nations Economic and Social Council (ECOSOC) Transport and Communications Commission recognized that the increased movement in international transport of dangerous goods required the greatest possible uniformity. The first step was recognized to be the preparation of draft regulations to address problems common to all forms of transport and the Secretary-General of the United Nations was requested to appoint a committee of experts from countries having a substantial interest in international transport of dangerous goods.

The first mandate of that Committee was to make a study and present a report to the ECOSOC's Transport and Communications Commissions:

- recommending and defining groupings or classification of dangerous goods on the basis of the character of risk involved;
- listing the principal dangerous goods moving in commerce and assigning each to its proper grouping or classification;
- recommending marks or labels for each grouping or classification, which shall identify the risk graphically and without regard to printed text;
- recommending the simplest possible requirements for shipping papers covering dangerous goods.

The first report, with the recommendations, was published in 1956. Class 7 (Radioactive substances) were defined in that report as «substances or a combination of substances which spontaneously emit ionizing radiations» and were included in the scope of the report and its recommendations.

With the creation of the IAEA in 1957, the Committee of Experts felt it was necessary to ensure coordination with the IAEA on questions relating to the transport of radioactive material. In 1959, the ECOSOC requested the Secretary-General of the United Nations to inform the IAEA of the Council's desire that the IAEA be entrusted with the drafting of

recommendations on the transport of radioactive substances, provided that they were consistent with the framework and general principles of recommendations of the Committee of Experts and that they were established in consultation with the United Nations and the specialized agencies concerned (ECOSOC resolution 724 (XXVIII) of 17 July 1959).

This has led to a constant cooperation between the Committee of Experts on the Transport of Dangerous Goods, other relevant United Nations bodies, the IAEA and specialized agencies, in particular IMO and ICAO.

TRANSPORT OF DANGEROUS GOODS REGULATIONS IN 1998

After more than 40 years, the Committee of Experts continues to produce the "Recommendations on the Transport of Dangerous Goods" [1], also called the "Orange Book", which are amended every two years. They contain all the basic provisions for the safe carriage of dangerous goods but they have to be completed by additional requirements which may have to be applied at national level or for international transport depending on the mode of transport envisaged. For radioactive material, the recommendations have historically only presented a list of generic entries to which a UN number has been assigned and a description of labels. For the other provisions, the recommendations refer to the IAEA Transport Regulations.

The UN Recommendations are now well implemented through national legislation in most countries and through the most important instruments governing the international transport of dangerous goods by various modes of transport: the International Maritime Dangerous Goods Code, the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air, and at regional level ADR, RID, ADN and ADNR.

BACKGROUND AND HISTORY OF THE IAEA TRANSPORT REGULATIONS

In response to the July 1959 ECOSOC resolution, and with the assistance of experts worldwide, the first edition of the IAEA «Regulations for the Safe Transport of Radioactive Material», Safety Series No. 6 (SS No.6) was published in 1961. In addition to being applied directly to the Agency's operations and to Agency supported activities in Member States, they were (and still are) "recommended to Member States and to international organizations concerned as a basis for national and international transport regulations".

While it was expected that the basic principles underlying the Regulations would remain acceptable for a long period, it was also expected that "feedback" from experience in applying the regulations might identify improvements that could be realized by periodic revision. This has proven true and has resulted in revisions being published in 1965, 1967, 1973, 1979 (minor amendments), 1985, 1990 (minor amendments) and 1996.

The procedure used by the Agency for the preparation of its Regulations is largely responsible for their extensive national and international application. At each stage of regulatory development, the Agency's procedure involves the convening of panels, whose members represent not only an extensive coverage of Member States and international transport organizations, but also who also have experience with any administrative and technical problems requiring a solution. On the basis of proposals co-ordinated by the IAEA Secretariat, these panels prepare draft Regulations for comment by all Member States and all international

organizations concerned. Then, following panel consideration of such comments, final drafts are prepared for approval by the Agency's advisory committees and subsequently, the Board of Governors.

The success of this approach is demonstrated by the world-wide adoption of regulations based on the Agency's Regulations. The Agency surveyed Member States in 1992 to determine the extent to which regulations based on SS No.6 had been adopted. Of the Member States responding to the questionnaire, 92% indicated that they had used SS No. 6 as the basis for their regulations. Most importantly from an international commerce view point, the twenty largest radioactive material shipping countries and all major international transport modal organizations reported using the Agency's regulations as their basis.

While there is no overall transport safety convention for radioactive material, SS No.6 has attained convention-like status because of its uniform world-wide adoption. The International Civil Aviation Organization and International Maritime Organization base their radioactive materials transport requirements on those of the Agency. Within Europe, the applicable road (ADR), rail (RID), and inland waterway (ADN and ADN R) regulations have been similarly based on SS No.6. Even carrier organizations such as the International Air Transport Association use the Agency's transport regulations as their basis.

As a "safety standard" document, the Regulations contain requirements which specify what must be done in order to be in compliance. The requirements are in large part performance based and technical detail on how to comply is not given in the Regulations themselves, but rather in supporting documents. The Regulations, although applying to the Agency's own operations, are "model regulations" recommended to Member States and international organizations.

Since the Regulations address the transport of all types of radioactive material it has avoided categorizing materials on the basis of their use, destination, or other non-transport safety-related criteria. The Regulations are structured topically in terms of Definitions, General Principles and Provisions, Packaging Contents Limits, Requirements and Controls for Shipment, Material and Packaging Requirements, Test Procedures, and Approval and Administrative Requirements. As such, a user desiring to transport a specified type of radioactive material consignment has to assimilate requirements from all sections of the Regulations. Prior to the 1996 Edition a series of «schedules» were published [1] which provided users of the regulations a more consignment-oriented presentation of the requirements.

DEVELOPMENT OF THE 1996 EDITION OF THE IAEA TRANSPORT REGULATIONS

Recognizing the need to keep the regulations up to date with the latest radiation protection principles and evolving transport technologies, the IAEA has regularly issued revisions to the transport regulations. Most recently the revisions have taken place at approximately 10 year intervals and the latest revision began in 1986. The revision process involves a comprehensive series of technical committee and consultants meetings which are mainly comprised of representatives of Member State and international safety regulatory agencies. The outcome of these meetings are proposed revisions to the regulations which are reflected in drafts that are circulated for comment and further consideration. In September 1996 the IAEA Board of

Governors approved the 1996 draft for publication, application to the Agency's operations, and recommended it to Member States and international organizations for adoption.

The 1996 Edition of the Regulations were published as part of the IAEA's restructured Safety Standards Series of documents and is now known as ST-1. There are numerous minor changes embodied in ST-1 as well as several major ones, including:

Type C Packages

The new regulations require a more robustly designed package type, called a Type C package, for high-activity packages transported by aircraft. Many of the design and performance requirements for Type C packages recommended in IAEA-TECDOC-702 were adopted.

Type C package requirements apply to all radionuclides. The new performance requirements include:

- most of the requirements applicable to Type B(U) packages and, if appropriate, packages for fissile materials;
- a puncture/tearing test
- an enhanced thermal test, with the same technical specifications as the Type B package thermal test but with a duration of 60 minutes;
- a 200 m water immersion test; and
- an impact speed of 90 m/s for the «drop» test.

Low dispersible radioactive material

Since the primary hazards being addressed in Type C requirements are dispersion and external radiation levels, provisions have been made for materials which exhibit limited dispersibility, solubility, and radiation levels. These provisions are contained in a material category known as "low dispersible radioactive material» (LDM). It was accepted that material (without any packaging) that has limited radiation levels, which when subjected to the Type C impact and thermal test would only produce limited gaseous, fine particulate, or dissolved aqueous activity should be excepted from the Type C packaging requirements. Test specifications for LDM material are included in the regulations and Type B packages are authorized for their transport by air with the limit on total activity being that specified in the approval certificate for the Type B package. Multilateral Competent Authority approval of the Type B package design and the design of the LDM is required.

Provisions for the safe transport of uranium hexafluoride

The technical committees which developed the revised regulations dealt with a number of difficult items concerning uranium hexafluoride (UF₆). Uranium hexafluoride is a unique material since its chemical toxicity is generally of more concern than its radiotoxicity and the material is routinely shipped in large volumes. No specific provisions for UF₆ existed in the 1985 edition of the transport safety regulations and a number of issues were considered. Provisions were adopted requiring that UF₆ packages:

- must withstand an internal test pressure of at least 1.4 MPa, but cylinders with a test pressure less than 2.8 MPa require multilateral approval;
- designed to contain 0.1 kg or more but less than 9,000 kg of UF₆ must meet the «Type B» thermal test of 800°C for 30 minutes;
- designed to contain 9,000 kg or more must either meet the thermal test requirements or have multilateral approval;

Incorporating the exemption values from the Basic Safety Standards

One of the major topics considered in the Revision Process was the incorporation of the new IAEA Basic Safety Standards (BSS) for radiation protection[1]. The BSS were revised to reflect the consensus surrounding the latest recommendations of the International Commission on Radiological Protection and the Regulations call upon the BSS as a general provision for radiological protection. Consequently, the Regulations need to take account of the revised BSS requirements. The most contentious aspect was the adoption of the exemption values given in the BSS.

The Regulations have always contained an exemption criteria which defined materials subject to their requirements. Previous editions of the Regulations defined radioactive material as any material having a specific activity greater than 70 Bq/g. The BSS, however, use a radionuclide-specific approach which leads to derived exemption values spanning seven orders of magnitude, and straddling 70 Bq/g in the case of activity concentration. The BSS also present exemption values for total activity quantities (Bq).

It was recognized that the single exemption level of 70 Bq/g has no dose basis and that it was unlikely that this level satisfied the general dose criteria of 10 μ Sv in a year for exemption for all radionuclides. A set of transport-specific scenarios were developed which reflected various exposure situations (exposure times, distances, source geometries, etc.). Based on these scenarios both activity concentration and total activity values were calculated which would result in meeting the 10 μ Sv/a value. These transport derived values were comparable to the exemption values in the BSS and resulted in recommended activity concentrations ranging from 1 to 10⁶ Bq/g. Given the difficulty in technically justifying the 70 Bq/g value and the similarity in results from the transport scenarios and the BSS scenarios, it was determined to be preferable to simply adopt the BSS derived exemption values. Consequently, the regulations contain both activity concentration and «total activity per consignment» exemption values. For mixtures of radionuclides, the «ratio rule» must be applied so that sum of the activities (or activity concentrations) present for each radionuclide divided by the applicable exemption value is less than or equal to 1.

Other changes

Other changes of interest to shippers and package designers involved in the nuclear fuel cycle include revisions to the requirements applicable to fissile materials. Fissile material exceptions (those conditions under which special packaging is not needed to account for the fissile nature of the contents) were amended and in one case now include a consignment as well as package limits. Consideration of accident conditions such as crush and the Type C test conditions were also added.

There is need to limit the accumulation of radioactive material packages during transport and to separate groups of packages from persons and film to limit radiation exposure. Additionally, it is necessary to limit the accumulation of packages of fissile material to ensure criticality safety. The Transport Index (TI) has been used for both purposes and has worked successfully but has given rise to situations where it is overly restrictive. The transport index (TI) has been simplified, now only applies for radiation protection purposes, and continues to be based on the radiation level at 1 m. A new criticality safety index (CSI) is based on the allowable number of packages that can be transported together. Separation of the two indices will allow shipments to be controlled on the basis of the specific value of concern. For example, fissile packages with low radiation levels will not have to be segregated from

persons on the basis of a high TI. Additionally, several tables in the Regulations will be simplified, since two simple rules are being substituted for the more complex combination of possible consignment make-ups. The changes introduce clarity which should enhance compliance with the regulations.

The primary purpose of displaying UN numbers on packages, and on conveyances when appropriate, is to key into emergency response procedures in a language-independent way. It was felt that an expanded set of UN numbers would support providing emergency workers with more specific response guidance.

Under the new system a UN number is assigned to each of the Schedules (which are now included in ST-1) including a set of numbers for packages containing fissile material. UN numbers are retained for uranium hexafluoride because of its importance as a commercial substance and its subsidiary (corrosive) risk. The new UN numbers will facilitate more specific emergency response procedures and help with compliance checks and controls through a numerical link with the Schedules. The tenth Edition of the UN Recommendations also includes the new UN numbers. Some UN numbers become redundant, but as none of the deleted numbers are re-used the transition process will be eased. The revised UN numbers and schedules generally have unique relationships which facilitate understanding of the package type or material being transported.

REFORMATTING OF THE UN RECOMMENDATIONS

In December 1994, the UN Committee of Experts on the Transport of Dangerous Goods recognized that reformatting the recommendations contained in the «Orange Book» into the form of «Model Regulations» annexed to a set of basic recommendations would provide certain benefits: more direct integration into all modal, national and international regulations and easier up-dating; enhanced harmonization; overall resource savings for the Governments of the Member States, the United Nations and other international organizations; improvement in the «user-friendliness» of the regulations; better identification of responsibilities in transport operations; and, improvement of compliance with the regulations, in particular in the case of multimodal operations.

It was decided to use, as a model, the structure of the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air.

The first reformatted version of the Orange Book (10th revised edition) was published in 1997. It contains the basic structure which is recommended for all national/international regulations dealing with the international carriage of dangerous goods. Additional work (e.g. including more detailed provisions to ensure that the Model Regulations can be used as comprehensive regulations for the carriage of dangerous goods) is being carried out in the present biennium (1997/1998). Parallel work on the corresponding major international instruments (i.e. IMDG Code, ICAO Technical Instructions, ADR and RID) has also started. The difference between these international instruments and the Orange Book is that they contain detailed requirements concerning the carriage of radioactive material which are based on the IAEA Transport Regulations but which are not at present included in the Orange Book.

INCORPORATION OF ST-1 PROVISIONS INTO OTHER REGULATIONS

Following the 1996 publication by the IAEA of the revised Regulations (ST-1), organizations responsible for the above instruments recognized that it would be desirable:

- to fix a uniform date for the implementation of the revised IAEA Transport Regulations through the international instruments;
- to combine the introduction of the new IAEA regulations with that of the new format, so as to avoid duplication of work.

It was thus decided that a uniform date for entry into force of the revised regulations should occur on 1 January 2001. Based on the organizations' projected schedules for revising their requirements this was the earliest date they were confident could be met. This would be possible only if all work on restructuring and on redrafting rules concerning the transport of radioactive material was finished, for all modes of transport, by the end of 1999.

In order to ensure consistent redrafting of rules concerning the international carriage of radioactive material in all modal instruments, it was suggested that IAEA and the UN Committee of Experts should cooperate in order to present the rules contained in ST-1 in a format compatible with that of the Model Regulations and to include these reformatted rules in the Model Regulations so as to obtain a comprehensive set of regulations including those relating to radioactive material.

A first draft was submitted by IAEA to the Sub-Committee of Experts on the Transport of Dangerous Goods (which reports to the Committee of Experts) in July 1997, and work is continuing with inputs from various experts and modal organizations concerned. Based on the comments received at that time additional revisions were made to «fine tune» the allocation of the ST-1 requirements into the various sections of the reformatted Model Regulations. The December 1997 meeting of the Committee of Experts provided additional input on the draft and a meeting is scheduled in March 1998 to prepare a «final» draft. This final draft will serve as the model for other organizations in their development of compatible «reformatted» regulations. In fact, the other organizations have been following the developments at the Committee of Experts very closely and have been revising their regulations in parallel.

The overall objective is to agree on a representation of ST-1 adapted to that of the Model Regulations at the latest by December 1998 so that the reformatted ST-1 provisions can be used and directly introduced by the organizations concerned into the relevant international instruments they are responsible for at the latest by the end of 1999 for entry into force on 1 January 2001.

CONCLUSION

The revised IAEA Transport Regulations are well on their way to be reflected in international instruments with a uniform effective date. The changes in the regulations include some that are sufficiently significant that consignors and carriers should plan for the necessary training/retraining of their personnel to ensure smooth transition to the new requirements.

[1] International Atomic Energy Agency, Regulations for the Safe Transport of Radioactive Material, 1996 Edition, Safe Transport No. 1, IAEA, Vienna.

[1] United Nations, Recommendations on the Transport of Dangerous Goods, Tenth Revised

Edition, UN, New York and Geneva (1997).

- [1] International Atomic Energy Agency, Schedules of Requirements for the Transport of Specified Types of Radioactive Material Consignments, As Amended 1990, Safety Series No. 80, IAEA, Vienna.
- [1] International Atomic Energy Agency, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna (1996).

SESSION 8.2

Front-End Transport

RENTON'S

Front End Transport