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World Nuclear Transport Institute

INFORMATION PAPER

Radioactive Materials Transport
The International Safety Regime

An Overview of Safety Regulations and the Organisations Responsible for their Development

Dedicated to the safe, efficient and reliable transport of radioactive materials

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This Information Paper is intended as a guide only. The official documents cited in the text must be consulted for a definitive description of their purpose and contents.

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1 Introduction

Each day thousands of shipments of radioactive material are transported on international and national routes. These consignments, which are carried by road, rail, sea, air and inland waterway, can range from smoke detectors, and cobalt sources for medical uses, to reprocessed fuel for use in electricity generation.

The transport of radioactive material worldwide is governed by a stringent regulatory regime, which includes standards, codes and regulations that have been continuously revised and updated over the past four decades. The safety measures have been developed to protect the general public, transport workers, emergency response teams and the environment against the risks posed by the cargoes. These risks include the radioactivity[1] itself and other chemical risks that the cargo may pose, such as toxicity or corrosivity. In addition to the safety regulations, the regulatory regime addresses other related issues such as physical protection and liability.

Basic regulations governing the carriage of dangerous goods in general were developed as early as the second half of the 19th century for rail, sea and inland waterway shipments. The growing number of uses to which radioactive materials were put for various peaceful purposes after the Second World War led to the conclusion that specific standards for ensuring the safety of these shipments were needed. Given that the transport of radioactive material takes place on a worldwide basis, it was recognised that these standards should provide a uniform, global regime to ensure that all parties apply the same provisions. It was agreed that the optimum way to assure universally accepted standards was to formulate them at the international level. In this way it would be possible to reach a common understanding on how to ensure the safety of radioactive material transport.

1 Hazards linked to the transport of radioactive material include:
- radiation: external exposure to ionizing radiation;
- contamination: dispersion of the radioactive contents;
- criticality: starting of an uncontrolled chain reaction in the case of fissile material;
- decay heat: emission of thermal power due to radioactive decay.

As a result, in 1959 the International Atomic Energy Agency (IAEA), established as an autonomous organization under the United Nations (UN) in 1957, was entrusted with the "drafting of recommendations on the transport of radioactive substances". In 1961 the IAEA first published its "Regulations for the Safe Transport of Radioactive Material".

Since 1961, the IAEA has published and periodically reviewed and updated the Regulations for the Safe Transport of Radioactive Material. These Regulations are used today by a majority of countries as the basis for their national regulations. In addition, the international modal organisations responsible for the safe transport of dangerous goods by road, rail, sea, air and inland waterways have incorporated the relevant parts of the IAEA Regulations into their own instruments. In September 1998 the General Conference of IAEA, which brings together all the Member States of the Agency, recognised that "compliance with regulations which take account of the Agency's Transport Regulations is providing a high level of safety during the transport of radioactive material" (Resolution GC(42)/RES/13).

This publication will outline the principal regulations that apply to the transport of radioactive material and the international organisations responsible for their development and implementation.

2 The UN Regime Governing the International Transport of Dangerous Goods

Development of Regulations Governing the Transport of Dangerous Goods including Radioactive Material

After the Second World War the increased pace of industrialisation around the world led to growth in the transport of goods classified as dangerous, including petroleum products, gases, explosives, petrochemicals, acids and radioactive material. Because of the safety-related issues linked to the intensifying international and multimodal movement of dangerous goods, in the early 1950s the Transport and Communications Commission of the United Nations Economic and Social Council[2] (ECOSOC) acknowledged a need for a uniform system of transport regulation. It was recognised that a consistent approach to regulating dangerous goods transport provided the best way of ensuring consideration of all hazards.

In April 1953, ECOSOC requested[3] the United Nations Secretary-General to appoint a committee to make a study and to present a report to the Transport and Communications Commission. This committee, which subsequently came to be known as the United Nations Committee of Experts on the Transport of Dangerous Goods (CETDG), was charged with the following tasks:

- recommending and defining groupings or classifications 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;

2 ECOSOC, established by the United Nations Charter, is placed under the authority of the General Assembly. It is responsible for promoting higher standards of living, full employment, conditions of economic and social progress and development as well as solutions to international, social, health and related problems. ECOSOC consists of 54 Members, elected for three-year terms by the General Assembly.

3 Resolution 468 G (XV) of 15 April 1953.

- recommending marks or labels for each grouping or classification, in order to identify the risk graphically and without regard to printed text; and
- recommending the simplest possible requirements for shipping papers covering dangerous goods consignments.

The original committee was composed of "not more than nine qualified experts from countries having a substantial interest in the international transport of dangerous goods" [4]. It met for the first time in 1954 and published its first recommendations in October 1956. In April 1957 ECOSOC approved the first edition of the UN Recommendations on the Transport of Dangerous Goods. These Recommendations later came to be known as the "Orange Book" because of the distinctive colour of the book's cover. The UN Orange Book established, amongst other things, a uniform, worldwide classification system for dangerous goods and a corresponding set of labelling standards.

Shortly afterwards, in 1957, the International Atomic Energy Agency (IAEA) was established. The Agency, based in Vienna, has 132 Member States which work together to fulfil the main objectives of the IAEA Statute, as defined in its Article II: "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world and to ensure, as far as it is able, that assistance provided by it, or at its request or under its supervision or control, is not used in such a way as to further any military purpose". IAEA reports on its activities annually to the UN General Assembly.

The scope of the IAEA's remit includes contributing to ensuring the safe transport of radioactive material. In July 1959, ECOSOC adopted a resolution expressing the desire that the IAEA "be entrusted with the drafting of recommendations on the transport of radioactive substances" [5], specifying that the recommendations would be consistent with the principles adopted by the UN Committee of Experts on the Transport of Dangerous Goods and would be formulated in consultation with the United Nations and the relevant specialised modal transport organisations. This request was fully consistent with Article III (A-1-6) of the IAEA Statute which authorises the Agency to carry out certain actions, and, in particular, to "establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialised agencies concerned, standards of safety for the protection of health and minimisation of danger to life and property (including such standards for labour conditions); and to provide

4 Resolution 645 G (XXIII) of 10 April 1962.

5 ECOSOC Resolution 724(XXVIII) if 17 July 1954.

for the application of these standards to its own operations as well as to the operations making use of materials, services, equipment, facilities and information made available by the Agency or at its request or under its control and supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of atomic energy."

In accordance with the ECOSOC resolution, and with the help of experts from all over the world, the IAEA compiled and published in 1961 the first edition of the Regulations for the Safe Transport of Radioactive Material. These Regulations were identified, within the IAEA system, as Safety Series No 6 (SS 6) but are now known as Safety Standard Series No. TS-R-1.

Thus, it can be seen that the safety regulations governing radioactive material transport have their origin in work carried out by the UN to develop standards covering the transport of all types of dangerous goods. With this approach it has been possible to ensure that the transport of dangerous goods, whatever their hazard class and whatever their transport mode, is carried out safely and in a consistent manner. Within this UN-based regulatory framework, IAEA has been the body responsible for developing requirements governing radioactive material transport for more than 40 years. Radioactive material is considered as one of the nine classes of dangerous goods, which are transported all over the world on a regular basis. The transport of the so-called Class 7 radioactive material, like that of the other eight classes of dangerous goods, is regulated by the international community through the organisations established by the UN in the second half of the 20th century.

The dangerous goods transport safety regime is established under the United Nations umbrella. In compliance with the ECOSOC request, IAEA works in close co-operation with the UN Committee of Experts, as well as with specialised UN agencies such as the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO) and the UN Economic Commission for Europe, responsible for the various sets of modal transport requirements.

Composition and Membership of the UN Committee of Experts on the Transport of Dangerous Goods and the Globally Harmonised System of Classification and Labelling of Chemicals

Since the inception of the UN Committee of Experts on the Transport of Dangerous Goods (CETDG), different ECOSOC resolutions have defined the criteria for participation in the Committee, i.e. the availability of expertise, the willingness of countries to make qualified experts available at their own expense, and the interest of countries in the international transport of dangerous goods. Adequate participation by developing countries is also a factor given careful consideration.

Originally, the Committee was to consist of not more than nine qualified experts made available by governments of the UN Member States and designated by the UN Secretary-General. The participating States at the Committee's first two sessions were France, India, Sweden, the United Kingdom and the United States[6] In 1975 the UN Council decided[7] to enlarge the CETDG composition by adding five members from developing countries, to ensure that such countries were adequately represented.

In 2001 ECOSOC agreed the UN Committee of Experts should be reconfigured as the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonised System of Classification and Labelling of Chemicals. Two sub-committees were established - the Sub-Committee of Experts on the Transport of Dangerous Goods (SCETDG) and the Sub-Committee of Experts on the Globally Harmonised System of Classification and Labelling of Chemicals (SCGHS).

The focus on developing a globally harmonised system (GHS) for the classification and labelling of chemicals stems from work carried out in the 1980s by the International Labour Organisation (ILO) which was developing a standardised system for hazard communication in the workplace. The issue was taken up at the UN Conference on Environment and Development, i.e. the "Earth Summit" held in Rio de Janero, in 1992 where it was decided to establish a harmonised system for the classification and identification of hazardous substances, taking into account those existing systems relevant to consumers, the workplace, transport and the environment.

6 Fifteen organisations also attended these two meetings.

7 Resolution 1973 (LIX) of 30 July 1975.

Apart from the transport sector, internationally harmonised criteria had never been established. The provision of a standard set of criteria, applicable to all needs, would result in less testing of substances, better availability of data, greater understanding and lower costs for those involved in international trade. The incorporation of health and environmental considerations into the classification system has introduced a number of criteria which are not regarded as relevant to transport. However, standardisation of environmental criteria is intended to minimise the differences which currently exist in the use of these criteria in the rules governing sea transport on the one hand and road and rail transport on the other.

Hazard communication is the last segment of GHS still to be completed. The dangerous goods transport experts are monitoring development of the new GHS hazard communication requirements to avoid any conflict with the established transport marking and labelling system as far as possible.

The GHS Sub-Committee has not involved itself in Class 7 matters and the remainder of this guide concentrates on the Sub Committee on the Transport of Dangerous of Dangerous Goods.

As of December 2005, the Sub-Committee on the Transport of Dangerous Goods comprised 26 full members[8], i.e. countries with voting status, and a further 3 countries[9] participated as observers.

The Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonised System of Classification and Labelling of Chemicals meets in December of even numbered years.

Moreover, representatives of specialised agencies, intergovernmental and non-governmental organisations participate in the sessions of the Committee and Sub-Committees.

Originally, CETDG reported to the Transport and Communications Commission of the UN ECOSOC. Today, through its Secretariat the Committee of Experts submits a biennial

8 Argentina, Australia, Austria Belgium, Brazil, Canada, China, Czech Republic, Finland France, Germany, India, Italy, Japan, Mexico, Morocco, Netherlands, Norway, Poland, Portugal Russian Federation, South Africa, Spain, Sweden, United Kingdom, and USA.

9 Bulgaria, Romania and Switzerland.

report on its work to ECOSOC, which adopts a resolution on the work of the Committee authorising publication of amended Recommendations and a future work programme.

Through these resolutions, the UN Recommendations on the Transport of Dangerous Goods, as updated by the Committee biennially, are addressed to Member States and to international organisations concerned with implementation at national and international levels.

The Sub-Committee on the Transport of Dangerous Goods is responsible for reviewing proposals from voting Member States and observers in relation to amendments to the UN Recommendations and issues relevant to its work programme. The Sub-Committee meets on a half-yearly basis, i.e. generally in July and December, and it reports to the Main Committee.

The UN Economic Commission for Europe (UNECE) provides secretarial services for the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonised System of Classification and Labelling of Chemicals.

UN Recommendations - Status and Future Development

The UN Sub-Committee of Experts on the Transport of Dangerous Goods updates and amends the UN Recommendations every two years. This biennial revision cycle allows the Experts to keep the Orange Book up to date with the latest developments in dangerous goods transport. The 14th revised edition, published in 2005, is the version which is currently applicable, while the 15th edition will be agreed in December 2006 and is scheduled for publishing in 2007.

The UN Recommendations only apply to "packaged" dangerous goods, i.e. ranging from small combination packagings, drums and intermediate bulk containers up to and including portable tanks, bulk containers, and railway wagons. By including reference to the IAEA Transport Regulations, the UN Recommendations also embrace a wide variety of packagings and containers used to transport radioactive material. The Recommendations do not apply to the transport of dangerous goods in bulk in ships or inland waterway vessels, which is the subject of other specialist sets of international maritime regulations, depending on the cargo being carried.

The UN Recommendations apply to all modes of transport and have been developed with the aim of preventing injury or harm to persons and damage to the environment and

property. SCETDG develop recommendations in the light of technical advances, the emergence of new substances and materials, the exigencies of modern transport systems and, above all, the requirement to ensure the safety of people, property and the environment.

The UN Recommendations have been developed for use not only by those bodies responsible for administering the key agreements and conventions governing the international transport of dangerous goods by different modes but also by governments as a basis for their national requirements covering domestic movements of dangerous goods. By providing a basic set of standards in this way, national and international regulations covering all modes of transport can be developed in a uniform fashion. At the same time, the Recommendations remain flexible enough to accommodate any special modal requirements that might have to be met.

The major international instruments which have worldwide or regional application, and which have implemented the UN Recommendations, include the following:

- International Maritime Dangerous Goods (IMDG) Code published by the International Maritime Organization (IMO);
- International Civil Aviation Organization (ICAO) Technical Instructions;
- ADR Agreement concerning the International Carriage of Dangerous Goods by Road;
- RID Regulations concerning the International Carriage of Dangerous Goods by Rail[10];
- ADN Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways;
- MERCOSUR/MERCOSUL[11] Agreement of Partial Reach to Facilitate the Transport of Dangerous Goods (signed by Brazil, Argentina, Paraguay and Uruguay); and
- ASEAN[12] agreement to establish dangerous goods transport rules on the basis of the Recommendations and ADR.

10 Under a series of "Framework Directives", agreed by the Member States in the 1990s, the RID and ADR rules for the rail and road transport of dangerous goods, including radioactive material, have been applied to domestic transport within the countries of the European Union (EU). The Directives permit Member States to implement the regulations therein in their own way and therefore offer an element of flexibility. In addition, a small number of national "derogations" have been agreed to allow for particular circumstances. Thus surface transport throughout the EU reflects very largely the UN Recommendations.

11 Mercado Comun del Sur(Spanish)/Mercado Comum do sul (Portugese): Southern American common market created by the 1991 Treaty of Asuncio, signed by Argentina, Brazil, Paraguay and Uruguay.

12 The Association of South Eastern Nations – Brunei Durassalam, Cambodia, Indonesia, Laos, Malaysia, Myanamar, Phillipines, Singapore Thailand and Vietnam.

The USA and Canada have applied most of the UN Recommendations for many years and now through the NAFTA [13] agreements are discussing common rules with Mexico on the basis of the UN Recommendations.

The UN Recommendations are relatively well implemented in individual countries through national legislation governing domestic traffic. National legislation for sea and air transport is based on the IMDG Code and the ICAO Technical Instructions respectively, and, as such, is consistent with the UN Recommendations. Dating back many years, several countries developed their own specific regulations dealing with the domestic overland transport of dangerous goods. More recently, however, these governments have progressively adapted their own systems to the UN system and national regulations for road and rail transport in most countries are now based on the UN Recommendations.

The UN system ensures compatibility between the international modes of transport so that a consignment may be carried by more than one mode without intermediate reclassification and repacking. The modal authorities listed above do introduce modifications to the basic UN system to take account of the peculiarities of the particular mode of transport. However, the overall need to ensure modal compatibility is a guiding principle, and additional provisions peculiar to one mode of transport should only be included where necessary. However a number of discrepancies continue to exist and the will to address them multimodally is not always found at the "expert" level, whatever may have been agreed diplomatically.

Content

The safety regime governing dangerous goods transport has been established by taking into account the hazards that these goods present during transport. From the outset it was recognised that some form of generic grouping by physical and/or chemical properties was needed for purposes of identification, packaging, labelling and documentation. Therefore, the UN Committee of Experts developed a nine-class substance identification and classification system based on hazardous properties [14].

13 North American Free Trade Area (Canada, Mexico and the USA)

14 Class 1: Explosives; Class 2: Gases; Class 3: Flammable Liquids; Class 4: Flammable solids, substances liable to spontaneous combustion and substances which in contact with water emit flammable gases; Class 5: Oxidising substances and organic peroxides; Class 6: Toxic and infectious substances; Class 7: Radioactive material; Class 8: Corrosive substances; and Class 9: Miscellaneous dangerous substances and articles.

As mentioned, radioactive material has been allocated to Class 7. The original mandate of the Committee of Experts, as laid down in 1953, has been enlarged over the years. Today, the Recommendations address the following aspects:

- the list of dangerous goods most commonly carried and their identification and classification;
- consignment procedures: labelling, marking, placarding and transport documents;
- standards for packaging, test procedures and certification; and
- standards for portable tanks (multimodal tank containers), tests procedures and certification.

In addition, the Manual of Tests and Criteria, which supplements the UN Recommendations and was published for the first time in 1985, provides the UN schemes for the classification of certain types of dangerous goods and describes the test methods and procedures considered to be the most useful to provide competent authorities with the necessary information to arrive at a proper classification of substances and articles for transport. In the main this still relates to Classes 1 and 5.2 but the scope has been widened to cover, for example aerosols and lithium batteries. The current Fourth Revised Edition of the Manual was published in 2003.

For radioactive material, the UN Recommendations 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 contained some requirements which referred to the IAEA Regulations. As part of the process of reformatting of the Recommendations, the 10th revised Edition (1997) included a direct reference to some IAEA paragraphs, while since the 11th revised edition (1999) the IAEA provisions have been fully integrated into the Recommendations. As a result, the IAEA Regulations are now not only a freestanding document but also part of the UN Orange Book.

The Reformatted UN Recommendations (the UN Model Regulations)

Although the basic provisions for the safe carriage of dangerous goods given in the UN Recommendations provide a uniform basis for the development of harmonised regulations for all modes of transport, not all the modal requirements were aligned in the past. The regulations laid down in the RID and ADR regimes have their origins in rules developed a century ago for rail movements of dangerous goods in Europe. Similarly, the sea transport rules included in the first edition of the IMDG Code owed much to the pioneering work

done by the United Kingdom in the 1920s and 1930s in developing its Report of the Standing Advisory Committee on the Carriage of Dangerous Goods in Ships, commonly known as the "Blue Book".

The different structures of these modal regulations have traditionally required consignors of dangerous goods to be familiar with the various sets of applicable provisions.

Throughout the 1980s and 1990s, as multimodal transport became more commonplace, much of the revision work on the various sets of modal dangerous goods rules was centred on ironing out the differences between them and bringing the rules into alignment as much as possible. During the early 1990s it was accepted that one final effort was required to achieve the optimum degree of rule harmonisation and that, as part of this exercise, it would be necessary to reformat the UN Recommendations. In this way, not only would the groundwork required for full international harmonisation of the various dangerous goods requirements be provided, but also the process of assimilating amendments to the UN Recommendations into the modal regulations would be greatly facilitated. In parallel with this exercise, it would also be necessary to restructure the RID and ADR regulations governing the transport of dangerous goods by rail and road, respectively, in Europe and the surrounding regions, and to reformat the IMDG Code governing the sea transport of dangerous goods.

Following decisions in 1993 to move ahead with the RID/ADR restructuring work and in 1994 for reformatting the IMDG Code, the UN Economic and Social Council passed a resolution [15] in July 1995 endorsing the Committee of Experts' view that the UN Recommendations should be reformatted into the form of Model Regulations. The aim was to provide a set of UN Model Regulations which could be directly integrated into all national and international dangerous goods regulations, irrespective of the mode of transport.

In order to reformat the UN Recommendations into Model Regulations, it was decided that the non-regulatory provisions, i.e. the Foreword and parts of Chapter 1 [16], would provide the introductory text of the new UN Recommendations. Furthermore, this introduction would recommend that each international organisation and each national authority should

15 Resolution 1995/5 of 19 July 1995.

16 Chapter 1 deals with the "Scope of the Recommendations".

adopt dangerous goods transport regulations consistent with the Model Regulations provided in the annex. The annex itself would contain those parts of the previous Recommendations which form the basis for transport requirements.

When the decision was taken to reformat the UN requirements into Model Regulations, it was anticipated that governments, intergovernmental organisations and other international organisations revising or developing regulations for which they are responsible would continue to conform with the principles laid down by the UN Committee of Experts, while following the new structure, format and content of the Model Regulations to the greatest extent possible. In this way the new UN Model Regulations would enhance international harmonisation by creating a more user-friendly approach, facilitating the work of enforcement bodies and reducing the administrative burden.

At the start of the reformatting work it was decided to take as a model the structure of the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air and to conduct the work in two steps. The ICAO Technical Instructions were chosen because these rules are the most recent set of modal dangerous goods rules to be developed. They were based closely on the UN Recommendations and were not encumbered by the long history and tradition of the other modal rules. The first step of the reformatting work was completed in 1997 when the first reformatted version of the UN Recommendations, i.e. the 10th revised edition, was published.

When the 10th revised edition appeared, it was widely acknowledged that the scope of these new Model Regulations should ensure their value for all those concerned with the transport of dangerous goods, either directly or indirectly. Among other aspects, the Regulations cover the principles of classification and a definition of classes; a listing of the principal dangerous goods; general packing requirements; package testing procedures; marking, labelling and placarding; and transport documents. There are also special requirements dealing with particular classes of goods.

The appearance of the 10th revised edition of the Orange Book, however, was only the first step in the process. During the 1997-98 biennium further work was done by CETDG to include additional regulatory requirements, such as packing instructions, tank instructions and further detailed provisions to enable the Orange Book to fulfil its role as a set of Model Regulations. One of the main tasks in this second phase of the reformatting

work was the inclusion, in co-operation with the IAEA, of detailed provisions for the transport of radioactive material. This required adapting the provisions contained in the 1996 Edition of the IAEA Regulations to the format of the Model Regulations annexed to the UN Recommendations. During this work the following three objectives had to be kept in mind:

- the IAEA Regulations should be fully reflected in the Model Regulations;
- the best location for the IAEA requirements in the Model Regulations should be identified; and
- any proposal to delete or amend texts taken from the IAEA Regulations should be justified.

Throughout the three biennial cycles from 1999-2004 and into the current 2005-2006, CETDG forged ahead with developing and consolidating its recommended Model Regulations, editing inconsistencies, filling gaps and adding new work. Major subjects included infectious substances, bulk containers, substances with both liquid and solid forms and limited quantities. This last subject has really seen little progress but it remains on the work programme.

Throughout this period, the integration of the IAEA Regulations for the Safe Transport of Radioactive Material was completed, refined and updated in the 12th, 13th and 14th published editions. The 15th revised edition that will embody CETDG work to be agreed in December 2006, and subsequently approved by ECOSOC resolution will be published in the summer of 2007 and will fully reflect the 2005 edition of IAEA Safety Requirements TS-R-1.

The 15th edition of the Recommendations is expected to see the beginning of a major editorial exercise on the Class 7 text. This has come about because:

- the text inserted in the 11th revised edition was taken directly from the IAEA Transport Regulations on an interim basis, and
- it has become clear that the current position of some of the text is not in the same place as it is for other classes (e.g. the classification chapter deals with some packaging and some transport operational provisions).

3 The IAEA Regulations for the Safe Transport of Radioactive Material

International Atomic Energy Agency (IAEA)

The International Atomic Energy Agency (IAEA) was established in 1957, a few years after US President Eisenhower proposed the creation of an international atomic energy agency in his historic Atoms for Peace speech before the UN General Assembly. The IAEA is responsible for accelerating and enlarging the contribution of atomic energy to peace, health and prosperity throughout the world. The IAEA Secretariat is responsible for all the programmes and activities approved by the IAEA's policymaking bodies, i.e. the General Conference and the Board of Governors.

The General Conference is composed of representatives of the Agency's entire membership of Member States and meets annually to consider, inter alia, the Board of Governors Report, approve the accounts, programme and budget, and any applications for membership. The Board of Governors has 35 members, of which 13 are designated by the Board and 22 are elected by the General Conference. Generally, the Board meets five times a year. It approves safeguards agreements and the publication of IAEA Safety Standards Series documents[17].

The IAEA Director General, who is the Agency's chief administrative officer, is appointed for a term of four years and heads the Secretariat. He is assisted by six Deputy Director Generals heading six separate departments - Technical Co-operation, Nuclear Energy, Nuclear Safety, Nuclear Sciences and Applications, Safeguards, and Management.

The Nuclear Safety Department was created in January 1996 with the specific responsibility of organising the preparation and review of the IAEA's safety standards. IAEA work on the

17 The publications by which IAEA establishes standards under Article III of its Statute are issued in the Safety Standards Series, which covers nuclear safety, radiation safety, transport safety, waste safety and general safety. The publication categories in the series are Safety Fundamentals, Safety Requirements and Safety Guides.

transport of radioactive material is carried out within this Department by the Transport Safety Unit[18]. The Transport Safety Unit is one of five units of the Radiation Safety Section, within the Division of Radiation and Waste Safety.

Status, Objectives, Scope and Guiding Philosophy of the IAEA Transport Regulations

In accordance with the 1959 ECOSOC Resolution, and with the help of experts worldwide, the IAEA published the first edition of the Regulations for the Safe Transport of Radioactive Material, Safety Series No 6 (SS 6) in 1961. This edition noted that the increasing amounts of radioactive material, including for use in the medical and engineering fields, in scientific research and for the generation of electricity, were being transported, and that this transport required specific procedures because of the hazards involved. The 1961 Edition of SS 6 pointed out that the necessary procedures to be complied with should apply to any mode of transport, and that they should not be too complex.

The IAEA Regulations establish standards of safety which provide an acceptable level of control over the hazards to persons, property and the environment posed by the transport of radioactive material. Since the 1961 Edition, the Regulations have been revised several times, but their status, objectives, scope and guiding philosophy remain unchanged.

Status

In approving the first revision to the SS 6 Regulations in 1964, the IAEA Board of Governors authorised the Director General to apply the Regulations to both the IAEA's own operations, including the transport of radioactive material to and from its research centres, and the IAEA's assisted field operations. The Director General was also authorised to invite Member States and international organisations to adopt the Regulations as the basis for controlling the transport of dangerous goods within their own national and international regulatory regimes governing the carriage of dangerous goods. By 1969 the Regulations had been adopted by almost all the international modal transport organisations and were also being used by many Member States as the basis for their domestic regulations. Today more than 60 Member States, including all major shipping and nuclear power generating countries, implement the IAEA Transport Regulations as the basis for their national regulations.

18 Prior to 1996, the Transport Safety Unit was part of the Nuclear Energy Department.

Scope

The IAEA Regulations apply to the transport of radioactive material [19] by all modes, including transport which is incidental to the use of the radioactive material. Transport comprises all operations and conditions associated with and involved in the movement of radioactive material, including the design, manufacture, maintenance and repair of packaging [20]; the preparation, consignment, loading and carriage, including in-transit storage; and the unloading and receipt at final destination of loads of radioactive material and packages. A graded approach is applied to the performance standards in the IAEA Regulations, characterised by the following three general severity levels:

- routine conditions of transport (in incident-free conditions);
- normal conditions of transport (including minor mishaps); and
- accident conditions of transport.

The IAEA Regulations address all categories of radioactive material, whatever their form or hazard and whatever their application. The scope of the provisions also encompasses both domestic and international movements. Shipments of radioactive material may cross national boundaries and involve international and multimodal transport operations. The same high level of protection should apply in all countries concerned, allowing unimpeded movement of compliant shipments.

Philosophy

The philosophy which has guided the development of the IAEA Regulations is that radioactive material being shipped should be adequately packaged to provide protection against the hazards of the material under all conditions of transport, including accident conditions. It is considered that, as far as possible, the following conditions are met:

- safety is vested in the design of the package; this, combined with simple operational controls, ensures safety;

19 Until the 1996 edition, the IAEA regulations defined radioactive material as "any material having a specific activity greater than 70Bq/kg". This definition does not specify a quantity, but only an activity concentration. Below this activity concentration, materials were not considered to be radioactive for purposes of transport. This limit aimed at avoiding bringing within the scope of the Regulations many substances, often naturally occurring, which contain in significant amounts of radioactivity, and which, if transported, pose no significant hazard. The 1996 Edition of the regulations has introduced new derived exemption values form the IAEA Basic Safety Standards (BSS). BSS use both activity concentration and total activity per consignment exemption values.

20 The "packaging" is the assembly of components necessary to enclose completely the radioactive contents. The "package" designates the packaging with its radioactive contents as presented for transport.

- the consignor bears most responsibility for ensuring transport safety, as the consignor prepares the package for transport (the IAEA Regulations also contain minimum requirements for the carrier); and
- packages of radioactive material should be dealt with in the same way as other dangerous goods consignments.

Objectives and Principles

The main objective of the IAEA Regulations is to protect persons, including the general public and transport workers, property and the environment from the direct or indirect effects of radiation during transport. The Regulations, therefore, provide appropriate levels of protection against the following risks:

- dispersion of radioactive material during normal transport, and also in the event of an accident;
- hazards due to radiation emanating from the package, i.e. the packaging with its radioactive material contents;
- the possibility that a chain reaction, i.e. criticality, could be initiated in packages containing fissile material; and
- hazards of high temperature (accessible hot package surfaces) resulting from decay heat.

Under the IAEA Regulations, this level of protection is achieved by the following measures:

- ensuring that the containment of radioactive material in a packaging is adequate to prevent the loss or dispersal of harmful amounts of radioactive material. The design and strength of the packaging and the activity and nature of its contents are all considered in satisfying this objective;
- controlling the external radiation level by incorporating shielding into the packaging and by providing warning of the level of radiation which exists external to a loaded packaging. The maximum radiation level external to the package, its labelling and its marking, and requirements for stowage are all considered in satisfying these objectives;
- controlling configurations of packages and their contents such that, if the contents are fissile, criticality control is provided. For that purpose, the packaging and its contents are treated in a very conservative fashion, and control is provided through design and the use of the criticality safety index; and,
- preventing excessive surface temperatures or damage to the packaging as a result of heat generated, both internally (decay heat) and externally (such as solar radiation). The maximum temperature of the package is controlled through proper design and instructions on stowage to provide for safe dissipation of heat.

All these functions are ensured by applying a graded approach to content limits for packagings and conveyances, and to performance standards applied to the package designs, depending upon the hazards of the radioactive contents. Requirements for the design and operation of packages and on the maintenance of packaging, including a consideration of the nature of the radioactive contents, are imposed, while administrative controls, including, where appropriate, the approval of Competent Authorities, are required.

The safety of radioactive material transport is assured when the IAEA Regulations are complied with, and confidence is achieved through quality and compliance assurance programmes. The IAEA Regulations prescribe certain actions; they do not assign the responsibility for carrying them out. It is considered to be the prerogative of each government to assign this responsibility.

IAEA Transport Regulations Revision Cycle

While it was expected that the basic principles and the philosophy of the IAEA Regulations would remain acceptable for a long period, the Agency was also mindful that revisions would be necessary to keep abreast of scientific and technological developments.

Since the first edition appeared in 1961, the IAEA Regulations have been revised several times. During the early years the IAEA concluded that a "feedback" of experience gained in applying the rules would be encouraged by a revision of the Regulations after approximately five years. As a result, three comprehensive revisions of the IAEA Regulations were published in 1964, 1967 and 1973.

Creation of SAGSTRAM

In 1978 the Agency decided that it needed a specialist body to advise on both the IAEA transport programme and the development and implementation of the IAEA Transport Regulations. A Standing Advisory Group on the Safe Transport of Radioactive Material (SAGSTRAM) was established, composed of representatives from the competent authorities of the Member States. The IAEA Director General was responsible for appointing the Group's members. In October 1978 the first SAGSTRAM meeting recommended that a further comprehensive revision of the IAEA Regulations should be undertaken. Following this recommendation, the Secretariat initiated a review process in 1979 which culminated in the 1985 Edition of the Regulations.

The Continuous Regulatory Review Procedure, 1985-1996

Twelve years had passed between the 1973 and the 1985 Editions of the IAEA Regulations, and the experience of developing the 1985 Edition revealed that delaying the review process too long could result in an onerous workload for the Agency. Accordingly, in 1986 SAGSTRAM recommended that the Agency should adopt procedures to ensure that future regulatory revisions proceed on a more continuous and structured basis.
The concept of the "continuous regulatory review procedure" was born.

This new procedure was based on a 10-year revision cycle aimed at providing stability and allowing sufficient time to address major issues. However, in view of the experience gained during the previous revision, it was decided to address specific changes by taking account of their particular nature. As a result, the following criteria governing the timing of the key publications were adopted (see Table 1):

- minor changes and changes of detail (provided Member States acceptance was determined after a comment period of 90 days) agreed by a Review Panel should be published in the form of Supplements to the Transport Regulations before the end of the 10-year revision cycle; and
- major changes, approved by the Board of Governors, would be published at the end of the 10-year cycle.

Table 1 – The Earlier 10-year Cycle of the Continuous Review/Revision Process

Year	Event
0	Major revision and publication of the Transport Regulations
2	Publication of supplements
4	Publication of further supplements
5-6	Reprints of all documents including all changes
10	Major revision and publication of the Transport Regulations

This continuous process allowed proposals for amendments to be considered in a more timely fashion, and provided Member States and international organisations with an opportunity to comment on regulatory proposals at an early stage. It also permitted the allocation of resources for the recommended activities.

The 10-year cycle process led to the 1996 Edition of the Regulations for the Safe Transport of Radioactive Material, Safety Standards No 1 (ST-1). When approving this Edition, the IAEA Board of Governors once again observed the need to continue working on review and revision cycles. Indeed, even though the 10-year process included good participation by Member States and international organisations, it was realised that the system could be improved still further. The cycle of revisions, in particular, appeared to place obstacles in the way of not only completing the work on all major issues by a set deadline but also addressing all the issues accumulated during the 10-year cycle. It was recognised that there was a need to re-evaluate the overall revision process and to try to improve the sequencing, timing and type of meetings. Attendant on this effort would be the need to reassess the related operating procedures relating to the submissions of papers, deadlines, etc, and the criteria for regulatory development.

Creation of the Advisory Commission on Safety Standards (ACSS) and the Safety Standards Advisory Committees

On January 1, 1996 the Agency created the Advisory Commission on Safety Standards (ACSS) together with four Safety Standards Advisory Committees, namely:

- the Nuclear Safety Standards Advisory Committee (NUSSAC);
- the Radiation Safety Standards Advisory Committee (RASSAC);
- the Waste Safety Standards Advisory Committee (WASSAC); and
- the Transport Safety Standards Advisory Committee (TRANSSAC).

The ACSS is a standing body of senior government officials holding national responsibilities for establishing standards and other regulatory documents relevant to nuclear, radiation waste and transport safety. The ACSS has a special overview role with regard to the Agency's safety standards and provides advice to the Director General on the overall safety standards-related programme. Its functions were defined as:

- to provide guidance on the approach and strategy for establishing the Agency's safety standards, particularly in order to ensure coherence and consistency between standards;

- to resolve outstanding issues referred to it by the committees involved in the Agency's preparation and review process for safety standards;
- to endorse, in accordance with the Agency's preparation and review process for safety standards, the texts of the Safety Fundamentals and Safety Requirements to be submitted to the Board of Governors for approval and to determine the suitability of Safety Guides to be issued under the authority of the Director General; and
- to provide general advice and guidance on safety standards issues, relevant regulatory issues and the Agency's safety standards activities and related programmes, including those for promoting the worldwide application of the standards.

With the establishment of the ACSS new uniform procedures were introduced for the preparation and review of safety standards across the four areas of nuclear, radiation, waste and transport safety. This preparation and review process involves in particular: organising expert group meetings whenever necessary;

- at different document preparation stages arranging for an internal review of each draft text by the Safety Series Review Committee;
- submitting documents to the relevant advisory committees for review;
- submitting draft texts to the Agency's Member States for comment;
- obtaining the Publication Committee's approval of each document in order to ensure compliance with the Agency's publication policy;
- submitting the Fundamentals and Standards to the Board of Governors for approval after endorsement by the Advisory Commission for Safety Standards (ACSS); and
- submitting the Guides and Practices to the Director General for Approval.

These changes thus introduced new steps in the process whereby a new safety standards series document could be produced and new steps in the process whereby existing safety standards documents could be reviewed and amended.

The Transport Safety Standards Advisory Committee (TRANSSAC) effectively replaced SAGSTRAM. It too was created as a standing body of senior regulatory officials with technical expertise in radioactive material transport safety. TRANSSAC members were initially appointed for a three year term by the IAEA Director General on the basis of recommendations from the Transport Safety Unit, the Division of Radiation and Waste Safety and the Department of Nuclear Safety. In common with the other three safety advisory committees membership was initially limited. 18 Member States were represented at its initial meetings together with a small number of international organisations.

TRANSSAC's terms of reference required it to meet ordinarily once a year for up to five working days.

The functions of TRANSSAC were defined as:

- to recommend the terms of reference of all standards in the Agency's radioactive materials transport safety standards programme and of the groups involved in the development and revision of those standards, in order to promote coherence and consistency among the standards and between them and the other safety related publications of the Agency;
- to agree on the texts of Safety Fundamentals and Safety Requirements to be submitted to the Board of Governors for approval and of Safety Guides to be issued under the authority of the Director General, and to make recommendations to the CSS, in accordance with the preparation and review process for safety standards;
- to provide advice and guidance on a continuous programme for reviewing and revising the Agency's radioactive materials transport safety standards
- to provide advice and guidance on radioactive materials transport standards, relevant regulatory issues, and activities for supporting the application of the transport safety standards; and
- to identify and advise on any necessary activities in support of the transport safety programme.

By its second three year term (1999-2001) a number of Agency Member States had requested to participate and TRANSSAC Members States for the term grew to 25 Member States[21]. Others attending in observer capacity included the European Commission (EC), the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA), the International Federation of Air Line Pilots' Associations (IFALPA), the International Maritime Organization (IMO) and the International Organization for Standardisation (ISO) and the World Nuclear Transport Institute (WNTI).

In June 2000 the Agency renamed the Advisory Commission on Safety Standards and the four Safety Standards Committees by removing the word "Advisory" from their titles. The restriction on membership was also lifted enabling any Member State to participate in the work of the Committees.

21 Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Egypt, France, Germany, Hungary, India, Israel, Italy, Japan, Netherlands, Poland, Russian Federation, South Africa, Spain, Sweden, Switzerland, Turkey, the UK and the USA.

Development of the Two-year Review/Revision Cycle

During its first meeting in February 1996, TRANSSAC decided that, in accordance with the Board of Governors' observations, and as a consequence of the protracted timescales implied by the introduction of the Advisory Commission on Safety Standards, recommendations on improving or modifying the review and revision process for the IAEA Transport Regulations should be prepared. A Consultant Services Meeting [22] (CSM) and two Technical Committee Meetings [23] (TCM) developed recommendations for an improved review and revision process, which was, in common with the processes used by the modal transport authorities and the Committee of Experts on the Transport of Dangerous Goods, based upon a two-year cycle. TRANSSAC IV approved this new review/revision process in April 1999 and recommended that it be initiated at the next available opportunity, i.e. in 2000.

The adoption of a two-year review/revision cycle for the IAEA Regulations represents a major change compared to the previous review and revision process. The two-year cycle offers the following significant advantages over the earlier 10-year cycle:

- a major change does not have to wait up to 10 years if it is not ready at the time when approval for publication is recommended; it can enter a revised edition at any two-year interval;
- it prevents accumulation of minor changes and changes of detail; and
- it is more in line with the revision processes of the other international dangerous goods transport regulations [24].

The new review/revision cycle does not require that a new issue should be resolved within two years. Rather, an issue, once it has been resolved, can be included in the Regulations less than two years after the solution has been accepted. In other words, the two-year cycle provides an opportunity to revise the IAEA Regulations every two years, but does not lay down an obligation to do so.

22 Consultant Services Meetings consists of small groups of experts (generally less than ~ 6 people) essentially designated by the Transport Safety Unit, the Division of Radiation and Waste Safety, and the Department of Nuclear Safety. CSM's are arranged ad-hoc and e.g. typically take place before or after a TCM, to prepare material for the meeting or to make a summary of it.

23 Technical Committee Meetings are larger groups (between fifteen and fifty persons) than CSMs. The participation generally is based on nominations by participating Member States and international organisations.

24 Since the UN Recommendations on the Transport of Dangerous Goods are revised every two years, many international and regional regulations on dangerous goods transport follow this revision cycle.

A two-year cycle will help to keep the Regulations up to date, while providing for flexibility with regard to any major change. Also, it is in line with the revision cycles for other international dangerous goods transport regulations. In particular, following the decision of the IAEA and the UN Committee of Experts to incorporate the IAEA Regulations into the 11th Edition of the UN Committee of Experts Recommendations in 1999, it facilitates the timely implementation of any necessary changes to the legally binding international modal instruments, which closely follow the UN Recommendations.

Review and Revision Procedure
The First Revisions: 1964, 1967, 1973

The first three comprehensive revisions of the IAEA Regulations, in 1964, 1967 and 1973, were carried out in a similar fashion. They relied on the key involvement of Member States and international organisations, proposals from which were co-ordinated by the IAEA Secretariat. The drafting process was then entrusted to panels of experts composed of members representing an extensive coverage of Member States and international organisations. These experts all possessed wide experience of the various administrative and technical problems requiring a solution. Drafts of new and revised texts were forwarded to Member States and international organisations for comment, leading to the preparation of a final draft for approval by the IAEA Board of Governors.

SAGSTRAM supervised the review and revision process between 1979 and 1985. The same process was used again, with specific topics examined by Consultant Services Meetings (CSM) and Technical Committee Meetings (TCM). A total of 150 experts from 22 Member States and 12 international organisations were involved. SAGSTRAM made minor changes and endorsed the text for the 1985 Edition, which was approved by the IAEA Board of Governors in late 1984.

Procedural Improvements - The Revision Process for the 1985 Edition

Soon after publication it became apparent that there were minor errors and omissions in the 1985 Edition of the IAEA Regulations. Most were presentation or translation mistakes. Changes of detail were required, and the work carried out on these changes provided a good opportunity to consider once again the revision process. A panel was convened to address minor changes[25], and its recommendations were endorsed directly by SAGSTRAM

25 Minor changes are limited to essentially to editorial corrections of typing errors, spelling mistakes and translation corrections.

in 1986. For changes of detail[26], a panel prepared proposals for submission to Member States under the 90-day amendment rule[27]. The detailed changes proposed by the panel received full support and were published after endorsement by SAGSTRAM in 1986.

This system was institutionalised in the following years with the implementation of the continuous review/revision procedure. SAGSTRAM recommended that a Review Panel for minor changes and changes of detail should be established and that it should meet every two years. Minor changes agreed by the Panel could be included directly in the Supplements, whereas changes of detail should also be published in the form of Supplements in accordance with the 90-day amendment rule. This process led to the 1988 Supplement and the "As Amended 1990" Edition.

Revision Process for the 1996 Edition and 1996 (Revised) Edition

Beginning in 1991, the Agency undertook a comprehensive review of its Transport Regulations, began to consider major changes[28], and convened a Revision Panel to produce drafts on the basis of proposals from Member States and international organisations. Once again, multiple drafts were distributed for comment until a final draft was produced. Two Revision Panel meetings and four Review Panel meetings[29] were convened in order to publish the comprehensively revised 1996 Edition of the IAEA Regulations. More than 400 proposals for changes were submitted by over 30 countries[30] and 10 international organisations[31].

In line with the introduction of the ACSS and new categorisation of its safety documents, the 1996 Edition became the first publication in the new "Safe Transport" category, coded "ST" and, accordingly, was numbered No. ST-1. It was issued as a "Requirements"

26 Changes of detail are limited to changes in the text but only in so far as to make a previously agreed meaning or intention of a provision clearer or more readily interpretable, or to correct minor errors.

27 This rule allows changes which receive no objection within 90 days to be made without further consultation.

28 Major changes include all changes that do not qualify as either minor changes or change of detail.

29 Revision and Review Panels were appointed by the Transport Safety Unit and the Department of Nuclear Energy. The Review Panel Meetings took place in June 1987 and July 1989, and the Revision Panel Meetings were convened in June 1991, May 1993, October 1994 and September 1995.

30 Member states directly participating included: Argentina, Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Egypt, France, Germany, Hungary, India, Israel, Italy, Japan, Netherlands, New Zealand, Poland, Russian Federation, South Africa, Spain, Sweden, Switzerland, United Kingdom and the United States.

31 Principally the International Maritime Organization, the UN Economic and Social Council, the International Air Transport Organization, the International Organization for Standardization, the International Federation of Air Line Pilots Associations and the International Commission on Radiological Protection.

document within the IAEA Safety Standards Series, i.e. it is of a regulatory nature, stating what "shall" be achieved in order to ensure safety.

Further review identified a number of minor editorial and other errors in the 1996 Edition. Corrections to these were issued initially by means of an errata sheet, followed in 2000 by publication of an updated version of the 1996 Edition of the Transport Regulations, incorporating the corrected text, and subtitled "1996 Edition (Revised)". In line with the latest thinking of the Secretariat and the ACSS on coding documents[32] at the time, but also recognising the previous coding, this edition carried the number "TS-R-1 (ST-1, Revised)".

The IAEA has adapted itself to the various types of changes by instituting different procedures for revisions according to their nature. This variable speed approval eases the procedure by dealing quickly with changes where there are no special problems and avoids situations in which Member States and international organisations are consulted endlessly on subjects of minor importance.

Review and Revision Procedure Post 2000

As noted above, in 1999 TRANSSAC endorsed a new revision and review procedure which features a two-year cycle. This new procedure is part of a broader movement involving not just the IAEA Transport Safety Unit but the entire Agency. Beginning in 1996, the Agency has been formalising a uniform preparation and review process covering all areas in which it establishes safety standards, as part of a major expansion of the Agency's safety-related activities, under the guidance of the Advisory Commission on Safety Standards. The original hierarchical structure for IAEA Safety Series publications, comprising Fundamentals, Standards, Guides and Practices[33] would be replaced by the Safety Standards Series. This category comprises those documents issued pursuant to Article III.A.6 of the IAEA Statute[34] and covers radiation safety, transport safety, nuclear safety, waste safety and general safety.

32 Documents were coded "WS", "NS", "RS", "TS" or "GS" representing, respectively, waste safety, nuclear safety, radiation safety, transport safety and general safety. The letter "R" or "G" following the first hyphen represents "requirements" or "guide" respectively and finally a number designates a serial number of the document (decimal numbers are used when several guides are to be associated with a particular requirements document).

33 From 1978 until 1995, the various publications in the Safety Series were divided into four categories as follows; IAEA Safety Standards, IAEA Safety Guides, Recommendations, and Procedures and Data.

34 Under Article IIIA.6 of its Statute, the IAEA is authorised to establish or adopt standards of safety in collaboration with the competent organs of the United Nations and with the specialised agencies concerned, and since soon after the Agency's inception the Secretariat has been involved in developing and setting such standards.

The Safety Standards Series documents fall into three sub-categories - Safety Fundamentals [35], Safety Requirements [36] and Safety Guides [37].

The Agency would also provide for the application of the standards, in accordance with Articles III and VIII.C of its statute, in other safety related publications including e.g. the Safety Reports Series [38].

The two-year cycle review/revision process of the IAEA Transport Regulations has been implemented three times: during 2000/2001, culminating in publication of the "1996 Edition (As Amended 2003)"; in 2002/2003, leading to publication of the "2005 Edition"; and in 2004/2005 leading to a further draft amended document. Whilst the product of the first cycle was seriously delayed (the 1996 Edition (As Amended 2003) was not actually published until 2004), during each of the following two cycles TRANSSC took steps to simplify and streamline the processes to ensure the timely availability of the revised draft documents. At the end of the first two review/revision cycles, TRANSSC carefully considered whether the agreed amendments were of sufficient importance to warrant going ahead to produce a new publication or whether the agreed changes could be held in abeyance for publication in a future cycle. In both cases TRANSSC strongly supported publication and, following endorsement by the CSS and approval by the Board of Governors, publication went ahead. However, in 2006 at its twelfth meeting, TRANSSC decided not to recommend publication of a 2007 edition following completion of the third two-year cycle. TRANSSC XII also confirmed amendments to the two-year review/revision process, as had been discussed and preliminarily agreed at its previous meeting, which include completing an early review of the need, or otherwise, for regulatory change prior to embarking on a revision. TRANSSC XI and TRANSSC XII also developed a set of criteria to be used to decide whether any particular proposed change(s) to the regulations would be sufficient to warrant publication of a new

35 Publications in the Safety Fundamentals category outline the basic objectives, concepts and principles involved in ensuring protection and safety in the development and application of atomic energy for peaceful purposes. They provide the reasons why such activities must fulfil certain requirement, but do not state what those requirements are nor do they provide technical details, and generally do not discuss the application of principles.

36 Publications in the Safety Requirements (previously Safety Standards) category specify basic requirements that must be satisfied in order to ensure safety for particular activities or application areas. These requirements are governed by the basic objectives, concepts and principles that are stated in Safety Fundamentals. The publications in this category do not contain recommendations, or explanations of how to meet requirements.

37 Safety Guides; publications in this category supplement Safety Requirements by presenting recommendations based on international experience regarding measures to ensure the observance of safety standards. The recommendations are presented, as "should" statements.

38 The Safety Reports provide more detailed information. They are not regulatory in style, but give examples and descriptions of methods, which can be applied in implementing both the Safety Requirements and Safety Guides.

document. The amended process would begin in the middle of each odd-numbered year, beginning in 2007, and potentially resulting in a new publication 4 years later.

Irrespective of the name changes, the IAEA Transport Regulations have developed and matured with each new edition. The procedures for their review and revision have evolved accordingly, while always providing for extensive participation by Member States and international organisations. The manner in which the IAEA prepares its Regulations contributes to their extensive national and international recognition and application.

Table 2 – Dates for Editions of IAEA Transport Regulations and SAGSTRAM/TRANSSAC/TRANSSC Meetings

Year	Event
1957	IAEA established
1958/59	Work began on transport rules
1961	SS 6 first publication
1964	SS 6 Revision
1967	SS 6 Revision
1973	SS 6 Revision
1978	SAGSTRAM established SAGSTRAM I
1979	1973 SS 6 Edition issued "As amended"
1980	SAGSTRAM II
1981	SAGSTRAM III
1984	SAGSTRAM IV
1985	SS 6 new Edition
1986	SAGSTRAM V SS 6 Supplement issued
1987	SAGSTRAM VI
1988	SS 6 Supplement issued
1989	SAGSTRAM VII
1990	SAGSTRAM VIII 1985 SS 6 Edition issued "As amended"

Year	Event
1995	SAGSTRAM IX
1996	TRANSSAC established TRANSSAC I SS 6 new Edition, published as ST-1
1997	TRANSSAC II
1998	TRANSSAC III
1999	TRANSSAC IV
2000	TRANSSAC V 1996 Edition (Revised) No. TS-R-1 (ST-1, Revised) published
2001	TRANSSC VI
2002	TRANSSC VII Completion of first new 2-year revision cycle
2003	TRANSSC VIII
2004	TRANSSC IX Completion of second 2-year review/revision cycle 1996 Edition (As Amended 2003) No. TS-R-1 published
2005	TRANSSC X TRANSSC XI 2005 Edition No. TS-R-1 published Completion of third 2-year review/revision cycle
2006	TRANSSC XII Publication of an amended (2007) edition deferred

Structure and Content of the 1985 Edition of the IAEA Regulations for the Safe Transport of Radioactive Material

Given the guiding philosophy of the IAEA Regulations is that safety should depend primarily upon the package rather than operational controls, it is not surprising that requirements relating to packages permeate the Regulations and appear in a number of Sections. Sections III and IV of the Regulations provide the activity limits for each package type. Section IV gives the marking and labelling requirements as well as requirements imposed on packages during transit. Section V details the performance design requirements for packagings, and Section VI gives the necessary test procedures.

Package Design and Testing

The 1985 Edition of the IAEA Regulations provided for four types of packages, depending on the activity and physical form of their radioactive content, as follows:

- excepted;
- industrial;
- Type A;
- Type B.

The IAEA Regulations apply performance standards (design and test requirements) for each of these packaging types. The rules list criteria for package design and require testing with associated pass criteria to demonstrate regulatory compliance.

Aside from the specific requirements for each different type of package, all packagings and packages should be designed to meet the following general requirements:

- the design of the package shall be (in relation to its mass, volume and shape) such that it can be easily and safely transported and handled; the package shall also be designed so that it can be properly secured in or on the conveyance during transport;
- the design shall be such that any lifting attachments on the packages will not fail when used in the intended manner;
- the packaging shall be so designed that the external surfaces are free from protruding features and can be easily decontaminated; the outer layer of the package shall be so designed as to prevent the collection and retention of water;
- the package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under conditions likely to be encountered in routine transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole;
- the materials of the packaging and any components or structures shall be physically and chemically compatible with each other and with the radioactive contents; and
- for radioactive material having other dangerous properties, the package design shall take into account those properties.

When industrial, Type A and Type B packages are intended to be carried by air, the Regulations require that they also meet additional requirements in order to be handled and transported safely under the special temperature and pressure conditions of air transport.

The values of these conditions are derived from the knowledge and experience of such organisations as the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA).

Excepted Packages

Excepted packages[39] are those in which the contents are sufficiently low in potential hazard that a minimum of packaging and labelling requirements need apply.
The following radioactive material can be transported in excepted packages:

- special form[40] solid material (can also be fissile material provided it also meets the conditions that allow it to be considered as non-fissile material, according to para. 560 of the Regulations) within the limit of 10^{-3} of the A_1 value[41];

39 In the 1973 Revised Edition (As Amended) of the Regulations, packagings containing radioactive material with low potential hazard were denoted as "items exempt from the prescriptions". However, these packages, which commonly became known as "exempt packages", were not truly exempt from all the prescriptions of the Regulations – the general design requirements for all packages and other controls during transport and storage where applicable. During the revision process which led to the 1985 Edition of the Regulations, it was agreed to change the nomenclature to indicate that these packages are "excepted from further prescriptions (or requirements)" but are not exempt from all requirements, and to clearly associate the name "excepted packages" to this class of packages.

40 Special form radioactive material is either an indispersible solid radioactive material or a sealed capsule containing radioactive material. This means that the material has a very high degree of physical integrity so that if the material were released from the package in an accident, while there might be a radiation hazard, it is highly unlikely that there would be any contamination hazard. Where the contents comply with the requirements for special form and if the A_1 value is higher than the A_2 value, significantly larger quantities are permitted in excepted packages because of the lower likelihood of dispersion of radioactive contamination as the result of an accident. This is also the case for Type A packages.

41 A_1 and A_2 are basic values that are used in the Regulations. Until the 1996 Edition, the IAEA Regulations define A_1 and A_2 as follows: "A_1 shall mean the maximum activity of special form material permitted in a Type A package. A_2 shall mean the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package". Special form (A_1) radionucides are non-dispersible following the package failure and other than special form (A_2) radionuclides could yield contamination if the package failed. Each radionuclide can be qualified either as a special form material or a non-special form material, depending on its conditioning. The system created to ensure safe transport of radioactive material is based on the assignment of a set of two values to each radionuclide depending upon its form (dispersible or not); as an example, for the radionuclide Fluorine ($^{18}F_9$), the A_1 value is 1 TBq and the A_2 value is 0.5 TBq (Note: this value was amended to 0.6 TBq in the 1996 and later editions of the Transport Regulations). The activity limitation on the contents of Type A packages for any radionuclide or combination of radionuclides is derived in the basis of radiological consequences, which are deemed to be acceptable, within the principles of radiological protection, following failure of the package after an accident. The potential resultant radiological hazards can arise either from incorporation of radioactivity into the body or from external radiation, and whichever is the more restrictive will determine the allowable activity limits on package content. These Type A package content limits (A_1 and A_2 values) are also used for several other purposes in the Regulations such as specifying Type B package activity leakage limits, LSA (Low Specific Activity) material specifications and excepted package content limits. As a result, the various limits for the control of releases of radioactivity from transport packages prescribed in the regulations are based upon the activity contents limits for Type A packages, These requirements are such as to reduce to a very low level the probability of significant release from such packages as a result of very severe accident. In the 1996 Edition of the Regulations A_1 and A_2 values have been completely reviewed, and amended where necessary, but they are still based on the same model as the one used in the 1985 Edition.

- non-special form solid material (can also be fissile material provided it also meets the conditions that allow it to be considered as non-fissile material, according to para. 560 of the Regulations) within the limit of 10^{-3} of the A_2 value;
- radioactive material (can also be fissile material provided it also meets the conditions that allow it to be considered as non-fissile material, according to para. 560 of the Regulations) enclosed in or forming a component part of an instrument or other manufactured article such as clocks, electronic tubes or experimental apparatus;
- manufactured articles in which the sole radioactive material is natural uranium, depleted uranium or natural thorium, provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material [42]; and
- empty packages which once contained radioactive material, provided that they are conscientiously cleaned to remove loose contamination, are in good condition and are securely resealed.

There is no requirement with regard to containment or shielding integrity and, therefore, it is assumed that in any accident they may fail completely and that the contents may be dispersed. Because of the extremely low hazard posed by the contents, it is considered that even if all these contents are dispersed, the consequences would be very small.

Although excepted from most design requirements, such packages must, however, meet the general requirements for all packages in order to ensure the proper and safe handling and stowage of the package, and to exclude adverse effects of shock, vibration, collection and/or retention of water, and chemical or radiolytic degradation of the packaging material.

The radiation level at any point on the surface of an excepted package cannot exceed 5 μSv/h [43] to ensure that any radiation dose to the public would be insignificant and that any sensitive photographic material in close proximity would not be damaged. A common type of excepted package is the postal package, containing radiopharmaceuticals for medical purposes.

42 This provision allows aircraft counterweights made of depleted uranium coated with an epoxy resin, the uranium shielding encased in metal in shipping containers, X-ray and empty gamma ray radiography, and medical treatment devices incorporating depleted uranium shielding to be transported as an excepted package.

43 The biological effects of radiation on the organism exposed is measured in sieverts (Sv). This is a health physics unit. It is expressed in dose equivalent and takes into account the characteristics of the radiation and of the organ irradiated. The millisievert (mSv), or one thousandth of a sievert, is very often used. Throughout the world, the annual average dose equivalent due to natural exposure is around 2.4 mSv.

Industrial Packages

Industrial packages are used to transport Low Specific Activity (LSA) material[44] and Surface Contaminated Objects (SCO)[45]. LSA material is radioactive material which by its nature has a low activity per unit mass (specific activity) or a low activity concentration, whereas SCO are solid objects which are not themselves radioactive but which have radioactive material distributed on their surfaces. LSA material and SCO present limited hazards, either because the activity concentration is very limited, the surface contamination is limited, or because the material is in a form which is not easily dispersed and which consequently presents a limited internal radiation hazard[46].

The maximum activity allowed in industrial packages is defined in terms of specific activity. There are no mass limits for packages, the materials so specified being of relatively low intrinsic hazard. However, the total activity is restricted indirectly by requiring that the radiation level from the unshielded package contents not exceed 10 mSv/h at 3 metres (this restriction was imposed because in the case of an accident the shielding integrity of the package may be lost). In the case of LSA-II and LSA-III (combustible solids, and all

44 LSA material is divided into three groups;
- LSA-1 materials are very low specific activity materials. They are intrinsically safe in that the radioactive concentrations such that a person is unlikely to breathe in enough of the material to give rise to significant doses. LSA-I comprises ores containing naturally occurring radionuclides (e.g. uranium and thorium) and uranium or thorium concentrates of such ores, unirradiated natural or depleted uranium and thorium compounds and ores, and non-fissile materials with unlimited A_2 values. LSA-I materials may be shipped unpackaged or they may be shipped in IP-I packages.
- LSA-II includes material in which the activity is distributed throughout and the estimated average specific activity does not exceed 10^{-4} A2/g for solids and gases, and 10^{-5} A_2 /g for liquids. LSA-II also includes water with tritium concentration up to 0.8 TBq/L. The materials expected to be transported as LSA-II could include nuclear reactor process wastes which are not solidified such as low activity resins and filter sludges, absorbed liquids and other similar materials from reactor operations, similar material from other fuel cycle operations, or hospital wastes. In addition LSA-II could include many items of activated equipment from the decommissioning of nuclear plants.
- LSA-III includes solids (e.g. consolidated wastes, activated materials) in which the radioactive material is distributed throughout a solid or is essential uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc) It must be relatively insoluble so that, even under loss of packaging the loss of radioactive material per package by leaching when placed in water for a week would not exceed 0.1 A_2 and it must have a specific activity not exceeding 2 x 10^{-3} A_2 /g. Materials transported as LSA-III could be concentrated liquid wastes solidified in a concrete matrix. Solidified resins and cartridge filters or irradiated reactor parts or equipment.

45 SCO is divided into two categories, SCO-I and SCO-II, which are differentiated by the levels of fixed and non-fixed contamination (that which can be removed from a surface during normal handling). Objects considered to be included in the SCO-I category are, for example, those parts of nuclear reactors or other fuel cycle machinery which have come in contact with primary or secondary coolant or process waste which has contaminated their surface with mixed fission products. On a SCO-II object, there are 20 times as much surface contamination and 100 times as much non-fixed contamination than on a SCO-1 solid object.

46 It should be noted that SCO-I and LSA-I material may be transported unpackaged under conditions specified in the Regulations, which provide assurance that the material is not dispersed during routine transport. Uranium and thorium, therefore, may be transported in closed rail wagons or road vehicles without bagging or boxing.

liquids and gases) and SCO, conveyance activity limits also contribute to restrict the total activity allowed in a shipment.

For the packaging of LSA material and SCO, three types of industrial packages have been specified: IP-1, IP-2 and IP-3. All the combinations of industrial packaging types and respective admissible LSA material and SCO contents are intended to give roughly equivalent levels of safety. The three industrial package types have graded performance requirements and differ regarding the degree to which they are required to be capable of withstanding damage which could occur in normal transport conditions. In any case, the packages are not required to be able to retain their contents under conditions of severe accidents.

IP-1 packages are designed to meet the general requirements for all packagings and packages and, therefore, simply to contain its radioactive contents under routine transport conditions. In addition, the smallest overall external dimension of an IP-1 package shall be not less than 10 cm.

IP-2 packages are designed to prevent the loss or dispersal of the radioactive contents and the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package in the event of minor mishaps occurring during normal transport conditions. IP-2 packages are submitted to the following tests:

- a free drop test: the specimen shall drop onto a target with an orientation so as to suffer maximum damage in respect of safety features to be tested. The free drop distance, which depends on the mass of the package, varies from 0.3 metres to 1.2 metres; and
- a stacking test (or compression test): unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 hours, to a compressive load equal to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package.

IP-2 packages must satisfy the same requirements as IP-1 packages regarding the smallest overall external dimension.

IP-3 packages are designed to sustain a series of tests to demonstrate the ability to withstand normal conditions of transport, i.e. the water spray test, the free drop test, the stacking test and the penetration test. These tests have been selected to reproduce the kind of damage that could result from exposure to the climatic and handling/transport conditions and stresses, such as falls from vehicles or drops from a similar height, exposure to rain, being struck by a sharp object which may penetrate their surface, or having other cargo stacked on top of the package.

The four tests to which IP-3 packages must be submitted can be described as follows:

- the water spray: the specimen shall be subjected to a water spray that simulates exposure to rainfall of approximately 5 cm per hour for at least one hour;
- the free drop test: the specimen shall drop onto a flat, unyielding target so as to suffer maximum damage in respect of safety features to be tested. The free drop distance, which depends on the mass of the package, varies from 0.3 metres to 1.2 metres;
- the stacking (or compression) test: unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 hours, to a compressive load equal to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package; and
- the penetration test: a bar of 6 kg shall be dropped from a height of 1 metre (1.7 metres in the case of packages which contain liquid or gases) onto the specimen, placed on a rigid, flat and horizontal surface. The longitudinal axis of the bar should be vertical, so that it falls onto the centre of the weakest part of the package.

Specimens of the IP-3 packages shall be subjected to the free drop test, the stacking test and the penetration test, preceded in each case by the water spray test. When submitted to these tests, IP-3 packages shall prevent the loss or dispersal of the radioactive contents and the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

Moreover, the design of IP-3 packages must satisfy additional specifications - known as Type A requirements - concerning the smallest overall external dimension, seals, tiedowns, temperature, containment, reduced pressure and valves.

There are alternative requirements for standard, commercially produced tank and freight containers to be qualified as IP-2 and IP-3 packages.

Most often, industrial packages contain low-level and intermediate-level radioactive waste. A typical container used for transporting low-level waste would be a 200-litre drum. Wastes also come in shapes and sizes, such as large items associated with decommissioning nuclear plants, which cannot be placed in drums. In this case, they may be effectively immobilised by grout or cement when placed in large boxes. Ores containing naturally occurring radionuclides, e.g. uranium or thorium, and concentrates of such ores are also transported in industrial packages.

Table 3 – Industrial Package Requirements

	IP-1	IP-2	IP-3
Design requirements	– General requirements for all packages – Additional pressure and temperature requirements, if transported by air – Requirement concerning smallest overall external dimension	– General requirements for all packages – Additional pressure and temperature requirements, if transported by air – Requirement concerning smallest overall external dimension	– General requirements for all packages – Additional pressure and temperature requirements, if transported by air – Type A additional requirements (smallest overall external dimension, seals, tiedowns, temperature, containment, reduced pressure, valves)
Test requirements Pass criteria		– Free drop (from 0.3 to 1.2 metres, depending on the mass of the package) – Stacking or compression (24 hours / equivalent to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package	Each of the following tests must be preceded by a water spray test (approximately 5 cm per hour for at least one hour): – free drop (from 0.3 to 1.2 metres, depending on the mass of the package) – stacking or compression (24 hours / equivalent to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package) – penetration (6 kg bar dropped from 1 metre) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package

Type A Packages

The Type A packages are used for the transport of relatively small, but significant, quantities of radioactive material. For example, they are needed for the transport of radioisotopes for medical diagnosis; technetium generators used to assist in the diagnosis of some cancers; or fresh nuclear fuel. It is assumed that a Type A package may be damaged in a severe accident and that a portion of the contents may be released. The IAEA Regulations, therefore, prescribe limits on the maximum amounts of radionuclides that can be transported.

The total activity of their contents is limited, for the radionuclides present, depending on whether they are in unspecified form (up to A_2) or comply with the requirements of special form (up to A_1). When A_1 is higher than A_2, higher activities are permitted because of the inherently lower dispersibility of the contents. The contents are limited to restrict the potential radiation doses if the package is damaged in an accident.

Type A packages are required to be capable of resisting both routine and normal conditions of transport. Type A packages must, therefore, be designed to satisfy the same tests requirements as those described above for IP-3 packages (water spray test, free drop test, stacking test and penetration test) with the same pass criteria. These tests demonstrate the ability to withstand normal transport conditions and are known as Type A tests.

Type A packages must also satisfy the same specifications as IP-3 packages concerning the smallest overall external dimension, seals, tiedowns, temperature, containment, reduced pressure and valves.

In addition, they must meet additional requirements when their radioactive content is in liquid or gaseous form. When the Type A packages are designed to contain liquids, their design shall make provision for adequate ullage in order to accommodate the expansion of the liquid contents of the package due to changes in environmental and transport conditions. They must also be provided with sufficient absorbent material to absorb twice the volume of the liquid contents or be provided with a two-part containment system of the type prescribed. Additional free drop and penetration tests for Type A packages designed for liquids and compressed or uncompressed gases are also required (see Table 4). The purpose of these additional tests is to demonstrate that the fraction of the liquid or gaseous contents that would be released in an accident would be comparable to that released from a Type A package designed to carry dispersible solids.

Table 4 - Type A Package Requirements

Design requirements	– General requirements for all packages – Additional pressure and temperature requirements, if transported by air – Type A additional requirements (seals, tiedowns, temperature, containment, reduced pressure, valves) – Additional requirements if liquid contents (ullage, and absorbent material or two-part containment system)
Test requirements Normal transport conditions Pass criteria	Each of the following tests must be preceded by a water spray test (approximately 5 cm per hour for at least one hour): – free drop (from 0.3 to 1.2 metres, depending on the mass of the package) – stacking or compression (24 hours/equivalent to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package 5 times the mass of the actual package) – penetration (6 kg bar dropped from 1 metre) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package
Additional tests for the packages designed for liquid and gases Pass criteria for packages designed for liquid Pass criteria for packages designed for gases	Specimen or separate specimens subjected to each of the two following tests (if one test can be demonstrated to be more severe than the other, the specimen shall be subject to the more severe test): – 9 metre drop test so as to suffer the maximum damage in respect of containment – penetration (6 kg bar dropped from 1.7 metres) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package **Prevent**: – the loss or dispersal of the radioactive contents

Type B Packages

Type B packages are used to transport materials with activities that may be in excess of A_1, if special form radioactive material, or in excess of A_2, if not special form radioactive material. It is necessary, therefore, to specify additional resistance to a release of radioactive material and an increase in external radiation levels under accident conditions. The concept of a Type B package

is that it is capable of withstanding severe accident conditions in transport without loss of containment or increase in external radiation level to an extent which would endanger any member of the general public or those involved in rescue or clean-up operations. The package could be safely recovered, but it would not necessarily be capable of reuse. In fact, the design requirements for Type B packages are such as to reduce to a very low level of probability any significant activity release from such packages as a result of very severe accidents.

The types of radioactive material typically transported in Type B packages include unencapsulated radioisotopes for medical and research uses, industrial, medical and research sources, fresh MOX fuel, used fuels, used research samples and vitrified residues.

In theory, a Type B package may contain any quantity of any type of radioactive material, provided that it has been designed to comply with all of the applicable requirements of the IAEA Regulations and is approved by the relevant transport safety regulatory authority. The requirements of the Regulations impose additional necessary design constraints over and above those imposed on containers which meet normal conditions of transport. These constraints dictate greater structural integrity, more careful consideration of containment and shielding features, and the ability to protect against potential accident forces. The design of Type B packages must also comply with specific requirements regarding internal heat generation and maximum surface temperatures.

In addition to the Type A tests[47], Type B packages are submitted to mechanical, water immersion and fire tests to demonstrate their ability to withstand accident conditions. The tests are not intended to reproduce the effects of any specific transport accident or accident scenario. They do, however, ensure that Type B packages possess sufficient resistance to accidental damage and are capable of adequately withstanding a wide range of possible severe accidents incurred during carriage by any of the transport modes.

Each package is submitted to the cumulative effects of the mechanical tests and the thermal test in that order. Following these tests, either the same specimen or a separate specimen shall be subjected to water immersion. The tests specific to Type B packages can be described as follows:

- mechanical tests: any given package must undergo an impact and a penetration (or puncture) test. These consist of dropping a package onto two different targets in such

47 When submitted to normal condition tests, the Type B packages shall restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour.

a way that maximum damage results. In one of the drop tests, the package must fall from a height of 9 metres onto a flat, horizontal unyielding surface[48]. In the other, it falls onto a steel bar, perpendicular to the target surface, from a height of one metre;

- thermal test: the package is required to be fully engulfed in a thermal environment having a temperature of at least 800°C for a period of 30 minutes. Any combustion of components of the package must be allowed to proceed naturally; and
- water immersion test: packages are required to be immersed in water at a pressure equivalent to a depth of at least 15 metres for not less than 8 hours. In addition, packages containing used nuclear fuel with activity greater than 37 PBq are required to be immersed in water at a pressure equivalent to a depth of at least 200 metres for not less than one hour.

When submitted to the accidental conditions tests (mechanical, thermal and 15-metre water immersion tests), Type B packages must retain sufficient shielding to ensure that the radiation level at 1 metre from the surface of the package will not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to carry. Moreover, it should also restrict the accumulated loss of radioactive contents in a period of one week to not more than A_2. Used fuel packages submitted to the 200 metre water immersion test must be immune to rupture of the containment system.

Finally, each Type B package design must be approved by the competent authority of the country in which the package was designed (Unilateral approval) and, under some conditions, by the competent authority of each country through or into which it is shipped (Multilateral approval)[49]. Under this classification system, the Type B package can be categorised as either a Type B(U) or Type B(M) package.

48 An alternative to the 9 metre drop test is required for some light-weight low density Type B packages which must withstand the effect of a crush test. This consists of placing the package on the unyielding target in such an orientation that it will experience maximum damage when a 500kg steel plate is dropped onto it from a height of 9 metres.

49 Because Type B packages are designed to withstand additional accident conditions in transport, the package design and construction become more important and the Regulations require, therefore, that the competent authority of the country of origin of a Type B package design independently review that design to ensure its adequacy. Moreover, the Regulations require a multilateral approval of the design for all the types of packages in the following cases:
- a package containing fissile material which exceeds limits specified for exception purposes;
- a package which is designed to other than the standard range of environmental temperature conditions, so that the competent authority for each country through or into which the shipment will pass has the opportunity to examine the adequacy of the controls relative to the proposed environmental temperature range;
- a package which is designed to allow controlled intermittent venting during transport (i.e. to relieve internal pressure build-up);
- a packaging manufactured to a design under the provisions of either the 1967, 1973, or 1973 (As Amended) Editions of the regulations;
- if certain specific requirements are not fulfilled by a package design requiring a unilateral approval.

Table 5 - Type B Package Requirements

Design requirements	– General requirements for all packages – Additional pressure and temperature requirements, if transported by air – Type A additional requirements (seals, tiedowns, temperature, containment, reduced pressure, valves) – Additional requirements if liquid contents (ullage, and absorbent material or two-part containment system)
Tests requirements Normal transport conditions Pass criteria	Each of the following tests must be preceded by a water spray test (approximately 5 cm per hour for at least one hour): – free drop (from 0.3 to 1.2 metres, depending on the mass of the package) – stacking or compression (24 hours / equivalent to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package 5 times the mass of the actual package) – penetration (6 kg bar dropped from 1 metre) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package
Additional tests for packages designed for liquid and gases Pass criteria for packages designed for liquid Pass criteria for packages designed for gases	Specimen or separate specimens subjected to each of the two following tests (if one test can be demonstrated to be more severe than the other, the specimen shall be subject to the more severe test): – 9 metre drop test so as to suffer the maximum damage in respect of containment – penetration (6 kg bar dropped from 1.7 metres) **Prevent**: – the loss or dispersal of the radioactive contents – the loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package **Prevent**: – the loss or dispersal of the radioactive contents

Packages Containing Fissile Material

Industrial, Type A and Type B packages may be designated as Fissile Packages if they are designed to carry fissile materials, i.e. materials capable of sustaining a nuclear chain reaction, which are not excepted by the Regulations. In such cases they are termed

IF, AF or BF packages. Packages containing fissile material which are not excepted by the Regulations require multilateral approval of their design.

Special assessments and controls are required for such packages. Each of these packages is submitted to the tests required by its classification [50], and a criticality safety assessment is carried out for both individual packages in isolation and arrays of packages.

For individual packages, it shall be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. The presence of water may be excepted from those void spaces protected by special preventive features, e.g. multiple high standard water barriers.

The determination of the subcriticality of arrays of packages is done by taking into account the two following conditions:
A number "N" shall be derived such that:

- five times "N" undamaged packages without anything between the packages would be subcritical; and
- two times "N" damaged packages with hydrogenous moderation between packages to the extent which results in the greatest neutron multiplication would be subcritical.

Damaged shall mean the evaluated or demonstrated condition of the package if it had been subjected to whichever of the following combination of tests is the more limiting:

- tests for demonstrating the ability to withstand normal transport conditions, including a free drop from a height of 0.3 metres on each corner preceding the free drop test from 0.3 to 1.2 metres, followed by tests for demonstrating the ability to withstand accident transport conditions (in this case, the specimen shall be immersed under a head of water of at least 0.9 metres for a period of not less than eight hours); and
- tests for demonstrating the ability to withstand normal transport conditions, including a free drop from a height of 0.3 metres on each corner preceding the free drop test from 0.3 to 1.2 metres, followed by the Type B immersion test (15 metres over eight hours).

Fresh fuel, for example, can be transported in industrial packages for fissile material or in Type A packages for fissile material.

50 Packages carrying fissile materials must satisfy specific additional criteria (examination of a change in dimensions of the package, evaluation of the influences of water on the packages and sufficient mechanical stability of the package design), when submitted to the tests for withstanding normal transport conditions. In addition, the free drop test for fissile packages shall be preceded by drop from a height of 0.3 metres on each corner of the package.

Other Requirements

In addition to the requirements for package design and testing, the IAEA Regulations (Section II) include general provisions such as radiation protection, emergency response, quality assurance and compliance assurance.

Moreover, Section IV of the 1985 Edition of the IAEA Transport Regulations has several requirements related to hazard communication in order to increase the safety of the transport operation. Awareness of the presence of radioactive material in a shipment is indeed of interest to carriers, consignees and other persons for many reasons. When accidents occur, information identifying the presence and nature of the radioactive material is of vital importance to the emergency response services. For this reason, the IAEA Regulations deal with matters such as transport documents, labelling and marking of packages, placards and notifications. The descriptive information required by the Regulations depends on the types and quantities of radioactive material present and the packaging type used for transport[51].

Transport Documents

Details of a consignment are to be given in the transport documents in order that proper knowledge of the consignment is available to those who have an interest in it. The IAEA Regulations provide a list of the information that needs to be stated, which includes the following:

- the proper shipping name, which describes the material in a general way;
- the United Nations hazard class number (number 7 assigned to radioactive material);
- the words "RADIOACTIVE MATERIAL", if they are not part of the proper shipping name;
- the United Nations number: this is a four-digit number, preceded by the letters "UN", which is recognised internationally. This number relates to the material and its hazard, and may be used in guiding emergency response actions;
- the identity of the radionuclides contained in the package;
- the total activity of the radioactive content;
- the category of the package;
- the physical and chemical form of the radioactive content or a statement that the content is special form material;

51 Because of the extremely low hazard posed by the contents of excepted packages, they are transported without all the accompanying descriptive information required for other radioactive material packages.

- the Type A or Type B category of the package, as appropriate; and
- other pertinent information, especially for Type B and fissile packages.

In addition, the consignor shall include in the transport documents a declaration in which he declares that the contents are classified, packed, marked and labelled, and are in all respects in proper condition for transport according to the applicable international and national governmental regulations.

Marking

Some markings are required on the packagings, including the following:

- a legible and durable mark of gross weight (if more than 50 kg) in order to facilitate mechanical handling, and observance of floor loading and vehicle loading limits;
- package design type, i.e. Type A, Type B(U) or B(M). For Type B packages, this marking provides information on the kind of competent authority design approval, and for Type A packages it signifies that the design has been made in accordance with the performance criteria in the Regulations and that the designer and/or consignor is satisfied that the package characteristics are adequate;
- identification markings assigned to the package design by the competent authority. This marking provides a link between the individual package and the corresponding national competent authority design approval; and
- in some cases, the serial number to uniquely identify each packaging which conforms to that design. This marking is required because operational quality assurance and maintenance activities are oriented towards each packaging.

Type B packages must have a durable fire and water-resistant marking, including the characteristic trefoil symbolising radioactivity, on the outermost fire-resistant surface of the package.

Labelling

All packages, other than excepted packages, must bear labels. Transport workers need to be aware of the contents of Packages, overpacks, tanks and freight containers they are handling. It is necessary to be able to identify the precise radiological hazard associated with the content of the cargo unit and the storage and stowage provisions which may be applicable. In the event of an accident in which a package is damaged, the radioactive content and activity information marked on the label is useful to emergency response personnel.

In terms of the radiation levels which may be encountered on the surface of the package, and in terms of transport index[52], packages are classified according to one of three categories. There is a different label for each category of package to simplify recognition and facilitate control by workers when handling packages. The labels are either white or yellow. The yellow labels indicate that limitations are placed upon how these packages can be stowed or stored to ensure radiation safety and guard against criticality.
The packaging categories and labels are as follows:

- Category I - White, in which the maximum radiation level at the surface is not more than 0.005 mSv/h and the transport index does not exceed 0;
- Category II - Yellow, in which the radiation level at the surface does not exceed 0.5 mSv/h and the transport index does not exceed 1; and
- Category III - Yellow, is usually for packages with a surface radiation level not more than 2 mSv/h and a transport index of not more than 10.

The radioactive material labels constitute part of a set of labels implemented by the UN Recommendations on the Transport of Dangerous Goods and used internationally to identify the various classes of dangerous goods. This set of labels has been established with the aim of making dangerous goods easily recognisable from a distance by means of symbols. The specific symbol chosen to identify cargo units carrying radioactive material is the trefoil. Moreover, the figure "7", corresponding to the number of the UN hazard class for radioactive material, should also appear on the labels.

In addition to identifying the radioactive properties of the contents, the labels also carry more specific information regarding the contents, i.e. the name of the nuclide and the corresponding activity. This information is particularly important in the event of an incident or accident where content information may be needed to evaluate the hazard. In addition, yellow labels show the transport index of the cargo unit.

Labels need to be affixed to packages and overpacks on two opposite sides so that at least one label is visible irrespective of how the package or overpack is placed. For tanks and freight containers the labels need to be displayed on all four sides in order to ensure that a label is visible without people having to search for it, and to minimise the chance of its being obscured by other cargo units.

52 The Transport Index (TI) is a number which is assigned to a package (or overpack, tank, freight container, or consignment) and used to provide control over groups of packages for the purposes of minimising nuclear criticality and radiation exposure risks. The transport index is obtained by calculation, as explained in the Regulations.

Placarding

Placards on vehicles, rail cars, freight containers and portable tanks are required in order to indicate the presence of radioactive material. Requirements may vary for different modes of transport, and for different types of consignment, but in all cases the placard indicates that radioactive material is present. These placards are designed in a similar way to the package labels (trefoil symbol and figure 7 indicated), although they do not bear the detailed information on transport Index, contents and activity. The size of the placard is intended to make it easy to read, even at distance.

Where the consignment in the freight container or tank is unpackaged LSA-I or SCO-I, or where an exclusive use[53] consignment in a freight container is packaged radioactive material with a single UN number, the appropriate UN number for the consignment shall also be displayed.

Labels and placards used to identify dangerous goods and their respective hazards are, for all classes of dangerous goods, designed in accordance with the standard format of the UN Recommendations on the Transport of Dangerous Goods. Symbols such as the trefoil are used to draw attention to the particular hazard presented by the dangerous goods. Through this system of standardised and internationally agreed label and placard designs, assurance is provided that hazards can be readily understood and interpreted, in both the national and international transport of radioactive material.

53 According to the IAEA Regulations, an exclusive use shall mean the sole use, by a single consignor, of a conveyance or of a large freight container with a minimum length of 6 metres, in respect of which all initial, intermediate, and final loading and unloading is carried out in accordance with the directions of the consignor or consignee.

Major Changes in the 1996 Edition of the IAEA Regulations for the Safe Transport of Radioactive Material

Following a comprehensive review by a panel of experts convened by the IAEA, a revised version of the IAEA's Regulations for the Safe Transport of Radioactive Material, Safety Standards Series No ST-1 (formerly Safety Series No. 6) was approved by the IAEA Board of Governors in September 1996[54]. This 1996 Edition, which superseded all previous editions, embodies several major changes as well as numerous minor ones. In 2000 an English-language revision of ST-1, incorporating several minor changes was issued under the new IAEA document designation TS-R-1. The major changes incorporated in TS-R-1 are described in the paragraphs below.

Incorporation of the International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources (BSS)

One major revision was the incorporation of the new Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources (BSS) (Safety Series No. 115, 1996) into the IAEA Transport Regulations. The Board of Governors first approved radiation protection and safety measures in March 1960 when it was stated that the "Agency's basic safety standards will be based to the extent possible on the recommendations of the International Commission on Radiological Protection[55] (ICRP)". Consequently, the Board first approved the Basic Safety Standards in June 1962. A revised version was published in 1967 and a third revision was published in 1982. New ICRP recommendations were issued in 1991 and, consequently, BSS was revised to reflect the consensus surrounding the standards. TS-R-1 has taken into account the new

54 This new Edition is structured into eight sections:
- Section I : Introduction;
- Section II: Definitions;
- Section III: General Provisions;
- Section IV: Activity Limits and Material Restrictions;
- Section V: Requirements and Controls for Transport;
- Section VI: Requirements for Radioactive Material and for Packagings and Packages;
- Section VII: Test Procedures;
- Section VIII: Approval and Administrative Requirements.

55 ICRP is a non-governmental scientific organization founded in 1928 to establish basic principles and recommendations for radiation protection.

BSS because the Transport Regulations recognise the standards as a general provision for radiological protection [56].

The IAEA Transport Regulations have always contained an exemption criterion, which defines materials subject to their requirements. This criterion is changed in the 1996 edition. Until 1996 the Regulations applied to radioactive material which were defined as "any material having a specific activity greater than 70 kBq/kg (2 nCi/g)". BSS, however, uses a radionuclide-specific approach which leads to derived exemption values spanning seven orders of magnitude, and straddling 70 Bq/kg in the case of activity concentration. BSS also presents exemption values for total activity quantities (Bq).

It was decided to harmonise BSS and the Transport Regulations and, therefore, to have the Transport Regulations adopt the BSS-derived exemption values. Consequently, the 1996 Edition of the Transport Regulations contains both activity concentration and total activity per consignment exemption values, [57] redefined as a function of the radiotoxicity of each isotope. For mixtures of radionuclides, the "ratio rules" must be applied so that the sum of the activities (or activity concentrations) present for each radionuclide divided by the applicable exemption value is less than or equal to 1. One of the main consequences of this new exemption value limit is that the 1996 Edition of the IAEA Regulations applies to natural sources such as ores or wastes containing radionuclides which had not been covered previously.

Among the other changes stemming from BSS is the inclusion of radiation protection programmes, i.e. systematic arrangements aimed at providing adequate consideration of radiation protection measures. The 1996 Edition of the Regulations stipulates that a radiation protection programme shall be established. The nature and extent of the measures to be employed shall be related to the magnitude and likelihood of the expected additional radiation exposures. These programme documents shall be available, on request, for inspection by the relevant competent authority. Thus, the programme must take into account the following annual individual dose levels:

56 The ST-1 clearly states in its introduction that the "Regulations utilize the principles set forth in both the Radiation Protection and the Safety of Radiation Sources and the International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation sources. The purpose of BSS is to establish basic requirements for protection against the risks associated with exposure to ionizing radiation and for the safety of radiation sources that may deliver such exposure".

57 According to ST-1, radioactive material shall mean any material containing Radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in Regulations.

- less than 1 mSv per year (no special requirement);
- between 1 and 6 mSv per year (monitoring at the work place or individual monitoring); and
- more than 6 mSv per year (individual monitoring).

The new BSS standards are also used within the Q system, i.e. a dose-based set of exposure models which is used to derive A_1 and A_2 values. Consequently, new A_1 and A_2 values have been introduced in TS-R-1.

Provisions for the Transport of Uranium Hexafluoride (UF_6)

Uranium hexafluoride (UF_6) is a chemical compound of uranium used in industrial processes to enrich uranium in the uranium-235 isotope. 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 UF_6 existed in the 1985 Edition of the IAEA Transport Regulations and a number of issues were considered by the different committees in charge of the revision process. The 1996 Edition of the IAEA Regulations contains new provisions to increase the safety of UF_6 transport.

Provisions have been adopted requiring UF_6 packages designed to contain 0.1 kg or more of uranium hexafluoride to comply with the following conditions:

- shall be tested hydraulically at an internal pressure of at least 1.38 MPa. When the pressure test is less than 2.76 MPa, the design shall require multilateral approval. Packages must withstand this pressure test without leakage and without unacceptable stress;
- must meet the free drop test required for demonstrating ability to withstand normal conditions of transport (Type A test). It must withstand this test without loss or dispersal of the UF_6 ; and
- when designed to contain less than 9,000 kg of UF_6, they must meet the Type B thermal test of 800°C for 30 minutes without rupture of the containment system. When designed to contain 9,000 kg of UF_6 or more, they either must meet the thermal test requirements or have multilateral approval.

Competent authority approval is required for packages containing 0.1 kg or more of uranium hexafluoride.

Type C Packages

The 1996 Edition of the IAEA Transport Regulations provides that the Type B(U) and Type B(M) packages, if transported by air, shall not contain activities greater than the following:

- for special form radioactive material, 3,000 A_1 or 100,000 A_2 which ever is the lower;
- for all other radioactive material, 3,000 A_2.

The consequence of this provision is the requirement for a more robustly designed package type - the Type C package - in order to transport higher activity materials by air. The Type C package requirements apply to all radionuclides, and these packages shall not contain any of the following:

- activities greater than those authorised for the package design;
- radionuclides different from those authorised for the package design; or
- contents in a form, or physical or chemical state, different from those authorised in the package design as specified in the certificate of approval.

Type C packages must satisfy all the additional requirements of Type A packages and most of the additional requirements of Type B packages. Type C packages shall be so designed that, if it were at the maximum normal operating pressure and subjected to Type A tests for demonstrating ability to withstand normal transport conditions, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour.

Type C packages are submitted to a series of tests to prove their ability to withstand transport incidents and accidents. These tests, some of which are new, include the following:

- mechanical tests: a drop test of 9 metres onto a flat and unyielding surface so as to suffer the maximum damage, and a dynamic crush test with a drop of a 500 kg mass from 9 metres onto the specimen so as to suffer the maximum damage;
- a puncture/tearing test: the specimen shall be subjected to the damaging effects of a solid probe made of mild steel. The orientation of the probe to the surface of the specimen shall be such as to cause maximum damage at the conclusion of the mechanical tests. This test is carried out with a probe of 250 kg. The test varies with the mass of the package. If the package has a mass less than 250 kg, the probe falls on the package from a height of 3 metres; if the package has a mass of 250 kg or more, the package is dropped onto the probe;

- an enhanced thermal test: the conditions for this test are the same as those for Type B packages, except that the exposure to the thermal environment shall be for a period of 60 minutes; and
- an impact test; the specimen shall be subject to an impact on a flat, unyielding target at a velocity of not less than 90 m/s at such an orientation as to suffer maximum damage.

A Type C package specimen shall be subjected to the effects of each of the first three test sequences in the order specified above. However, a separate specimen can be used for the impact test.

A Type C package must be so designed that if it was at the maximum normal operating pressure and subjected to the accidental tests described above, it would meet the following requirements:

- retain sufficient shielding to ensure that the radiation level at 1 metre from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and
- restrict the accumulated loss of radioactive contents in a period of one week to not more than A_2.

In addition, the Type C specimen shall be subjected to an enhanced water test, in which it is immersed under a head of water of at least 200 metres for a period of not less than one hour with no rupture of the containment system.

Table 6 - Type C Package Requirements

Design requirements	– General requirements for all packages – Additional pressure and temperature – Most of the Type A and Type B requirements
Tests requirements Normal transport conditions Pass criteria	Each of the following tests must be preceded by a water spray test (approximately 5 cm per hour for at least one hour): – free drop (from 0.3 to 1.2 metres, depending on the mass of the package) – stacking (24 hours equivalent to the greater of the equivalent of 5 times the mass of the actual package or the equivalent of 13 kPa multiplied by the vertically projected area of the package) – penetration (6 kg bar dropped from 1 metre) – Would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour
Test requirements Pass criteria	A. Test sequences Cumulative effects of: 1. Free drop from 9 metres 2. Dynamic crush test (drop of a 500 kg mass from 9 metres onto a specimen) 3. Puncture / tearing test (package subjected to the damaging effects of a solid mild steel probe) 4. Enhanced thermal test (fire of 800°C intensity for 60 minutes) A separate specimen may be used for the following test: – Impact test (not less than 90 m/s) Prevent: – that the radiation level at 1 metre from the surface of the package would exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain – the accumulated loss of radioactive contents in a period of one week to not more than A_2 B. Enhanced immersion test (200 metres for not less than one hour) – Pass criteria: no rupture of the containment system

Low Dispersible Material (LDM)

Since the requirements for Type C packages are intended to prevent the dispersion of materials and high radiation levels, the IAEA Regulations allow materials which present a limited risk of dispersion and which have limited radiation levels to be transported by air in Type B packages. These materials are named Low Dispersible Materials (LDM) and constitute a new category in TS-R-1. The 1996 Edition of the IAEA Regulations includes test specifications for LDM.

According to the Regulations, low dispersible radioactive material means "either a solid radioactive material or a solid radioactive material in a sealed capsule, that has limited dispersibility and is not in powder form". The rules stipulate LDM shall be such that, when without any packaging, the total amount of the radioactive material intended to be loaded into the packaging shall meet the following requirements:

- the radiation level at 3 metres from the unshielded radioactive material does not exceed 10 mSv/h;
- if subjected to the Type C enhanced thermal test and impact test[58], LDM would release gaseous and particulate forms of up to 100 μm aerodynamic equivalent diameter not exceeding 100 A_2; and
- if subjected to an immersion test for 7 days at ambient temperature, the activity in the water would not exceed 100 A_2. In the application of this test, the damaging effects of the impact and thermal tests shall be taken into account.

Air transport of LDM can be carried out using Type B(U) and Type B(M) packages with the limit on total activity being specified in the approval certificate for the package. Multilateral competent authority approval of the Type B(U) and Type B(M) package design for low dispersible radioactive material, and of the design of the LDM is required.

Amendments of the Fissile Materials Exceptions

Some fissile materials are excepted from the requirements to be transported in packages that comply with the specific requirements for packages containing fissile material. In the 1996 edition of the IAEA Regulations these exceptions have been amended and they now include a mass limit per consignment, package limits and content restrictions. Only one type of exception is allowed per consignment.

Criticality Safety Index (CSI) - A New Index

A Criticality Safety Index (CSI) has been introduced by the 1996 Edition of the IAEA Transport Regulations. It is defined as an index assigned to a package, overpack or freight container containing fissile material and "shall mean a number which is used to provide control over the accumulation of packages, overpacks or freight containers containing fissile material". This index limits the accumulation of packages containing fissile material to ensure criticality safety.

58 A separate specimen may be used for each test.

In previous editions of the IAEA Regulations, the Transport Index (TI) was used for this purpose and also to separate groups of packages from persons and film and to limit radiation exposure. In the 1996 Edition the Transport Index has been simplified and now only applies for radiation purposes. It continues to be based on the radiation level at 1 metre from the package surface. Consequently, the TI is defined in the new Regulations as a number which is "used to provide control over radiation exposure", whereas in the past it was "used to provide control over both nuclear criticality safety and radiation exposure".

Separation of the TI and CSI 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. The changes introduce clarity which should enhance compliance with the IAEA Regulations.

Incorporation of the New United Nations Numbers

Based on recommendations of the IAEA, the 1995 Edition of the UN Recommendations for the Transport of Dangerous Goods incorporated a new set of proper shipping names and UN numbers in which a UN number is assigned to each type of material identified or defined by the IAEA Regulations. In this way an expanded set of UN numbers was provided. The 1996 Edition of the IAEA Transport Regulations (TS-R-1) incorporates these new UN numbers and requires that they be displayed on packages and on conveyances. The new UN numbers will facilitate understanding of the package type or material being transported, and specific emergency response procedures.

Major Changes in the 1996 (As Amended 2003) Edition of the IAEA Regulations for the Safe Transport of Radioactive Material

The following major changes (relative to the previous 2000 Edition) were incorporated into the 1996 (As Amended 2003) Edition of the IAEA Regulations, as approved by TRANSSC and subsequently endorsed by the CSS and approved by the Board of Governors.

Changes in the Scope of the Regulations

Changes were made, describing those materials to which the Regulations do not apply, to clarify the intent of the Regulations regarding natural materials and ores, and to clarify the conditions under which surface contaminated objects are excluded from the scope of the Regulations.

Changes to the General Provisions of the Regulations

At the request of the CSS, language in Section III, specifying the values for dose to be used for the purpose of calculating segregation distances or radiation levels, was amended to highlight the need to take account of exposures from all relevant sources and practices under control when performing such calculations.

New provisions were added covering action to be taken when a non-compliance with a radiation or contamination limit is evident. In addition, a new sub-section was added covering training requirements.

Changes in the Requirements and Controls for Transport

In this section three changes were made, namely:

- to clarify that paragraph 514 only applies to unpackaged radioactive material;
- to exclude consumer products which have received regulatory approval, or which do not individually exceed the exempt consignment activity limits of Table I, from the need to be marked "RADIOACTIVE" on the product itself, provided such products are transported in a package that bears the marking "RADIOACTIVE" on an internal surface in such a manner that warning of the presence of radioactive material is visible on opening the package; and
- to ensure that each individual package in an overpack, freight container, or conveyance has the required information available and that appropriate documentation be available at points of intermediate unloading.

Changes in the Requirements for Radioactive Materials and Packages and Packagings

This section was amended to correct the pressure differential requirement for packages to be transported by air.

Changes in the 2005 Edition of the IAEA Regulations for the Safe Transport of Radioactive Material

Some of the significant changes (changes were no longer differentiated as "major", "change of detail" or "minor" during the second review/revision cycle) relative to the previous "As Amended 2003" Edition incorporated into the 2005 Edition of the IAEA Regulations, as approved by TRANSSC and subsequently endorsed by the CSS and approved by the Board of Governors are listed below. It should be noted that, despite its title (which suggests a comprehensively revised new edition) the 2005 Edition is, in effect, a further amendment of the 1996 Edition and contains no significant changes to the package design or test requirements which would warrant amending the transitional provisions or amending the symbols "-96" required in the approval design type codes. Attention to this fact is drawn towards the end of the Preface to the 2005 Edition.

The definition of multilateral approval was amended to avoid the misunderstanding of the concept in some quarters that it only applies to transport operations involving two or more states.

Text was also extensively revised and reformatted in respect of the radiation protection requirements to bring them into closer line with the requirements of the Basic Safety Standards.

Material restrictions are amended to state more precisely what must not be contained in UF_6 packages.

Amendment was made to require that the UN Number, Proper Shipping Name, categorisation, labelling and marking be in accordance with the appropriate certificate of approval of the country of origin of design in the case of international transport where competent authority approval is required.

When measuring the increase in radiation level on packages under test conditions the text is amended to refer to the maximum radiation level at any external surface rather than simply the radiation level at any external surface.

Companion Documents to the IAEA Transport Regulations
Historic Development of the Companion Documents

Explanatory and Advisory Material

In 1961 IAEA published a document, Notes on Certain Aspects of the Regulations (Safety Series No. 7), as part of an initiative to provide detailed guidance on the Transport Regulations themselves. In 1973, another document, Advisory Material for the Application of the IAEA Transport Regulations (Safety Series No 37), was published as a companion document to the 1973 revised edition of the Regulations. In 1982, a second edition of SS 37 was published, and a third edition was issued later to reflect the 1985 Edition of the Transport Regulations.

This last edition provided information about the technical requirements of the Regulations and about methods and technology which may be employed to fulfil them. This kind of information is mainly for the benefit of designers and manufacturers of packagings, consignors, carriers, competent authorities. To the extent practicable, information on the intent and rationale of the regulatory requirement was removed from this third edition of SS 37 and it was decided to present it in a second edition of Safety Series No. 7, under the new name of Explanatory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, referring to the 1985 edition of the Transport Regulations. Thus, the advisory and the explanatory information material has been separated since 1985 and presented in two different documents - SS 37 and SS 7.

Schedules

Despite the availability of the two documents, it was agreed that the system was not comprehensive enough and that another type of companion document was needed. As originally configured, Safety Series No. 6, i.e. the Transport Regulations, was structured solely in terms of topics - definitions, general principles and provisions, packaging contents limits, requirements and controls for shipments, etc - rather than in terms of specified types of radioactive material. As a consequence, SS 6 could give the impression of being difficult to implement, especially for unfamiliar users. A user wishing to transport a specified type of radioactive material consignment has to study and assimilate requirements from all sections of the IAEA Regulations, even though much of the information may not apply to that type of consignment.

To overcome the problem and to assist users, a set of Schedules, listing in abbreviated form the requirements to be met for the transport of specific types of consignments, was appended to the 1973 Edition of the Regulations. In endorsing the 1985 Edition of the Regulations, SAGSTRAM recommended that these Schedules should be issued as a separate Safety Series document, the Schedule of Requirements for the Transport of Specified Types of Radioactive Material Consignments. This was agreed and the document was published in 1986 as Safety Series No 80 (SS 80).

New versions of these companion documents were issued in 1985 (SS 7 and SS 37) and 1986 (SS 80). Changes to SS 7, SS 37 and SS 80 were made following the 1988 Supplement to the 1985 Edition of the Safety Series No 6, and "as amended" versions were published in 1990.

Purpose of the Companion Documents

Taken together, the IAEA Transport Regulations, the Advisory Material and the Explanatory Material provide users with a comprehensive picture of the regulatory regime governing radioactive material transport. The three documents cover the regulatory framework by prescribing "what" is to be achieved in the basic rules (SS 6), describing the "why" of certain regulatory requirements in the explanatory material (SS 7), and providing examples of "how" certain regulatory requirements can be met in the advisory material (SS 37). This tripartite system is complemented by the Schedules, another important support document.

Schedules

The SS 80 Schedules list what must be done for specified types of consignments. However, this document does not have the same status of that of the Transport Regulations, since it is only a summary of the main provisions for each specified type of consignment. As a consequence, the SS 80 text frequently refers back to the Transport Regulations to supply details which are not given directly in the Schedules.

Explanatory Material

The purpose of Safety Series No. 7 is to "explain the provisions of SS 6 in order to help comprehension of the Regulatory standards and to promote compliance, public acceptance

and further development of the Regulations". The intent is to show why certain provisions of the IAEA Regulations exist and the rationale behind them. SS 7 does not address all the provisions. In some cases the purpose of a particular provision was considered self-evident and, therefore, explanatory text was not required.

Advisory Material

The principal purpose of SS 37, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, is to assist in achieving compliance with the Regulatory standards by describing methods, techniques and practices which can be considered as means of satisfying certain requirements. The guidance provided in SS 37 should always be taken as offering "a way" or "ways" rather than "the only way" of achieving compliance. Furthermore, the information provided is to be viewed as being purely advisory and never mandatory, except where a competent authority may require use of any part or parts of the text. As is the case with SS 7, not all provisions of the IAEA Regulations are addressed in the advisory document.

A paragraph numbering system coordinated with Safety Series No. 6 has been used in all supporting documents to facilitate cross-referencing. If explanatory material for a given SS 6 paragraph is provided, it is identified in SS 7 by "E" followed by the corresponding paragraph number from the Regulations. Advisory material is identified by "A" in the same way.

Excerpts from SS 6, SS 7 and SS 37 follow as an example of the different types of information these documents provide.

Table 7 - Excerpts from SS 6, SS 7 and SS 37

The Regulations (SS 6)	Explanatory Material (SS 7)	Advisory Material (SS 37)
Target for drop tests 618. The target for the drop tests specified in paras 607, 622, 625(a) and 627 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.	Target for drop tests E-618. The target for drop tests is specified as an essentially unyielding surface. This unyielding surface is intended to cause damage to the package which would be equivalent to or greater than that anticipated for impacts onto actual surfaces or structures which might occur during transport. The specified target also provides a method for assuring that analyses and tests can be compared and accurately repeated if necessary. The unyielding target, even though described in general terms, can be repeatedly constructed and provides relatively large mass and stiffness with respect to the package being tested. So-called real targets, such as soil, soft rock and some concrete structures, are less stiff and impose less damage on a package for a given impact velocity. In addition, it is more difficult to construct yielding surfaces that give reproducible test results, and the shape of the object being dropped can affect the yielding character of the surface. Thus, if yielding targets were used, the uncertainty of the test results would increase and the comparison between calculations and tests would be much more difficult.	Target for drop tests A-618. One example of an unyielding target to meet the regulatory requirements is a steel plate as the upper surface of a concrete block. The combined mass of the steel and concrete should be at least 10 times that of the specimen to be dropped on it. The block should be set on firm soil and the steel plate should be at least 4.0 cm thick and floated onto the concrete while it is still wet. The plate should have protruding fixed steel structures on its lower surface to ensure tight contact with the concrete. Since flexure of the target is to be avoided, especially in the vertical direction, it is recommended that the target should be close to cubic in form, with the depth of the target comparable to the width and length. Other targets which have been used are described in Refs [38, 39].

Revision of the Companion Documents

The publication of the 1996 Edition of the IAEA Regulations for the Safe Transport of Radioactive Material (TS-R-1) was followed by another important milestone - the preparation of its revised supporting documents. In conformity with the IAEA's new document publication policy, it was agreed that the Explanatory Material and the Advisory Material should be combined into a single document to be published in the form of an IAEA Safety Guide, Advisory Material for the Regulations for the Safe Transport of Radioactive Material (TS-G-1.1). SS 7 and SS 37 were merged in order to avoid significant duplication. TS-G-1.1 was published in 2002 and contains both types of information, explanatory and advisory material, which support the adoption and application of TS-R-1. A further revised publication of TS-G-1.1 is planned for 2007 which will incorporate changes to bring the guidance up-to-date with the 2005 Edition of the Transport Regulations. The draft of this document, DS 346, was approved by TRANSSC at its 11th meeting in 2005 and is currently under review by the other committees prior to submission to the Commission on Safety Standards for final review.

It was also decided that the Schedules (SS 80) should be incorporated as an appendix to the 1996 Edition of the Regulations. TS-R-1 continued to incorporate the Schedules in the 2000 and 2003 publications. However, the Schedules were abandoned in the 2005 publication as a consequence of their removal from the international modal instruments (RID, ADR and the IMDG Code) and recognition that the advisory nature of the schedules made them inappropriate in a "requirements" document. Considerable interest has, however, persisted in many quarters to revive and even enhance the Schedules, which are seen as very useful "roadmaps" to the regulatory requirements for the various types of package and shipment. At the time of publication of this document, 31 July 2006, a Document Preparation Profile (DPP) had been endorsed by TRANSSC and the CSS to enable the Schedules to be reintroduced in a separate Safety Standards Series Guide (to become TS-G-1.6).

Other Companion Documents

In 1988 the Agency published a guidance document entitled "Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material – Safety Series No 87". This Safety Guide reflected the requirements of the 1985 edition of the Transport Regulations.

The publication of the 1996 edition of the IAEA's Transport Regulations necessitated that Safety Series No. 87 be reviewed and revised to reflect the new regulatory requirements.

The Agency convened a consultants services meeting and followed this with a technical committee meeting in 1996. Further actions were taken by the Secretariat, including adding recently published information from the IAEA Safety Requirements publication on Preparedness and Response for a Nuclear or Radiological Emergency and a related TECDOC. In 2002 the Agency finally published a further transport safety guidance document in the new Safety Standards Series entitled "Planning and Preparedness for Emergency Response to Transport Accidents Involving Radioactive Material – Safety Guide No. TS-G-1.2"

In 1994 the Agency published two documents in the Safety Practices category giving guidance in the areas of quality assurance and compliance assurance in transport, as these were defined in the then extant Transport Regulations – i.e. the 1985 Edition (As amended 1990). These were entitled "Quality Assurance for the Safe Transport of Radioactive Material – Safety Series No. 113" and "Compliance Assurance for the Safe Transport of Radioactive Material - Safety Series No. 112". As of July 31 2006, both of these documents were at an advanced stage of revision in the light of up-to-date practice and standards in quality management and were expected to be published in the near future as guides in the Safety Standards Series. TS-G-1.3, entitled "Management Systems for the Safe Transport of Radioactive Material" will supersede Safety Series No. 113, and TS-G-1.4, entitled "Compliance Assurance for the Safe Transport of Radioactive Material" will supersede Safety Series No. 112.

Following the introduction of the requirement for radiation protection programmes (RPP's) in the 1996 Edition of the Transport Regulations, work began in 2000 to produce appropriate guidance on the establishment of RPP's. As of July 31 2006, a draft safety guide had been prepared and endorsed for publication by the CSS which will be published in due course as TS-G-1.5 entitled "Radiation Protection Programmes for Transport of Radioactive Material".

4 The Modal Regulations Governing the Transport of Dangerous Goods

The UN Model Regulations and the IAEA Regulations are relevant not only to governments for the development of their national requirements for domestic transport, but also to the organisations responsible for administering the regulations governing the international transport of dangerous goods by sea, air, road, rail and inland waterway. These latter bodies give effect to the UN Recommendations (Model Regulations) and the IAEA Regulations by incorporating their provisions into the various modal rules. Member states of each of these organisations then implement the modal rules for international dangerous goods traffic across their borders and as a basis for their domestic regulations. The IAEA Transport Regulations have been incorporated, for example, in the International Maritime Dangerous Goods (IMDG) Code for sea transport, the International Civil Aviation Organisation (ICAO) Technical Instructions for air transport and the RID and ADR Regulations governing the transport of dangerous goods by rail and road, respectively, throughout much of Europe and surrounding territories.

The principal modal dangerous goods organisations and the latest status of their respective rulebooks, including the provisions on radioactive material transport, are described in the paragraphs below.

Sea Transport
International Maritime Organization (IMO)

The International Maritime Organization[59] was established by a United Nations conference in 1948 as the first ever international body devoted exclusively to maritime matters. The agreement, adopted on 6 March 1948, came into force 10 years later, on 10 March 1958. Over the past four decades IMO has become recognised as the UN agency which provides

59 Until 1982 the Organization was called the Inter-Governmental Maritime Consultative Organization (IMCO)

the global maritime community with a forum for all matters affecting the safety of shipping and the protection of the marine environment[60].

The purpose of IMO is summarised more specifically in Article 1(a) of the Convention on the Inter-Governmental Maritime Consultative Organization, i.e. "to provide machinery for co-operation among governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships". IMO is also empowered to deal with administrative and legal matters related to these purposes. The UN body has 166 Member States, 36 Inter-Governmental Organizations and 63 Non-Government Organisations.

IMO comprises an Assembly, a Council and five main committees. The Organization's governing body, the Assembly, consists of all IMO Member States and meets every two years in regular session. It is responsible for approving the work programme, voting the budget and determining the financial arrangements of the Organization. The Council is the executive body of the Organization. Composed of 40 Member States elected by the Assembly for two years, the Council is responsible for supervising the work of the Organization. Between sessions of the Assembly, the Council performs all the Assembly's functions, except that of making recommendations to governments on matters relating to maritime safety and pollution prevention.

The technical work of IMO is carried out by its five committees - the Maritime Safety Committee, the Marine Environment Protection Committee, the Legal Committee, the Technical Co-operation Committee and the Facilitation Committee. In addition, there are nine Sub-Committees which assist the Committees in addressing specific technical problems. Committees and Sub-Committees in turn are supported by Working Groups which meet during the sessions and are constituted in relation to items on the agenda.

60 UN specialised agencies reporting directly or indirectly to ECOSOC (www.un.org/aboutun/chart.html) These agencies are autonomous bodies created by intergovernmental agreement and have wide-ranging international responsibilities in the economic, social, cultural, educational, health and related fields. All these organizations have their own governing bodies, budgets and secretariats. Together with the UN, they are known as the UN family or the UN system.

While Committee and Sub-Committee work is undertaken by the representatives of IMO Member States, the views and advice of intergovernmental and international non-governmental organisations which have a working relationship with IMO are also welcomed in these bodies. Many of these organisations have direct experience in the various matters under consideration, and are therefore able to assist the work of IMO in practical ways. There are 63 non-governmental organisations, including the World Nuclear Transport Institute (WNTI), which have consultative status with IMO, while 36 intergovernmental organisations have concluded Co-operation Agreements with IMO.

In relation to dangerous goods, the IMO committees with responsibility for technical decisions are the Maritime Safety Committee (MSC) and the Marine Environment Protection Committee (MEPC). Amongst the sub-committees, the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers (DSC), which reports to MSC, is the most active in this field.

When IMO adopts instruments, it strives for consensus in order to have them implemented by as many States as possible. IMO adopts both conventions and codes. Member governments are responsible for implementing a convention by agreeing to make it part of national law, whereas codes have the status of recommendations.

Regulatory Regime
Development of Regulations for the Sea Transport of Dangerous Goods

The need for international regulations governing the carriage of dangerous goods by sea was recognised by the 1929 International Conference on the Safety of Life at Sea (SOLAS), which recommended that rules on the subject should have international effect. The Safety of Life At Sea Conference of 1948 adopted a classification system for dangerous goods and certain general provisions concerning their carriage in ships in Chapter VI of the SOLAS Convention. It also recommended further study with the object of drafting international regulations.

Meanwhile, in 1956 the UN Committee of Experts published its first Recommendations, which offered a general framework to which existing modal dangerous goods transport regulations could be adapted and within which they could develop. The ultimate aim of the UN Orange Book was to bring uniformity to maritime and other modal transport rules on a worldwide basis.

As a further step towards meeting the need for international rules governing the carriage of dangerous goods in ships, the International Conference on Safety of Life at Sea in 1960 laid down a general framework of provisions in Chapter VII of the SOLAS Convention. The Conference also invited IMO to undertake a study with a view to establishing a unified international code for the carriage of dangerous goods by sea in co-operation with the UN Committee of Experts, taking account of existing maritime practices and procedures. The Conference further recommended that the unified code prepared by IMO should be adopted by the governments party to the SOLAS Convention. Following completion of the necessary development work, the International Maritime Dangerous Goods (IMDG) Code was adopted by the fourth IMO General Assembly in November 1965.

Like the other modal dangerous goods requirements, the IMDG Code covers nine classes of dangerous goods. Class 7 radioactive material is covered through incorporation in the IMDG Code of the relevant provisions of the IAEA Regulations for the Safe Transport of Radioactive Material. During the 1980s, the scope of the IMDG Code was extended to include provisions and requirements for the transport of substances and materials harmful to the marine environment, identified as marine pollutants. Inclusion of marine pollutants in the Code also assisted in the implementation of Annex III of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by its 1978 Protocol[61] (the 1973/78 MARPOL Convention[62]). Annex III contains the regulations for preventing pollution by harmful substances carried in packaged form, including packages in portable tanks, freight containers, road tankers and rail tank wagons. The harmful substances covered by MARPOL Annex III are thus those identified by GESAMP[63] as marine

61 This convention covers all technical aspects of pollution from ships, except the disposal of waste at sea by dumping, and applies to ships of all types, although it does not apply to pollution arising out of the exploration and exploitation of sea-bed mineral resources. It entered into force on October 2, 1983. It has two Protocols dealing respectively with *Reports on Incidents Involving Harmful Substances* and *Arbitration*. It also has six Annexes which contain regulations for the prevention of various forms of pollution. The six annexes are:
- pollution by oil (Annex I, entered into force 6 April 1987);
- pollution by noxious substances carried in bulk (Annex II, entered into force 6 April 1987);
- pollution by harmful substances carried in packages, portable tanks, freight containers, or road or rail tank wagons (Annex III, entered into force 1 July 1992);
- pollution by sewage from ships (Annex IV, entered into force September 2003);
- pollution by garbage from ships (Annex V, entered into force 31 December 1998);
- prevention of air pollution from ships (Annex VI, entered into force May 2005).

62 In fact, the 1978 Protocol to MARPOL, introduced stricter regulations for the survey and certification of ships. This procedure, in effect, meant that the Protocol has absorbed the parent Convention. States which ratify the Protocol must also give effect to the provisions of the 1973 Convention; there is no need for a separate instrument of ratification for the latter. The 1973 MAROPOL Convention and the 1978 MARPOL Protocol, therefore, should be read as one instrument, usually referred to as MARPOL 73/78.

63 Criteria for the designation of a substance as a marine pollutant are assessed by the Group of Experts in the Scientific Aspects of Marine Environment Protection (GESAMP), consisting of independent experts appointed by United Nations Agencies.

pollutants in the IMDG Code. GESAMP has not considered packaged radioactive material in the context of marine pollutants and Annex III does not apply to radioactive material.

In addition to the IMDG Code, the IMO introduced the Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes in Flasks on Board Ships (the INF Code) in 1993.

Convention for the Safety of Life at Sea (SOLAS Convention) Historical Development

The SOLAS Convention, in its successive forms, is the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the sinking of the Titanic, the second followed in 1929 and the third in 1948.

Up to the time of the 1948 SOLAS Conference, it was forbidden to carry "goods which by reason of their nature, quantity and mode of stowage" were likely to endanger the lives of passengers or the safety of the ship[64]. However, it was left up to each administration to determine which goods were to be considered dangerous and to indicate the precautions which had to be taken in their packing and mode of stowage. By 1948 maritime traffic had grown considerably and more and more cargoes were being transported which could conceivably be dangerous. To provide an international baseline, a new Chapter VI was added to the 1948 SOLAS Convention dealing specifically with the "Carriage of Grain and Dangerous Goods". The Conference recognised that existing provisions were not fully adequate and stressed the importance of international uniformity in the safety precautions applied to the transport of dangerous cargoes by sea. However, nothing concrete was to happen until the convention establishing the Inter-Governmental Maritime Consultative Organization (IMCO, the original name of IMO) entered into force in 1958.

Following the inception of IMO, a new SOLAS Conference was held in 1960. Effectively the first major task for IMO, the drafting of the 1960 SOLAS Convention represented a considerable step forward in modernising regulations and in keeping pace with technical

64 In SOLAS 1914, " the carriage of goods which by reason of their nature, quantity and mode of stowage" were likely to endanger the lives of the passengers or the safety of the ship was, in principle, forbidden. However, the way of drafting the convention established that national Administrations and competent authorities were responsible for defining which goods were dangerous and advising safety measures to be take in the packing, stowage and segregation of the goods. Even if SOLAS 1914 did not enter into force, the principle of relying on national administrations was established and resulted in the development of many diversified regulations and practices for the transport of dangerous goods.

developments in the shipping industry. Chapter VII of the revised 1960 Convention, which entered into force in 1965, dealt exclusively with the carriage of dangerous goods.

The intention was to keep the SOLAS Convention up to date by periodic amendments. However, the SOLAS amendment procedure proved to be very slow and it soon became clear that it would be impossible to secure the entry-into-force of amendments within a reasonable period of time. To overcome the problem a new SOLAS Convention was adopted in 1974[65] and entered into force in 1980. SOLAS 1974 has since been augmented by a 1978 Protocol and a 1988 Protocol. In addition, the 1974 SOLAS Convention has been amended several times, either through resolutions passed by IMO's Maritime Safety Committee (MSC) or Conferences of SOLAS contracting governments. The 1974 SOLAS Convention has been ratified by 155 countries and applies to some 98% of the world merchant marine gross tonnage, with 109 countries ratifying the 1978 protocol and 78 countries ratifying the 1988 protocol.

Content

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships. Flag states are responsible for ensuring that ships under their flag comply with these requirements and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow contracting governments to inspect ships of other contracting states if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the SOLAS Convention.

65 The content of the Convention is as follows:
- Chapter 1: General provisions (application, definitions, surveys and certificates);
- Chapter II: Construction: subdivision and stability, machinery and electrical installations, fire protection, fire detection and fire extinction;
- Chapter III: Life-saving appliances and arrangements;
- Chapter IV: Radiocommunications;
- Chapter V: Safety of navigation;
- Chapter VI: Carriage of cargoes;
- Chapter VII: Carriage of dangerous goods;
- Chapter VIII: Nuclear ships;
- Chapter IX: Management for the safe operation of ships;
- Chapter X: Safety measures for high-speed craft;
- Chapter XI-1: Special measures to enhance maritime safety;
- Chapter XI-2: Special measures to enhance maritime security;
- Chapter XII: Additional safety measures for bulk carriers.

Chapter VII, dealing with the carriage of dangerous goods, contains mandatory requirements for the transport of dangerous cargoes by sea and thereby initiates the legal basis for international and national regulations. Regulation 1 of Chapter VII Part A (Carriage of dangerous goods in packaged form or in solid bulk)[66] defines the International Maritime Dangerous Goods Code (IMDG Code). Regulation 2 covers application, and Regulation 3 specifically states that "the carriage of dangerous goods in packaged form shall comply with the relevant provisions of the IMDG Code". Regulation 4 deals with documentation. Regulation 5 refers to IMO's Cargo Securing Manual, and Regulation 6 covers the reporting of incidents involving dangerous goods.

Although there are neither specific requirements for non INF material nor a reference to the IAEA Regulations in SOLAS Chapter VII, Regulation 3 cross-references the IMDG Code. The Code, in turn, reproduces the IAEA Regulations as being the provisions which govern the carriage of Class 7 radioactive material by sea.

Chapter XI-2 introduced special measures to enhance maritime security adopted in December 2002 and entered into force on 1 July 2004, Regulation XI-2/3 of the new chapter enshrines the International Ship and Port Facilities Security Code (ISPS Code). Part A of the Code is mandatory and part B gives guidance

International Maritime Dangerous Goods Code (IMDG Code) Historical Development

The 1960 SOLAS Conference recommended, inter alia, that governments should adopt a uniform international code for the carriage of dangerous goods by sea, covering such matters as packing, containerised shipments and stowage. It further recommended that IMO, in co-operation with the UN Committee of Experts on the Transport of Dangerous Goods, should pursue its studies on such an international code, especially in respect of classification, description, labelling and shipping documents.

To carry out this mandate, in January 1961 IMO's Maritime Safety Committee (MSC) established a Working Group on the Carriage of Dangerous Goods (CDG)[67], bringing

66 There are two other parts: Part B deals with the Construction and Equipment of ships carrying dangerous liquid chemicals in bulk, Part C with the Construction and Equipment of Ships carrying liquefied gases in bulk and Part D with the Special Requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive waste on board ships.

67 In May 1995, the Sub-Committee was combined with the Sub-Committee on Containers and Cargoes (BC) to become the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers (DSC).

together experts nominated by Member States with considerable experience in this area. The Working Group met several times and worked in close co-operation with the UN Committee of Experts on the Transport of Dangerous Goods. This work culminated in the preparation of the International Maritime Dangerous Goods Code (IMDG Code), which was adopted by the fourth IMO General Assembly in 1965.

The Code set out in detail the requirements applicable to each individual substance, material or article. All those cargoes appearing in the list of dangerous goods prepared by the UN Committee of Experts were considered for the original Code. The exclusion of substances not carried by sea; the inclusion of further substances; and the transfer of substances between classes are dealt with in consultation with the UN Committee of Experts on a regular, ongoing basis as part of the rule amendment process.

Since its introduction in 1965, the IMDG Code has been amended many times to keep pace with technological and regulatory developments. Amendments to the IMDG Code originate from two sources - proposals submitted directly to IMO by member governments, and amendments required totake account of changes to the UN Recommendations on the Transport of Dangerous Goods. The latter requirement is embedded in Assembly Resolution A.717(17) adopted by IMO in November 1991, which stipulates that amendments to the UN Recommendations should be incorporated into the IMDG Code to ensure that it remains harmonised with the requirements of the other transport modes.

IMDG Code Amendment 32

The Code was reformatted into two volumes in 2001 with a Supplement, as Amendment 30 and was made a mandatory instrument. The Code now sets out the regulations and requirements for dangerous goods according to UN number, with the relevant parts of the IAEA Transport Regulations. The Supplement contains the INF Code.

The IMDG Code was reformatted to align with the UN Model Regulations on the Transport of Dangerous Goods as well as the other modal regulations governing the movement of dangerous goods by air, road, rail and inland waterway, which have also recently been harmonised with the UN requirements. Alignment of the various modal rules is seen as an important step in the drive to simplify the carriage of hazardous cargoes and streamline international multimodal transport operations.

Amendment 32 of the IMDG Code, based on the 13th edition of the UN Model Regulations, entered into force on 1 January 2005 with a transitional period lasting until 31 December 2005. During 2005 compliance with either Amendment 31 or 32 is permitted. However, as of 1 January 2006, shipping dangerous goods by sea must comply with Amendment 32 to the Code. This 12-month transitional period is deemed necessary because of complications from the amendment procedures for SOLAS and the Code (see below).

The Mandatory IMDG Code

The IMDG Code was not a mandatory instrument prior to 2001, but rather a recommendation which SOLAS member governments were urged to adopt as the basis for national regulations. In practice, the IMDG Code was well-supported and provided the accepted regime governing the international carriage of dangerous goods by sea. Considering the widespread acceptance of the Code, the IMO reviewed the practical and legal implications of making the Code mandatory. Many member states believed that such a step would strengthen the essential features of the Code; prevent misinterpretation; streamline the amendment process; and enable shipboard inspections to be carried out with non-compliances identified against a proper legal backdrop. In December 2000 the IMO Maritime Safety Committee (MSC) concurred and agreed to make the IMDG Code mandatory under SOLAS 1974.

However, MSC recognised the need for a degree of flexibility and that it would be impractical to make all the provisions of the Code mandatory. As a result, the following chapters of the Code remained as recommendations:

- Chapter 1.3 (Training);
- Chapter 2.1 (Explosives);
- Part of Chapter 2.3 (Determination of flash point);
- Chapter 3.2 (Dangerous Goods List);
- Chapter 3.5 (Transport schedules) (since deleted);
- Part of Chapter 5.4 (Multimodal dangerous goods form); and
- Chapter 7.3 (Special Provisions in the event of an incident).

Because the amendment procedures for the SOLAS Convention are more formal and time-consuming than the process historically used for the Code, it effectively takes a year longer for amendments to enter into force. Thus, revised editions of the IMDG Code are 12 months out of phase with the two-year revision cycles of the other modal regulations.

The most expedient solution to this problem has been to allow signatory countries to implement IMDG Code amendments early on a voluntary basis. For example:

Table 8 - Related Activities Amending the Mandatory IMO IMDG Code

Date/ Period	Session	Activities related to amendments to the IMDG Code
Dec – Even Year (2006)	UNCOE* (Geneva)	Adopts amendments to the UN Recommendations on the Transport of Dangerous Goods serving as a basis for the next (34) amendment to the Code
Jan – Odd Year (2007)		Provisions of amendment (33) apply on a provisional basis pending entry into force on 1 January next even year
Odd Year (2007)	IMO DSC	Agrees amendment (34)
Jan – Even Year (2008)		**IMDG Code amendment (33) enters into force and is mandatory without any transitional period**
Even Year (2008)	IMO MSC	Adopts amendment (34)
Dec – Even Year (2008)	UNCOE* (Geneva)	Adopts amendments to the UN Recommendations on the Transport of Dangerous Goods serving as a basis for amendment (35) to the Code

*UNCOE – United Nations Committee of Experts on the Transport of Dangerous Goods and the Globally Harmonised System of Classification and Labelling of Chemicals

Content

The new Code includes seven Parts, two Appendices and an Index, as follows:

- Part 1 - General provisions, definitions and training;
- Part 2 - Classification;
- Part 3 - Dangerous Goods List (DGL) and limited quantity exceptions;
- Part 4 - Packaging and tank provisions;
- Part 5 - Consignment procedures;
- Part 6 - Construction and testing of packagings, intermediate bulk containers (IBCs), large packagings, portable tanks and road tank vehicles;
- Part 7 - Requirements concerning transport operations;
- Appendix A - List of generic and NOS (not otherwise specified) Proper Shipping Names;
- Appendix B - Glossary of terms; and
- Index.

The first volume of Amendment 32 covers Parts 1, 2, 4, 5, 6 and 7, while the second volume incorporates Part 3, the two Appendices and the Index. The Supplement contains several related texts, including a new revised Medical First Aid Guide (MFAG), the INF Code, the Emergency Procedures (EmS) and sections on packing cargo transport units and the safe use of pesticides.

Like the reformatted UN Recommendations, the reformatted IMDG Code has, since Amendment 30, reproduced as its Class 7 provisions the IAEA Regulations for the Safe Transport of Radioactive Material. The Code refers to, and is consistent with, IAEA Regulations (TS-R-1) definitions, quality assurance and compliance, stowage and segregation measures, contamination/decontamination operations, categories, marking and labelling, transport documents and accidents. Packing, labelling, placarding, stowage, segregation and other requirements vary according to the radioactivity of the material. Packages are divided into three categories, depending upon radiation levels, and labelled appropriately.

International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes On Board Ships (INF Code)

In November 1993 the IMO Assembly adopted[68] the Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes in Flasks on Board Ships (INF Code). In May 1999 the IMO Maritime Safety Committee adopted amendments to Chapter VII of the SOLAS 1974 Convention making the INF Code mandatory under its new name, the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships. The amendments to the SOLAS Convention making the INF Code mandatory entered into force, under the tacit acceptance procedure, on 1 January 2001.

Complementing the IMDG Code and the IAEA Transport Regulations, the INF Code sets standards above those set by the SOLAS Convention for conventional ships. These enhanced standards apply to the design and operation of ships carrying cargoes included in the Code. The Code applies to all new and existing commercial ships, including those below 500 gross tons. The Code contains provisions for damage stability, fire protection, temperature control of cargo spaces, structural considerations, cargo securing arrangements, electrical supplies, radiological protection equipment, management, training and shipboard emergency plans.

The application of these provisions varies depending on the total activity of the INF cargo carried onboard and the type of ship. Ships carrying the materials covered by the Code are assigned to one of the following three classes:

- Class INF 1 ship: Ships certified to carry irradiated nuclear fuel, high-level radioactive wastes and plutonium with an aggregate radioactivity less than 4,000 TBq;
- Class INF 2 ship: Ships certified to carry irradiated nuclear fuel or high-level radioactive wastes with an aggregate radioactivity less than 2×10^6 TBq and ships certified to carry plutonium with an aggregate radioactivity less than 2×10^5 TBq; and
- Class INF 3 ship: Ships certified to carry irradiated nuclear fuel or high-level radioactive wastes and plutonium with no restriction on the maximum aggregate radioactivity of the materials.

Cargoes classified for INF 3 type ships may only be carried on purpose-built INF cargo ships, whereas cargoes specified for INF 1 and INF 2 class ships can be carried on conventional cargo and passenger ships.

68 Resolution A.748 (18).

Air Transport Regulations
International Civil Aviation Organization (ICAO)

History

The Convention on International Civil Aviation was signed in Chicago on 7 December 1944. The 96 articles of the Chicago Convention establish the privileges and restrictions of all contracting states, provide for the adoption of "International Standards and Recommended Practices"[69] regulating air navigation, recommend the installation of navigation facilities by contracting states and suggest the facilitation of air transport by the reduction of customs and immigration formalities.

Pending ratification of the Convention by 26 states, the Provisional International Civil Aviation Organization (PICAO) was established. By March 1947 the 26th ratification was received and the International Civil Aviation Organization (ICAO) came into being on 4 April 1947. In October 1947 ICAO became a specialised agency of the United Nations linked to the UN Economic and Social Council (ECOSOC). ICAO now has a membership of 189 contracting states.

The Convention on International Civil Aviation, or the Chicago Convention as it is known, is the constitution of ICAO and sets forth its purpose as follows:

"WHEREAS the future development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and peoples of the world, yet its abuse can become a threat to the general security; and
- WHEREAS it is desirable to avoid friction and to promote that cooperation between nations and people upon which the peace of the world depends;
- THEREFORE, the undersigned governments having agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operate soundly and economically;
- Have accordingly concluded this Convention to that end."

69 According to the ICAO, the Standard is a specification, the uniform application of which is necessary for the safety or regularity of international civil air navigation, while the Recommended Practice is a specification, the uniform application of which is desirable in the interest of safety, regularity or efficiency of international civil aviation.

The permanent body charged with the administration of these principles is the International Civil Aviation Organization (ICAO), made up of an Assembly, a Council of limited membership with various subordinate bodies, and a Secretariat. The chief officers are the President of the Council and the Secretary General.

ICAO Constituent Bodies

The Assembly, composed of representatives from all member states, is the sovereign body of the ICAO. It meets every three years, reviewing in detail the work of the Organization and setting policy for the next three years. During these sessions, the complete work of the Organization in the technical, economic, legal and technical cooperation fields is reviewed in detail and guidance given for future work. The Assembly also establishes a triennial operating budget. In the Assembly each contracting state is entitled to one vote and decisions of the Assembly are taken by a majority of the votes cast, except when otherwise provided in the Convention.

The ICAO Council is the Organization's governing body and is selected by the Assembly for a three-year term. It is composed of 36 member states, chosen by the Assembly from amongst the following three headings:

- states of chief importance in air transport;
- states that make the largest contribution to the provision of facilities for air navigation; and
- states whose designation will ensure that all major areas of the world are represented.

The Council, as the governing body, gives continuing direction to the work of ICAO. One of the major duties of the Council is to adopt "International Standards and Recommended Practices" and to incorporate these as Annexes to the Convention. The Council, with the assistance of the Air Navigation Commission (technical matters), the Air Transport Committee (statistical and economic matters), the Committee on Joint Support of Air Navigation Services, the Finance Committee, the Committee on Unlawful Interference, the Personnel Committee and the Technical Co-Operation Committee, provide the continuing direction for the work of the Organization. The Secretariat, headed by a Secretary General, is divided into five main divisions[70].

70 The Air Navigation Bureau, the Air Transport Bureau, the Technical Co-operation Bureau, the Legal Bureau and the Bureau of Administration and Services.

The Air Navigation Commission (ANC) is one of ICAO's three main bodies. Although the Council has responsibility for adoption of the "Standards and Recommended Practices" and approval of procedures, the Air Navigation Commission is the principal body concerned with their development. The Commission is composed of 16 experts who have "suitable qualifications and experience in the science and practice of aeronautics", appointed by the Council on the basis of proposals by contracting states. The ANC experts do not act as official representatives of their respective states, but rather as independent experts.

ANC reports to the Council and is responsible for the examination, coordination and planning of ICAO's technical work programme in the air navigation field. It is assisted in this work by the ICAO Secretariat and, particularly, the Air Navigation Bureau. In the advancement of solutions to particular problems requiring up-to-date and specialised expertise, the Commission is assisted by panels. Panels are small groups of experts, nominated by contracting states and international organisations and approved by the Commission. Once again, the panel members act in their personal expert capacity and not as national representatives.

ICAO and Dangerous Goods Transport Regulations

For nearly 30 years the air transport industry, through the International Air Transport Association (IATA), developed regulations for the international transport of dangerous goods by air. However, such industry-based rules did not carry the measure of policy control by member states required to ensure full international acceptance and compliance. For this reason the ICAO Air Navigation Commission initiated a study in 1975 on the international carriage of dangerous goods by air, and established a Dangerous Goods Panel of Experts to develop appropriate "Standards and Recommended Practices", together with supporting "Technical Instructions".

Now well-established, the Dangerous Goods Panel (DGP) is responsible for ensuring that ICAO requirements on the transport of dangerous goods, i.e. the Technical Instructions, are kept up to date. The DGP meets every two years and between sessions, DGP members meet annually in a "Working Group of the Whole". A special Ad-Hoc Group on Radioactive Material was convened to deal with specific items associated with the transport of radioactive material, although such meetings are likely to be rare now that the structure of the Technical Instructions is compatible with the IAEA Regulations.

At the DGP full and working group meetings proposals for changes are discussed and revised editions of the ICAO Technical Instructions prepared. Panel members propose changes and consider the latest amendments to the UN Recommendations and the IAEA Transport Regulations. Amendments to the ICAO Technical Instructions recommended by DGP will be reviewed by the Air Navigation Commission. The ICAO Council then will consider proposals, with a view to approving the amended version of the Technical Instructions and authorising their publication.

Air Transport Regulations
ICAO Technical Instructions (TI)

Annex 18 of the Convention on International Civil Aviation and the Technical Instructions for the Safe Transport of Dangerous Goods by Air (TI)

The main thrust of the technical work of the International Civil Aviation Organization since its inception has been to achieve agreement amongst Contracting States on the necessary level of standardised requirements governing the safe, regular and efficient operation of international civil aviation. The Organization agrees standards acceptable to the majority of Contracting States primarily through the creation of Annexes to the Convention on International Civil Aviation.

Today, there are 18 Annexes to the Chicago Convention, and the broad principles governing the international transport of dangerous goods by air are contained in Annex 18, the Safe Transport of Dangerous Goods by Air. Containing 12 chapters[71], Annex 18 was adopted in 1981 and became applicable on 1 January 1984.

71 Chapter 1: Definitions
Chapter 2: Applicability
Chapter 3: Classification
Chapter 4: Limitation on the transport of dangerous goods by air
Chapter 5: Packing
Chapter 6: Labelling and marking
Chapter 7: Shipper's responsibilities
Chapter 8: Operator's responsibilities
Chapter 9: Provision of information
Chapter 10: Establishment of training programmes
Chapter 11: Compliance
Chapter 12: Dangerous goods accident and incident reporting.

The Technical Instructions for the Safe Transport of Dangerous Goods by Air, often referred to as the Technical Instructions (TI), were first published in 1983. They contain the detailed specifications which support the broad provisions of Annex 18 and provide a fully comprehensive set of international regulations governing the air transport of dangerous goods.

A Supplement to the Technical Instructions provides information on the safe transport of dangerous goods by air that is primarily of interest to Contracting States. By publishing this information in a separate document, material which the average user does not need to know is removed from the Technical Instructions, thus reducing the size and complexity of the document and enhancing its comprehensiveness. Subjects dealt with in the Supplement include guidance for the issue of certain exemptions or approvals by States and the reporting of dangerous goods accidents and incidents to ICAO by Contracting States. The Supplement is published at the same time as the Technical Instructions. The ICAO provisions for the transport of dangerous goods are based on the UN Recommendations on the Transport of Dangerous Goods and on the IAEA Regulations for the Safe Transport of Radioactive Material.

Chapter 2 to Annex 18 of the Chicago Convention covers the applicability of the ICAO Technical Instructions. More specifically, paragraph 2.2.1 provides that "each contracting State shall take the necessary measures to achieve compliance with the detailed provisions contained in the Technical Instructions, approved, issued and amended in accordance with the procedure established by the ICAO Council". Paragraph 2.5.1 requires Contracting States to notify ICAO of those cases where they have adopted provisions different from those contained in the Technical Instructions. The variations, which have been notified by States, are listed in the Technical Instructions, together with or notified variations from airline operators. The effect is that, pursuant to Chapter 2, the Technical Instructions are a "standard" for the purposes of Annex 18 and are mandatory.

To keep pace with the constant introduction of new substances and developments in packaging technology, the Technical Instructions are reissued every two years. The current edition has been effective since 1 January 2005 whilst the 2007 – 2008 edition was finalised in October 2005 and will be published the second half of 2006 for implementation from 1 January 2007.

The ICAO Technical Instructions are divided into nine parts[72] and their detailed content gives all the necessary provisions to enable a consignment of dangerous goods to be correctly prepared for air transport. The Technical Instructions contain, among other things, a list of dangerous goods, including radioactive material, which is based on that of the UN. They also provide for classifying goods according to the UN system and give quantity limitations for each item, together with requirements for packing, marking, labelling, documentation, acceptance procedures, storage, loading.

IATA Dangerous Goods Regulations (DGR)

For many years before the development of the Technical Instructions by ICAO, the carriage of dangerous goods by air was generally carried out according to the provisions of the Restricted Articles Regulations (RAR) drawn up by the International Air Transport Association (IATA). IATA is a trade association representing and serving airlines throughout the world. Its primary objective is the promotion of safe, reliable and secure air services, and it includes over 263 airline members from all over the world.

In the early 1950s IATA recognised that there was a need to standardise the rules governing the transport of dangerous goods by air. As a result, a team of airline and technical experts was given the task of producing the IATA Restricted Articles Regulations. The first set of IATA regulations governing the international transport of dangerous goods was issued in 1956.

Updated editions of the IATA Restricted Articles Regulations were issued on a regular basis, usually annually, until 1983 when the ICAO Technical Instructions were first introduced. At that point the Restricted Articles Regulations were renamed the IATA Dangerous Goods Regulations (DGR) and aligned closely with the Technical Instructions. IATA decided to continue publishing DGR annually as an easy-to-use manual for its member airlines. In addition to the provisions of the ICAO Technical Instructions, DGR incorporates

72 Part 1: General
Part 2: Classification and list of dangerous goods
Part 3: Packing instructions
Part 4: Shipper's responsibilities
Part 5: Operator's responsibilities
Part 6: Training
Part 7: Packaging nomenclature, marking, requirements and tests
Part 8: Classification testing methods and procedures
Part 9: Provisions concerning passengers and crew

requirements such as specific guidance on the completion of the Shipper's Declaration for IATA airlines and member airline variations.

IATA acknowledges that its Dangerous Goods Regulations are based on the requirements of ICAO Annex 18 and the Technical Instructions, which are recognised as the sole authentic legal source material in air transport of dangerous goods. It is also stated in DGR that any additional or explanatory material added by IATA does not form part of the authentic text of the ICAO Technical Instructions and, therefore, does not have the same legal force.

The Dangerous Goods Regulations are updated by the IATA Dangerous Goods Board [73] and are published annually. The current (47th) Edition of the IATA Dangerous Goods Regulations came into effect on 1 January 2006, but is aligned with the current Edition of the ICAO Technical Instructions which covers the biennium 2005-2006.

Road and Rail Transport
Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID)

Development of RID

The rail transport of passengers and goods in Europe and in some other countries is subject to the provisions of the Convention concerning the International Carriage by Rail (COTIF) [74]. COTIF was adopted in May 1980 and entered into force 1 May 1985. The Convention has two appendices: one dealing with the carriage of passengers (CIV Uniform Rules) [75] and the other, with the carriage of goods (CIM Uniform Rules) [76]. The Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) [77] form Annex 1 of CIM [78].

73 The Dangerous Goods Board is composed of 12 airline dangerous goods experts who meet twice a year to review developments in the dangerous goods air transport field and, if necessary, establish new proposals or interpretations.

74 The acronym COTIF comes from the French title: **C**onvention relative aux **t**ransports **i**nternationaux **f**erroviaires.

75 The acronym CIV comes from the French title: **C**onvention **i**nternationale concernant le transport des **v**oyageurs et des bagages par chemins de fer.

76 The acronym CIM comes from the French title: **C**onvention **i**nternationale concernant le transport de **m**archandises par chemins de fer.

77 The acronym RID comes from the French title: **R**èglement concernant le transport **i**nternational ferroviaire des marchandies **d**angereuses.

78 Annex 2 is the *Regulations concerning the International Haulage of Private Owner's Wagons by Rail* (RIP) and Annex 3 is the *Regulations concerning the International Carriage of Containers by Rail (RICo)*.

The first regulations to control freight traffic by rail were developed in 1850, and in 1893 the first convention governing international goods traffic by rail in Europe entered into force. This included provisions regarding certain types of traffic, such as dangerous goods that were only to be accepted under specified conditions. Although it has been subject to considerable expansion and amendment over the years, the 1893 Convention represents the origin of the modern RID Regulations. RID applies to the international transport of dangerous goods by rail between the 42 COTIF signatory States[79]. In addition, the RID requirements have been annexed to European Union Council Directive 96/49/EC[80], so that they also apply to the rail transport of dangerous goods, including radioactive material, within and between EU Member States.

RID sets out the minimum standards for safe packing and transport of various types of dangerous goods travelling to or through another country. These standards concern, inter alia, packaging, labelling, and consignment procedures.

The dangerous goods covered by the RID are classified in accordance with the UN system, and the IAEA Regulations have been adopted to apply to the rail transport of radioactive material. RID consists of three basic parts:

- Part I: General requirements which contain the structure of the regulations, definitions and a list of units of measurements;
- Part II: Special requirements for the various classes. In RID dangerous substances and articles are categorised according to type of hazard into nine main classes, the numbering of which follows that of the UN Recommendations. As regards radioactive material, RID like the other modes has fully adopted the provisions of the IAEA Transport Regulations; and
- Part III: Appendices providing details of technical requirements for testing and approval of tanks, receptacles and equipment and other matters.

When provisions governing the international transport of dangerous goods in the European region were first considered in the 1950s, RID served as a model their development. Not only has the European Agreement concerning the International Carriage

79 Albania, Algeria, Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iraq, Iran, the Republic of Ireland, Italy, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Macedonia, Monaco, Morocco, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria, Tunisia, Turkey, Ukraine, the United Kingdom of Great Britain and Northern Ireland.

80 Council Directive 96/49/EC of 23 July 1996 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by rail.

of Dangerous Goods by Road (ADR) been closely aligned with RID from the outset, the modal authorities responsible for both sets of provisions have continued to work jointly since that time to update the two sets of regulations in a harmonised manner. The two sets of regulations are updated and amended, like the other major modal transport regulations, biennially. The revised editions of the two sets of regulations incorporate the latest agreed changes to the UN Recommendations (UN Model Regulations), which are also amended every two years.

Intergovernmental Organisation for International Carriage by Rail (OTIF)

The first International Convention concerning the Carriage of Goods by Rail (CIM) was adopted in 1890 and entered into force three years later. CIM included provisions regarding certain types of traffic, such as dangerous goods that were only accepted under specified conditions. The Convention has been updated regularly and, in addition, an International Convention concerning the Carriage of Passengers and Luggage by Rail (CIV) has also been adopted.

In May 1980 several countries, recognising the need to adapt the provisions of international transport law to economic and technical requirements, adopted the Convention Concerning International Carriage by Rail (COTIF). COTIF states that "Parties to this Convention shall constitute, as Member States[81], the Intergovernmental Organisation for International Carriage by Rail (OTIF)[82]. OTIF is based in Bern, Switzerland, and is comprised of a number of key constituent parts. These include its General Assembly, the Administrative Committee, the Revision Committee, the Committee of Experts on the Carriage of Dangerous Goods and the Central Office for International Carriage by Rail (OCTI). The General Assembly, composed of representatives of Member States, is the sovereign body of the Organisation, and the Administrative Committee is the governing body. The Central Office acts as the Secretariat for the Organisation.

81 OTIF Member States are Albania, Algeria, Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iraq, Iran, the Republic of Ireland, Italy, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Macedonia, Monaco, Morocco, the Netherlands, Norway, Poland, Portugal, Romania, Serbia and Montenegro, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria, Tunisia, Turkey, the United Kingdom and Ukraine.

82 The acronym comes from the French name: Organisation Intergouvernementale pour les **T**ransport **I**nternationaux **F**erroviaires.

The Committee of Experts on the Carriage of Dangerous Goods is responsible for updating and amending the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) and is composed of representatives of the Member States. On the basis of the agreement of a majority of the Member States, the Central Office can invite non-member States, international organisations and independent experts having competence in transport matters to the meetings of the Committees in an advisory capacity.

For many years, a safety sub-group of the Committee of Experts, known as the RID Safety Committee has been meeting jointly with the ECE's Working Party on the Transport of Dangerous Goods (WP 15) for the purpose of ensuring harmonisation between the provisions governing the carriage of dangerous goods by rail and road.

European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)
Development of ADR

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)[83] is a two-volume Agreement drawn up by the United Nations Economic Commission for Europe (UN/ECE). Under the auspices of this rulemaking, most states in Europe have agreed on common rules for the movement of dangerous goods by road across their frontiers and through their territories[84]. Although the ADR Agreement was first signed in 1957, it did not enter into force until 29 January 1968. The long entry-into-force period necessitated an update to the detailed provisions as originally drafted. The detailed rules were first published, as Annexes A and B, in 1969.

The ADR requirements have been annexed to European Union Council Directive 94/55/EC[85]. Under this initiative, ADR has applied to the domestic transport by road of dangerous goods, including radioactive material, both within and between EU Member States since 1 January 1997.

83 Accord europeen relatif au transport international des merchandises **d**angereuses par **r**oute et protocole de signature en date, a Geneve, du 30 Septembre 1957.

84 The 40 contracting parties to the Agreement are: Albania, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Morocco the Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Serbia and Montenegro, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, Ukraine and the United Kingdom Note: Ireland is not a party to ADR but the EU Framework Directive requires its application.

85 Council Directive 94/55 EC of 21 November 1994 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road.

The second article of the ADR Agreement states that, apart from a limited number of dangerous goods, dangerous goods may be moved internationally in road vehicles provided that the following conditions are met:

- the packaging and labelling are in accordance with Annex A to the Agreement. Annex A lists the dangerous goods that may be carried internationally. It also gives rules for packaging and labelling, and for describing goods in the transport documents. All these rules must be applied by the consignor of the goods; and
- the vehicle construction, equipment, and operation are in accordance with Annex B. The carrier is responsible for compliance with the Annex B provisions governing the vehicles and the transport operations.

The system of classification of dangerous goods under ADR follows closely that of the UN Recommendations. Regarding radioactive material, ADR, like the other modal dangerous goods transport rules, implements requirements which are based on the principles and provisions of IAEA Transport Regulations.

As mentioned, RID and ADR retain their common base, and are revised together at joint meetings for subsequent, separate approval by the respective rail and road experts. Additional requirements, specific to the particular mode of transport, are also agreed at these follow-up plenary meetings. During the regular joint RID/ADR revision meetings, every effort is made to achieve the greatest possible harmony of the rail and road provisions with the UN Recommendations and the IAEA Transport Regulations. ADR, like RID and the other modal dangerous goods regulations, is amended every two years to tie in with revision cycle of the UN Recommendations (UN Model Regulations).

UN Economic Commission for Europe (UNECE)

The Economic Commission for Europe (ECE) is a United Nations agency and one of the Economic Commissions set up by ECOSOC to enable countries within various regions to study relevant economic problems and to recommend concerted and cooperative approaches that will help overcome these regional problems. The countries of North America, Western, Central and Eastern Europe, and Central Asia gather at the UNECE forum to negotiate agreements and develop assistance activities as part of the drive to harmonise their individual policies and practices. Such harmonisation not only facilitates targeted investment and the integration of transport networks, but also increases the effectiveness of environmental measures.

The ECE Transport Division and Inland Transport Committee (ITC) were established shortly after 1945. The ITC has responsibilities for transport by road, rail and inland waterways. The following subsidiary bodies of ITC are responsible for dangerous goods transport by differing modes:

- the Working Party on the Transport of Dangerous Goods (WP 15) is mainly responsible for the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). It also is empowered to amend Annexes A and B of the ADN as the need arises;
- the Joint Meeting of the Working Party on the Transport of Dangerous Goods (WP) and the RID Safety Committee. This joint Meeting is serviced jointly by the ECE Secretariat and the Secretariat of the Intergovernmental Organisation for International Carriage by Rail (OTIF). It is responsible for ensuring harmonisation between ADR and RID; and
- the Meeting of Experts on the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterway (ADN) which is responsible for amending and restructuring ADN. This body is a subsidiary body of the Working Party on the Transport of Dangerous Goods (WP 15).

Restructured RID and ADR

The 2005 editions of the ADR Agreement and the RID Regulations entered into force on 1 July 2005.

In the 2001 editions of RID and ADR provisions were amended in such a way as to reflect the format of the UN Model Regulations. This necessitated a major restructuring of these two sets of modal transport regulations. Subsequent editions have continued this format.

The ADR Agreement has now been ratified or acceded to by 40 countries of which 24 are members of the European Union.

MERCOSUR/MERCOSUL Agreement

The MERCOSUR/MERCOSUL[86] Agreement of Partial Reach to Facilitate the Transport of Dangerous Goods signed by Brazil, Argentina, Paraguay and Uruguay regulates the road

86 Mercado Comun del Sur (Spanish) Mercado Comum do Sul (Portugese): Southern American common market created by the 1991 Treaty of Asuncio, signed by Argentian, Brazil, Paraguay and Uruguay. Chile and Bolivia have been Associate Members since 1996.

and rail transport of dangerous goods, including radioactive material, between these States and is consistent with the IAEA Transport Regulations.

ASEAN Agreement

The ASEAN Agreement[87] will eventually require compliance with the provisions of ADR for land transport within the Member States and will include the radioactive material provisions.

Inland Waterway Transport

European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)

Until recently, European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) had the status of recommendations and was published as the European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterways. The ADN Provisions were prepared as guidelines for use by governments of European countries having an inland waterway network, and by the various international River Commissions. The ADN Provisions were not regularly updated due to the existence of specific agreements for rivers, such as the ADNR Convention covering international dangerous goods traffic on the River Rhine.

However, following proposals by the Danube Commission and the European Commission that the recommendations be updated, a consolidated edition of the ADN Provisions, taking into account all the amendments adopted up to June 1996, was published in 1997 by the Economic Commission for Europe. At the same time this work was underway, it was agreed that it would be useful to have a binding instrument governing the inland transport of dangerous goods. In January 1995 the Inland Transport Committee of the UN Economic Commission for Europe established an international working group to draft, jointly with the other organisations concerned, a European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways. The decision accorded with the expressed will of the European Union to harmonise the regulations of its Member States.

87 The Association of South Eastern Nations – Brunei Durassalam, Cambodia, Indonesia, Laos, Malaysia, Myanamar, Phillipines, Singapore Thailand and Vietnam.

A draft instrument was duly prepared by this special working group and at a diplomatic conference on May 25, 2000 the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterway (ADN) was adopted under the joint auspices of UN Economic Commission for Europe and the Central Commission for the Navigation of the Rhine (CCNR). ADN thus provides a legal instrument for the control of the international transport of dangerous goods by inland waterway. It is also the intention of the European Union to adopt a Council Directive which would oblige EU Member States to use the ADN Agreement as a basis for national rules governing the transport of dangerous goods by vessels on inland waterways. In this way not only would national and international inland waterway rules be aligned, but also these rules would be harmonised with the UN system and other modal dangerous goods transport regulations to the greatest extent possible.

As currently configured, the ADN Agreement consists of a number of technical Annexes. Annex A contains the provisions concerning dangerous substances and articles. The Annex B.1 provisions deal with the carriage of dangerous goods in packages or in bulk, and include requirements applicable to vessels; general service requirements; additional requirements concerning the loading, carriage, unloading and other handling of cargo; additional requirements concerning the operation of vessels; specific provisions applicable to the carriage of dangerous goods; and rules for construction. Annex B.2 sets out provisions concerning the carriage of dangerous goods in tank vessels.

The ADN Agreement is based on the UN classification system for dangerous goods and follows the IAEA Transport Regulations where the carriage of radioactive material is concerned. For these cargoes, ADN requires that packagings be segregated by a distance of 15 metres during transport to limit radiation exposure of persons, accommodation or regularly occupied working areas if no protective material separates them and when the duration of exposure does not exceed 250 hours per year. The ADN Agreement also requires radioactive material be segregated from other dangerous goods; from packages bearing the word "FOTO"; and from mailbags in accordance with a table which indicates minimum distance in metres by taking into account the total number of packages; the sum of transport indexes; and the journey or storage duration.

The ADN Agreement has been reformatted to reflect the layout of the UN Model Regulations, in much the same way as has already been done with the other modal dangerous goods transport regulations. Since 2001, the UN Secretariat has applied relevant developments to RID and ADR to update the text of the ADN Agreement pending its entry

into force. As part of this initiative, Annexes A, B.1, B.2, C, D.1 and D.2 is be replaced by a regulation consisting of nine parts. As part of the overall alignment process, the Central Commission for the Navigation of the Rhine (CCNR) has announced that it is restructuring its own regulations governing the carriage of dangerous goods on those sections of the River Rhine that fall within the aegis of the Commission.

The CCNR regulations are typical of a number of agreements governing the transport of dangerous goods on specific rivers in Europe, all of which are now closely aligned with the ADN Agreement. The development of the CCNR regulations - Europe's original inland waterway regulations for dangerous goods - are described below.

Agreement Concerning the International Carriage of Dangerous Goods on the Rhine (ADNR)

The Agreement concerning the International Carriage of Dangerous Goods on the Rhine (ADNR)[88] is a Convention covering international traffic on the River Rhine. The carriage of goods on the River Rhine was first regulated under the Convention of Mannheim of 1868. Signed by Rhine riverside states, the Convention affirmed, inter alia, the right of free passage on the Rhine waterway from Switzerland to the open sea, deterring any state from obstructing such passage. The Central Commission for the Navigation of the Rhine (CCNR) is responsible for implementing the Mannheim Convention and for the safety of navigation of the waterway. Under this obligation, CCNR developed a safety control regime for dangerous goods transport. Directed mainly at bulk cargoes transported by barge initially, the regime was extended to encompass packaged dangerous goods. Known as ADNR, the regime sets the technical and operational safety requirements for the licensing and operation of inland navigation vessels carrying dangerous goods, i.e. ADNR.

Membership of CCNR includes representatives from Germany, Belgium, France, Netherlands and Switzerland. The Commission meets half-yearly and adopts various resolutions for the promotion of Rhine navigation, as well as technical and administrative regulations covering the safety of navigation. The Dangerous Goods Committee and its Working Group on Dangerous Goods are responsible for ADNR. CCNR is in the process of restructuring ADNR to align more closely with the UN Model Regulations and participated, with the UN Economic Commission for Europe, in the similar exercise involving ADN.

88 This acronym comes from the French ADR title (**A**ccord relatif au transport de merchandises **D**angereuses par voies de **N**avigation interierures), which has been adapted for the provisions on the **R**hine.

Postal Transport
Universal Postal Union (UPU)

In 1874 representatives from 22 countries signed a treaty establishing the General Postal Union in Berne. Membership in the Union grew so quickly that the name of the organisation was changed to Universal Postal Union in 1878. UPU became a specialised UN agency on 1 July 1948, and today there are 189 Member States of the Union.

According to its constitution, the Union is charged with "developing communication between peoples by the efficient operation of the postal services, and contributing to the attainment of the noble aims of international collaboration in the cultural, social and economic fields".

The Universal Postal Congress brings together representatives of all Member States, and is the Union's supreme authority. Congress meets every five years in order to revise the Acts of the Union. In recent years Congress has tended to delegate more regulatory power to two UPU Councils, in order to focus more closely on broad policy issues.

The UPU Council of Administration (CA) ensures the continuity of the Union's work between Congress sessions by supervising Union activities and studying regulatory, administrative, legislative and legal issues. The Council has 40 Member States and, in principle, it meets annually. In order to ensure the UPU's ability to react quickly to changes in the postal environment, CA has been given the power to approve proposals from the UPU Postal Operations Council for the regulations or new procedures until the next Congress can decide on matters. CA can also take measures within its competence that it considers necessary to resolve urgent affairs. CA approves the annual budget and accounts of the Union, as well as yearly updates of the UPU's Programme. It also is responsible for promoting and coordinating all aspects of technical assistance among Member States.

The Postal Operations Council (POC), consisting of 40 elected Member States, is the UPU's technical and operational body. It deals with the operational, economic and commercial aspects of international postal services, promotes the introduction of new postal products, and prepares recommendations to Member States concerning standards for technological, operational or other processes within its competence where uniformity of practice is essential.

The UPU International Bureau provides secretariat and support facilities for the UPU's bodies, serves as a liaison, information and consultation body, and promotes technical cooperation among UPU Members.

The UPU bodies most involved with the shipment of radioactive material using postal services are the UPU Congress and the Council of Administration.

Detailed Regulations Implementing the Universal Postal Convention

UPU Member States are bound by the Acts of the Union. The UPU Constitution is the fundamental Act containing the organic rules of the Union. The provisions relating to the application of the Constitution and the operation of the Union are contained in the General Regulations of the Universal Postal Union. These are revised at each Universal Postal Congress. The common rules applicable to the international postal service and the provisions concerning the letter-post and parcel post services are given in the Universal Postal Convention and its Detailed Regulations[89]. The Detailed Regulations set out measures for ensuring the implementation of the Convention. The Postal Operations Council has the authority to amend the Detailed Regulations at its annual sessions.

The UPU Convention was signed in Vienna in 1964. Under the terms of the Convention, the IAEA Transport Regulations were implemented with respect to postal services in 1966. Congress has regularly amended the Convention; the last major updating took place during the 1999 Beijing Congress.

The UPU Convention is now included in a publication called the Manual of the Universal Postal Convention published by the Union, replacing Volume 2 of the Annotated Acts. The Manual also includes the Detailed Regulations as revised by the Postal Operations Council in 2000, and the commentary made by the International Bureau. The 2000 version of this Manual is the current edition.

89 The other Acts include: the Postal Parcels Agreement and Detail Regulations, the Money Orders Agreement, Giro Agreement, and Cash-on-Delivery Agreement.

The Convention is composed of five parts[90]. Article 26 addresses items prohibited from insertion in letter-post, including explosive, flammable and other dangerous goods. According to the Convention, radioactive material, as well as perishable biological substances, can be despatched via letter-post, subject to compliance with a stringent set of conditions.

Article 24 of the Universal Postal Convention states that radioactive material made up and packed in accordance with the Detailed Regulations may only be posted by duly authorised senders. The corresponding Detailed Regulations (Article RE 2402) state that "Items containing radioactive material, whose contents and make-up comply with the regulations of the International Atomic Energy Agency providing special exemptions for certain categories of items, shall be admitted for conveyance by post subject to prior consent from the competent authorities of the country of origin". The Article also requires that the outside packing shall be plainly and durably marked with the words "Radioactive material. Quantities permitted for movement by post." These words should be officially crossed out should the packing be returned empty to the place of origin. It shall also bear, in addition to the name and address of the sender, a request in bold letters for the return of the items in the event of non-delivery.

The conveyance by post of radioactive material is restricted, therefore, to consignments exempted from special conveyance prescriptions within the meaning of the IAEA Regulations for the Safe Transport of Radioactive Material, because of their very low activity. This is subject to prior consent from the competent authorities of the country of origin.

90 Part I: Rules applicable in common throughout the international postal service
Part II: Provisions concerning the letter post: Provisions of services
Part III: Provisions concerning the letter post: Relations between postal administrations
Part IV: EMS
Part V: Final Provisions

5 Achievement of a More Harmonised Safety Regime

The 1996 Edition of the IAEA Transport Regulations, as revised (TS-R-1) entered into force for all modes of transport through incorporation in the various modal dangerous goods regulations. Table 9 (see below) illustrates the implementation and enforcement dates of the current edition of the various modal dangerous goods regulations.

Table 9 – Implementation Dates for Radioactive Material Transport Regulations

	Mode	Implementation Date	Enforcement Date	Transition Period
ADR Regulations	Road	1 January 2005	1 July 2005	6 months
RID Regulations	Rail – Europe	1 January 2005	1 July 2005	6 months
ICAO/Technical Instructions	Air	1 January 2005	1 January 2005	0
IMO/IMDG Code	Sea	1 January 2005	1 January 2006	12 months

Ideally, the new editions of the modal transport regulations will all enter into force and become mandatory on the same dates. The various modal regulations are now harmonised on a biennial revision cycle, in line with the schedules used by the experts responsible for amending and updating the UN Recommendations on the Transport of Dangerous Goods and the IAEA Transport Safety Regulations. The new editions of all the modal transport regulations incorporate amendments contained in the 13th Edition of the UN Recommendations which was agreed in December 2002, including the provisions of TS-R-1 governing radioactive material transport. The UN Recommendations were reformatted to provide a set of UN Model Regulations on which all modal dangerous goods transport regulations can be based.

The 2001 editions of the modal transport regulations represented a major breakthrough and the greatest degree of modal rule harmony then achieved. The UN, IAEA and modal authorities are geared up to working in close cooperation to fine tune the regime even further in future. Implementation of the 2003 edition and the processing of the 2005 edition confirm this expectation. The 2005 edition of the IAEA regulations should be duly incorporated in due course after the changes therein are included the CETDG&GHS report to ECOSOC in December 2006, and the modal transport regulations are aligned accordingly during 2007- 2008 for implementation from 1 January 2009.

6 Conclusion

A network of modal safety regulations based on the IAEA Transport Regulations applies to the transport of radioactive material, assuring a stable and consistent regulatory framework for the transport of radioactive material. These regulations have been reviewed regularly to keep pace with scientific developments. Close interaction between all parties to this international transport safety regulatory regime is important to ensuring consistency in implementation and future revisions.

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