

# The IAEA Transport Regulations

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by G.E. Swindell

Substances such as fuels, corrosive chemicals, poisons and explosives, which are potentially harmful to human health and to the natural environment, have been moved within countries, and between different countries for many years. National and international rules have been established for the packing and transport of these materials. Accidents have occurred from time to time leading to loss of life and pollution of the countryside or the sea coast. The risks are broadly accepted by the public as part of the price of industrial development. Occasionally the damage is sufficient to create a public demand for improvement in the regulatory control.

Radioactive materials are also potentially harmful. They must be prevented from spreading outside the packaging in which they are transported and the external radiation outside the package must be reduced to acceptable levels. Two additional factors must be taken into account in the transport of radioactive materials. First, some of those which are used for medical purposes have a short life and any undue delay will destroy their usefulness. Second, public opinion demands a higher standard of safety in all matters connected with radioactive substances.

The problems arising in the safe and rapid movement of radioactive materials were foreseen, and an effective world-wide regulatory control system was established before they became a significant proportion of the potentially dangerous goods being handled. Several millions of packages have now been transported throughout the world. Accidents still occur in all modes of transport. But as a result of the regulatory control, no serious injuries can be attributed to the radioactive properties of the materials and no significant contamination of the environment has occurred.

The relevant regulations enforced by the international transport organizations and by most of the national authorities are firmly based on the IAEA Regulations for the Safe Transport of Radioactive Materials which were first issued in 1961 and have since been brought up to date and expanded at appropriate intervals.

## DEVELOPMENT OF THE IAEA TRANSPORT REGULATIONS

By 1959, there were various national and international regulations permitting the transport of radioactive ores and relatively small amounts of radioactive substances for medical and industrial applications. These were based mainly on the United States Interstate Commerce Commission regulations. Special permits had to be issued for the transport of larger quantities of radioactive and fissile materials.

It was recognized that the IAEA was in a favourable position to take the lead in drawing up truly international regulations, applicable to all modes of transport. The Economic and Social Council of the United Nations accordingly passed a resolution in July 1959 advising,

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“that the Agency be entrusted with the drafting of recommendations on the transport of radioactive materials, provided that they are consistent with the framework and general principles of recommendations of the Committee of Experts on the Transport of Dangerous Goods of the United Nations and that they are established in consultation with the United Nations and the specialized agencies concerned”.

With the help of panels, comprising experts recommended by Member States and representatives of international organizations concerned with the transport of goods, in 1960 the IAEA prepared draft Regulations for the Safe Transport of Radioactive Materials. These Regulations were approved by the Board of Governors in 1960 as a component of the Agency's Safety Standards and were published as Safety Series No 6 in 1961. As approved, the Regulations are mandatory only for work performed by the IAEA and for work in Member States for which the IAEA provides substantial assistance under the terms of an agreement. However, the Board also recommended that all Member States and international organizations should take them into account when establishing or revising their own regulations.

The Regulations were reviewed at intervals between 1963 and 1966 by consultants and by panels of experts. These reviews expanded the prescriptions relating to packaging design principles and tests, to criticality control, and to specific design and shipment procedures for the transport of spent reactor fuel. Revised editions of the Regulations were published in 1964 and in 1967. A comprehensive review of the Regulations, based on almost ten years of experience, was undertaken by a panel of experts between February 1970 and October 1971. In the words of the Chairman of the panel, the aim of the review was to ensure that the revised regulations should be safe, practical, clear and concise. The draft revised Regulations were approved by the Board of Governors in 1972 and later published as the 1973 Revised Edition of Safety Series No.6. Ref. [1]

During this review, descriptions of technical procedures for complying with the basic regulatory requirements were deleted from the Regulations. These procedures, together with additional material of an advisory nature, were published in 1973 as Safety Series No.37, “Advisory Material for the Application of the IAEA Transport Regulations”. Ref. [2]

The Director General was also authorized by the Board of Governors to promulgate from time to time any changes of detail necessary to keep the Regulations technically up to date. Such promulgation requires that written notice be given to Member States at least ninety days in advance and that due account be taken of any comments they may submit. Changes of detail were promulgated by the Director General in May 1975 and December 1977.

In the review of the Regulations and the development of advisory material the IAEA has been greatly helped by the Radioactive Transport Study Group, an independent association of representatives of the competent authorities of countries which are actively engaged in the international transport of radioactive materials. This Study Group was set up in 1967 under the aegis of the IAEA, and has met eight times since, at intervals of twelve to eighteen months. The discussions of the Group have helped to resolve many practical problems and its recommendations on administrative regulatory requirements were accepted as formal proposals by the panels reviewing the IAEA Regulations.

In accordance with the recommendations of an Advisory Group which met in March 1977 to consider the IAEA's future programme on the safe transport of radioactive materials, a

Standing Advisory Group has been established. This will provide continuing advice to the Agency on the interpretation, implementation, evaluation and revision of the Regulations. It met for the first time in October 1978.

## ADOPTION OF THE IAEA REGULATIONS

The 1973 Revised Edition of the IAEA Regulations, modified to take into account the subsequent changes of detail, has been incorporated into other relevant international regulations and recommendations. These include.

- a) The International Maritime Dangerous Goods Code, which covers transport of goods by sea and is issued by the United Nations Intergovernmental Maritime Consultative Organization. Ref. [3]
- b) The European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), prepared by the Economic Commission for Europe. Ref. [4]
- c) Regulations (RID) annexed to the International Convention Concerning the Carriage of Goods by Rail. Ref. [5]
- d) The current edition of the Regulations Relating to the Carriage of Restricted Articles by Air, issued by the International Air Transport Association. Ref [6]

It forms the basis of the national regulations of very many Member States. Its incorporation in national regulations has often been delayed because of the time-consuming negotiations required for inclusion in the applicable international regulations. Some problems still exist, stemming largely from a lack of public understanding and acceptance of the level of safety provided by these Regulations. These problems require early and co-ordinated international attention.

## BASIC SAFETY REQUIREMENTS OF THE IAEA REGULATIONS

The Regulations aim to provide safety by ensuring the protection of transport workers, the general public and the environment against any damage that might be caused by the radioactive or fissile properties of the materials. They do not necessarily provide complete protection against diversion, theft or deliberate opening or damage of the packaging. Protection against such additional hazards is provided by supplementary physical protection or security measures.

The safety prescriptions aim at providing, under normal and accident conditions:

1. Adequate containment of the radioactive material in the packages.
2. Adequate control of the levels of external radiation surrounding the packages
3. Safe means of dissipating any heat generated within the radioactive material
4. Criticality control, if the material is also fissile.

Another important requirement is that the consignments can be transported rapidly with a minimum of special treatment. Where possible they should be dealt with in the same way as other goods that are carried by conventional means of transport and handled routinely by workers with no specialized training. This entails incorporating the necessary safety features in the packaging and making them the responsibility of the consignor so far as possible. Any contribution to safety by the carrier should be reduced to a minimum.

## **(a) Containment**

One of the functions of the packaging is to prevent the radioactive contents from escaping. It would impose an intolerable burden to require that all packaging should prevent any release of the contents during both normal conditions and the most severe accident conditions. Two types of packaging are therefore prescribed, Type A and Type B.

### **Type A packaging**

The Type A packaging is designed to withstand normal conditions including the somewhat rough handling it will receive from busy transport workers. It must pass a series of tests to ensure that it will withstand these conditions. It must be assumed that Type A packaging will be damaged in a severe accident and that a fraction of the contents may be released. Limits are therefore prescribed in the Regulations for the maximum activities of individual radionuclides that can be transported in Type A packaging. Observance of these limits ensures that in the event of a release, the hazards resulting from external radiation or contamination are not unacceptable.

### **Type B packaging**

Larger activities must be transported in a Type B packaging. Type B packaging is intended to withstand the most severe accidents. It must pass an additional series of mechanical and fire tests and must be certified by the competent authorities of the country in which the packaging was designed. The approval certificate specifies the largest activities of individual radionuclides that can be transported in the packaging. Packaging which meets all of a series of design requirements is referred to as Type B(U). It requires unilateral approval by the competent authority of the country of origin of design only. Packaging which does not meet all of these requirements is referred to as Type B(M). It requires multilateral approval by the competent authorities of all the countries through which, or into which, the package is to be transported.

### **Low specific activity and low-level solid radioactive materials**

These materials are inherently safe either because the specific activity is very low or because the material is in a form which cannot easily be dispersed. Low specific activity materials, such as radioactive ores, can be transported either in bulk as a full load, or in packaging meeting less stringent requirements than those for Type A. Low-level solid radioactive materials, such as processed low-level wastes, can be transported as a full load in strong industrial packaging.

## **(b) Shielding**

Many radioactive substances emit penetrating radiation which is only partially absorbed in the containment system of the packaging. Additional shielding must be incorporated to reduce the radiation levels around the packaging to acceptable values. These acceptable values are based on considerations of the exposure of persons and of very sensitive materials such as photographic emulsions. It would again impose an intolerable burden to require that all packaging should be shielded to such an extent that it need not be segregated from persons or photographic films, however long the journey.

Packages are therefore classified in three categories, defined in terms of the radiation levels on the surface of the package and at a distance of one metre from the surface. These categories are:

1. Category I-WHITE, in which the maximum level at the surface is 0.5 mrem/h. The package is identified by a label carrying the trefoil symbol on a white background, the word RADIOACTIVE and one red stripe.
2. Category II-YELLOW, in which the radiation level at the surface does not exceed 50 mrem/h and the level at one metre does not exceed one mrem/h. The background of the upper part of the label is yellow and there is a written statement of the radiation level at one metre (transport index), the word RADIOACTIVE and two red stripes.
3. Category III-YELLOW, in which the radiation level at the surface does not exceed 200 mrem/h and the transport index does not exceed 10. The background of the label is again yellow and there is a written statement of the transport index, the word RADIOACTIVE and three red stripes.

Transport workers are provided with tables which permit them to segregate consignments of Category II-YELLOW and Category III-YELLOW packages from persons and from photographic film on the basis of the sum of the transport indices of the packages in the consignments. Category I-WHITE packages do not need to be segregated.

#### **(c) Dissipation of heat**

Heat is generated in packages containing high activity materials and means may be required for cooling the outer surface of the package. The outer surface of large casks for transporting spent fuel are provided with fins and possibly means of forced ventilation.

#### **(d) Criticality control**

The Regulations require that fissile materials, comprising plutonium-238, plutonium-239, plutonium-241, uranium-233 and uranium-235, shall be packed and transported in such a way that criticality cannot occur under any foreseeable conditions during transport.

Three classes of packages are prescribed for fissile materials. Fissile Class I packages contain neutron absorbers and are designed to be nuclearly safe under all foreseeable conditions. The design requires either unilateral or multilateral approval. Fissile Class II packages are nuclearly safe in limited numbers under all foreseeable conditions. The transport index inscribed on the label also serves to determine the allowable number of such packages in a consignment. The design of the package requires either unilateral or multilateral approval. Fissile Class III packages are nuclearly safe under all foreseeable conditions because of special administrative or operational controls during transport. The design requires unilateral or multilateral approval and because of the controls needed during transport, the shipment requires multilateral approval.

### **FUTURE DEVELOPMENT OF THE IAEA REGULATIONS**

It is now envisaged that the next comprehensive review of the Regulations will be started in 1980, with the aim of publishing a revised edition about 1983, that is, ten years after the publication of the current version. In this review particular attention will be given to the

continuing adequacy of the requirements for packaging design and testing, for containment and limitation of radiation levels, and for quality assurance. As a basis for this review, studies will be made on individual and collective doses to transport workers and to the public, on the incidence and consequences of accidents involving consignments of radioactive materials and on general risk assessments for transport by various modes.

The companion volume of advisory material for the application of the Regulations will be brought up to date and expanded as required, possibly at intervals of two to three years.

A start has been made on the preparation of yet another companion volume of explanatory material. This will explain in easily understandable terms the principles and philosophy of the safety requirements, the overall risks and benefits of nuclear transport and any other material which will help the public to understand and accept the need for nuclear transport and the standard of safety provided by compliance with the Regulations. In summary, the Regulations will lay down what has to be done, the advisory document will describe how to comply with the prescriptions and the explanatory document will explain why it is necessary to do so.

#### References

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Materials (1973 Revised Edition), Safety Series No 6, IAEA, Vienna (1973).
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Advisory Material for the Application of the IAEA Transport Regulations, Safety Series No 37, IAEA, Vienna (1973)
- [3] INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION, International Maritime Dangerous Goods Code, IMCO, London (1977)
- [4] ECONOMIC COMMISSION FOR EUROPE, European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva (1976).
- [5] OFFICE CENTRAL DES TRANSPORTS INTERNATIONAUX PAR CHEMINS DE FER, Regulations Concerning the Substances and Articles not to be Accepted and to be Accepted Subject to Certain Conditions (RID) – Annexed to the International Convention Concerning the Carriage of Goods by Rail (CIM), OCTI, Berne (1977).
- [6] INTERNATIONAL AIR TRANSPORT ASSOCIATION, Regulations Relating to the Carriage of Restricted Articles by Air, IATA, Geneva (1978)