

# Safety in transport of radioactive materials – the next 10 years

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The number of shipments of radioactive material is increasing steadily – some estimates indicate by about 10 per cent a year. Several million packages are already shipped about the world each year and this number will increase at least for the next 10 years.

Part of this increase will come from the expected growth in the number of nuclear power plants which will be shipping irradiated fuel that had previously been stored on-site or in use, and from the associated shipments of nuclear waste [1]. The increase in production and use of nuclear fuel requires increased production (and hence increased shipments) of uranium and thorium ores; and of concentrates, nitrates, fluorides and fresh fuel. Shipments of highly active waste from reprocessing nuclear fuels, already occurring to some extent in Europe, will increase and may begin again in the USA in the next few years. Also in the next 10 years, decommissioning of some reactors will take place requiring special types of shipments [2, 3].

A new type of shipment that may arise within the next 10 years is that of several kilograms (millions of curies) of tritium. A few of these large, easily controlled shipments will be required for the operation of the prototype fusion reactor, a joint project supported through the IAEA by the USSR, USA, and others. The technology for designing such packaging is well established, but it does not appear that any of the existing designs are capable of handling such large amounts of tritium and so new designs will be needed. The medical, industrial, and research uses of radioactivity are expected to continue to grow and the associated shipments of radioactive material to become even more frequent.

The Agency is collecting data on shipments in all Member States [4] and will issue an analysis of that data in 1981. For several years to come, however, we can expect the largest number of packages to be exempt shipments (e.g. smoke detectors and luminous watches) and medical isotopes; the greatest volume to be uranium ores and concentrates; and the highest activity levels to occur in shipments of irradiated nuclear fuel.

## Development of regulations

The Agency first published "Regulations for the Safe Transport of Radioactive Materials" (Safety Series No. 6) in 1961 and the version currently in force is the

1973 Revised Edition (As Amended)\*. By 1969 the regulations covered most shipments of radioactive materials, following their adoption by national competent authorities and by various international transport authorities [5] (among them the International Air Transport Association, the Inter-Governmental Maritime Consultative Organization, the Council for Mutual Economic Assistance, the International Convention concerning the Carriage of Goods by Rail). In April 1980 the Agency's Standing Advisory Group on the Safe Transport of Radioactive Materials recommended that the transport regulations should be comprehensively reviewed at intervals of at least ten years, although this interval could be extended if no new circumstances had arisen to make such a review necessary.

The first step in reviewing the 1973 Revised Edition of the transport regulations has just been completed by the Agency. An ad-hoc group of over 50 participants from Member States and other international organizations reviewed the regulations\*\* in the light of comments from interested parties, and found that relatively few changes were necessary. The first draft of their revision, prepared in September 1980, contained only three significant changes: adding a requirement that irradiated-fuel flasks should be tested by immersion in 200m of water; limiting the term "low specific activity" to materials whose radiation level does not exceed 1 rem/h at 3m from the unshielded material; and specifying design standards for exposure of people and film. Nevertheless, editorial changes and conversion of all terms to SI units requires redoing much of the text. Therefore the current comprehensive review and the resultant revision of the Regulations, which is expected to be issued in late 1983, should stand for at least 10 years based on the results of this review and the recommendations of the standing advisory group.

## Implementation and compliance

Since the first work on the international standards began in the Agency, the importance of adequate implementation of the regulations and compliance assurance was recognized. A deliberate decision was made not to undertake a convention or treaty which

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\* The English text which incorporates all the recent amendments to the 1973 Revised Edition was published in December 1979; the French, Russian, and Spanish versions are to be issued soon.

\*\* The section on nuclear criticality was separately reviewed by specialists in that area in March 1981.

would have required Member States to apply the regulations. Rather it was left to Member States and international transport regulatory organizations to implement the regulations under their own respective authorities and to establish adequate programmes for compliance. In 1961 the Agency published "Notes on Certain Aspects of the Regulations" (Safety Series No. 7) and in 1973 "Advisory Material for the Application of the IAEA Transport Regulations" (Safety Series No. 37) both containing information on implementation and compliance. Beginning in 1982 the Agency will conduct regional training courses to advise and assist developing countries in establishing adequate programmes for implementation and compliance.

The extent to which the Regulations are being applied throughout the world, and the excellent record of safety which has been achieved as a result of their being followed, indicate their acceptance and their completeness. However, their development cannot be considered to be finished since transport, as with most other nuclear activities, is a dynamic field. Changes, improvements, refinements will take place in the designs of packages and in handling and transporting methods. Special equipment for handling packages, specialized trucks, railcars, and ships, will be developed to meet the demands for even greater radiation protection. Already Japan has a specially-constructed cargo ship for carrying large flasks of irradiated fuel [6]. Sweden is planning to use a sea-transport system — spent fuel flasks and big concrete containers for carrying drums and concrete blocks on a specially built roll-on, roll-off-ship — to transport spent fuel and reactor wastes to a central re-processing centre or a central repository [7]. For irradiated fuel, larger flasks are being developed to take the place of the smaller flasks so the fuel-load can be carried more efficiently.

**LAARC (Light-weight Air-Transportable Accident-Resistant Container):** an advanced design of package developed primarily for Agency use in shipping plutonium samples by air. It was designed to meet test requirements imposed by the USA which are much more severe than the current IAEA regulatory requirements.

Each container weighs about 32 kg, carries up to 15 g of plutonium and costs about US \$15 000 to build. The design is currently undergoing regulatory review in the USA.

### Development of regulations

- 1898 — Radium discovered by Curies
- 1947 — Regulations for shipping radioactive materials adopted in USA
- 1959 — UN-ECOSOC gave IAEA task of establishing recommendations for the safe transport of radioactive materials
- 1959–1960 — To prepare draft recommendations, IAEA convened panels of experts on
  - Radioisotopes, ores and residues, and
  - Large radioactive sources and fissile material
- 1961 — IAEA published "Regulations for the Safe Transport of Radioactive Materials", Safety Series No. 6, and "Notes on Certain Aspects of the Regulations", Safety Series No. 7
- 1963–1964 — IAEA panels carried out comprehensive review
- 1964 — IAEA issued 1964 revised edition of "Regulations"
- 1967 — IAEA issued 1967 edition of "Regulations"
- 1970–1971 — IAEA panels carried out comprehensive review
- 1973 — IAEA issued 1973 revised edition of "Regulations" and published "Advisory Material for the Application of the IAEA Transport Regulations", Safety Series No. 37
- 1975 and 1977 — IAEA circulated further changes under "90-day rule" which gave Member States 90 days to object
- 1979 — IAEA issued "1973 Revised Edition (As Amended)" of "Regulations"
- 1980–1982 — IAEA advisory group making comprehensive review
- 1983 — IAEA plans to issue 1983 edition of "Regulations" together with revised Advisory Material and the first in a series of Explanatory Documents

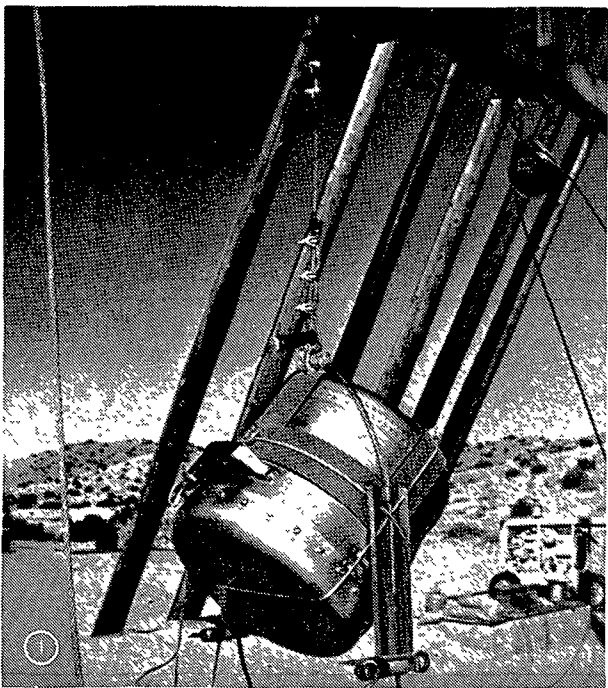


Figure 1. Pristine package ready for rocket sled pull down test.  
 Figure 2. Following 1 hour fire test.  
 Figure 3. Inner container after undergoing all tests.

### Training of carrier personnel

Increased emphasis may be expected to be given to the training of carrier personnel. Dedicated vehicles, such as aircraft, railcars and trucks, have been used for high activity and large bulky shipments for many years in some States. For these movements additional requirements may be expected for the training of carrier personnel to be able to carry out effective surveillance over such shipments, deal with emergencies that might arise, and act more responsibly during routine transport. Use of trained personnel should not only reassure the public but also reduce unnecessary exposures in transport.

### Emergency preparedness

With many more shipments being made and more and more people throughout the world becoming involved, even with the very low probability of an incident for any one shipment the number of incidents will inevitably increase. The risk will continue to be low, but many small incidents will happen and a serious accident may occur now and then.

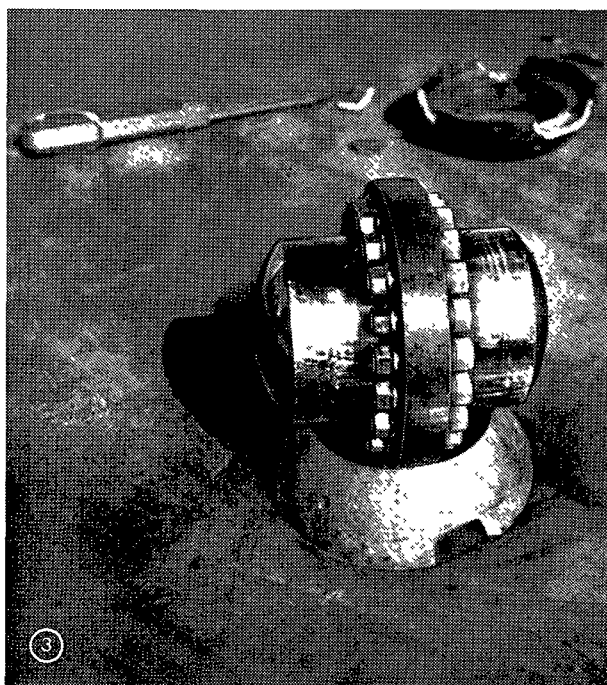
Emergency planning and preparedness is already getting increased attention in most Member States. The Agency has published some guides for that purpose [4, 5]. In the next few years, many emergency plans must be developed. Each shipper must have a plan for dealing with emergencies that might arise in transport of his materials and for providing any special instructions to the carrier in connection with his consignment. Each carrier transporting radioactive materials must have a plan for dealing with any emergency, including whom to notify in case radioactive materials are involved and whom to contact for special advice and assistance. Emergency crews — police, firemen, and medical services — must have plans,

training, and some equipment for dealing with radioactive materials. And the countries in which radioactive materials are being transported must have plans, equipment, and trained crews available (through mutual assistance or their own provision) for dealing with the kinds of emergency that can arise from the types of radioactive materials being transported in the country. An essential but often overlooked, component of any emergency plan is provision of a communications team able to provide the press and the public with clear and intelligible statements of "what is going on". Because incidents occur infrequently, it is imperative to test regularly the plan's operation and to carry out test exercises using the equipment. The industry is doing as much as can reasonably be expected for prevention: emergency planning and preparedness must provide for the few possible but very unlikely accidents in which releases of radioactivity or excessive radiation levels occur.

### Risk assessment

Studies show that the risks from transport of radioactive material are small, much smaller than the risks from many other activities which are readily accepted. The record of safety in transport is excellent [6]. Nevertheless more effective communication with the public is necessary to allay its fears, be they of real or imagined dangers. The Agency and others have concerted efforts underway for that purpose.

The Agency has undertaken a programme to assess the risk from transport of radioactive materials through the world. With technical support from Sweden, USA and several other countries, a universally agreed method of evaluating the risk from transport of radioactive materials is being developed (to be distributed to all Member States in 1982) so that each State in which any transport takes place can estimate the risk from that



transport. The results of the individual assessments will be combined by the Agency, with technical assistance from Sweden, to provide a global assessment.

### Package approval certificates

The Agency is also collecting information on the design of packages approved by national competent authorities. By collecting the details of the various approvals, it is possible to relate the several acceptances and approvals by competent authorities of the same design so that all can be informed of changes in or cancellations of the original design. The common and essential features of each design can thus also be identified.

Over the next few years, as a result of the analysis of many hundreds of competent authority approval certificates, and with advice and assistance from the competent authorities of many Member States who have prepared, accepted, or approved such certificates, the Agency expects to provide some standardization of approval certificates and other documentation for transport of radioactive materials.

It is to be hoped that with standardization will come some simplification. The seemingly excessive amount of documentation is due to many different organizations being involved, the different stages of handling, sorting, and dispatching through which each shipment must go, and the need to provide everyone who comes in contact with the shipment with details about the packaging and its contents.

More use of overpacks — that is bags or boxes into which a number of small packages are placed by a single shipper for ease of handling and storage — may be expected in the future. This may reduce the amount of paperwork and will certainly reduce the number of small packages falling off carts in airports and being run over. That type of accident has been most frequent in recent experience.

To assist Member States in assuring safety in transport in the future, the Agency's standards for safe transport will be published in three sections: Regulations (What), Advisory Material (How) and Explanatory Material (Why) [7]. The Revised Regulations (Safety Series No. 6) together with an updated revised version of Advisory Material (Safety Series No. 37) and the first issue of a new series of explanatory documents, will be published in late 1983 or early 1984.

The Agency has for several years offered assistance to Member States, in response to specific requests, by providing advisory missions to deal with technical and administrative problems in transport safety. Few requests have been received. As the Member States become more involved in transport safety regulations, the Agency expects an increased number of requests for such services. Most requests can be handled by the

Staff, or arrangements can be made with countries which already have transport safety programmes to provide equipment or experienced personnel.

The Regulations are expressed as performance standards. There remain some areas of application of these standards which require more attention:

- Special facilities and experienced personnel are necessary for testing prototypes of packages. The Commission of European Communities is compiling a list of available package test facilities.
- Specialists in heat transfer, mechanical engineering, nuclear criticality safety and other areas are needed, and computer codes are often used in reviewing package design for approval. A programme being carried out by the USA for the Nuclear Energy Agency is expected to provide, in 1981, benchmark calculations for nuclear criticality safety assessments of packages designed for low-enriched uranium nuclear fuels.
- The Agency is gathering information on quality assurance and quality control and expects to provide guides and codes of practice, for use by national authorities in establishing adequate programmes in these areas.

In the next few years, a much greater effort must be put forward to reassure the public that the transport of radioactive materials can be and is being carried out safely — i.e. with no unacceptable risk. Nevertheless, those efforts are unlikely to be entirely successful. There will always be some who emphasize the unlikely or highlight the impossible. But, the best response to such concerns is to present the full picture to the audience and rely on general knowledge, common sense and good judgement to prevail.

### References

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