

## THE APPLICATION OF DANGEROUS GOODS REGULATIONS TO THE TRANSPORT OF RADIOACTIVE WASTES

*J J Blenkin (1), C K Carrington (2), W P Darby (1), J D Heywood (1),  
M A Murray (3) and H L Wilkinson (1)*

(1) AEA Technology, Thomson House, Risley, Warrington, Cheshire WA3 6AT, United Kingdom

(2) Nycomed Amersham plc, Amersham Laboratories, White Lion Road, Amersham, Bucks HP7 9LL, United Kingdom

(3) formally UK Nirex Limited, Greengarth Hall, Holmrook, Cumbria CA19 1UL, United Kingdom (now RM Consultants)

### SUMMARY

Some radioactive materials to be transported, including certain radioactive wastes, contain materials that qualify as dangerous goods as defined by the United Nations Recommendations on the Transport of Dangerous Goods (United Nations 1997).

The regulations governing the transport of radioactive and dangerous goods in the UK are largely based on the IAEA Regulations for the Safe Transport of Radioactive Material (IAEA 1990) and the UN Recommendations (United Nations 1993). Additional legislation will also apply including the Carriage of Dangerous Goods by Road (Driver Training) Regulations, 1996 (UK 1996).

The IAEA Transport Regulations are clear that where radioactive materials have other dangerous properties the requirements of other relevant transport regulations for dangerous goods must also be met. They require that consignments are appropriately segregated from other dangerous goods, in accordance with relevant legislation, and that dangerous properties such as explosiveness, flammability etc. are taken into account in packing, labelling, marking, placarding, storage and transport. In practice, however, it requires a clear understanding of the relationship between the IAEA Transport Regulations and other dangerous goods legislation in order to avoid a number of problems in the approval of package design.

This paper discusses the regulations applying to the transport of dangerous goods and explores practical problems associated with implementing them. It highlights a number of opportunities for developing the regulations, to make them easier to apply to radioactive materials that also have other potentially dangerous properties.

## REGULATORY REQUIREMENTS

### Introduction

Both the IAEA Transport Regulations and the UN Recommendations are based on the use of a range of packages that become more robust as the hazard potential of the material to be transported increases. In the IAEA Transport Regulations these different package types are designated as Excepted, Industrial Packages, Type A and Type B, together with Type C which has recently been introduced (IAEA 1996); and there are additional requirements for packages designed to carry fissile material. In the UN Recommendations, materials to be transported are generally assigned a packing Group with Group I having the most stringent design requirements and Group III the least.

In the UK the two sets of recommendations are enacted through different sets of legislation, and different approval bodies exist for the package designs. When designing and operating a package for a particular material with more than one hazardous property it is therefore necessary to determine which is the appropriate approval body, or bodies, which standards they will be applying, and what are the appropriate operating requirements.

The relevant UK legislation includes:

### Radioactive Materials Regulations

- The Radioactive Material (Road Transport) (Great Britain) Regulations 1996 [SI 1996 No. 1350]
- The Packaging, Labelling and Carriage of Radioactive Material by Rail Regulations 1996 [SI 1996 No. 2090]

### Other Dangerous Goods

- The Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations [SI 1996 No. 2092]
- The Carriage of Dangerous Goods by Road Regulations 1996 [SI 1996 No. 2095]
- The Carriage of Dangerous Goods by Rail Regulations 1996 [SI 1996 No. 2089]

These regulations implement the requirements of the 1995 editions of the European Regulations: The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR 1995), and Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID 1995). These are based on the 1993 edition of the UN Recommendations (UN 1993) and the 1985 (as amended 1990) edition of the IAEA Transport Regulations (IAEA 1990).

In the sections below the requirements of these recommendations and regulations are set out and discussed.

## Requirements

The IAEA Transport Regulations (1990) state that, where radioactive materials have other dangerous properties, the requirements of other relevant transport regulations for dangerous goods (if applicable) must also be met. They require that consignments are appropriately segregated from other dangerous goods, in accordance with relevant legislation, and that dangerous properties such as explosiveness, flammability etc. are taken into account in the packing, labelling, marking, placarding, storage and transport [Paras 105, 406 and 407]. Note that design and testing are not specifically mentioned. In addition the Regulations require that:

*Account shall be taken of the formation of other dangerous substances that may result from the reaction between the contents of a consignment and the atmosphere or water in the event of breaking of the containment system caused by an accident. [208]*

Where the material to be carried has no dangerous properties apart from those associated with radioactivity, the UN Recommendations are clear that the IAEA package requirements are to be followed. In addition, the UN Recommendations (UN 1993) explicitly state in Chapter 7 that:

*In practice, radioactive material consisting of one or more radionuclides, alone or associated with small quantities of non-radioactive material (as is common), transported in accordance with the IAEA Transport Regulations will be satisfactorily covered in respect of any other hazardous properties possessed by them.*

They do, however, emphasise that with the exception of Special Form material, radioactive materials may be associated with comparatively large quantities of non-radioactive material (particularly a gas or a liquid) which may possess other hazardous properties requiring additional consideration. They note a particular need for attention where the radioactive material is present in Excepted quantities, is LSA-II or -III, or is SCO. Such materials may be transported in Excepted packages or Industrial Packages, which generally have less onerous design and testing requirements than the Type A, B or C packages. The UN Recommendations therefore state that radioactive material possessing other dangerous properties (subsidiary risk) should:

- (a) *be packaged in accordance with the IAEA Transport Regulations;*
- (b) *be labelled with subsidiary risk labels corresponding to any subsidiary risks indicated for the radioactive material (United Nations 1993, Chapter 2) or, if no subsidiary risks are indicated, with subsidiary risk labels corresponding to each non-radioactive hazard exhibited by the material;*
- (c) *be allocated to Packing Group I, II or III as appropriate, by application of the grouping criteria provided in Reference 1 corresponding to the nature of the predominant subsidiary risk; and*
- (d) *unless transported in a Type A, Type B or Type C package,*
  - (i) *be transported in a package with a net mass of 400 kg or less and a capacity of 450 litres or less which conforms to all applicable provisions of Chapter 9 (general recommendations on packing) appropriate to the packing group of the material; or*

- (ii) *be transported in packagings with a net mass of greater than 400 kg or with net capacity of greater than 450 litres approved by the competent authority.*

Note that the "competent authority" referred to here is the one for hazardous materials packaging and transport, and not the competent authority for radioactive materials transport.

ADR [ADR 1995] states [Marginal 3770] that:

*Radioactive Material having other hazardous properties shall be packaged:*

- (a) *in accordance with the provisions for Class 7; and*  
 (b) *unless carried as a Type A or Type B package, also in accordance with the provisions of the appropriate class.*

ADR also sets down some additional provisions for uranium hexafluoride [Marginal 3771], pyrophoric radioactive material [3770] and material in excepted packages [2002(12) and (13)].

The UK legislation applies to movements carried out within the UK and largely implements the requirements of the 1995 ADR/RID and the 1985 (as amended 1990) IAEA Transport Regulations. For example, the Radioactive Material (Road Transport) (Great Britain) Regulations 1996 require in Schedule 2 (General Requirements for Packages and Packaging) that *In addition to the radioactive properties, any other properties of the contents ....shall be taken into account.* The Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations refer directly to ADR.

## INTERPRETATION

Where the material to be transported has no other dangerous properties, there is no ambiguity. The radioactive material regulations apply.

For Excepted quantities of radioactive material having other dangerous properties, the requirements applying to radioactive materials and those applying to dangerous goods are both relevant. Packages must be designed, tested and approved in accordance with the requirements of both sets of regulations.

For LSA and SCO material carried in Industrial Packages the dangerous goods transport regulations again require that the material is also packaged in accordance with the provisions of the appropriate dangerous goods class. However, the radioactive properties are generally assumed to take precedence.

Where the radioactive properties are such that the material must be carried in Type A or Type B packages (and by implication Type C also), ADR and UK dangerous goods transport regulations do not require that the material is also packaged in accordance with the provisions of the appropriate dangerous goods class. However, the radioactive materials transport regulations do require that other dangerous properties are taken into account for packages and packaging. The competent authority under these regulations will therefore need to be satisfied that this has been done in an appropriate fashion or, where self-certification applies, that the approval authority is applying appropriate standards.

In the UK the packaging requirements for the appropriate class of dangerous goods as given in ADR are considered one appropriate standard. This does not necessarily mean that the design type must have been certified by the appropriate competent authority, but evidence should be recorded to show that the design does meet the standard. Where the appropriate ADR test requirements exceed IAEA requirements, written evidence that the package design would be capable of meeting these requirements will be expected (this may apply particularly to Type A packages designed to carry solid material). Other standards may also be considered acceptable if a robust justification can be provided.

## PRACTICAL PROBLEMS ENCOUNTERED

Transport of radioactive materials that have other dangerous properties is relatively rare. When it is necessary a number of difficulties have been experienced in the practical application of the regulations. Some of these are described below.

- What should be considered dangerous?

Substances such as uranium oxide are known to be chemically toxic and are handled as such on site; but they are not listed in ADR as Class 6.1. It may therefore be necessary to carry out the toxicity tests specified in the regulations to confirm whether or not they should be treated as toxic for transport purposes. Expert advice needs to be sought in this area. Operators often assume that if the material is not specifically listed, it is not hazardous; this is not necessarily true.

Small quantities of toxic material intimately mixed and often immobilised with large quantities of radioactive material (as for example may occur in radioactive wastes) will present a much reduced hazard. The dangerous goods regulations contain weight limits, depending on the danger, below which certain requirements of the regulations may be relaxed. These indicate limits below which quantities can be considered to present an insignificant hazard. However, where the hazardous materials are well diluted or immobilised, less restrictive limits or a lower Packing Group may be appropriate (by analogy with Low Specific Activity materials).

- What hazardous property should take precedence?

It is not always clear what hazardous property should take precedence. For example, when transporting RAM in the LSA-II solid or SCO-II category, the IAEA Transport Regulations imply that packaging may conform to test requirements associated with those set to meet UN Packing Group III criteria. This suggests that this particular level of radioactivity may be considered equivalent to a Packing Group III hazard. Where LSA-II or SCO-II material possesses a non-radioactive hazard requiring a higher UN Packing Group (e.g. Sodium (UN PG-I)) a comparison of hazard groups would indicate that the greater hazard arises from the sodium content. However, it is generally presumed that the radioactive properties take precedence and this can lead to anomalies. (Note that under ST-1 (IAEA 1996), the requirement for IP-2 and IP-3 are strengthened to UN Packaging Group 1 or 2.)

- What standards are appropriate for large or heavy packages?

The standards for packages given in the dangerous goods transport regulations do not apply above certain maximum capacities and/or net masses (usually around 450 litres or 400 kg) according to the type of package. Clearly many packages designed to convey RAM exceed these limits. Appropriate standards for larger packages have to be derived from the

standards given in the regulations and justified by appropriate calculations, and approval sought from the appropriate authority. Testing of packages to demonstrate that they meet these standards would be an onerous and expensive route for many operations, especially for those involving limited numbers of consignments. If material had to be transferred to new packaging, this would have its own safety risks.

- What if the package defined for the purposes of the radioactive materials regulations is a freight container?

Owing to an omission in ADR, freight containers are not explicitly given as acceptable as packagings under Schedules 5, 6, 7 and 8. One possible solution is to qualify UN certified drums carried inside the freight container as IP-2 packages [Para 519, IAEA] and treat the freight container as an overpack. However, this is not always practicable, especially where radioactive material is already grouted into non-UN certified drums. Use of freight containers is, however, specifically permitted under the radioactive material road transport regulations in Great Britain.

- What happens where there are inconsistencies between the regulations, or lack of clarity?

Inconsistencies between the regulations, and lack of clarity in areas of overlap, can result in the regulations being incorrectly implemented. They may also lead to additional, perhaps unwarranted, expense and complexity, even when the regulations are implemented properly. A number of areas where UK operators have encountered difficulties are listed below.

- The radioactive material transport regulations require evidence that a comprehensive QA regime has been applied through package design, manufacture etc. This prevents the use of many containers designed and certified for the carriage of dangerous goods because full QA records are not available. For example, tankers certified for the carriage of corrosives cannot, in many instances, be used for the carriage of radioactively contaminated acid because manufacturing records cannot be made available for inspection.
- It is not always clear to operators when they need to use packages that are also formally certified by the dangerous goods competent authority, or when formal approval is only required under the radioactive materials transport regulations.
- Under Paras 521, 522 and 523 of the IAEA Transport Regulations, a UN certified package is accepted as adequate for transport of certain classes of radioactive material. There is no reciprocal concession in the dangerous goods regulations.

For many radioactive loads there is no suitable UN certified package readily available, or those that are available have been tested with very different contents. For example, UN packages are usually tested with sand or gravel; those tests would generally need to be repeated for liquids or solids with significantly different properties. This will be time consuming and expensive (e.g. requiring testing of six packages).

- The assumption that the radioactive properties of a material (above Excepted quantities) always take precedence has led to a belief that subsidiary labels are not required.
- The labelling requirements for Excepted packages containing material with other dangerous properties is unclear. The IAEA Transport Regulations do not require that Excepted packages are labelled on the outside with radioactive hazard labels. The dangerous goods transport regulations require that packages are labelled with primary and subsidiary risk labels as appropriate. No subsidiary risk labels are provided for radioactive materials.

- What other hazardous substances regulations apply?

There are a number of regulations, not specifically concerned with transport, which can have an impact on package design or operation. Where transport of radioactive materials has not been specifically considered in the formulation of the regulations, inconsistencies can arise. For example, the Pressure Systems and Transportable Gas Containers Regulations, 1989 (UK 1989) are concerned with the hazard of stored energy in pressure vessels. If a package may, in normal use, be transported at internal pressures exceeding 0.5 bar gauge these regulations would appear to apply. However, packages being carried as part of an international transport operation carried out under ADR or RID are specifically exempted from those regulations. Thus an anomaly arises: a package transported as part of an international operation would be exempt; but the same package, designed and operated to exactly the same standards, would not be exempt if it was transported wholly within the UK.

## CONCLUSIONS

Many of the problems noted above arise because transport of radioactive material with other dangerous properties is relatively rare and operators are unfamiliar with the requirements of the regulations. The radioactive material transport operating environment is very different from the generality of dangerous goods transport. The two regulatory regimes have been designed to suit these different operating environments and are very different in detailed implementation. Operators find it difficult to reconcile these different regimes. Some specific inconsistencies appear to exist, and lack of clarity in the requirements leads to further difficulties. Effort to remove the inconsistencies and specific, clear guidance for operators is clearly needed.

The radioactive material regulations contain a number of provisions to facilitate safe operations within the particular transport environment. These include:

- Specification of less onerous standards for low hazard potential material (e.g. low specific activity material)
- Special arrangement provisions
- Standards applicable to large and heavy packages
- A testing and approval regime designed to be cost-effective for specialist packagings with limited application.

Explicit adoption of similar measures for dangerous goods transport, where Excepted or Industrial Package quantities of radioactive material having other dangerous properties are being carried, would alleviate many of the practical problems encountered.

Persons responsible for radioactive materials transport need to make full use of dangerous goods advisors, if they believe that radioactive material may also have other dangerous properties, to ensure that the packaging and labelling requirements are fully understood.

Operatives involved in radioactive materials transport also need to monitor developments in hazardous materials regulations to ensure that the transport implications are fully understood and accounted for at the consultation stage.

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