Radiation protection programmes for the transport of radioactive materials

W. L. Wilkinson

World Nuclear Transport Institute, United Kingdom

Abstract
The IAEA requires organisations involved in the transport of radioactive material to implement a Radiation Protection Programme (RPP) in order to control radiation dose exposure to both workers and the public. In some cases, the transport is by dedicated carriers. However, there are many transport organisations for which the transport of radioactive materials is only a small part of their business. Such companies may not have fully developed RPPs in place and may be concerned that implementation and application of RPPs, in addition to the existing radiation protection provisions, could have a substantial impact on their business.

An analysis carried out by the World Nuclear Transport Institute (WNTI) of the data of dose up-take during the various modes of transport of nuclear fuel cycle materials showed that it is very unlikely that any worker or member of the public would receive annual doses in excess of 1mSv. The transport of nuclear fuel cycle materials should therefore fall into the lowest category for which no workplace or individual dose monitoring is required.

In the interest of supporting organisations in the continued supply of services for radioactive transport, this paper will discuss the practical initiatives in education and training undertaken through WNTI to control dose uptake and reduce the administrative burden.

1. Introduction

Radioactive materials are the basis of the nuclear power industry which now generates electricity in 32 countries, and supplies over 16% of the world's electricity demand. Nuclear power will continue to play a significant role in meeting the world's increasing need for affordable and secure electricity with virtually none of the greenhouse gas emissions thought to cause global warming and climate change.

Radioactive materials are also widely used in medicine for diagnostic purposes and therapy. Gamma processing provides 40% of the world's sterile medical disposables and devices (from swabs and syringes to hip joints and heart valves) as well as sterile ingredients for pharmaceuticals. Large sources are also used for sterilisation purposes in the food industry and in many industrial applications, for example in the radiography of high duty metal fabrications. These gamma sources are manufactured in very few countries and sea transport is therefore vital to distribute them from the manufacturers to several hundred users worldwide.

The manufacture and distribution of radio-pharmaceuticals is also a rapidly increasing business.

All these industries are becoming increasingly global in terms both of products and services. Safe and secure national and international transport of radioactive materials by all modes of transport is essential to support them.

2. Radiation Protection Programmes

The International Atomic Energy Agency (IAEA) has set standards for organisations involved in the transport of radioactive material to implement a Radiation Protection Programme (RPP) in order to control radiation dose exposure to both workers and the public from transport operations. RPPs are intended to provide for and document the framework of controls applied by a transport organisation to limit the normal and potential exposure. They have to include details on the procedures to be adopted to optimise protection and safety, including such issues as dose assessment, segregation of packages, emergency response, training and quality assurance. The nature and extent of control measures employed at the operational level to satisfy radiation protection requirements has to be decided by the operator.

In some cases materials are transported by dedicated carriers, notably for some nuclear fuel cycle materials, and they are familiar with radiation protection measures. However, there are many transport organisations for which the transport of radioactive materials is only a small part of their business; typical of these are trucking companies, sea carriers, port handling organisations and airline services. Previously, such companies may not normally have had fully developed RPPs in operation which would meet the requirements of the new IAEA Regulations. Accordingly, without a good understanding of what is required in an RPP, there is the possibility that they would perceive the development and implementation of a formal RPP as difficult to justify in terms of the value to them of the business. This could result in the loss of essential transport routes for a number of essential radioactive cargoes. In some instances, such as for sea carriers of large sources used for the sterilisation of medical supplies, this is already becoming a reality.

It is necessary to ensure that RPPs are implemented properly to protect workers and the public. It is also important to allay the concerns of operators and workers in the transport chain as well as perceived risks to the public. Education and training are essential to achieve these aims.

2.1 Elements of an RPP

In preparing an RPP consideration should be given to the following:

- scope and nature of the transport operation, including the type and volume of the radioactive materials and packages;
- the roles and responsibilities of staff for radiological protection and administrative duties in each organisation involved in the transport operation;.
- dose assessment and optimisation for workers and the public;
- surface contamination checks on third party equipment not exclusively used for radioactive material transport;
- segregation and other protective measures during loading etc. need to be considered by qualified personnel;
- emergency response procedures;
- training of staff involved in the transport operation needs to be carried out under the supervision of the person responsible for radiological protection;
- a quality assurance programme which includes procedures for document control and operating instructions is required.

2.2 Dose assessment

Dose assessment and evaluation is a key issue since this allows experienced staff to decide if reasonable measures have been taken to optimise protection by comparing dose up-take with that in comparable transport operations. Dose assessment at the pre-operational stage ensures that account has been taken of all reasonably practicable radiation protection measures, as well as radiation monitoring and dose assessment where appropriate during transport, to demonstrate compliance and to establish good practice.

In particular, the RPP should relate to the magnitude and likelihood of radiation exposure to both workers and the public for the transport operation. On this basis it is then possible to apply a graded approach to the requirements as follows:

- where it is unlikely that the dose will exceed 1mSv/year, no workplace or individual dose monitoring is required;
- where it is likely that the dose will be 1 - 6mSv/year, a dose assessment programme is necessary, and can involve workplace or individual dose monitoring;
- where it is likely that the dose will exceed 6mSv/year, individual monitoring of transport personnel is mandatory.

The 1mSv/year effective dose limit is the dose limit for members of the public and the requirements for an RPP are therefore considerably less onerous for operations below this level. The categories will generally be based on a prior radiological assessment using existing dose data for similar transport activities. This is why it is important to collect reliable dose data relating to radioactive material transport operations to assess the implications of the new requirements.

The International Basic Safety Standards also require operators to adopt the safety principle in operations where employees may be exposed to radiation, that occupational (and public) exposures to radiation should be As Low As Reasonably Achievable (ALARA). For transport operations, the ALARA principle can be met by demonstrating that attention has been paid to minimising dose up-take

and that best practice has been adopted; e.g. in the segregation and storage of containers, the shielding of drivers, the supervision of working practices, and operator training. Operations resulting in low occupational doses may require only basic implementation of the optimisation principle with the application of common sense and good practice.

2.3 Nuclear fuel cycle materials

A study carried out by the WNTI with the co-operation of its member companies [1] made an assessment of the likely doses to different types of worker in the transport chain, and also to members of the public for the transport of various nuclear fuel cycle materials, for various modes of transport, mainly based on experience of actual operations. The aim of the WNTI study was to analyse historical dose uptake of various types of workers in the transport chain. The study used both existing published sources and actual monitoring data of some WNTI member companies. The objective was to provide quantitative data which would be of benefit to transport operators in the preparation of their RPPs

Non-irradiated nuclear fuel cycle materials - uranium ore concentrates, uranium oxide powder, uranium hexafluoride, and new fuel - are normally carried in containers on trailers. Loading for road, rail or sea transport is carried out with limited access by workers. The quantities of uranium ore concentrates and uranium hexafluoride are quite large - typically thousands of tonnes per year in countries involved in the nuclear fuel cycle industry. Low-level radioactive wastes are transported by road and rail under conditions similar to those for uranium ore concentrates.

Spent nuclear fuel is transported within a country mainly by rail, with road transport confined to the short journeys from the reactor site to the railhead; international transports are mainly by sea. The limited transports of high-level waste, for example from la Hague in France to storage facilities in Germany or from Europe to Japan, are similar to spent fuel transport.

Analysis of the data on dose up-take during the various modes of transport of nuclear fuel cycle materials indicates that it is very unlikely that any group of workers, or any member of the public, would receive annual doses in excess of 1mSv. The transport of nuclear fuel cycle materials should therefore fall into the lowest category, which is the least onerous and for which no workplace or individual dose monitoring is required.

This information on the likely doses to workers and the public is not only important in the preparation of RPPs but also in meeting the safety concerns of the public and potential carriers.

2.4 Non-fuel cycle materials

Dose up-take data have also been assessed for a range of non-fuel cycle materials for various modes of transport [2,3,4]. These studies confirm that the radiation exposures received by transport workers and the public are generally low, in the region of 1mSv per year or less. The exception is some drivers and handlers involved in the transport of radio- pharmaceuticals who can receive higher doses close to the limit which would require personal dose monitoring [3].

3 Actions to Facilitate Implementation

3.1 IAEA Guidance on RPPs

The requirement for radiation programmes is included in the IAEA Transport Safety Regulations as part of the General Provisions, and as such, sets down the basic principles. Detailed guidance is essential to achieve successful implementation of these principles by the industrial organisations concerned. WNTI and its members have co-operated closely with the IAEA and national competent authorities by providing an input of industrial experience to ensure that the guidance document, the IAEA Provisional Safety Guide (TS-G-1.5) clearly interprets the intentions of the regulations and gives detailed guidance and information sources to the various organisations in the transport chains which have to implement them. It is important to set down clearly the various responsibilities of the transport organisation, its management and workers.

3.2 Involvement of supply chain

In addition, WNTI has held extensive discussions within its working groups to prepare advice for onward transmission to the supply chains involved in nuclear fuel cycle transport. One example is a

series of seminars organised by leading nuclear fuel cycle companies for their transport service providers which covered all aspects of RPPs and discussed typical examples.

3.3 Pro-formas of RPPs

WNTI has produced a series of pro-formas for RPPs which would be applicable to the various types of organisation in the transport chain, i.e. consignors, carriers and port handling organisations. They are intended to assist operators in identifying the minimum requirements which have to be addressed in an RPP for specific types of organisation and modes of transport.

4 Conclusions

Many vital industries depend on radioactive materials and they are becoming increasingly global in terms both of products and services. The national and international transport of radioactive materials by all modes of transport is essential to support them.

The organisations involved in the transport of radioactive materials fully support the need to establish RPPs to ensure that an adequate framework of controls will be applied throughout the transport chain to meet the radiation protection principles of the IAEA to protect workers and the public.

However this is a new requirement for many organisations which have traditionally played an important role in the transport of these materials and there is the possibility that some would perceive the development and implementation of a formal RPP as difficult to justify in terms of the value to them of the business. The detailed guidance provided by the IAEA coupled with the help and advice provided by WNTI is intended to help them to reduce the administrative burden in developing effective RPPs. The sharing of best practice within the industry is also beneficial and needs to be encouraged.

These education and training initiatives are important to allay the concerns of operators and workers in the transport chain as well as the perceived risks to the public. They will also facilitate the continued provision of safe and reliable international transport services for radioactive materials.

References

[1] Radiation Dose Assessment for the Transport of Radioactive Materials, WNTI Study Series 2, 2001

[2] Occupational and Public Exposures arising from the Normal Transport of Radioactive Materials in Germany, G Schwarz et al, Proc. IAEA Conference, 7-11 July 2003, Vienna, page 97

[3] Dose of Ionising Radiation received by Transport Workers in Canada, Proc. IAEA Conference, 7-11 July 2003, Vienna, page 81

[4] Dose Assessment and Shielding for the Transport of Radio-pharmaceuticals in Cuba, Proc. IAEA Conference, 7-11 July 2003, Vienna, page 77

Corresponding Author:
W.L. Wilkinson
World Nuclear Transport Institute
7 Old Park Lane
London, United Kingdom
T: 020 7408 1944
F: 020 7495 1964
e-mail: wnti@wnti.co.uk