PRACTICAL IMPLICATION OF THE ADOPTION OF EXEMPTION VALUES IN TRANSPORT

P. Francois [1], HJ. Fett [2], J. S. Hughes [3], F. Lange [2], D. Raffestin [4], P. Pellow [3]; T. Schneider [4], G. Schwarz [2], K. B. Shaw [3]

[1] IPSN, BP 6, 92265 Fontenay-aux-Roses, France
[2] GRS, Schwertnergasse 1, D-50667 Cologne, Germany
[3] NRPB, Chilton, OX11 ORQ, United Kingdom
[4] CEPN, BP 48, 92263 Fontenay-aux-Roses, France

SUMMARY

IAEA Safety Series 6, 1985 Edition (amended 1990) states that "Radioactive material shall mean any material having a specific activity greater than 70kBq/kg". The new 1996 regulations now defines radioactive material as any material with specific activity and total activity greater than radionuclide dependent values given in the regulations. The values of activity concentrations mainly range from 1 to 100 Bq/g and total activity from 10^3 to 10^7 Bq. As these values are radionuclide dependent and generally lower than 70 Bq/g, their implementation for transport practices may give rise to changes in the present management of transport as well as measurement procedures. However, the 70 Bq/g value was for all radionuclides present while the new radionuclide specific values are for parent radionuclides and include the contribution from daughter radionuclides.

In this context, the aim of this paper is to present the evaluation of the main impacts arising from the implementation of the new exemption regulation. This evaluation is performed within the framework of a project funded by the European Commission involving different teams from France, United Kingdom and Germany. For this evaluation, the following steps were developed on the basis of the different national contexts:

- Analysis of the exemption concept in the national transport regulation
- Identification of the transport practices affected by the modification of the regulations
- Evaluation of the practical implication for selected practices

Special attention will be given to transport practices involving natural radionuclides in different European countries, as well as material originating from the decommissioning of nuclear installations.

INTRODUCTION

The definition of exemption criteria was given in IAEA Safety Series 6, 1985 Edition (amended 1990) and stated that "Radioactive material shall mean any material having a specific activity greater than 70kBq/kg". On the basis of radiological concern and for the purpose of homogeneity with the IAEA Basic Safety Standard, the new 1996 regulations now defines radioactive material as any material with specific activity and total activity greater than radionuclide dependent values given in the regulations.
As these values are radionuclide dependent and rather low, their implementation for transport practices may necessitate an update of the present management of transport as well as the procedures of measurement. This paper presents the results of a joint project (France, United Kingdom and Germany) funded by the European Commission DG XVII. It aims at analysing the

main impacts of the implementation of the new exemption regulation. For this purpose, the following steps have been considered:

- Analysis of the exemption concept in the national transport regulation
- Identification of the transport practices concerned with the new regulation in France, UK and Germany
- Preliminary determination of the impacts for the selected practices

THE EXEMPTION CONCEPT IN THE TRANSPORT REGULATION

The principles and methods for establishing exemption values have been published by the European Commission DG XI (Radiation Protection 65) and endorsed by the International Atomic Energy Agency (Basic Safety Standards). These documents contain radionuclides specific activity and activity concentration values, below which reporting is not required for all practices.

Concerning the transport of radioactive materials, the basic radiological dose criteria of the International Basic Safety Standards for Protection Against Ionizing Radiation (BSS) and for the Safety of Radiation Sources (Safety Series No. 115-I) (including an individual dose of 10 µSv per year and a collective dose of 1 man.Sv per year) were endorsed for the revision of the IAEA transport regulation.

Nevertheless the BSS approach, which leads to radionuclide specific exemption values, is not compatible with a single specific activity figure such as the 70 kBq/kg used in the current transport regulations. Therefore a first study, performed under contract to the EC DG XI, was held in order to examine the relevance of the BSS exemption values to the transport regulation. As far as no specific transport scenarios have been considered in the methodology used by the BSS, this study took into account relevant transport scenarios for selected radionuclides in order to derive specific exemption values using the same basic radiological dose criteria.
Because of the general agreement between the transport specific exemption values and those of the BSS, it was considered reasonable to adopt, in the 1996 Edition of the Transport Regulations, the BSS exemption values below which the transport regulation would not apply (Figure 1). Special rules have been adopted for the transport of materials containing natural radionuclides, in that case, a factor of ten is applied to the exemption activity concentration value.

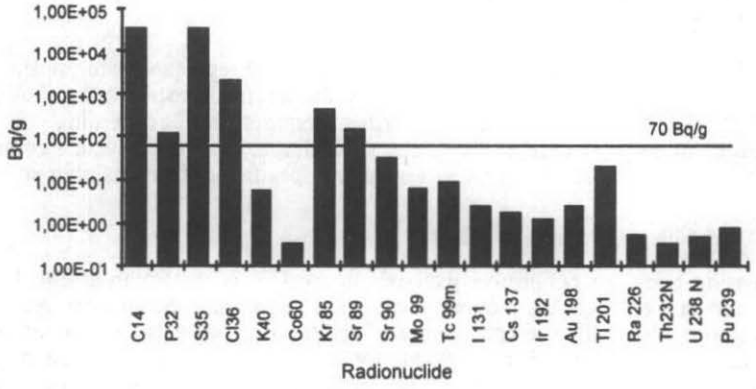

Figure 1. Exemption values for selected radionuclides versus 70 Bq/g

REGULATORY FRAMEWORK AND CONTROL

According to the present national regulatory framework, it appears that the level of concern for the application, the monitoring and the controls varies depending on the practices and countries.

General provision

The existing International Transport Regulations and, consequently, the nationally applicable Regulations demand any material having a specific activity per unit mass in excess of 70 Bq/g be subject to the safety requirements of the Regulations. Explicitly excluded from the safety requirements of the national and international Regulations are according to § 2009 ADR :

- transport of limited quantities of hazardous material carried by private individuals, if the material is properly packaged and exclusively used for private or household purposes or for leisure life or sport activities, e.g. thoriated gas mantles.
- transport of limited quantities of hazardous material forming an integral part of machinery or consumer products.
- transport of wrecked vehicles carrying hazardous cargo provided that all precautionary measures are taken to assure a completely safe transport.

We note, that the items and materials referred to under a) and b) exempt a broad variety of consumer products containing limited quantities of radioactive material and carried or used occasionally or periodically by private individuals from the safety requirements of the Regulations, e.g. timepieces, fluorescent lamp starters, electronic tubes, smoke detectors etc. The exemption provisions provided for by § 2009, however, may not apply to transport of RAM by commercial shippers or carriers, if these items and materials are carried in larger volumes.

National provision

FRANCE

Since 1997, the executive role of the French competent authority, whatever the mode of transport, is carried out by the Direction de la Sûreté des Installations Nucléaires (DSIN) with the technical support of the Institut de Protection et de Sûreté Nucléaire (IPSN). This organisation allows consistency between all the nuclear practices, including transport, especially to ensure compliance with the relevant legislation.

The current IAEA transport regulations and international modal regulations are implemented in the French domestic legislation for ground transport by the recent decrees dated 5 («ADR») and 6 December 1996 («RID») which include further requirements concerning, in particular, consignors's declarations and transport documents. In addition, the French nuclear companies have implemented their own dedicated requirements including specific notifications prior shipment.

UNITED KINGDOM

The main licensing body for radioactive materials in the UK is the Environment Agency (EA), which administers and enforces the requirements of the Radioactive Substances Act, 1993. This Act requires registration for the use and storage of radioactive materials and authorisation for its disposal. The EA is also the Competent Authority for a number of EC Directives on the shipment of radioactive substances and sealed sources between EU Member States, and shipments of radioactive wastes into, out of, and within England and Wales to ensure that appropriate disposal arrangements are in place before the shipment of the material or waste. Occupational exposure to

ionising radiation is regulated by the Health and Safety Executive (HSE) under the Health and Safety at Work Act, 1974, and the Ionising Radiation Regulations, 1985. Both the EA and HSE have inspectors that periodically visit premises in which radioactive materials are used to ensure compliance with the relevant legislation.

The UK implements and enforces the european agreement concerning the international carriage of dangerous goods by road and rail. The executive role of the competent authority is carried out by the Radioactive Materials Transport Division of the Department of Environment, Transport and Regions.

GERMANY

In addition to the general exemption provisions with relevance to RAM provided for by the Transport Regulations, other items and materials have been explicitly exempted from the safety requirements of the Regulations on the national level based on provisions codified in the Hazardous Cargo Exemption Ordinance (GGAV). The items and materials exempted from the safety requirements of the regulation for road and rail transports by virtue of the Hazardous Cargo Exemption Ordinance include the following, provided that these items and materials are not subject to the licensing and notification requirements of the Atomic Energy Law (AtW) and its subordinated regulations:

- Pacemakers
- Radiopharmaceuticals
- Products (e.g. timepieces, dials) for personal use containing radioactive paint
- Thoriated gas mantles
- Thoriated welding rods
- Electric lights and lamp starters containing natural thorium or Krypton 85

These nationally relevant exemption provisions are - in contrast to the „general" exemption provisions - generally applicable and apply to both private individuals and commercial shippers.
Any other radioactive materials fall in the scope of the Transport Regulations and are subject to the administrative and technical controls, including supervision and enforcement, laid down in the nationally existing decrees and regulations.

MATERIALS OF CONCERN

The analysis performed in this project is focused on the transport practices involving the shipment of materials with low specific activities. It could include the transport of food, coal and coal ashes, building materials, thoriated welding rods and gas mantles, fertilisers, pipeline scale, ores, radioactive wastes, radioactive materials used in hospitals, lighting products, smoke detectors and other consumer products. According to the activities observed and the associated transport, the manufactured products and materials containing radionuclides with relevance to the study can be broadly grouped in:

- building material
- mining and agricultural products
- contaminated/irradiated materials from decommissioning of nuclear fuel cycle facilities and other areas
- other manufactured products

Building material

This category includes clay, sandstone, bricks, concrete and cement. These materials mainly contain the following natural radionuclides: K-40, Ra-226. With respect to the exemption activity concentration limits (respectively 1000 Bq/g and 100 Bq/g), the observed activity appears to be two orders of magnitude below. Consequently, the building material would not fall within the scope of the new regulation.

Mining and agricultural products

Mining and milling products concern the ore industry and the oil and gas extraction industry.

Within the ore industry, the study focused on phosphate, potash, Niobium, iron, zircon sand, microlith concentrate, tin process and rare earths such as Monazite, bastnaesite. Table 1 presents the maximum values of activity concentration observed in France, United Kingdom and Germany.

Table 1. Maximum activity concentration in ores etc. (Bq/g)

	Phosphate	Tin	Niobium	Zircon sand	Rare earths monazite,bastnaesite	Exemption value
Po-210,	500		500	400	500	100
Pb-210	500		500	400		100
Th-228		15	80	40	3000	10
Th-230			10	74	500	10
Th-232					3000	100
Ra-226					500	100
Ra-228					3200	100
U-234					500	100
U-238					500	100
Pa-231					23	10
Ac-227				3	23	1

Iron, potash and coal production related activity appear to be not of concern for the new regulation. According to German data, an average of 120 Bq/g of Ra-226 is observed within the microlith concentrate and thus could be affected by the new regulation.

Oil and gas extraction in industry present a significant concentration of radium, and thorium. These figures (Table 2) largely exceed the exemption threshold.

Table 2. Maximum activity concentration in oil and gas extraction (Bq/g)

	Oil and gas extraction	Exemption value
Th-228	200	10
Ra-226	1100	100
Ra-228	360	100

Contaminated/irradiated materials from decommissioning of nuclear fuel cycle

With regard to the nuclear industry in France, the main concern for exemption is the dismantling and decommissioning of nuclear installations. Also in France, the exemption values do not directly apply to the materials arising from dismantling and decommissioning, they should be considered as upper limits for the clearance levels. In France, the authority for the safety of nuclear installations (DSIN) is not favourably disposed towards the use of exemption values for the wastes arising from the dismantling and decommissioning of nuclear sites. A specific methodology has been proposed recently to classify the dismantling wastes according to their spatial origin and the operational history of the area they belong to. Consequently, waste cannot be exempted only on the basis of its total activity or activity concentration. According to preliminary analyses, EDF now envisages the transport of the main dismantling wastes in excepted packages, even if some of them should respect the exemption criteria for transport because it is expected that the activity concentration of most of the dismantling wastes will be about 10 Bq/g.

Other manufactured products

The materials of concern involve thorium compounds (such as thoriated welding electrodes, gas mantles and electric light devices) and smoke detectors. The maximum values observed in France, United Kingdom and Germany are presented in Table 3.

Table 3. Maximum activity concentration in other manufactured products (Bq/g)

	Thoriated welding electrodes (1-4%)	Gas mantles	Electric light devices	Exemption (Bq/g)
Th-228	35 - 140	1700	500	10
Th-232	35 - 140	3600	500	100
Th-230		460		10
Ra-228		2100		100
Kr-85 *			10^6	10^5

* Kr-85 is not concerned by the special rule applying a factor 10 on natural material and ores

For thoriated electrodes: the percentage of Th 228 / 232 ranges from 1 % to 4 %. For a 2 % rod, the activity per item was assessed as 3120 Bq to be compared with the maximum activity allowed per shipment of 10000 Bq. Due to the exemption level of activity concentration for the thorium (10 Bq/g), the thoriated tungsten welding electrodes (calculated activity from 71 Bq/g up to 280 Bq/g) would come under the scope of the regulation (current and future).

Concerning thoriated luminous products, the maximum activity observed in Th 228/232 is 10^4 Bq per item (Xenon short arc lamp / mercury vapour short lamp).For electric light devices, the maximum activity of 5000 Bq per item (metal halide lamps) for Kr 85 is to be compared with 10^4 Bq exemption value per shipment. Analyses on light devices containing thorium or Krypton 85 indicate activities that closely approach or exceed both the 1996 activity exemption limits and activity concentration limits. Consequently, practically most shipments of such luminous and related consumer products, especially if shipped in larger quantities, would fall in the regulation regime of the new 1996 transport regulation.

Smoke detectors normally contain a single isotope either Am 241, Pu-238 or Ra-226. According to UK data up to 33.3 kBq of Am 241 can be included in a detector. As one pallet contains 1080 units, the total activity per consignment is about 3.6 10^7 Bq ,to be compared with the exemption value of Am 241 per consignment of 10^4 Bq.

European traffic of material containing natural occurring radionuclide

In order to appraise the amount of material concern within the scope of the study, the Eurostat basic statistics were analysed. They provide exhaustive data on import and export for the European Union in 1987. About 7250 000 tons of phosphate were used in Europe, major EC producers being France, Spain and Belgium and Luxembourg. The use of Niobum metal ores represents 3250 tons and Zircon sands 122 tons. With respect to the manufacture and use of thorium, 1 million gas mantles, 16 tons of thoriated glass and 20 000 pieces of thoriated electrodes were used.

DISCUSSION/CONCLUSION

The majority of materials transported in France, UK and Germany will be unaffected by the new exemption requirements in the 1996 edition of the IAEA transport regulations. The materials transported were either not considered radioactive under the old regulations and remain so under the new ones, or they were within the scope of the old regulations and remain so in the new regulations. A few transport operations may be affected by the new regulations, especially those materials containing large quantities of thorium and some bulk movements of consumer products. For these material, the application of the transport regulation is not constraining, nevertheless special attention should be given regarding the implementation of a radiation protection programme. Exemption orders, based on radiological assessments, exist in Germany and UK for some such operations: these orders are however currently subject to review and thus could be extented to some practices identified in this study. With regards to the materials related to decommissionning of nuclear plant, exemption of material using the radionuclide dependant values will not be envisaged in the french regulation according to the safety authorities.

With regard to the 1996 edition of the IAEA transport regulations, it appears that the new exemptions for naturally occurring radionuclides and for consumer products are unlikely to impose greater or lesser restriction than that imposed by the previous transport regulations.

REFERENCES

Regulations for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. ST-1, 1996

Establishement of Reference Levels for Regulatory Control at Workplaces where Materials are Processed which Contain Enhanced Levels of Naturally -occurring Radionuclides, J. S. S. Penfold, J-P. Degrange, S. F. Mobbs and T. Schneider, NRPB-M855, 1997

EUROSTAT Basic Statistics, 32 ème Edition, 1995

The application of Exemption Values to the Transport of Radioactive Materials, PATRAM'95, P. Francois, A. Carey, M. Harvey, J. S. Hughes, J. Lombard, S. Mobbs, D. Raffestin, T. Schneider and K. B. Shaw

Study on Consumer Products containing Radioactive Substances in EU member States, European Commission, Radiation Protection 68, Report EUR 15846 EN, 1995

Anthropogene Stoffe und Produckte mit naturlichen Radionukliden Teil I: Uberblick uber die wichtigsten Expositionspfade, Bayerisches Staatsministerium fur Landesentwicklung und Umweltfragen (Hrg.), Becker, D. E. Und Reichelt, A. Munchen, Aug. 1991

Bundesministerium fur Umwelt, Naturschtz und Reaktorsicherheit (BMU): Umweltradioaktivitat und Strahlenbelastung, Jahresbericht 1993, BMU (Hrg.), Bonn, 1996

Harvey et al. Principles and Methods for Establishing Concentrations and Quantities (Exemption values) Below which Reporting is not Required in the European Directive. CEC report DOC XI-028/93, RP-65 (1993).

International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. Safety Series N° 115-I, Interim Edition, Vienna, 1994. IAEA

Regulations for the Safe Transport of Radioactive Material. 1985 Edition (As Amended 1990). Safety Series N° 6, Vienna, 1990. IAEA