

## TRANSPORT OF CONSUMER PRODUCTS CONTAINING RADIOACTIVE MATERIALS: ARE EXEMPTION LEVELS EXEMPTED?

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### ABSTRACT

Despite of the fact that IAEA Transport Regulations do not apply to radionuclides in consumer products that have received regulatory approval, following their sale to the end user, transport of consumer products may be subjected to these regulations because of the small but detectable amounts of radionuclides still incorporated in such products. This can lead to denial of shipment of consumer products in some cases. In this paper, minimal detectable activities for radionuclides present in different types of consumer products (including irradiated gemstones) are given in comparison to exemption levels established by International Basic Safety Standards together with resulting gamma dose rates. Examples of national practices on this subject are provided and recommendations for improvements to national transport regulations for consumer products are given.

### BACKGROUND

In the IAEA safety standard on Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Interim Edition) [1], a consumer product is defined as “a device or manufactured item into which radionuclides have deliberately been incorporated or produced by activation, or which generates ionizing radiation, and which can be sold or made available to members of the public without special surveillance or regulatory control after sale”. Three distinct categories of consumer product can be identified:

- (1) Products to which small amounts of radionuclides have been added either for functional reasons or because of its physical or chemical properties;
- (2) Equipment capable of generating ionizing radiation;
- (3) Products which, as a result of being intentionally exposed to ionizing radiation, contain activation products.

A number of different products to which small amounts of radionuclides have been added are currently widely available for use by members of the public and are marketed and sold around the world. These include: ionization chamber smoke detectors (ICSDs), radio luminous products using luminous paint or containing gaseous tritium light sources (GTLs), various types of lighting products that utilize  $^{232}\text{Th}$ ,  $^{85}\text{Kr}$  and tritium such as xenon car lighting and low wattage specialist lamps.

Other products to which small amounts of radionuclides have been added are less widely available but are still manufactured and sold in some Member States. These include: some electronic components such as voltage regulators, current surge protectors, spark gap irradiators and indicator lights, weapon sights, gas mantles containing thorium, thoriated tungsten welding electrodes used in tungsten inert gas (TIG) welding techniques, glassware and tableware that may contain uranium compounds, and dental porcelains that may contain incorporated uranium compounds.

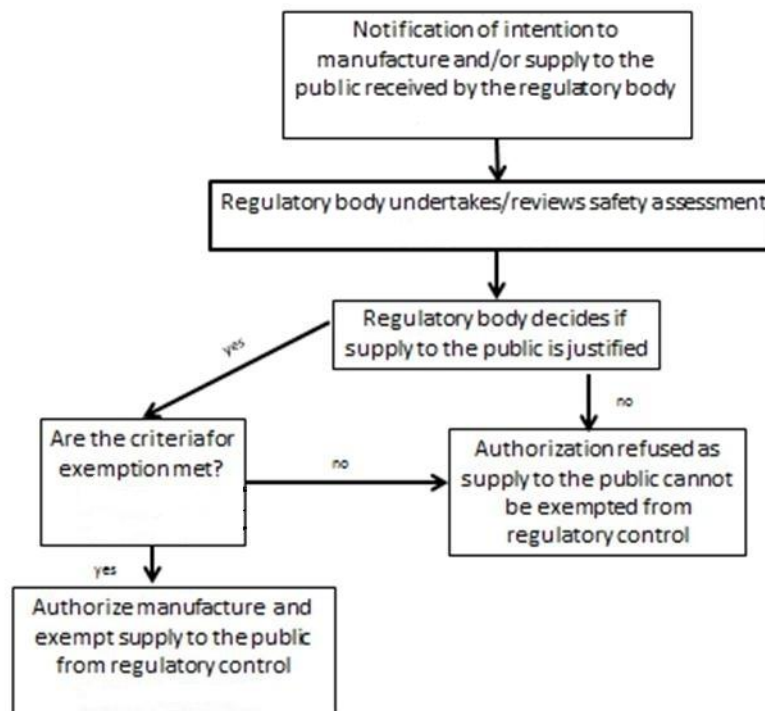
The color of gemstones may be intensified or altered by irradiation. This process can happen naturally over a long period of time but artificial irradiation can also be used to enhance the color of gemstones, and thus to increase their commercial value. There are three different methods of artificially irradiating gemstones: gamma irradiation, irradiation with an electron beam in a linear accelerator or neutron irradiation in a nuclear (research) reactor. With electron beam and neutron irradiation, radionuclides in the form of activation products can be produced within the gemstone structure. The half-life of these activation products is normally short, i.e. of the order of a few weeks, but some activation products have longer half-lives.

## **INTRODUCTION**

Some consumer products may be supplied directly to the public through commercial outlets while others are intended for specialist use by professionals but may still be purchased by members of the public. For example, ICSDs are on sale in many hardware stores worldwide and irradiated gemstones can be purchased from many jewelers. On the other hand, weapon sights normally sold under controlled conditions for military purposes in some Member States, may be freely purchased by the public in others. Discharge lamps containing added radionuclides are routinely used in private cars while others have a specialist application as floodlights in sports arenas and projection lamps in cinemas. Thus, members of the public may be exposed to ionizing radiation as a consequence of the personal or professional use of these products or activities such as their transport, storage, recycling and disposal.

## **IAEA SAFETY STANDARDS**

The IAEA safety standards provide the basic requirements for regulatory control of such products. The typical regulatory scheme applied to the consumer product chain is illustrated by Figure 1. The most relevant documents are the Governmental, Legal and Regulatory Framework for Safety [4] and Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (hereafter referred to as the BSS) [1]. These requirements include notification of a practice to the regulatory body and authorization of the practice by the regulatory body. Provision is made for the exemption of practices from these and other regulatory requirements based on general criteria given in the BSS or any exemption levels specified by the regulatory body on the basis of these criteria. The BSS, which is jointly sponsored by the IAEA and several other international organizations, apply to all facilities and all activities that give rise to radiation risks.



**Figure 1. Regulatory Control of Consumer Products (correspondent paras. From [1] are mentioned)**

## HARMONIZATION

In the interest of harmonization of approaches among Member States, some guidance on justification and the application of the criteria for exemption from regulatory control of consumer products has been provided in a number of IAEA Safety Guides e.g. Regulatory Control of Radiation Sources [3], Application of the Concepts of Exclusion, Exemption and Clearance, [4] and Application of the Principle of Justification to Practices, including Non-Medical Human Imaging [5]. Nevertheless, the process of justification and the application of the provisions for exemption to consumer products are not straightforward and have resulted in different approaches being adopted by Member States. This potential difficulty is a particular issue with regard to some very common consumer products, whose supply to the public is considered justified in some Member States, but is prohibited in others. Inconsistencies of approach may be a cause of confusion since the reasons for the different approaches will not be clear to the manufacturers and suppliers of products and the public who might use them.

Further harmonization of the regulatory approaches in Member States in the application of the justification principle [6] and the use of the exemption provisions in the BSS in relation to the supply of consumer products to the public is desirable. Such consumer products may be marketed globally, and lack of harmonization can be a cause of confusion among the public and others regarding the risks posed by their use. In addition, more consistent regulatory approaches can assist regulatory bodies with the efficient and effective use of their limited resources, leaving them more time to devote to those activities and practices that present more significant radiation risks. A more harmonized approach by regulatory bodies also has clear benefits for international trade.

A further argument in support of greater harmonization relates to the increasing use of the internet for the marketing of products. If a particular consumer product is authorized for supply to the public in one State, it will be extremely difficult, if not impossible, to prevent it being sold online and purchased by consumers in an adjacent State. While it may be possible to intercept and impound such products during transport to a State in which supply to the public is not authorized, this is likely to involve significant resources in terms of both manpower and training. It is clearly in the interest of all States and all

regulatory bodies to adopt a harmonized approach to ensure that consumer products authorized for supply to the public in one State are similarly authorized in another.

## **SAFETY ASSESSMENT**

According to International Basic Safety Standards [1], the consumer product may be exempted from regulatory control without further consideration provided that under all reasonably foreseeable circumstances, the effective dose expected to be incurred by any member of the public (normally evaluated on the basis of a safety assessment) owing to the exempted consumer product is of the order of 10  $\mu$ Sv or less in a year. To take into account low probability scenarios, a different criterion could be used, namely that the effective dose expected to be incurred by any member of the public for such low probability scenarios does not exceed 1 mSv in a year. Even if these dose criteria are not met, [1] provides for exemptions on the bases that regulatory control would yield no net benefit.

The safety assessment is an essential input to the determination of the justification of a practice and in the optimization of protection. It covers the doses that are likely to be received from normal use, reasonably foreseeable accidents and disposal. The assessed doses should be compared with established dose criteria. In the case of consumer products, the dose criteria are those for exemption contained in the IAEA safety standards. [1, 7]

Some consumer products are likely to be used singly or in small numbers. Other products, such as those installed in places of work to which the public may have access, may be used in greater quantities. For example, householders may install one or two ionization chamber smoke detectors (ICSDs) in their home but a much larger number of similar ICSDs may be used to as part of a fire protection system in an office block, shopping mall or hotel. ICSDs installed as components of fire detection systems of this nature are not consumer products as defined in the BSS [1] since they are not supplied to members of the public. However, the criteria for construction and design are the same and a similar approach should be taken for dose assessment. Any dose assessments carried out should take account of the number of ICSDs deployed in a dwelling and hence the total potential exposure to an individual.

## **TRANSPORT**

While the amount of radionuclides in an individual consumer product is normally small, much larger amounts of radionuclides are likely to be present during transport and storage in the warehouses of distributors. Separate safety assessments are necessary in dealing with the storage and transport of bulk quantities of consumer products containing individually small amounts of radionuclides. These stages should be assessed separately and should consider the doses that might be received during normal operations and in the event of an accident such as fire. Such assessments will indicate whether a limit should be placed on the numbers of products being stored or transported in order to ensure that the criteria for exemption are not exceeded. As indicated in above, the starting point for the safety assessment should be the numbers of items typically transported or stored together; the analysis should then be expanded to calculate maximum allowable numbers of products in transport or storage.

Denial of shipment could occur for shipments of consumer products that are below the exemption levels, yet trip an alarm at a radiation portal monitor located at a point of entry to a given country, or provide a radioactive trace to a hand held radiation detector used by border control of customs officials. Often denials are due to a lack of knowledge of the established limits or how the activity of the consumer good containing radionuclides compares to these limits.

As stated in para. 107 (e) of the IAEA Transport Regulations (SSR-6) [7], SSR-6 does not apply to “radioactive material in consumer products that have received regulatory approval, following their sale to the end user”. Consumer products are therefore outside the scope of the Transport Regulations only after

supply to the end user. All other transport of consumer products, including the use of conveyances between manufacturers, suppliers, distributors, and retailers, as well as the transport of large quantities of individually exempted consumer products, should be carried out in compliance with the IAEA Transport Regulations.

## CONCLUSIONS

Consumer products containing small amounts of radionuclides of artificial origin are widely available in the world market. The transport of such consumer products should be based on exemption levels established by the national regulatory bodies, based on IAEA safety standards, and which necessitate harmonization in case of international trade. Examples of safety assessments of different consumer products, including their transport scenarios, are provided in [8]. In addition, the IAEA is developing the Radiation Safety Guide, *Radiation Protection and Regulatory Control for Consumer Products*, currently in draft (DS 458), in which the above issues will be addressed.

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