HERCA

Heads of the European Radiological protection Competent Authorities

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Title:	**Information paper on lamps containing small amount of radioactive substances**

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Information paper on lamps containing small amount of radioactive substances

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Small amounts of radioactive substances have been added to some lamps to increase light intensity or to provide a starter aid function. Such technologies were introduced by the industry many decades ago into some lamps used in professional environments such as stadia, shop, and office lighting as well as specialised industrial and cinematic applications. However, the market for these lamps is growing rapidly and includes some public uses such as high intensity discharge head lights in cars.

Whilst the quantity of radioactive substances contained in individual lamps is too small to require authorisation by the regulator for the use, the authorisation criteria in European or national legislation can be exceeded for manufacturing, for import or export to or from the EU, for transboundary shipment within Europe, or when many lamps are used, stored, or disposed of together.

Technologies involving the addition of radioactive substances

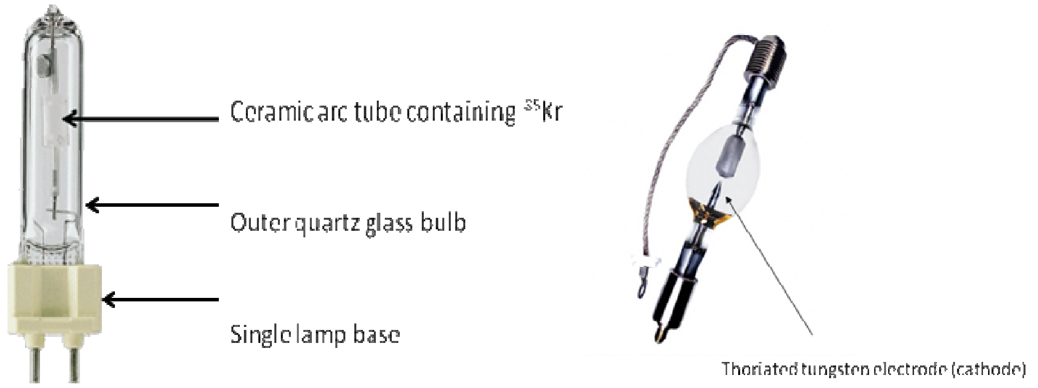
Thorium 232, Krypton 85 or Tritium are the main radioactive substances used by the lamp industry in small quantities either to improve electrode metallurgical properties, to optimize the light spectrum, or to provide a starter aid function.

High Intensity Discharge (HID) lamps contain a gas tight tube. On both ends of the tube an electrode is present and the tube is filled with a mixture of noble gas and metals. At ignition, a high voltage is applied over the lamp to form an initial plasma arc between the electrode tips. Some HID lamps contain radioactive substances to facilitate the formation of the initial arc:

- adding a noble gas nuclide like Krypton 85 provides free electrons in the discharge tube helps to form the initial arc;
- adding thorium to the tungsten electrodes lowers the emission potential of the electrode material.

Electrodeless Induction Lighting is a special lamp type in which no electrodes are present but a high frequency electromagnetic field is agitating the mercury molecules inside the bulb. This lamp also needs some Krypton 85 to generate free electrons for the lamp ignition in the dark.

Glow switches are used in older fluorescent systems with a copper-iron gear for linear tubes or compact fluorescent lamps. In the glow switches Tritium or Krypton 85 is used to generate some free electrons to help to form the arc between the electrodes.



Examples of lamps containing small amount of radioactive material (left: HID metal halide lamp with an outer bulb used in industrial lighting and retail, right: short arc lamp with a thoriated tungsten electrode used in industrial process and cinema)

These technologies are further described in [Reference 2, Annex II].

Dose estimates under various scenarios over the lamps' lifetime

This section presents a summary of the available estimates of effective doses received under various scenarios. These scenarios have been devised or assessed by competent authorities or their technical support organizations or described in peer-reviewed articles. The scenarios may not be directly comparable because they are based on different assumptions. They do not necessarily cover all the types of lamps containing a given radionuclide. The reader should refer to the documents listed below to get all the relevant details.

Manufacturing

Lamps containing small amounts of radioactive substances are being manufactured in Europe, e.g. in Belgium. The radiation protection implications of manufacturing activities are assessed by the licensing procedure in these countries and are not presented in this paper.

Transport

Radionuclides	**Scenario**	**Effective dose**	**References**
^{3}H, ^{85}Kr or ^{232}Th	Transport under various routine conditions	≤ 8 µSv/y	[3]
^{85}Kr or ^{232}Th	Transport under various routine conditions	≤ 8 µSv/y *	[4]
^{85}Kr or ^{232}Th	Transport under various routine conditions	≤ 1 µSv/y	[6]
^{3}H, ^{85}Kr or ^{232}Th	Accidental situations	≤ 3 µSv/y	[3]
^{85}Kr or ^{232}Th	Accidental situations	≤ 3 µSv/y	[4]
^{85}Kr or ^{232}Th	Instantaneous release of a consignment of 20 pallets of lamps	≤ 5.2 µSv	[6]

* the result is considered sensitive to assumptions. It might be more than 10 µSv/y with other assumptions

Storage

Radionuclides	Scenario	Effective dose	References
^{85}Kr or ^{232}Th	Employee standing next to lamps part or all of his working time	≤ 4 µSv/y	[4]
^{85}Kr or ^{232}Th	Employee standing 1 meter away from a pallet of lamps	≤ 4 µSv/y	[2]
^{85}Kr or ^{232}Th	Accidental situations	≤ 5 µSv/y	[4]
^{85}Kr or ^{232}Th	Instantaneous release of a consignment of 20 pallets of lamps	≤ 5 µSv	[6]

Non professional use

Radionuclides	Scenario	Effective dose	References
^{85}Kr or ^{232}Th	Employee standing next to lamps part of his working time	≤ 1 µSv/y	[4]
^{85}Kr or ^{232}Th	End-use under various routine and accidental situations	≤ 1 µSv/y	[6]
^{85}Kr or ^{232}Th	Accidental situations	≤ 10 µSv/y	[4]

Professional use (installation and maintenance)

Radionuclides	Scenario	Effective dose	References
^{85}Kr or ^{232}Th	Employee manually handling lamps 250 hours per year	≤ 1 µSv/y	[4]
^{85}Kr	Employee in direct contact with a lamp for 10 hours per year	≤ 1 µSv/y	[6]
^{232}Th	Employee working close to a pack of lamps and manually handling large numbers of lamps	≤ 6 µSv/y	[6]

End of life

Radionuclides	Scenario	Effective dose	References
^{3}H, ^{85}Kr, ^{228}Th or ^{232}Th	Various routine situations covering various disposal routes	≤ 1 mSv/y	[3][4][5]
^{85}Kr	Various routine situations covering various disposal routes	≤ 0.3 mSv/y*	[6]
^{3}H, ^{85}Kr, ^{228}Th or ^{232}Th	Accidental situations covering various disposal routes	≤ 10 µSv/y	[3]
^{85}Kr or ^{232}Th	Accidental situations covering various disposal routes	≤ 8 mSv/y**	[4]

* 0.3 mSv/y would be the effective dose received by a person standing at the point of emission of a recycling plant if the ^{85}Kr concentration is lower than the maximum concentration allowed under German regulation.
** The author of the report [4] views the scenario leading to an effective dose close to 8 mSv/y as very maximising and inappropriate for a regulatory decision. The scenario notably assumes a severe fire occurring at a waste management centre which regroups all the used HID lamps and whose capacity is saturated.

Regulatory issues at European and national levels

Directive 96/29/Euratom of 13 May 1996 (or “Basic Safety Standards” Directive) [7] provides that:

“Exceptionally, as provided in Article 3, individual Member States may decide that a practice may be exempted where appropriate without further consideration, in accordance with the basic criteria, even if the relevant radionuclides deviate from the values in Table A, provided that the following criteria are met in all feasible circumstances:
(a) the effective dose expected to be incurred by any member of the public due to the exempted practice is of the order of 10 µSv or less in a year; and
(b) either the collective effective dose committed during one year of performance of the practice is no more than about 1 man × Sv or an assessment of the optimization of protection shows that exemption is the optimum option.”

As a result, some Member States have taken a regulatory decision to exempt some or all of the practices related to lamps containing small amount of radioactive substances.

The table below shows the regulatory regime applicable in various Member States:

	Authorisation or notification	**Exemption**
Import into the EU	FI, BE[2], ES, NL	UK, NO[1], SE[1], GR
Storage	BE[2]	UK[1], NO[1], NL[1], DE, SE[1], FI, ES, SI[1]
Use		UK, FI[1], DE, NO[1], SE[1], BE, ES, NL[1], SI[1]
Disposal	BE[2], NL	UK[1], FI[1], NO[1], SE[1], ES

[1] a license is required over a certain radioactivity threshold per lamp
[2] operators are exempted if they can prove that the radiation protection impact of their activities is sufficiently low

Article 20 of the new « Basic Safety Standards » Directive [8], which must be transposed into national legislation in EU Member States by February 2018, also provides that Member States shall assess the justification and the fulfilment of the criteria for exemption from notification before authorising practices involving consumer products.

The common regulatory framework [9] on the transport of dangerous goods applies to the transport of lamps containing small amount of radioactive substances.

References

[1] HERCA interim statement about the regulatory status of small amounts of radioactive substances added to lamps, http://www.herca.org/herca_news.asp?newsID=12

[2] IAEA-TECODC-1679, Exemption from regulatory control of goods containing small amount of radioactive material, International Atomic Energy Agency, Vienna, ISSN 1011-4289; no. 1679, ISBN 978-92-0-129910-9, 2012

[3] HPA, HPA-CRCE-008, Assessment of the Radiological Impact of the Transport and Disposal of Light Bulbs Containing Tritium, Krypton-85 and Radioisotopes of Thorium, ISBN: 978-0-85951-678-5, October 2010

[4] IRSN (report in French), FT/AV/PRP-HOM/2012-00014, fiche technique établie en support à l'avis IRSN/2012-00118 du 20 mars 2012, to be published

[5] IRSN (report in French), FT/AV/PRP-HOM/2012-00026, fiche technique établie en support à l'avis IRSN/2012-00280 du 26 juin 2012, to be published

[6] European Commission, Transport of Consumer Goods containing Small Quantities of Radioactive Material: Radiation protection – sealed radioactive sources – leakage test method, NRPB GRS, May 2001

[7] Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation

[8] Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

[9] Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods

[10] Janssen, M.P.M. (report in Dutch), Radioactiviteit in Nederlandse gebruiksartikelen, RIVM-report 61023002/2002, NL (2002).

[11] Eleveld, H. Pruppers, M.J.M. (report in Dutch), Schattingen van de individuele en collectieve doses als gevolg van consumentenproducten waarin radioactieve stoffen zijn verwerkt, RIVM-report 610310 005, NL (2000).