

## Implications of the implementation of the revised dose limit to the lens of the eye: the view of IRPA professionals

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**Abstract**—In April 2011, the International Commission on Radiological Protection issued a statement on reduction of the equivalent dose limits for the lens of the eye, and strongly recommended its consideration in the revision of the International Atomic Energy Agency's International Basic Safety Standards on Radiation Protection. The reduced dose limit was incorporated in the final version of the Basic Safety Standards. As significant concern was expressed by radiation protection professionals worldwide, the International Radiation Protection Association (IRPA) established a task group to assess the impact of implementation of the revised dose limit for the lens of the eye for occupational exposure. IRPA Associate Societies (ASs) were asked for their views using a questionnaire addressing three topics: implications for dosimetry, implications for methods of protection, and wider implications. The responses received indicate various methods of approach and express different points of view, reflecting nuances of particular ASs or specific professional groups. Topic experts nominated by ASs were selected to assist with collation of responses, and a report was produced by the task group. Conclusions were drawn on the three issues, including potential cost implications. A number of recommendations were drawn from the responses received including: the request for more understanding about the relationship between exposure of the lens of the eye and cataract formation, and further guidance to assist implementation; the importance of economic and social considerations when introducing the limits into national regulations; the

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This paper does not necessarily reflect the views of the International Commission on Radiological Protection.

need to propose or define procedures related to employment of people with existing or pre-cataract conditions; and the practical aspects relating to dosimetry and protective equipment.

*Keywords:* Dose limit; Lens of eye; Views of radiation professionals

## 1. INTRODUCTION

The primary purpose of the International Radiation Protection Association (IRPA) is to provide a medium whereby those engaged in radiation protection activities in all countries may communicate more readily with each other, and thereby advance radiation protection in many parts of the world. IRPA's vision is 'to be recognized as the international voice of the radiation protection profession'.

In April 2011, the International Commission on Radiological Protection (ICRP) revised its eye dose threshold for cataract induction to 0.5 Gy; the previous threshold doses for vision-impairing cataracts were 5 Gy for acute exposures and >8 Gy for highly fractionated exposures. Further, ICRP recommended a reduction in the dose limit for occupational exposure in planned exposure situations (in terms of equivalent dose) for the lens of the eye from 150 mSv to 20 mSv year<sup>-1</sup>, averaged over defined periods of 5 years, with no dose in a single year to exceed 50 mSv (ICRP, 2012).

The International Atomic Energy Agency (IAEA) swiftly introduced the requirement for the revised dose limit to the lens of the eye, with less than the usual time for consultation; this left many radiation practitioners somewhat puzzled regarding the need, the implications (both practical and financial), and the possible timescale for introduction of any possible change to legislation. It took some time for the concerns to surface, but by October 2012 at a meeting of the European Presidents of IRPA Associate Societies (ASs), sufficient interest had been expressed for the IRPA President, Renate Czarwinski, to commission John Broughton, President of the Society for Radiological Protection (SRP), to form and lead a task group to undertake a survey of all IRPA ASs. The requirement was to return a rapid initial response of the reaction and possible concerns of radiation practitioners worldwide to the implications of the introduction of such a change to the dose limit.

## 2. THE IRPA TASK GROUP: OBJECTIVES AND METHODOLOGY

The IRPA task group was established in December 2012 under the leadership of the SRP/UK in close cooperation with the Italian Association of Radiation Protection. IRPA ASs were asked to complete a questionnaire to provide views and comments, addressing three different topics: implications for dosimetry, implications for methods of protection, and wider implications of implementing the revised limit.

The questionnaire was circulated to all 48 ASs within IRPA. Answers were obtained from 12 ASs (covering 16 countries), including most of the larger

organisations. Input was received from regions including Europe, North and South America, and Asia.

After collation of the responses by nominated experts, a report was produced by the IRPA task group, and general and specific conclusions were drawn<sup>1</sup> (Broughton et al., 2013; Czarwinski, 2013).

### 3. SUMMARY OF FINDINGS

#### 3.1. General

Various methods of approach and differing points of view were expressed in the responses received. Considerable disparity was found in the following aspects:

- cost implications for the procedures aimed to reduce the dose to the eye;
- implications related to the employment of people with existing cataract or pre-cataract conditions; and
- current perceptions of future compensation claims related to the new dose limit to the lens of the eye.

As choices and decisions will remain largely within each country, it will be useful to have further interchanges aimed at achieving better understanding of the various aspects considered in the report. It is recommendable that a harmonised approach should be sought in implementation of the reduced dose limit.

#### 3.2. Specific

As well as some general conclusions, five specific aspects were considered and addressed, namely: field of impact, eye lens dosimetry, protection of workers, wider implications, and potential cost implications/socio-economic effects.

##### 3.2.1 Field of impact

There is broad consensus that the main impact of the new limit will be in the medical sector (interventional radiology and cardiology). Minor concerns emerged in the fields of veterinary x rays. Some other working areas still need investigation concerning their relevance to higher exposures for the lens of the eye, and therefore for protective measures.

##### 3.2.2 Lens dosimetry

In the field of interventional radiology and cardiology procedures, workers could be exposed to doses close to, or in excess of, the revised limit. It is particularly important, in these cases, to know that the dosimeter will definitely record a dose indicative of the dose received by the lens of the eye.

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The relationship between dose and cataract formation is not well understood, and the causality needs better clarification.

There is a need for international recommendations to ensure harmonisation of radiation protection criteria, and for an agreed standardised system of dose recording (double-dosimetry system or single badge) with appropriate empirical formula to record the personal dose equivalent at 10 mm depth  $H_p(10)$  and at 3 mm depth  $H_p(3)$ . Arrangements should be confirmed or put into effect for assessing and recording the total dose to the lens of the eye of itinerant workers.

### 3.2.3 Protection of workers

By considering the protection of workers, the analysis by the task group indicated that established radiation protection techniques and shielding devices to reduce the dose to the lens of the eye are available to all ASs, but they are used somewhat sporadically. Training for effective and consistent use of these techniques presents a significant hurdle because of limitations of both time and availability of staff to organise effective training. Radiation protection training, especially in areas where the dose could exceed established limits, is a priority; therefore, funding of training is very important.

The application of methods of protection varies considerably from one location to another, even within the same country, and explicit guidelines relating to their use would be very beneficial. Even if decisions regarding which techniques and equipment should be used must rest at local level, it would be useful if international guidelines could be prepared and issued. Mandatory use of eye protection should be considered for all exposed workers.

### 3.2.4 Wider implications

In terms of wider implications, the majority of the ASs emphasised that the new limit could affect current methods of working, and could cause problems in relation to employment issues, high costs for possible additional medical eye examinations, possible increases in compensation in legal actions, and difficulties in explaining how to answer queries about previously unrecorded doses which are below current dose limits, but possibly above the new limit.

A number of ASs noted that significant concern and confusion exists among radiation practitioners on the rationale of changing the dose limit, since it appears that fatal and non-fatal effects are being considered in a similar way.

The evidence to support this change is not linked to harm, but to potential changes to the eye that are not considered a very significant detriment. Additional concerns are related to the fact that the findings in the literature are not consistent, the results are tenuous, and the changes to radiation protection practice could have evident socio-economic implications while the risk to the eyes may be considered to be small.

The work of the international organisations (ICRP, IAEA) on this topic seemed to be undertaken in a hurry, with an inadequate period of open consultation

(which the community has been accustomed to having for many years). It was felt that the case for the revised dose limit should be made more visible to practitioners.

### **3.2.5 Potential cost implications**

For the survey presented in the task group report, it was not possible to quantify the additional costs imposed by the new dose limit. However, most ASs had some concerns over the implied costs for:

- additional training;
- dosimetry and shielding;
- the possible need to formally classify more workers;
- systematic investigations of workplaces for their relevance;
- the need to recruit extra staff if current specialist staff are likely to approach the dose limit; and
- enhanced medical eye examinations for workers.

## **4. RECOMMENDATIONS**

From the responses received, representing the voice of radiation protection professionals, a series of recommendations has been derived, grouped under three main headings.

### **4.1. Understanding and guidance**

Support should be given to further studies on the relationship between radiation exposure of the lens of the eye and cataract formation. A more rational explanation should be provided for using the same numerical dose limit for the eye as for non-fatal deterministic and fatal stochastic effects. In addition, it will be of help if the relevant international organisations could explain the reason for the revised dose limit more clearly, so that it is more easily understood by the practitioners.

A further study leading to an international protocol for monitoring doses to the lens of the eye is also needed, and this should be promoted by the IRPA Executive Council. The introduction of guidelines to correctly identify groups of workers who could be exposed to lens doses close to the limit is recommended. Such guidance, to be provided by regulators, is necessary to assist in implementation of the changes introduced, including requirements on management, means of protection, and monitoring procedures and systems.

### **4.2. Practical aspects**

There is a need for a new system for detecting and reporting cataract data, or at least the need for clear comparison of existing systems. Further investigation is required on the validity and limitations of a whole-body dosimeter (at the collar above the apron) to assess  $H_p(3)$ . Further investigation on the effectiveness of the common protection methods (lead glasses and screens) is also recommended, as well as dissemination of the results to users via training sessions.

It will also be necessary to ensure that dosimeters and protective equipment are comfortable to use and do not interfere significantly with the effectiveness of medical procedures. Optimisation of radiation exposure is required for workers who could be exposed to levels approaching the dose limit, as well as radiation protection for the public. Procedures for emergency situations need to be taken into consideration.

### **4.3. Social, economic, and management considerations**

In general, economic and social considerations have to be taken into account according to national characteristics (e.g. national infrastructure) when introducing new dose limits (as in the present case for the lens of the eye) into national regulations. There is also a need to better detail the costs, showing the additional costs incurred, while reducing eye exposure, in comparison with the total costs of the procedure and the overall costs of any required installation. The new dose limit results in even greater emphasis on the training of key groups of workers who are likely to be most highly exposed.

There is a need to address training on the use of protective equipment, increasing awareness about effectiveness, and correct wearing of relevant dosimeters.

There is a need to define procedures relating to the employment of people with existing cataract or pre-cataract conditions, taking into consideration: (1) the risk of discriminating against people seeking employment on the basis of a condition that is quite common; and (2) the risk of inducing additional deterioration of visual acuity for exposed workers.

IRPA will continue its work to ensure that these findings are integrated into the ongoing international discussion of these implementation issues.

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