

ICRP publication
Radiation detriment calculation methodology
IRSN comments

The draft submitted for consultation by ICRP details the methodology used to calculate the total and relative detriment, which is then used to derive the tissue weighting factors that are needed to calculate the effective dose.

This document is very welcomed since the methods for calculating this detriment were only partly explained in ICRP 103. It fills a void and allows everyone to understand the methodology and to assess its advantages and limits. Nevertheless, the connection between ICRP pub 99, ICRP pub 103 and the pending publications on the effective dose (TG 79) and tolerability (TG 114) could be more highlighted (or anticipated) to ensure the consistency between these correlated documents.

Besides, the concept of “detriment” is not of common use for radiation protection practitioners. To be more helpful, this publication could better explain how to use this quantity and what for but also the choice of the commission to calculate only one quantity (radiation detriment) representing the harmful effect of radiation in order to have only one (or very few) dose limit(s) which can be operationally applied to very different exposure scenarios. Another choice could have been to calculate different indicators (for acute or for protracted exposure, for external irradiation, for internal contamination, for exposure to alpha, beta or gamma radiation...) and to give different dose limits for all these type of exposure but this would be less operational than a single or few dose limits.

The section about sensitivity analysis of detriment to different parameters is very informative even though it is to be mentioned that many of those related to nominal risk calculations have been already addressed in ICRP pub 99.

The comments of IRSN focus on the “evolutions” section that could be included in the future for the calculation of the detriment. The main comments are:

1/ Whatever the future recommendations about detriment could be, IRSN firmly supports the effective dose as a useful tool to manage radiation protection in many cases. Associated with the ALARA concept, it has proven to be and it continues to be a very powerful tool to decrease both the individual and collective exposures of workers and populations, to inform all stakeholders (workers, population, patients) with a single figure and to aid non-specialist decision-makers with the management of the risk to ionising radiations.

2/ This document mixes technical information (addendum of ICRP 103), presenting different options with open questions in section 5, which is not necessarily the expectations of the ICRP publication usual reader. The objectives and timeframe of the various types of information provided in the document are very different.

3/ IRSN supports the willingness to update the data that support the detriment modelling (baseline risk, structure of the population, average years of life lost...). Such updates are scientific improvements of the method and would not modify the concepts and applications of the radiological protection system recommended in ICRP 103 publication. However, the need to present such a long list of possible

updates in an ICRP publication at the same level as “recommendations” publication is debatable: is there a recognised consensus on such updates and can we consider these updates as endorsed by ICRP? In addition, these evolutions should be handled carefully to avoid a kind of discredit on the present calculation of the detriment, which is unwanted at a time when all stakeholders are still working hard to implement the ICRP 103 recommendations (first review and then decide if it’s worth to change the limits for example).

4/ IRSN is in favour to use other cohorts than the LSS to challenge the risk models but wonders if the pattern of the current ICRP risk models fit with cumulative exposure scenarios.

5/ About adjustment for severity, it seems to be more effective and understandable to use values issued by WHO (updated to figure out DALY for calculation of the global disease burden).

6/ The detriment is a concept that ICRP uses for effective dose calculations. Nevertheless the use of the detriment (product of the effective dose by the nominal risk coefficient adjusted to the detriment) as a health-informative output value is questionable.

- It mixes fatality and non-fatality

- The multiplicative term relative to years of life lost makes it a relative quantity difficult to understand.

As a result, it’s extremely difficult to define it in plain words using units (or pseudo units) that make sense. And consequently the pros and cons of the detriment vs. risk-based approaches should be clarified.

In addition, the pre-requisite of exposure scenario (chronic and homogeneous exposure) is not necessarily met when the detriment is used.

So, to be informative about health effects, it might be useful to propose additional indicators that can be explained directly such as:

- Risk of cancer incidence/gray

- Risk of cancer lethality (per/gray)

- Risk of years lost or risk of years with cancer (/gray).

For this purpose, which consists in replacing detriment assessment by risk assessment, additional recommendations from ICRP would be needed in terms of tolerability of risks (as many countries do for cancer risks due to exposure to carcinogenic chemical substances). Moreover, if parameters like gender, age at exposure, baseline rate and so on should be taken into account, radiation protection practitioners have no practical approaches and tools to face to this growing complexity and ICRP will be asked for their development (or conducting a survey on existing tools). If the trend to shift to more transparent units related to health is confirmed, the question raised by UNSCEAR 2012 about attributability vs. inference should be also addressed, especially when collective doses are used to assess health effects on a population exposed to low doses. These issues could be addressed in a dedicated ICRP publication.

7/ there is no ICRP position either in the integration of the new cancer risk data, nor in integrating the lens or cardiovascular effects in the calculation of the detriment. Clear recommendations are expected from ICRP on both subjects. IRSN does not underestimate the multiple difficulties of including these effects in the calculation of the detriment including ignorance of the mechanisms of action and the difficulties in calculating a dose directly linked to any vascular effects. However, this issue should be addressed by ICRP even if the conclusions are that these effects should be treated separately and not

included in the calculation of an effective dose. IRSN therefore hopes that this technical document is a first volume of a series in this area and will soon be followed by clear recommendations.

To conclude, the follow-up of the contents of this document could be addressed in 2 different frameworks:

- the first one could be a periodic scientific review in order to weigh the impact of data changes on the detriment calculation (which is not actually recommendations)

- the second one which could be recommendations about future evolutions of the concept of detriment. This task needs further investigation to solve open questions raised in the draft of TG 102 and should look into details about the need to develop a new detriment with respect to quantities developed into ICRP pub 99. In addition a discussion about the use of ERR determined by epidemiological studies as a supplement to the detriment could be fruitful.

Meanwhile, ICRP should state that the effective dose and related recommendations as presented in ICRP 103 remains fully relevant for the management of the risk of ionising radiation in many situations.