Sociedad Argentina de Radioprotección (SAR)

Comments about the document "ICRP Radiation Detriment Calculation Methodology"

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The Argentine Radiation Protection Society (SAR) decided to appoint an ad hoc working group to analyze the "ICRP Radiation Detriment Calculation Methodology" document. The professionals coming from different fields prepared a document that SAR Executive Council is sending to ICRP as a contribution and that it hopes will be useful.

SAR decided to contribute with its comments to the ICRP document, with the conviction that the concept of "Detritment" is of the utmost importance in risk communication, the definition of activities and the design of optimization programs in Radiation Safety. It is precisely the risks communication in the nuclear industry and in medical practices that encourages us to point out observations to this document. In the words of the ICRP "Radiation Detriment Calculation Methodology" document itself "216 It is also desirable to improve the way of expressing radiation detriment and to illustrate the data of reference populations so that non-specialists can have a balanced perspective on the health risks of radiation".

The document establishes that "270 Radiation detriment can be used for prospective risk assessment of exposure situations for radiological protection purposes or to assess risks in retrospective situations for exposures of identified individuals". Whether this is indeed the case, or not, it is very important to clearly define the limitations and uncertainties of the concept.

Comments

1. It is understood that the document has been proposed as an objective to clarify the methodology for calculating radiological harm, as formulated in Publication ICRP 103. Now, it is considered that the document would be a much more valuable contribution, if it developed and discussed the foundations and limitations of the concept of Radiological Detriment as defined. This would improve its communication to stakeholders, and avoid misapplication of the concept of Radiological Detriment.
2. The document doesn't develop the very different limitations in the application of the concept of radiological detriment, depending on the exposure interval being considered:
   - on the one hand, the health effects of low-dose exposures (when calculating collective doses) are conjectures and their existence is assumed solely by conservative criteria. In other words: it should be clearly stated that in the current state of knowledge, effects of exposure at low doses can't be attributed and that they are only an assumption. (At doses generally below an absorbed dose of about 100

mGy, the uncertainties associated with epidemiological studies become increasingly large and tend to mask any possible effect. The probability that stochastic effects occur at low and very low doses can only be inferred subjectively through expert judgments)
- against this, the effects of high dose exposures can actually be determined.

Addressing this issue there is an UNSCEAR publication that the document should take into consideration: UNSCEAR 2012 Report to the General Assembly with Scientific Annexes A and B - Annex A. Attributing health effects to ionizing radiation exposure and inferring risks
Annex B. Uncertainties in risk estimates for radiation-induced cancer

3. It is consider that the document should explicitly include this distinction and develop it in detail, since failing to do so would maintain the current situation, which has led to very wrong conclusions when calculating expected cancer cases in emergency situations.
4. It is proposed that the document clearly include the exposure intervals in which the developed calculation methodology (mathematical expectation) is valid. And in particular, it should be explained that the collective dose magnitude can't be rigorously considered to be proportional to the risk, in the low dose intervals. In this sense, as the document also intends non-specialists to grasp the idea and significance of radiation detriment (216) it is important to emphasize that multiplying very low doses by large numbers of people to estimate the number of radiation-induced health effects in a group exposed to very low doses is not correct.
5. The document explicitly recognizes with respect to various topics, that models and parameters should be updated with scientific information published in recent years. And it doesn't. It is quoted verbatim:
   a) "1222 5.1.2. Cancer risk models
   The calculation of the radiation detriment requires the use of models describing the relationship between the organ/tissue dose and cancer risk for specific cancer sites. The following points provide a summary of cancer risk models in Publication 103 (ICRP, 2007) and possible ways of updating them.
   • Radiation-associated cancer risk models for 11 categories of organs or tissues (oesophagus, stomach, colon, liver, lung, female breast, ovary, bladder, thyroid, other solid cancers and red bone marrow) were derived from the LSS, based on a follow-up from 1958 through 1998 (Preston et al., 2007). Since then, new models with longer follow-up have been published, that can be used to update the risk models."
   b) "1253 Most of the risk models were derived from the LSS without incorporating findings from other sources. During the last decade, many reports provided risk models derived from other epidemiological studies, especially for populations with protracted exposures (e.g. nuclear workers, Mayak workers, residents along

the Techa river, and Chernobyl clean-up workers). Evaluation of the models derived from these studies should be performed based on a detailed analysis of their respective limitations and advantages, and discussion of the consistency of their results."

c) "1260 The models to calculate the nominal risks rely on several assumptions, including the LNT model, application of a DDREF, and the use of a transfer scheme based on the weighting of ERR and EAR models. The validity of these assumptions must be examined in the light of the latest scientific findings. In this regard, recent epidemiological literature has been reviewed by the National Council on Radiation Protection and Measurements to examine the validity of the LNT model (NCRP, 2018; Shore et al., 2018, 2019). The Commission has launched a Task Group to review the scientific basis of the DDREF in terms of epidemiology, animal experiments and cell biology. Several papers have already been published (Rühm et al., 2015, 2016, 2018; Shore et al., 2017; Tran and Little, 2017; Wakeford et al., 2019) and a dedicated report will be released in due course.".

d) "1284 Adjustment for quality of life of cancer patients was based on the use of very approximate value judgements. More elaborate approaches such as disability-adjusted life years (DALY) are now available to estimate and characterise the quality of life for a wide range of conditions (Chen et al., 2015; Shimada and Kai, 2015). A review of these methods and of available data can help, taking into account the variation with age, sex and geographical región".

e) "1134. With the improvement in diagnostic techniques and treatment, the cancer death rate has declined during recent decades. //…//. The situation may lead to a considerable change in the values of lethality fraction, and this should be taken into consideration in the future".

f) "1182 Conversely, the progress in diagnostic techniques and treatments should bring about a decrease in radiation detriment as of today and may lead to a significant decrease in the future".

g) The value of "dose and dose-rate effectiveness factor" (DDREF) has great importance in the result of the Detriment. As the document states: "763 Recognising uncertainties, the Commission recommended in Publication 103 (ICRP, 2007) that a DDREF of 2 continued to be used for radiological protection purposes. The Commission stressed that its recommendation was a broad judgement including elements of both subjectivity and probabilistic uncertainty." it is suggested that the recommendations of other organizations in this regard should be included, as expressed in lines 961 to 969.

6. As the document itself states, "1404. There is no simple way to express the multidimensional nature of detriment, and it will be necessary to improve its presentation in the future so that the make-up of radiation detriment becomes more comprehensible to non-specialists."

Conclusion

From the foregoing, it is proposed that this document be revised, especially that it is necessary to include the results of research carried out in recent years and explicit clarifications of the limitations of the concept of Detriment, before its official publication as a new document on the “application” of the concept of Detriment.

These new recommendations would allow the virtuous cycle to be resumed, that is, UNSCEAR providing basic science, ICRP recommending on that basis a paradigm that reflects a universal consensus, and intergovernmental organizations under the aegis of the IAEA establishing international standards.