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EDITORIAL COMMENT

Editorial comment on: The "as low as reasonably achievable" (ALARA) principle: a brief historical overview and a bibliometric analysis of the most cited publications https://doi.org/10.1051/radiopro/2019016. Which future for the ALARA principle implementation?

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In this issue of *Radioprotection*, Yeung presents quite an original approach of the ALARA principle *via* an overview of the term ALARA through the history of scientific publications on this topic (Yeung, 2019). To support his historical approach, the author made a quantitative and qualitative analysis of occurrences of the acronym ALARA and of the topic "as low as reasonably achievable" in the Web of Science database hosted by Clarivates.

This article of Yeung illustrates how ALARA principle, as defined by ICRP (ICRP, 1977) as a key element of the international radiation protection system, implemented across the world through regulations, and promoted by scientific or professional communities, has had a deep and positive impact on radiation protection practice over the last 25 years, in spite of scientific controversies and significative knowledge gaps about low dose exposure health effects (Repussard, 2017).

Optimization and reasonableness in the practical implementation of the ALARA principle have been the object of recent publications in *Radioprotection* (Bourguignon *et al.*, 2017; Schneider *et al.*, 2017). It is also worth reflecting about future challenges for ALARA, as its risk reduction potential necessarily narrows over time through its very implementation, for given technologies and related practice.

ALARA allows for dialogue between regulators, licensees and other stakeholders (notably exposed groups of persons) on the choice of "optimized" risk preventing or mitigating measures. In this context the possibility of technology and/or organizational changes is weighed: the risk reduction effectiveness of such measures has a "cost" in terms of investment/training/acceptance by those concerned as well as, possibly, in terms of productivity and client satisfaction. As the search for further optimization progresses over time, associated "costs" may progress by significant increments, whereas the LNT paradigm may imply a very limited associated "benefit" in term of stochastic risk reduction potential. With the possible consequence of having the ALARA process progressively grinding to a premature halt, resulting in frustration of some actors and stakeholders.

In addition, it can be observed that an ALARA approach may lead to detrimental results in terms of overall risk management, when it reaches limits of its validity in a broader sense:

- measures to reduce exposure may result in increased risks, other than radiological, for the exposed persons. Such risks, even if outside the scope of the radiological regulatory regime, could be of a larger magnitude than the radiological safety gain;
- in the opposite direction, exposure quantities resulting from an ALARA approach may still be felt to be totally unacceptable by some stakeholders who have not been fully involved in the optimization process (groups or individuals), and lead to detrimental behavior on their part, towards themselves or society, caused by radiation phobia. This has happened notably in the context of long term post-accident situations.

These observations raise the question of the future potential of ALARA as a driver of further radiation risk optimization. As the ALARA based risk reduction potential necessarily narrows over time through its very implementation, for given technologies and related practice, it could be useful to provide a complementary methodological framework to help "mining" as effectively and finely as possible remaining optimization opportunities.

Based on several explicit parameters, all related to aspects of the notion of risk, such a framework could help enrich the necessary dialogue between stakeholders as well as the regulator/licensee relation. In this way, within the broad domain of what may still be in theory feasible to reduce exposure risks, could emerge an agreement on the practical solution(s) which appear to be reasonably implementable.

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Such parameters could be the following:

- "uncertainty parameter" about the quantity of exposure (a dose, or dose rate): this implies that instead of incorporating uncertainty in the calculation steps through the wider concept of safety margins, dose or dose rate would be expressed as a mean value plus or minus an uncertainty value calculated as covering for example 95% of probable exposure situations. Making safety margin areas explicit may lead to an optimization approach aimed at reducing uncertainty (but not margins themselves!) by appropriate measures, still procuring a benefit in terms of radiation protection, but at a "cost" which may then be deemed acceptable;
- "risk transfer parameter": this is about the eventual increase of risks other than radiological, to the same persons or to different persons, likely to result from an incremental measure to reduce radiological exposure. For example a widening of the evacuation zone after an accident causing radiological pollution may lead to public health detriment caused by the consequences of evacuation. Or in a professional environment, measures to reduce ambient dose rate by further isolating a source may increase the risk of incidents (falls, or exposure to other risks such as asbestos, for example). Or the road transport of very low level waste to reduce environmental dose rate may lead to an increased risk of traffic accidents. The formalization of such a parameter would broaden the dialogue to other risk prevention actors, with the potential to achieve optimization in a broader perspective, with possible direct benefit for radiation protection aspects;
- "radiological risk individual perception parameter": different individuals have a different appreciation of the nature and relative importance of the radiological risk they are encountering. The general acceptance of different regulatory exposure limits for workers and members of the public is an indirect proof of this. As the views of stakeholders matter for an effective risk optimization ALARA process, it would therefore be fair to take this parameter more explicitly into account. For example, in the event of a nuclear accident requiring the long term evacuation of some territory, there is no single perimeter which objectively (based on science) delineates safe/unsafe zones. The imposition by an authority of any such perimeter therefore will not be perceived as acceptable by a part of the population concerned. Taking into account this perception parameter would lead to a more graduated approach where, in a band of territory the decision could be left to the choice of inhabitants: if they choose to leave, they receive support from public authorities, if they choose to stay they also receive support (including dose meters and training about reducing their exposure, as well as socioeconomic measures to support the sustainability of such local communities).

Of course, such a complementary approach to ALARA methods would require the elaboration of guidance for radiation protection practitioners and experts, as well as for stakeholders:

- about how to make exposure uncertainty explicit in the risk assessment analysis, keeping it separated from safety margins which should reflect precaution, including remaining uncertainties, as a risk management decision at the end of the risk assessment process;
- about defining a scale for the "risk transfer factor" on the basis of a dialogue between radiation protection professionals and other professional risk preventers (physical, chemical, psycho-social...), in order to facilitate an informed entry into this multi-risk approach;
- also a scale for individual risk perception should be elaborated through social sciences research. This could take for example the form of a standard questionnaire, which could be normalized and bench marked through tests in reference populations, and later serve as a resource (*via* internet?) for individuals or families or groups confronted to difficult situations.

Finally, it could be noted that in the longer term, radiobiology might well provide an operational answer to the question of individual response to ionizing radiation (Foray *et al.*, 2016). If and when this occurs, a whole set of new ethical questions will arise for radiation protection actors and stakeholders, possibly generating some jeopardy for the continued implementation of today's rules and practice. The "parametric approach" to ALARA sketched above would certainly not resolve the problem by magic, but it might make it easier to factor in this new parameter, becoming just one more incremental parameter in the dialogue about radiological risk optimization process.

References

Bourguignon M, Bérard P, Bertho JM, Farah J, Mercat C. 2017. What's next in Radioprotection? *Radioprotection* 52(1): 21–28.

Foray N, Bourguignon M, Hamada N. 2016. Individual response to ionizing radiation. *Mut. Res.* 770: 369–386.

ICRP. 1977. Recommendations of the ICRP. ICRP Publication 26. *Ann. ICRP* 1(3): 1–53.

Repussard J. 2017. Low dose effects research in Europe: eight years of evolutiontowards new paradigms. *Radioprotection* 52(4): 251–258. DOI: https://doi.org/10.1051/radiopro/2017032.

Schneider T, Lecomte JF, Schieber C, Andresz S, Chambrette V, Le Guen B, Vaillant L. 2017. Synthesis of reflections and conclusions of the SFRP-IRPA workshop on the reasonableness in the practical implementation of the ALARA principle. *Radioprotection* 52(4): 259–263. DOI: https://doi.org/10.1051/radiopro/2017031.

Yeung AWK. 2019. The "As Low As Reasonably Achievable" (ALARA) principle: a brief historical overview and a bibliometric analysis of the most cited publications. *Radioprotection* 54(2). https://doi.org/10.1051/radiopro/2019016.

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