



The Application of ALARA for Occupational Exposures

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The National Council on Radiation Protection and Measurements (NCRP), in Reports No. 116 and No. 127 (NCRP, 1993; 1998), reiterated its philosophy that radiation protection be based on the guiding principles of justification, dose limitation, and the reduction of dose to levels as low as reasonably achievable (the ALARA principle), economic and social factors being taken into account. In its presentation of dose limitations, the Council set specific upper limits of acceptable dose for occupationally exposed individuals, and the general public, with additional concern for the embryo/fetus. Through the inclusion of the ALARA principle, the NCRP wished to emphasize that adherence only to dose limits was not sufficient.

In its definition of ALARA, the NCRP was very general in stating that, "In many applications, ALARA is simply the continuation of good radiation-protection programs and practices which traditionally have been effective in keeping the average and individual exposures for monitored workers well below the limits" (NCRP, 1993). This was deliberate because sound professional judgment on the part of radiation protection managers in the application of the ALARA principle is an essential aspect of a successful radiation protection program. However, in some instances, the application of the ALARA principle has been inappropriately exaggerated so that the use of radiation has, at times, been unnecessarily restricted and beneficial outcomes forfeited.¹ Additionally, the specification in the ALARA principle that

¹The assumption, for radiation protection purposes, that "the risk of stochastic effects is proportional to dose without threshold throughout the range of the dose and dose rates of importance in routine radiation protection" (NCRP, 1993) has led some to the belief that even the lowest exposures are unduly hazardous. The NCRP has always endeavored to ensure that the hazards associated with exposure to ionizing radiation be accurately estimated. It continues to stand by its position stated in 1975 that, "Undue concern, as well as carelessness with regard to radiation hazards, is considered to be detrimental to the public interest" (NCRP, 1975).

economic and social factors be considered has at times been overlooked, resulting in excessive monetary costs with little benefit. The ALARA principle should not be misinterpreted as simply a requirement for dose reductions irrespective of the dose level; sound judgment is essential in its proper application. Nevertheless, even at very low exposure levels, if simple and low-cost means would result in still lower exposures while retaining the beneficial outcome, sound judgment would indicate that such means should be encouraged.

To prevent unnecessary restrictions and to focus attention on the higher exposures, the NCRP recommends that the procedures and documentation required to implement the ALARA principle be less formally applied as the annual dose to an individual is reduced farther and farther below the occupational limit. For example, studies of patterns of occupational exposure have shown that over 80 percent of collective dose is due to a small portion of workers receiving in excess of 1 mSv y^{-1} , emphasizing that the greatest potential impact of an ALARA program is obtained by focusing on these individuals (EPA, 1984).

For a specified group or population of occupationally exposed individuals, the procedures and documentation should be minimal if the potential collective effective dose is likely to be less than 0.01 person-sievert (NCRP, 1998). If this is the case, “the total value of the dose that might be partially avoided by a formal ALARA program does not justify the effort required for the preparation of formal procedures and documentation” (NCRP, 1998). However, the NCRP has also pointed out that “less formal efforts to maintain doses below that level may still be justified” (NCRP, 1998). In addition, the NCRP has recommended that an annual effective dose of 0.01 mSv per source or practice be considered a negligible individual dose (NCRP, 1993).

This guidance should keep exposures and the assumed associated risks to a reasonable minimum without forfeiting potentially increased benefits or incurring unreasonable costs.²

²As an example, 1 mSv y^{-1} over a working lifetime of 40 y could potentially expose a worker to an excess risk of fatal cancer of 0.16 percent. This assumes a nominal lifetime cancer mortality risk of four percent per sievert. This was derived by extrapolation from high-dose rates and high doses (with the application of a dose/dose-rate reduction factor of two) to lower doses where excess cancer risk cannot be identified statistically (NCRP, 1993). For comparison, fatal cancers were the cause of 23 percent of all deaths in the United States in 1995 (Landis *et al.*, 1999).

References

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