Development and Dissemination of ALARA Culture

Sotirios ECONOMIDES[1], Frank HARDEMAN[2], Cristina NUCCETELLI[3], Serena RISICA[3], Caroline SCHIEBER[4], Annemarie SCHMITT-HANNIG[5], Fernand VERMEERSCH[2]

[1] **GAEC, P.O. Box 60228, Agia Paraskevi 15310, Athens, Greece**
[2] **SCK/CEN, Boeretang 200 B-2400 Mol, Belgium**
[3] **ISS, Viale Regina Elena 299, I-00161 Rome, Italy**
[4] **CEPN, 28, rue de la Redoute, F-92260 Fontenay-Aux-Roses, France**
[5] **BfS, Ingolstädter Landstrasse 1, D-85764 Oberschleissheim, Germany**

Abstract
This paper, elaborated by a working group from the European ALARA Network (EAN) discusses the elements that constitute ALARA culture, its current status in relation to the various exposure situations, and the role of networks to further develop and disseminate it.

Key Words: ALARA, Culture, Optimisation, Network

1. Introduction

ALARA culture is at the heart of radiation protection culture and is based on the hypothesis of a linear dose-effect relationship without a threshold for stochastic effects. It should result in attitudes and behaviours of individuals and organisations, which are always committed to searching for an acceptable level of risk taking into account societal and economic factors.

The need to further develop and disseminate ALARA culture comes at a time when there is an increase of the awareness of risk, a constant development of scientific knowledge about radiation health effects [1], the introduction of new exposure situations, and an increase in the number of applications of ionising radiations.

2. The ALARA principle

Justification of radiation exposures, optimisation of radiation protection and application of individual dose limits are the three radiation protection principles, as adopted for the first time in ICRP publication 26 [2] and incorporated in the subsequent Commission's recommendations [3, 4]. Publication 103 states that optimisation of protection is the process by which "*the likelihood of incurring exposures, the number of people exposed, as well as the magnitude of their individual doses should be kept As Low As Reasonably Achievable taking into account economic and societal factors*"[4].

The principle of optimisation of radiation protection is a direct consequence of the adoption of the linear dose-effect relationship with no threshold for "stochastic effects". It resulted in a search for risk reduction whatever the level of exposure. The wording of the ALARA principle has evolved through the various ICRP publications, integrating the question of how far the risk should be reduced. At the beginning, the Commission proposed a radiation protection philosophy based on a minimum or even zero level of risk. This philosophy was expressed as a recommendation to "reduce doses to the lowest possible level" [5]. In 1959 the initial wording changed [6] to "as low as practicable" and in 1966 to "as low as readily achievable economic and social considerations being taken into account" [7]. In its 1990 Recommendations [3], ICRP introduced the current wording of the optimisation principle,

known as the “ALARA” principle – As Low as Reasonably Achievable. The acronym “ALARA” has been used for more than 20 years by radiation protection professionals. It is considered that the two expressions – optimisation of radiation protection and ALARA - are synonymous and interchangeable [8].

The objective of implementing ALARA is to reach an ‘acceptable’ level of risk, below the dose limit which is the upper bound of the ‘tolerable’ level of risk. ALARA is an obligation of means, and not an obligation of results, in the sense that the result of ALARA depends on processes, procedures, and judgments and is not a given value of exposure. The acceptable level of exposure depends on the exposure situation as well as the societal and economic considerations.

According to ICRP 101 [9], optimisation is a frame of mind, always questioning whether the best has been done in the prevailing circumstances. It requires a forward-looking iterative process aimed at preventing exposures before they occur. It is continuous, taking into account feed-back experience as well as technical and socio-economic developments. It requires both qualitative and quantitative judgments.

3. Why think about “ALARA culture”?

The European ALARA Network (EAN) has been discussing the issue of “ALARA culture” for a long time. A definition was proposed during the 10th EAN Workshop (Prague 2006) as follows [10]:

“ALARA culture is a reference framework, a state of mind and attitude

- *Allowing an individual and/or an organisation to act in a responsible way in order to manage radiation risks and giving radiation protection the priority it should have;*
- *Characterised by risk awareness, balanced judgement of risks and benefit, and the capability to develop and use required skills and tools for risk assessment and management, balance of resources and economic and societal considerations;*
- *Realized through transdisciplinary education and training tailored at each level;*
- *Supported by management commitment, guidance and supervision of competent authorities on European and national level;*
- *Making use of a clear definition of responsibilities.*

It should have a continuous character covering all processes where radiation protection is involved. It should have full support of authorities and professional organisations while systematically integrated in continuous quality improvement”.

At the IRPA 12 Associate Societies Forum held in Buenos Aires in October 2008 [11], an IRPA working group on "Improvement of the Radiation Protection Culture" was launched with the aim of preparing IRPA Guiding Principles on that topic. EAN gave its support to the work of IRPA, focusing on the contribution of ALARA to radiation protection culture. A dedicated EAN working group on ALARA Culture[1] was then set up to maintain and further develop a high level of radiation protection by:

- promoting ALARA culture in all fields of application,
- implementing the ALARA principle into practice, and
- analysing feedback from implementing ALARA in various sectors.

[1] Members of the EAN Working Group on ALARA culture are the following: *Sotirios ECONOMIDES (GAEC, Greece), James GEMMILL (SEPA, UK), Frank HARDEMAN (SCK/CEN, Belgium), Bernd LORENZ (GNS, Germany), Cristina NUCCETELLI (ISS, Italy), Serena RISICA (ISS, Italy), Caroline SCHIEBER (CEPN, France), Annemarie SCHMITT-HANNIG (BfS, Germany), Fernand VERMEERSCH (SCK/CEN, Belgium), Angela WRIGHT (SEPA, UK).*

This paper presents a synthesis of the main elements contributing to the dissemination and development of ALARA culture.

4. Some elements of ALARA culture

Many elements contribute to a good ALARA culture. Some examples are presented below.

Attitudes and behaviour
Fundamental elements of the ALARA culture are the attitudes and behaviour of the relevant persons towards radiological risk, which are influenced by different cultural backgrounds, personal opinions, existing economic and social conditions or exposure situations. This can explain the differences observed in the degree of implementation of ALARA between different exposure situations or, even within a same type of exposure situation, between individuals, organisations and countries.

Positive attitudes towards radiological risk should include at the individual and/or organisational level:

- a questioning attitude (e.g. did I do what I could to save doses? is the management committed to the introduction of new technologies to save doses or prevent accidents?,...);
- openness and transparency (e.g. open to changing habits, reporting mishaps, explaining radiation protection options,…);
- commitment to dose reduction (e.g. appropriate individual behaviour in the presence of radiation sources, willingness to invest in protection measures,…).

Radiation risk awareness
Risk awareness is the basis of ALARA culture. There is thus a need to reach a common understanding of radiation risk among all the stakeholders involved in the exposure situations. The degree or level of knowledge has to be adapted to the situation, the level of responsibility, the required competences in radiation protection, etc. Therefore, various methods of raising risk awareness may be appropriate: education, training, continuous professional development, communication and information.

Stakeholders engagement and participation
The efficiency of an ALARA-oriented radiation protection system strongly depends on the engagement and the participation of the stakeholders involved. Different categories of stakeholders can be identified whose main roles and responsibilities in the ALARA process are the following.

Competent authorities are responsible for introducing special optimisation provisions in national legislation according to international safety standards (IAEA, EC). Moreover, they should establish and apply appropriate methodologies for the verification of ALARA implementation and to issue recommendations and take enforcement actions if required. They set the regulatory objectives for ALARA. Regarding the relationship with the public, they should not only provide transparent information, but also facilitate public involvement in the decision making processes.

Licensees have to show their commitment to ALARA through an adequate organisation, facilitating implementation of the ALARA process, allocating necessary resources, providing training at all levels of the organisation (from senior management to shop floor). They should establish and implement an effective radiation protection management system. Clear management support must exist to translate the regulatory objectives into reality. Therefore, distribution of responsibilities is fundamental for the effective implementation of ALARA. People involved should be well aware of their role and duties and act accordingly.

Manufacturers, suppliers and designers need to ensure that the design and construction of facilities, equipments or sources are based, not only on requirements and limitations introduced by national legislations, but also on considerations about optimisation of radiation protection for their full life cycle (installation, operation, dismantling).

Radiation protection professionals are responsible for the design, establishment, implementation and surveillance of radiation protection systems which are ALARA-oriented. They have a major role in stimulating and supporting ALARA attitudes and initiatives. Moreover, they should register possible non-compliances, propose corrective actions or improvements and evaluate related results. These non-compliances should be appropriately turned into lessons learnt.

Professional associations have a role in the dissemination of ALARA culture among their members, for example by providing a forum for exchange of experiences, elaborating radiation protection guidance or protocols specific to their field of activities, etc.

Exposed workers are responsible for properly applying the established ALARA procedures after having received the appropriate training. They should have an attitude towards dose reductions for themselves as well as their colleagues. They should not only follow given guidelines and protocols but also identify and report possible problems, as well as applying the required corrective measures. They should participate in the continuous improvement of radiation protection providing practical feed-back.

The public should be allowed to take a proactive role in decision making regarding their protection against ionising radiation. While consultation processes are already implemented in several countries, this approach needs to be applied more often. This will lead to clearer decisions agreed by the public. Therefore, initiatives should be further developed to facilitate an improvement of risk awareness and the radiation protection knowledge of the public.

5. Challenges related to ALARA culture

Depending on the exposure situation, the current status of ALARA culture varies significantly:

- In the *nuclear industry*, ALARA has been applied for more than 20 years, resulting in a significant reduction of occupational collective doses. However, the ageing of existing installations, and a large-scale retirement of nuclear workers requires a new focus on maintaining and expanding ALARA culture. In parallel, new nuclear installations (nuclear waste disposal, nuclear power plants, research reactors, etc.) will be built in the near future, requiring the introduction of ALARA at an early design stage, and decommissioning activities will increase in parallel.

- In the *NORM industry*, there has been a continued increase in radiation risk awareness, and elements of ALARA culture have been introduced. The new regulations in this sector (like the IAEA and EURATOM Basic Safety Standards at the final approval stage) will play an important role in this process.

- Regarding the *medical sector*, occupational and patient exposures have to be considered, taking into account benefits and risks for the patient. An increasing awareness of the importance of radiation protection is observed within the medical profession [12]. However, efforts still have to be made to disseminate ALARA culture more widely, as a huge increase in the use of radiations for medical purposes has been seen in many countries.

- For *existing exposure situations*, like radon in dwellings or phosphogypsum landfills, the practical implementation of optimisation of radiation protection is relatively complex. It needs the involvement of new stakeholders for which the first step is to be informed about radiation risk and ALARA philosophy.

- In *emergency exposure situations*, according to ICRP, optimisation of protection also applies for public and worker exposures. However, due to the complexity that arises in emergency situations, ICRP recently recommended [13] that optimisation should be integrated into the planning stage of protection strategies as well as during the implementation of emergency response.

6. Role of networks in the dissemination of ALARA culture

Several actors, addressing various stakeholder groups, play a valuable role in the dissemination of elements of ALARA culture; like regulators, education and training organisations, professional organisations, networks, etc. They use a variety of tools, such as symposia, workshops, publications, research projects, web sites, discussion forums, etc.

Several types of network involved in or connected to radiation protection exist, at national, or international levels, like professional societies (e.g. medical physicists, industrial radiographers, radiation protection professionals, etc.) or associations/NGO (e.g. patients, public, environmental associations, etc.). They group together various stakeholders and competences, with the same objectives.

The value of these networks for ALARA culture dissemination is to provide a platform to exchange views and experience and to create relationships. They can also contribute to creating knowledge, providing education and training, and identifying and harmonising good practices.

In particular, the European ALARA Network (EAN), as well as related ALARA networks, such as the European Medical ALARA Network (EMAN) and the EAN NORM net contribute to the development and dissemination of ALARA culture.

7. Conclusions

The continuous technological developments in ionising radiation applications and the increasing number of exposure situations highlight the need for further actions to develop and disseminate ALARA culture. At the same time, the number of radiation protection specialists with relevant knowledge and experience is decreasing due to retirement.

Therefore, there is a need to re-establish the elements that constitute ALARA culture (exposure situations, attitudes, responsibilities, etc.) in order to facilitate its practical implementation. That’s why the elements presented in this paper will be further elaborated by the EAN working group on ALARA culture in a publication under preparation on “Optimisation of radiation protection (ALARA): a practical guidebook” [14].

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