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The ALARA approach and related classical safety factors

Introduction

Since his formulation in 1977 (ICRP-26), the ALARA approach has shown an evolution that is fruitful and diversified. During the last twenty-five years, many sectors of the nuclear activities have had a real benefit by implementing the very valuable ALARA programmes. Moreover, some sectors where the ALARA approach was not really recognised seems to be more and more involved.

Nevertheless, and if this has been very early mentioned [(1)] the field of the classical safety (this means the safety dealing with non nuclear risks) seems to have been, partially or totally, excluded from this approach. But, some observation in the workplaces, the evidence of an evolution of the regulations and the conclusions of some working groups stress the need for asking the following question: "What are the relations between the ALARA approach and the problem of the classical safety in the non nuclear industrial sectors?"

The purpose of this presentation is to point out a few elements, based on a 10-year practice in a nuclear research centre, with the aim to provide a first answer to this question.

1. The ALARA approach

The literature contains many presentations about the ALARA approach. Let us very briefly resume the most relevant characteristics as far as the are of concern for our purpose. The optimisation principle, stated between the justification principle and the limitation principle [(2)], stresses the need to maintain the dosis at a level, which is As Low As Reasonably Achievable, all economic and social factors taken into account. It has to be recognised that the ALARA principle copes with the optimisation in the field of the radiological protection; this means that this approach applies in the region of very low risks or, with other words, in the cases where the stochastic effects are of major concern.

As very often pointed out in the literature [(3) (4) (5)], the main discussions still dealing with the last part of the statement of the ALARA principle. "Taking economical and social factors into account" is a very simple expression but this imposes finally to give an answer to some questions that are... complex. Examples of such questions are:

- What's the price of life?
- How to implement the ALARA approach to be consistent with the equity principle?
- ...

2. Ten years of ALARA at the Belgian Nuclear Research Centre (SCK•CEN): From theory to practice[(6)]

The wish to implement the ALARA approach at the SCK•CEN has been initiated by the General Management and the Head of the Health Physics Department at the end of the eighties. Supported by well-defined projects, the Management of the Belgian Nuclear Research Centre decided to give a strong support to the implementation of the optimisation principle. After having clearly indicated his wishes, the Management line decided for a first training course. Three persons were invited to take part to this training course in Saclay (France). Two years later, in 1991, ten people belonging to the different installations followed a new training course at the CEPN office in Fontenay-aux-Roses (France). These workers were then chosen as the first ALARA co-ordinators at the SCK•CEN. In 1992, each installation of the Belgian Nuclear Research Centre has its own ALARA officer. Two years later, the decision was taken to develop an ALARA procedure. After some contacts and discussions with the colleagues of the NPP in Doel, the first draft of the SCK•CEN ALARA procedure was published. Before being put into practice, this draft has been presented to almost eighty people belonging to the SCK•CEN. Their experience, their remarks and proposals were very fruitful. The first version of the procedure has been implemented in 1994.

It has to be noted that the decommissioning project of the Belgian Reactor 3, the first PWR in Europe, strongly supported the first attempts to write such procedure. The procedure, which is still actually applied at the SCK•CEN, has been built in such a way that:

- there is always a sufficient degree of flexibility, taken into account as well the nature of the tasks as the different categories of workers at the SCK•CEN
- the criteria which are used are accepted by everyone and that they don't give rise to unnecessary delay for decision
- a Committee "ALARA and Safety", reporting directly to the General Manager, meets once a month and provides guidance for each ALARA co-ordinator

It is also worthwhile to note that the criteria that were defined are the following:

- collective dose lower than 0,5 m.mSv: only the results of the operations have to be collected
- collective dose lying between 0,5 m.mSv and 5 m.mSv: the whole procedure has to be applied
- collective dose above 5 m.mSv and/or individual dose higher than 1 mSv: the whole ALARA procedure is required as well as the prior advice of the "ALARA and Safety Committee"

Due to some internal reorganisation, some "first" ALARA co-ordinators have disappeared but in January 2000, a training course on the background of the optimisation has been given to seven new colleagues. These colleagues are now in charge of the ALARA approach in their installation. As clearly mentioned, the implementation of the ALARA approach requires a strong commitment of the Management. But such commitment has to be translated in such a way that all levels of the Management can reach a conviction level authorising each worker to make proposal for improving the safety of every body. A period of almost ten years seems to be adequate to reach such level of mutual support.

3. *Ten years of ALARA at the Belgian Nuclear Research Centre (SCK•CEN): Lessons learned*

Having provided a brief survey of the way for implementing the ALARA approach at the SCK•CEN, let us now describe the most significant results of ten years practice.

The first main observation is undoubted by the decrease of both individual and collective doses. This is of course one of the goals of such approach. As a consequence of this decrease, it has been possible at the SCK•CEN to implement an annual dose limit of 20 mSv in 1993 and to reduce again this value up to 10 mSv per year in 1996. These values were considered as "constraints" as recommended by the ICRP.

The table hereunder gives the evolution of the values of the maximal individual dose, the collective dose and the numbers of people with dose lower than 2.00 mSv, between 2.01 and 10 mSv, or higher than 10 mSv. The higher values are due to special operations related to clean up and/or decommissioning (hot cells, BR3).

	1993	1994	1995	1996	1997	1998	1999
Dmax (mSv)	9.55	10.98	8.76	10.65	8.25	8.22	8.27
S (m.mSv)	274.00	341.25	289.70	390.24	271.94	238.37	205.84
D < 2.00	179.00	187.00	166.00	207.00	189.00	263.00	216.00
2.01 < D < 10	45.00	48.00	48.00	65.00	41.00	30.00	22.00
D > 10	0.00	3.00	0.00	1.00	0.00	0.00	0.00

A second noteworthy result is the attempt of each installations of the SCK•CEN to particularise the ALARA-procedure to the local approach of the safety. For example, the ALARA procedure has been fully integrated in all the technical procedures at the BR3 decommissioning project; at the Belgian Reactor 2 installation, the ALARA procedure belongs to the set of the standard procedures for exploitation of the BR2.

Thirdly, the ALARA approach has gained more and more acceptance by the workers. A very recent example has occurred at the BR2 installation. Ten years ago, the replacement of the resins was performed with a very high collective dose. A first ALARA study has led to a first reduction of a factor two. A few weeks ago, the team in charge of such operation has demonstrated that, by modifying the technical procedures without any new protection rules, it was possible to reduce again by a factor 2 the collective dose. In other words, the ALARA approach has contributed to an increase of the Safety Culture level in this group, which has spontaneously tried to improve its own safety!

A fourth consequence deals with the development of new tools. As shown in the poster session, the SCK•CEN has developed new software, the VISIPLAN. This tool gives now to the ALARA co-ordinators the opportunity to simulate as well the installations/workplaces as the different options in a very simple way (see poster of Mister Fernand Vermeersch of the Belgian Nuclear Research Centre, SCK•CEN).

The fifth result, maybe the most astonishing, is the observation that the number of "classical" incidents/accidents was also decreased. This is partially due to the documents of the ALARA procedure, which require paying attention for these classical factors or risks. But we think that's also a more general consequence of an increase of the Safety Culture as a whole.

It has to be noted that we also have been faced with some operations that have given rise to "unexpected" results. For example, we have had two sets of operations where the estimated dose was significantly lower than the recorded doses. One of the reasons for such discrepancies has been identified as the lack of precision by evaluating the ambient dose for the workers. A second reason was found as an unexpected technical problem.

4. *The ALARA approach: The new challenges!*

As already mentioned, we can find a first mention of the new challenges of the ALARA approach in the following sentence: "Maximum permissible doses were such as to involve a risk which is small composed with other hazards in life [(1)]". This publication was the first where the threshold for radiation dose was rejected. Consequently, the way was drawn to introduce the ALARA principle that took his definitive formulation with the publication 26 of the ICRP.

Since then, a lot of effort has been done in such a way that the dose should be as low as reasonably achievable (ALARA) or as reasonably practicable (ALARP). In other words, the biggest efforts have been made to reduce the dose (individual and collective), trying to take social and economical factors into account but... leaving "on the low side of the street" the comparison with "other hazards in life".

This last statement seems certainly exaggerated. Nevertheless, there is a lot of evidence leading to the need for reconsidering our ALARA approach. Before gaining more in-depth with the arguments supporting this need, let us once more stress on the beneficial answers that the ALARA approach has brought during the last twenty-five years. It has to be clearly reminded that the ALARA approach has led to a general increase of the safety level in the nuclear sector. This is mainly due to the structured, coherent and self-critical approach which underlines the ALARA principle. More than a technical/mathematical tool, the ALARA approach is a "way of life" and efforts still have to be pursued to cope with more activities where ionising radiations are involved.

What are the new challenges we mentioned here above?

To introduce as a simple way the future needs as far as the ALARA approach is concerned, let us indicate some facts, some trends and some general considerations.

A lot of facts seem to give support to an extension of the ALARA approach.

Indeed, in some circumstances, the Safety and Health Physics Officers are faced with both radiological and non-radiological risks. As already written somewhere else [(7)], decommissioning of old nuclear installations give rise to operations where one has to eliminate some dangerous chemical substances like asbestos. In such situation, the optimisation may not be restricted to the radiological risks. Moreover, it has already been demonstrated that there is a beneficial support coming from the optimisation for the operations dealing with such substances.

The second fact, which is a very simple one, can be referred to as the "ladder syndrome". Someone who has to work in a controlled area with a ladder was wondering about the potential contamination of his tool. His ladder was made out of aluminium, so the decontamination should easily performed afterwards. Then he considered that the rubberpieces placed on the extremities of his ladder should give rise to problems for further decontamination. These rubber pieces are safety-related in such a way to avoid the ladder to glide during use. Our worker decided to put some little plastic bag around the rubber extremities. Then he went into the controlled area and used his tool that glided! The worker fell and one of his legs was broken. So he had to stay home for three months! This is a very simple example of interaction between radiological and non-radiological hazards. There are many other cases. The question is "By optimisation of the radiological side of our works, don't we transfer some risks to the non radiological field?"

Now, as far as new safety trends are concerned, it is worthwhile to point out some new regulations. These regulations, as well at European level as at country level, put an increasing pressure on a global approach of the safety of the workers. For example, the last Belgian Royal Decree (6th August 1996)[9] requires that the department in charge of the Health and Safety on the workplaces takes into account all kinds of risks (without any distinction) and – furthermore – to take into account the social and psychological factors (stress,...). Bearing such requirement in mind, one should be faced, in particular circumstances, with choices which will be sometimes based on "not yet solved" questions (price of life, equity principle,...).

Another consideration we have to cope with is whether we have up to now <u>really</u> optimised, <u>how far</u> did we optimise and <u>what</u> did we optimise? For sure, the answer to the first question is yes. Furthermore, as already said, efforts still have to be extended to new areas. But the optimisation still encounters some difficulties. For example, how far do we have to consider a technical operation for applying the ALARA procedure? The question of the nuclear waste produced during some operations and the influence of the solutions retained for handling this waste remain still unsolved!

Finally, the extension of the ALARA approach to other industrial risks should be a good step for developing another base for discussion with the public. Public acceptance is of major importance for some decisions that still have to be taken. Sometimes one has the feeling that there in an "artificial" distinction between the "radiological" language and the "non radiological" one. Moreover there is a trend to pay more attention to a global approach as far as the life condition of mankind is concerned. Environment is considered as a whole and many conferences have pointed out the complexity of the factors, which play a role in decisions, which have to be taken, but also the need for a good communication with the public.

To conclude with this section, we would like to add the following consideration in our mind. The ALARA approach was, and will remain, the only way to reach an equilibrium between all kinds of hazards. Up to now, maybe this approach has always been too restrictive. This was a first and obligatory step. But bearing in mind the remaining questions such as the price of life and the level of risks we can accept for a given level of welfare, it seems to us that only a more general approach will give rise to answer to these question.

5. *Conclusion*

Without any doubt, the ALARA approach has been, and will remain, a very fruitful approach to improve the safety of the workers in the nuclear sectors. It's a very beneficial operation way to manage the radiological risk. Furthermore, this approach is responsible for a general increase of the safety culture of the workers.

Nevertheless, some observations and new trends indicate the need for an extension of the ALARA approach. This should lead to a more efficient management of the hazards and, last but not least, improve the efficiency of the communication with the public and the decision makers. The next workshop of the European ALARA Network will be an unavoidable step to compare the approaches and to try to enlighten the way for reaching the "<u>A</u>s <u>S</u>afe <u>A</u>s <u>R</u>easonably <u>A</u>chievable" principle.

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