European ALARA Network Issue 2 - January 1997

European ALARA Newsletter

Editorial

The first issue of the ALARA Newsletter covered the establishment of the European ALARA Network, as well as its main goals and objectives. It gave also an opportunity to remind ourselves of some of basics concerning the ALARA management of the radiation risk, to describe the regulatory perspective concerning the implementation of ALARA in Swedish nuclear power plants, and to point out that the non nuclear sector provides some ALARA challenges for the future in Germany and the UK.

In the last few years some specific tools have been developped that facilitate the implementation of ALARA. This second issue of the ALARA Newsletter presents two of these tools developped with the support of the Commission of the European Union. OPTI-RP is a software that provides decision makers with a simple tool facilitating the selection of radiation protection options using monetary values of the collective dose unit through Cost-Benefit analyses. The second one, IRID, is a new feedback database in the UK that covers radiological incidents in industrial and medical fields in order to learn lessons from the past and improve ALARA implementation in these fields. Such type of tools permit more transparency and efficiency in the knowledge of actual riks, the definition of radiation protection options and in the decision making process. The efficiency of these tools will be maximised if there is a clear willingness of the management to implement ALARA. Feedback experience from many countries, such as Spain, shows that practical implementation of ALARA relies essentially on personnel motivation and involvement, ALARA being mainly a way of thinking, similar to the very well known "safety culture" or "total quality" approach in the industrial field. ALARA is a predictive approach, that means first one has to better prepare the work and improve work management during operations ; doing that often lead to both reduction of exposures and costs. In many industrial installations it is therefore possible to reduce doses up to 30 to 40% without cost. For these reasons it is worthwile to say that ALARA is a work management approach.

Christian LEFAURE

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IRID: IONISING RADIATIONS INCIDENT DATABASE

John CROFT (NRPB)

Technologies that make use of ionising radiations are widespread in industry, medicine, research and teaching. They provide many benefits but, as with other technologies, the use of ionising radiation carries with it the potential for incidents and accidents. Their severity can vary from the trivial to the fatal and may involve substantial economic penalties. Learning the lesson from past events is an important element of pursuing ALARA. However there is a natural tendency for organisations not to publicise their own accidents, especially if the accident was a 'near miss' that fortuitously did not have serious consequences - this time! As a result our feedback experience from accidents both nationally and internationally can be limited, fragmented and difficult to pass on to the next generation of workers. Thus there is a need for a more coherent means of feedback. Impetus to address this problem was provided by the Commission of the European Communities (CEC), both in supporting work in this area and as a result of their 4th European Seminar on Optimisation of Radiation Protection in April 1993 which concluded that a principal challenge for the future is "…. to improve our feedback from past experiences by developing databases". As a result of subsequent work, the NRPB, Health and Safety Executive (HSE) and Environment Agency (EA) of the UK have entered into a partnership to gather incident and accident data in a confidential form in the Ionising Radiations Incident Database (IRID). Details of the specification and operation of the database together with the proposed feedback mechanisms, have recently been published. The objectives are:

(a) to establish and operate a database that will act as a national focus on radiation incidents primarily in the non-nuclear sector, ie. industry, research, teaching and medicine;

(b) through appropriate publications, to provide feedback and guidance to users of ionising radiations on preventing or limiting the consequences of radiation incidents; and

(c) to provide regulatory bodies and others with advisory responsibilities, analyses of relevant data that help in assessing priorities in resource allocation.

The database is designed to cover radiological incidents including near misses and occurrences involving actual or potential occupational and public exposure. However, some types of incident are excluded from IRID since they are already covered by existing arrangements in the UK. Those excluded are nuclear incidents, transport incidents and patient exposure incidents.

❑ Organisational Arrangements

To date, the partnership which controls the operation of IRID and shares the cost of its funding includes NRPB, HSE and the EA. The partners determine the operating rules and format of the database, approve publications, and control distribution of data (including possible slide sets and electronic distribution). They have responsibility for the overall management of IRID. NRPB will be responsible for the day to day management of the database.

The partners are currently reviewing their files to identify readily available historical data. This will be generally limited to the last decade, although some earlier incidents will be included because of their value in 'learning the lesson'. It is recognised that this data will be incomplete and that any retrospective analyses would need to be used with caution. The partners are keen to encourage other organisations to contribute incident reports and will be working to persuade appropriate bodies to participate.

❑ Database Structure

The database operates on a Personal Computer (PC) using DBASE V software and consists of 24 field. Fields 1 to 23 contain either numeric data (eg. dose in mSv) or one or more codes that categorise the incident and have been designed to permit useful analyses of the database; for example searching for incidents over a specified period of time involving industrial radiography and resulting in doses in excess of the dose limit. In defining the fields, a balance has had to be made between the level of detail, its usefulness and the effort involved by those submitting incident data. To maximise the overall benefit it was felt important to achieve a high reporting percentage and that this would only be achieved if the reporting system was not onerous on the contributors. Therefore the number of data fields has been minimised to that consistent with categorisation and analysis requirements. Field 24 is a text field and is perhaps the most important in that it contains descriptions of the incidents, the causes, the consequences, follow up actions and lessons to be learned. The format has been designed to allow it to be directly reproduced in publications to provide feedback to the users. Examples are shown in the boxes.

❑ Confidentiality

The information entered into the database will not contain any names or addresses of organisations or individuals. Only the originator of the incident entry will know the names of the organisations or individuals concerned and all data presented to NRPB will be in a sanitised format. NRPB has undertaken not to divulge any privileged information to a third party. HSE and EA are well aware of the natural wariness that potential contributors may have in respect of the involvement of regulatory bodies. Therefore they have given assurances that they will not seek to obtain further information from the other partners (or the contributing organisation, if different) about any incident recorded on the database which was not reported to regulators. This would not prevent HSE or EA following up incidents that are notified to them by other means.

❑ **Example 1**

A researcher working in a laboratory used for handling unsealed radioactive materials was manually dispensing, in a fume cupboard, a routine delivery of what he believed to be 74 MBq phosphorus-32. When the stock solution was removed from its shielding the portable radiation monitor placed in the fume cupboard by the researcher went off scale; he expected this because the monitor could only measure the much lower dose rates from diluted material. It was then switched off. The appropriate beta shielding was used for the activity concerned. The containers into which the material was dispensed were placed behind Perspex shielding and the monitor switched back on. The expected drop in dose rate was not observed and the RPS was contacted. Investigations revealed that the activity that was delivered was, in fact, 1000 times greater than was ordered, invoiced for, and that stated on the package. A packaging note did, however, state the correct activity but had not been noticed. Although a few spots of contamination, up to 480 Bq cm^{-2}, were found on a laboratory coat, significant levels of contamination were limited to the fume cupboard. The researcher's film badge recorded a penetrating radiation dose of 0.04 mSv. An investigation and reconstruction concluded that any intake of activity had been negligible but that his fingers had received doses of around 120 mSv.

Lessons

1 *A radiation dose rate monitor capable of measuring all expected dose rates should always be used.*

2 *Whenever any radioactive source is purchased and received on the premises all paperwork must be examined in order to ensure that the activity and nuclide delivered are as expected. If there is any doubt or conflicting information is given, further advice should be sought. A radiation monitor should be used in order to ensure that the associated dose rates are as expected for the quantity and type of material concerned.*

3 *Suppliers of radioactive materials must continually ensure that all quality assurance procedures are effective.*

❑ **Feedback And Future Developments**

Undoubtedly the value of IRID will be judged on the quality and accessibility of feedback to users and regulators. Equally this will be a crucial factor in maintaining the flow of contributions from various organisations. Initially the primary feedback route will be through publications:
(a) NRPB/HSE/EA will publish periodic review documents that reproduce the text descriptions of incidents, where appropriate enhanced by diagrams or drawings of accident scenes, and analyses of the distribution and trends in incidents.
(b) Incidents that are of particular relevance will be published in NRPB's 'Radiological Protection Bulletin' HSE's 'RPA Newsletter' and the 'Bulletin' of the EA.

A key use of the feedback from IRID should be in the training of all those involved in the use of ionising radiation. Therefore a number of short joint publications that can be used as training material targeted at specific work groups will be produced. Where possible this will be supplemented with slide sets.

Although NRPB, HSE and EA will provide the initial input, it is intended that IRID is made as wide a collaborative effort as possible. There are also valuable lessons to be learned from incidents outside the UK and it is envisaged that one future development will be to add a module covering such incidents. This may be influenced by the development of comparable databases in other countries and international organisations such as IAEA and the European Union (EU). Undoubtedly each country or international organisation will have a need for specific data fields but it should be possible to agree on core data fields and formats - a challenge for the future.

❑ **Example 2**

A radiography remote exposure container, housing a 550 GBq iridium-192 source, was being used to examine a circumferential weld on a steel vessel under 'open shop' conditions, ie. a barriered off area of a factory. On completion of the exposure, the winding mechanism was used to return the source to its container. During this procedure the portable dose rate meter located at the winding position recorded a drop in the dose rate, and this was assumed to mean that the source had been safely returned to the container. However, when the equipment was used five days later the resulting radiographs were all blank, revealing that the source was missing from the radiography container; obviously the source had been lost. After a search the source was found near the location at which it was last used. Later investigation showed that the source had become detached from the drive cable, for some unknown reason, and had fallen unnoticed from the guide tube during dismantling.
The dose rate meter had not been used correctly to ascertain that the source had fully returned to its container. The noted drop in dose rates at the winding position had arisen because the source had become detached from the drive cable close the source container, which shielded the dose rate meter from direct radiation from the source. The source was recovered in a controlled manner by the RPS. It was found that during the five days since the source had been lost 78 workers had been irradiated to some degree. Their estimated doses are given below. The source was in a readily accessible position and had it been picked up during the five days that it was missing this would have led to radiation burns and, possibly, fatalities.

Number of staff	Dose Range, (EDE (mSv)
2	100-150
4	30-100
9	11-30
63	< 11

Lessons

1 *The monitor should have been taken up to the container to verify the source was fully in the safe position.*

2 *Monitoring should have been carried out when the container was returned to the source storage location. This would have identified much sooner that the source was missing.*

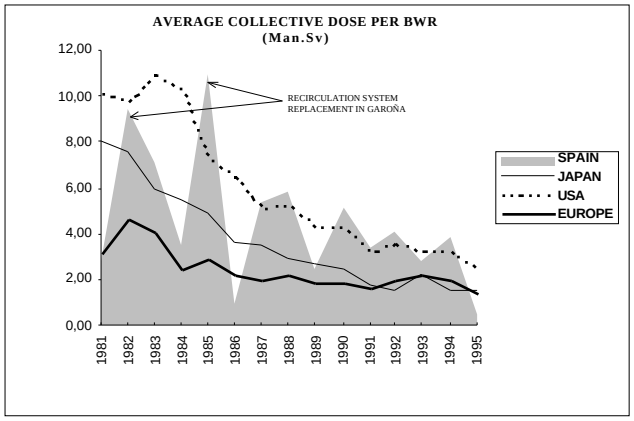
ALARA ORGANISATION IN OPERATING SPANISH NPPs

P. O'DONNELL, I. AMOR, J.L. BUTRAGUEÑO
Nuclear Safety Council of Spain (CSN)

❑ Introduction

Until the beginning of the 90's, implementation of the criterion of optimisation during the operating phase of the Spanish nuclear power plants was accomplished fundamentally by way of the so-called Dose Reduction or Minimisation programmes.

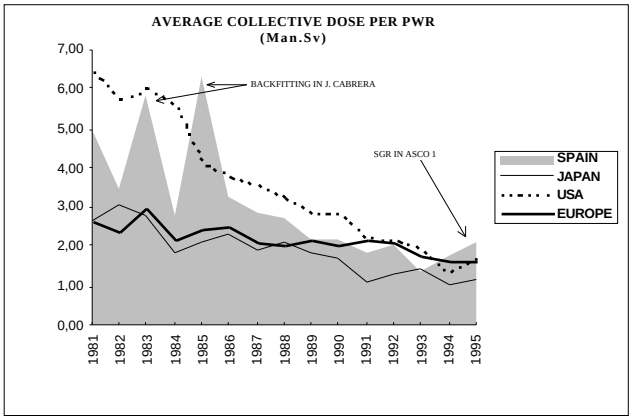
Although it is explicitly recognised that ultimate responsibility for Radiological Protection is on the plant owner, and in particular on the Plant Manager, in practice this responsibility was delegated to the Head of the RP Department, as regards management of these programmes. In some plants, this responsibility has sometimes been transferred to the installation's Plant or Nuclear Safety Committees, depending on the relevance of certain tasks or the radiological risk involved. On an increasing number of occasions, the Plant Nuclear Safety Committee became involved in the development of specific ALARA proposals, although its role was very different from the functions of what is understood as constituting an "ALARA Committee".



At some plants specific structures had been developed for ALARA reviews relating to refuelling tasks; these structures were complementary to that of the RP Department, but their scope did not go beyond the task in question. One way or another, there has been no systematic approach encompassing efforts relating to the source term, design or the process of contracting external companies.

❑ The Strategy of Cooperation

In 1991, the Nuclear Safety Council (CSN) drew up an overall strategy aimed at promoting practical implementation of the ALARA criterion in operating Spanish plants. The main lines of this strategy are briefly described below.



- It was understood that there should be a formal and sincere commitment by the upper management of the companies, and the establishment of a system of responsibilities at the right level of management and in all the departments involved, this being reflected in the official operating documents.
- It was felt that the existence of a specific structure aimed at improving the operating efficiency of an ALARA programme would be extremely useful.
- It was also considered essential to promote the ALARA approach in the day-to-day work of the plant, and ensure that this philosophy of management covered all the plant operating periods and modes.
- It was appreciated than in order to spread the ALARA policy and motivate the plant staff and contracted personnel, the basic lines of the ALARA programme should be included in the basic initial and on-going radiological protection training plans.
- The efforts made in relation to the source term and design modifications should be integrated within the scope of the procedures including the ALARA policy of the plant.
- It was considered necessary that the ALARA philosophy be shared by all contractor companies, so that the parameter of dose should be included throughout the process of contracting of external firms, and the contracted personnel should be more actively involved in ALARA programmes of the plant.

In other words, the ALARA approach should affect all the activities, it should be shared and assumed by all people and it should be recognised that their behaviour and attitude are the main aspects that characterise the concept of “culture” applied to ALARA.

❑ Present Practices

The corporate structures underlying the commitment of the plant owners to optimisation of Radiological Protection are varied in their style, but all coincide in their essential aspects.
The most relevant characteristics are as follows:

Corporate Commitment
The organisation contributes to incorporating the principle of optimisation (ALARA) in all plant operations. Specific ALARA responsibilities have been defined at the highest levels of company management.
The management's commitment and motivation regarding the optimisation of radiological protection is transferred to all the workers and organisations involved, so that the ALARA policy incorporates the principle that responsibility is shared by all, from the highest to the lowest levels.
An ALARA policy is established at company level and collective dose objectives are defined and approved, along with objectives relating to production (cost reduction, minimisation of refuelling outage times, optimisation of maintenance and others), both for refuelling outages and on an annual, fuel cycle or three-year basis.
The ALARA commitment naturally extends to all outside organisations providing support for the work of the plant staff itself, this being clearly established in the corresponding contracts. The contractor companies should prepare specific ALARA programmes and the incorporation of these programmes in the plant's systematic ALARA schedule, particularly for important projects.

Promotion of the Alara Culture
A series of talks and presentations is established in order to explain the basic lines of the ALARA policy at corporate and plant management levels. These also include contractor companies, in order to ensure their understanding and support. The fundamentals of the ALARA philosophy are included in the basic training on radiological protection, along with the main bases for the management's commitment to the ALARA criterion at all levels. Specific ALARA courses are delivered to the design, engineering, mechanical maintenance, RP, etc. personnel.
Attempts are made to involve the personnel by means of open and general information on the tracking and results of dose objectives, through daily meetings, appropriate distribution of the information, announcements in frequently visited locations, etc. A system of dose budgeting for different plant departments is introduced in the ALARA policy, and at certain plants also for the different contractors.

Administrative System
The ALARA organisation and corresponding responsibilities are included in the Operating Regulations and the procedures developing the ALARA responsibilities, co-ordination, relations and program are general administrative procedures.
The drawing up of minutes or reports for the different meetings held is included, to reflect both the contents and commitments.

Scope
The criteria of optimisation of radiological protection is incorporated into all the phases of activity: design, construction, operation, decommissioning, shutdown and refuelling and initial and on-going training, and shall be a constant point on the agenda of all Management meetings and in all operating reports.

Structure
Specific ALARA responsibilities have been defined at the highest levels of company management, so that the ALARA policy incorporates the principle that responsibility is shared by all, from the highest to the lowest levels.

A. Top Level Management, with the following functions:

- Promotion of the ALARA culture within the company.
- Approval of, or supporting ALARA policy and dose objectives.
- Deployment of the economic, technical and personnel resources required for development of this policy and achievement of the objectives.

B. Interdisciplinary plant management Committee, ALARA Committee, comprising the Plant Manager (or Assistant) and the Heads of the main departments, the functions of which are as follows:

- Definition of an ALARA programme with specific goals and objectives, among them objectives relating to collective dose.
- Periodic revision of results of ALARA programmes, studies and practices, refuelling outage reports, decision-making with respect to proposed improvements and corrective actions and follow-up of implementation.
- Co-ordination of the efforts of the different groups involved (Operations, Maintenance, Engineering, RP, etc.).

C. Interdisciplinary task performance group (ALARA Group or ALARA Activity Units), comprising representatives of RP and of the departments responsible for task performance, the functions of which shall be as follows:

- Analysis of specific activities and/or planning of specific tasks.
- Tracking of task performance, including verification of the implementation of contractual requirements, analysis of deviations and the implementation of possible corrective actions within its sphere of influence.
- Revision of the results of specific tasks, including analysis of the lessons learned and proposals for improvements to the senior Committee.

❑ Conclusions

In view of the standard of development of the approach presented above, it may be stated that we are achieving the objective of undertaking practical implementation of the ALARA criterion. In the wider context it is one more element of what is known as the "safety culture", and managing "total quality" on the basis of personnel motivation and involvement (rather than penalties), supported by an organisational structure ensuring that adequate forums are set up for a systematic approach to optimised operation of nuclear power plants.

OPTI-RP: A Software to Evaluate, Compare and Select Radiation Protection Options

Caroline SCHIEBER (CEPN)

The purpose of OPTI-RP software is to provide decision makers with a very simple and friendly user computer tool facilitating the selection of radiation protection options when applying the ALARA procedure. The options are characterised by their associated collective doses and costs. Three decisions aiding techniques are included in the software: Cost-Benefit Analysis, Differential Cost-Benefit Analysis and Reasonable Cost Analysis. All of them utilise a monetary value of the collective dose unit for the evaluation of options. The results are presented in table or graphic form. The software can work in both English and French language.

❑ Data to be provided

Reference monetary value of the collective dose unit (alpha value)

The International Commission on Radiological Protection (ICRP) has recommended the use of decision aiding techniques to evaluate the efficiency of protection options to reduce exposures as low as reasonably achievable. Most of these techniques rely on the existence of a reference monetary value for collective dose (man.Sv), often known as the 'alpha value'. Various values are used in different countries: values recommended by the Authorities, corporate values within companies, contractual values. A system of alpha value may consist of a single value or of several values that depends essentially on the individual level of exposure.

In order to meet the requirements of various users, entering alpha values into the OPTI-RP program can be done in two different ways:
- the user can either directly enter his/her set of alpha value(s); or
- the alpha value(s) can be calculated using the model developed by the CEPN to satisfy the recommendations of the International Commission on Radiological Protection (ICRP) in Publication 60

The software is provided with a table of initialised alpha value systems that includes:

- the system of values recommended by the National Radiological Protection Board (NRPB) in the United Kingdom. This system comprises values adapted to various situations: workers in normal situation, the general public, patients, etc.;
- the system of values used by the French utility Electricité de France (EDF). These values increase with the annual individual dose ranges.

Radiation Protection Options set

An "options set" is composed of the group of radiation protection options that one wants to analyse in order to select the optimal option. At this stage, it is only a description of the options, i.e., their name and label. The dosimetric and financial data are entered at the scenario stage.

Scenario

A « scenario » allows to group together a set of radiation protection options and an alpha values system. The estimated collective doses and costs for each option are related to one scenario.

The collective dose for an option is entered according to the individual dose ranges of the selected alpha value system. If an alpha value system has several values corresponding to various individual dose ranges, the user can select the dose ranges associated with his/her options, then enter the collective dose for the option by distributing it among the selected individual dose ranges. If the user wishes to use a single individual dose range, or if the selected alpha value system has only one value, the user then enters only the total collective dose of each option.

Grouping an options set and a system of alpha values in a scenario enables sensitivity analyses to be performed by creating several scenarios in order to test the impact of different alpha values sets on the determination of the optimal option.

The cost of the options can be defined in various ways according to the available data. One can either enter:
- the total cost corresponding to the actual cost of implementing the options; or
- data relative to the total investment cost, the life time of the investment and the annual operating cost.

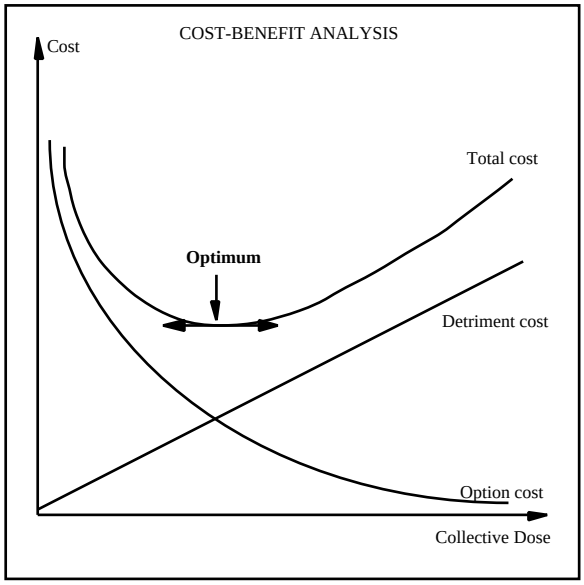
In the latter case, the user can compute the annualised cost or the discounted cost by entering an interest rate or a discount rate. This type of input is particularly useful when one wishes to perform sensitivity analyses of option costs.

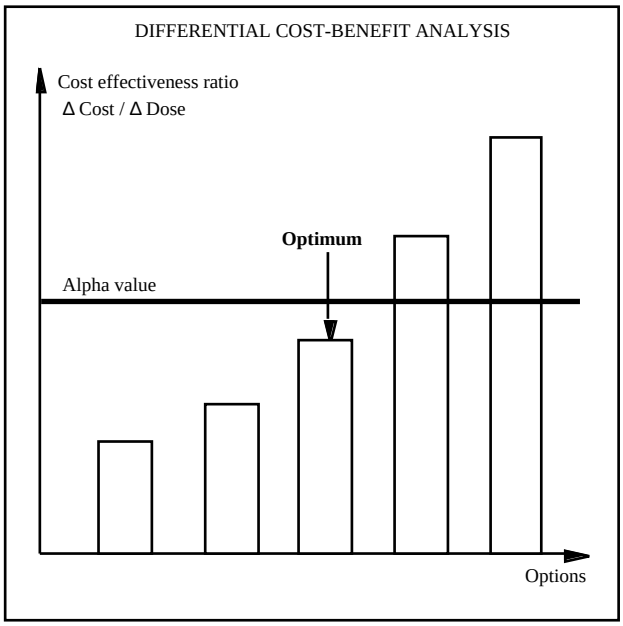
❑ Three types of analyses

As said previously, the OPTI-RP program offers three analysis methods: the cost-benefit method, the differential cost-benefit method and the reasonable cost method. These methods are identical in terms of results: for a same scenario, the optimal option will be identical whatever the method used. The methods only differ in the way the results are presented, with however the reservation that the differential cost-benefit method can only be used when the scenario under analysis is using only one alpha value.

- ***« The cost-benefit method »***

This method is based on the simple equation that defines the optimal option as the option associated with the minimum total cost. In this case, the total cost of each option is defined as being the sum of the implementation cost of the option and the cost of its associated detriment. The latter is computed by multiplying the collective doses of the option by the chosen alpha values.





- ***« The differential cost-benefit method »***

The objective of this analysis is to determine from the options set, the optimal option in terms of the cost-effectiveness ratio in relation to a single monetary reference value for the collective dose unit.

When switching from one option to another, the cost-effectiveness ratio is obtained by dividing the variation in cost in relation to the previous option by the variation of the collective dose that is obtained. It thus represents the implicit cost of an avoided marginal dose unit if this option is implemented. The cost-effectiveness ratio is then compared to the alpha value that represents the maximum one is willing to spend in order to avoid a collective dose unit.

The optimal option is the option that has the highest cost-effectiveness ratio while remaining below the reference alpha value.

- ***« The reasonable cost method »***

This method enables selecting the options known as "acceptable". When one switches from one option to the other, the increase in cost between the two options is compared with the monetary value of the collective dose saving that is obtained, called "reasonable cost" of the option. As the value of alpha represents the maximum one is willing to spend in order to avoid a collective dose unit, if one multiplies the dosimetric saving by this value, one obtains "what it would be reasonable" to spend given the effectiveness of the option. The optimal option is the last option with a real cost lower than the reasonable cost.

❑ **Practical information**

OPTI-RP runs on PC AT and compatible systems which have a 80386 SX processor, 6 MB RAM, 10 MB free space on the hard disk, MS-DOSâ version 3.1 or later, and Microsoftâ Windows 3.1 or later. The software has been developed using Microsoft Access 2.0. It uses the graphic interface of Microsoft Access and is therefore straightforward and easy to use.

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1997 International ALARA Symposium

Hyatt Orlando (Illinois, USA) March 16-19, 1997

The 1997 International ALARA Symposium is organised to provide a global forum to promote the exchange of ideas and management approaches to maintaining occupational radiation exposures ALARA. The symposium will feature technical papers and exhibits on the latest approaches in work management, dose control and dose measurement and recording. Benchmarking NPPs world class performance in ALARA with special emphasis on outage duration and dose management are key topics for the 1997 symposium. Innovative applications of electronic dosimetry and remote monitoring systems will also be featured. Global dose trends and benchmarks will to presented for major NPP initiatives including steam generator replacements, refueling outages and self-monitoring programs.

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ALARA NEWS

European Commission:
Radiation Protection

1st EUROPEAN ALARA NETWORK WORKSHOP

1st-3rd December 1997 at INSTN-Saclay, FRANCE
organised in collaboration with CEPN, NRPB & INSTN.

This is the first announcement of a Workshop on ALARA and Decommissioning

The objectives of the workshop are to provide a means of disseminating feedback experience from the application of ALARA in decommissioning projects covering both the nuclear and non-nuclear sectors, and to identify problems in that area that need further research and developments

The workshop will cover problems such as: - ALARA at the planning and implementation stages of a decommissioning project (design of dismantling tools, prediction and follow-up of dose rates and doses related to individuals and tasks…), - available options and experience of implementing them, - impact of regulatory requirements and clearance levels, - rôle of radiological protection within the decision process,…

All papers will be invited presentations. To promote discussions, appropriate time will be made available and the number attending the workshop will be limited to sixty.
The language of the workshop will be English.

The attendance fee will be **FF 2000.**

For further details and an application form, please contact :
Mr. P. Croüail (CEPN) ; Fax: +33 1 40 84 90 34 or,
Mrs. M.-C. Pajadon (INSTN) ; Fax: +33 1 69 08 97 77

« ALARA Course »
Saclay (Paris), 13th-15th March 1997

A 3-days ALARA training course will be held at the Nuclear Sciences and Techniques National Institute (INSTN). This course - in French - will present both theoretical and practical examples with the participation of representatives of the French utilities and research centres.

Contact : Mrs M.-R. LEBOURG
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ALARA in the Italian Regulation

The ALARA concept was introduced in the Italian legislation in March 1995 with the new law on radiation protection that come into force from the 1st January 1996.

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ALARA Course: « Optimisation of radiological protection in the design and operation of NPP » Prague, 1st-5th September 1997

This course is sponsored by the European Union and IAEA. The Czech safety authority will participate to the financing. The expected attendance is 30 to 35 NPP's senior health physicists, managers, and representatives of national authorities from 11 Central and Eastern Europe countries.

Contact : Mr C. LEFAURE (Tel: +33 1 46 54 74 67)

Patient doses requested in France

Since the autumn of 1996, all individuals covered by the French national health insurance system (« Sécurité Sociale ») progressively receive an individual "health booklet" covering all their expenses. It also requires actual individual dose corresponding to each X-Ray examination. The updating of the booklet will become mandatory.
This should be in the near future an important incentive for dose reduction and implementation of ALARA in the medical field in France.

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