European ALARA Network

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European ALARA Newsletter

Please take a look at the Web site at http://ean.cepn.asso.fr/

Editorial

When, some decades ago, the process of implementing ALARA for external exposure was just starting, the use of film badges dosimeters, in most cases, could not provide answers to the questions : when and where were the doses received ? What could be done reasonably to reduce individual and collective exposures ? Since then, much has been done in order to assess and follow up as realistically as possible the doses per job, task, category of workers etc. Several generations of electronic dosimeters have been developed, feed back experience has been improved, computerised data bases have been set up, ALARA programmes have been developed and implemented…

« Any exposure at work …should be included in the occupational exposure » (ICRP 60), therefore the optimisation of radiological protection should be implemented for both external and internal exposures of workers. However to date, apart from specific cases, little effort has been directly devoted to implementing ALARA for internal exposures. Within the work of our Network, this has been highlighted several times over a range of sectors. For example, in the nuclear sector, where the radiological risk is well understood, it was an issue during the first EAN Workshop on « ALARA and Decommissioning »; similarly, as was identified in the second EAN Workshop on « Good Radiation Practices in Industry and Research », it has become a major topic, in areas where that risk is receiving an increasing recognition, particularly in the case of use of Natural Occurring Radioactive Material.

Over the years, research has improved our understanding and ability to model physical and biological characteristics of internal exposure, i.e pulmonary, digestive, biokinetics and dosimetric models. Many strategies have been proposed for the assessment and the follow-up of occupational internal doses, but these strategies, have, in most cases, essentially dealt with dose limits. However, some case studies have demonstrated the feasibility of the implementation of the ALARA approach for internal exposure.

In that context, the EAN has decided that its third Workshop should cover « ALARA and Internal Exposure ». This will focus on using practical experience of recent improvements in monitoring and work management, as well as seeking to identify what is still needed to provide the realistic, analytical and sensitive assessments of exposure in order to implement ALARA. It is hoped that the results of the Worshop will identify for the European Union areas of research and strategies to help to manage the different exposure pathways for the many radionuclides and compounds which contribute to occupational exposure during normal operation.

This, the seventh issue of the European ALARA Newsletter, provides me with the opportunity to inform you that our Network continues to grow : a contact person from Finland has been designated and on going positive discussions with representatives of other european countries allow us to expect further countries to be represented in the near future.

Finally, due to the success of our Network, the Experts Steering Group has unanimously agreed to propose to the Commission that they continue to support the Network during the Community Research Fifth Framework Programme. We will propose to organise several Workshops and some provisional topics have already been selected such as :

- « Comparison of Occupational Risks Management : Input for ALARA » in 2000.
- « ALARA and Industrial Radiography », in 2001.

I wish to all of you and to our Network a good « century end » and no bug to continue.

Christian LEFAURE

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The Use of the VISIPLAN ALARA Planning Tool in ALARA Studies at the SCK-CEN Mol

F. Vermeersch, C. Van Bosstraeten

❑ Introduction

ALARA dose assessment for work planning in complex nuclear installations is difficult. The aspects of geometry, source distribution and shield geometry play an important role in the dose prognoses. Also work organisation, type and work duration are non-negligible aspects in ALARA considerations. In order to structure and streamline this information we developed the VISIPLAN 3D-ALARA planning tool. This PC-based tool calculates a detailed dose account for different work scenario's defined by the ALARA analyst, taking into account worker position, work duration and subsequent geometry and source distribution changes.

In the following we give a general description of the VISIPLAN ALARA planning tool together with examples of its present use for ALARA studies in decommissioning and maintenance at the Belgian nuclear research centre SCK-CEN.

❑ VISIPLAN General Description

The aim of the VISIPLAN software tool is to provide the ALARA analyst with a tool that allows a fast dose assessment for work planned in a radioactive environment. The calculations in the program are based on a 3D model of the work place including geometry, material and source information. All calculations are based on the point-kernel calculation technique using an infinite media build-up correction. The user is provided with a set of tools that allow him to perform a dose assessment and to investigate different work scenarios in order to reduce the dose to the workers.

The VISIPLAN methodology is based on four major steps; the model building stage, the general analysis stage, the detailed planning stage and the follow-up stage.

Model building stage

A set of model building tools is provided to translate the geometrical model and associated materials information of the work area into a VISIPLAN model by using primitive volumes such as boxes, spheres, cylinders and tubes. The material information is entered in the model as standard materials such as concrete, water, iron... and is attributed to the different volumes. The density of these materials can be changed according to the model needs. Mixtures of materials can also be attributed to a volume in order to simulate the attenuation by complex internal structures. Source position, source strength, source geometry and source composition can be entered directly in the model. The source spectrum is elected from an isotope list or can be defined by the user.

General analysis stage

Once the model is defined, tools become available for the general analysis stage. They involve the calculation of dose maps of the working areas. The doses rates can be displayed as contours or as colour patterns on grids perpendicular to be x-, y- and z-axes of the model. Thus allows a quick detection of the high dose rate areas. A graphical interface is provided to display the contribution of each source to the dose at each location on a grid. This tool helps the analyst to suggest and test possible shielding before going to the detailed work planning.

Detailed planning stage

The tools available for the *detailed planning phase* involve a « trajectory » calculation and a scenario building tool. A « trajectory » is defined as a sequence of tasks to be performed in a fixed geometry and source distribution. These trajectories contain information involving the task description, the location and the duration of the sequential tasks to be performed. The dose account is then calculated for the trajectory based on the radiological and geometrical information of the model.

Uncertainties on the work duration can be taken into account making it possible to calculate an upper and lower limit for the acquired doses. A calculated trajectory contains information on the accumulated dose versus time, the dose rates and the doses per tasks. Per tasks details are given on the contribution of each source to the accumulated dose. This information supports the analyst in decision to introduce new shielding solutions or to reduce the source strength by other techniques.

From a set of trajectories the analyst can build a scenario. The scenario is defined by selecting a set of calculated trajectories and associating each to a worker or a group of workers. The scenario results include collective dose for the work as well as the individual dose specified for each worker. The intercomparison of different scenario's then leads to the selection of an optimal work scenario.

Follow-up stage

The graphs and tasks lists produced in the detailed planning stage make it possible to perform a thorough *follow up* of the dose account during the work. This is achieved through comparison of the predicted and the received dose. Large deviations between both are an indication that risks which were not foreseen in the planning stage are present at workplace. An appropriate answer, and new prognoses can then be formulated based on new measurements and an adaptation of the model including the detected risks. This approach makes it possible to update the model during the work progression and to suggest scenario's with a lower dose account for future activities.

❑ Applications

The VISIPLAN tool was applied to several ALARA studies at the SCK.CEN. The applications ranged from decommissioning, maintenance and the installation of new experimental devices. A sample of some applications is given below:

BR3 decommissioning

The VISIPLAN ALARA planning tool was first applied to perform dose predictions for the decommissioning activities at the BR3 PWR-reactor at the SCK.CEN [2]. A dose assessment was made for works planned near the primary circuit (see Figure 1).

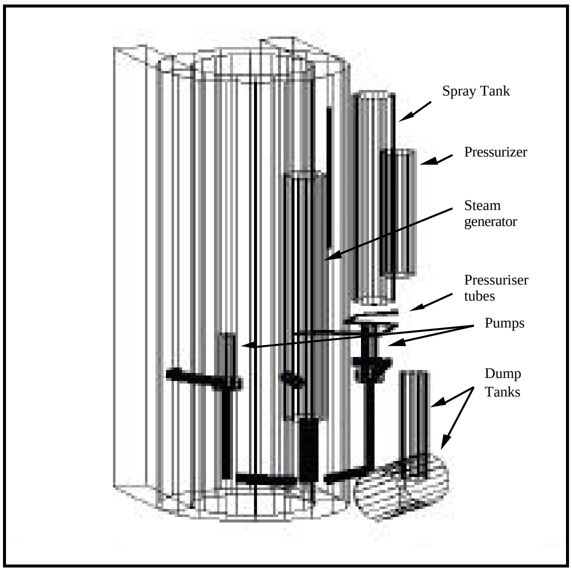

Figure 1. VISIPLAN model of the BR3 decommissioning site

The sources strengths were estimated based on the combination of a dose mapping and source inference technique. The analysis of the radiation field helped to pinpoint the sources with a large contribution to the dose for the planned operations. By adapting the model we were able to study different scenario's with the aim to reduce the dose for further work. These scenario's involved shielding but also the reduction of the contamination in some vessels through chemical cleaning. The predicted and actual doses for the work performed at the BR3 agreed within 20%.

Hot cell decommissioning

The VISIPLAN tool was also used to perfom a dose assessment for the decommission of a Hot cell. The source distribution for a contaminated workfloor in the hot cell was calculated with the source inference tool. The dismantling of the hot cell walls and the removal of the workfloor with the contamination was simulated. Predicted and measured collective dose agreed within 30 %.

Sampling in a linear accelerator target room

The program was also applied for the dose assessment for sampling activities at the target room of a linear accelerator. The working area covered a rectangular area of 6 by 14m. No information was available for the multiple sources present in the target room. The source strengths were estimated, with the source inference technique available in the software, based on detailed dose mapping of the target room and information on the location of the main sources. The predicated values for the accumulated dose agreed with the measured one within 30%.

Construction works near BR2 research reactor heat exchangers

An ALARA study which is in progress concerns construction works near the BR2 heat exchangers. The model is used to determine the most suitable technique considering dose uptake, the need for supplementary shielding and cost (see Figure 2).

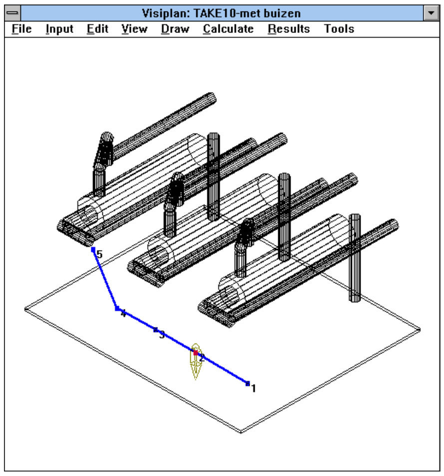

Figure 2. VISIPLAN model of the BR2 heat exchangers. A trajectory is also plotted on the model.

During this study we are examining the combined use of VISIPLAN and a gamma scanner for remote hot spot mapping "RadScan 700" from BNFL instruments. The combined use should provide us with a more detailed radiological model for the heat exchangers. The results of this combined use will be published in a later report.

In all of these cases the VISIPLAN software contributed to the ALARA decision-process by performing a dose account in a structured way. Not only the planned but also the preparatory tasks such as shield placement or chemical cleaning could be taken into account before deciding on the final work plan.

❑ Conclusion

The planning and the dose predictions for a work in a radioactive environment involves the handling of data concerning geometry, materials, sources distribution and work organisation. In order to streamline this information we developed the PC-based VISIPLAN ALARA planning tool. The use of a graphical interface for the dose rate representation and for the work definition allows a straightforward approach towards an effective ALARA work planning. Trajectories can be visualised and different work scenarios can be investigated, evaluated and documented in a short period of time. The program has been applied with success for different applications such as dose predictions for routine work and doses predictions for decommissioning activities.

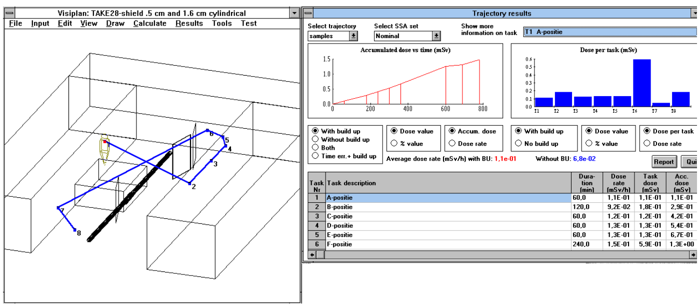

Figure 3. VISIPLAN screen shot for trajectory calculations

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New Safety Guide: Practical Implementation of the Optimisation on Radiation Protection in Spanish NPPs

J.J. Montesinos, P. O'Donnell, I. Amor, J.L. Butrageño

❑ Introduction

On February 1999 the CSN (Consejo de Seguridad Nuclear) approved a new guide within the Nuclear Power Plants Safety Series where the main recommendations regarding the management of the radiation exposure optimisation are presented. As it is today internationally admitted the ALARA approach is understood as a common devotion and motivation of the whole organisations for maintaining individual and collective doses as low as possible, therefore this guide comprises the ALARA responsibility assignments to all the involved parties. Besides a well established ALARA policy it is necessary to implement a set of actions, called ALARA Program, to be addressed by the Licensee such as ALARA goals, Work Management, Source Term Control and Reduction, ALARA review of design modifications, special training and internal audits. The guide covers these aspects in a wide and flexible way to adapt every particular facility circumstances.

❑ Scope

The document applies to the facility and outside organisations involved in all the phases of activity: design, construction, operation, dismantling and modifications.

❑ General Criteria

The management should support the ALARA principle in all phases of activity as part of the « safety culture ». This commitment should hold line management responsible for adhering to this policy and operating philosophy. This compromise should be also extended formally to all departments of the organisation and to all contractor companies. All the personnel, both plant and outside workers should be made aware of management's commitment. In order to motivate the personnel the basic lines of the ALARA programme should be included into the basic and ongoing radiological protection training plans.

❑ Responsabilities

The management support to reducing individual and collective exposures is a critical element in ensuring a successful ALARA achievement. Consequently, a clear ALARA policy statement reflecting this commitment should be formally issued by the highest level of corporate management and transmitted to the lowest levels.

Three different levels of responsibility have been defined

· Top level of Management, with the following functions:

- Promotion of ALARA culture within the company
- Approval of ALARA policy and dose objectives
- Provide economic and technical resources to develop this policy and to achieve dose objectives

· Interdisciplinary plant management Committee, comprising the Plant Manager and Heads of the main plant department, their functions are as follows:

- Proposal of ALARA program, goals and objectives. Review performance in achieving the goals, the lesson learnt and those proper corrective measures.
- Co-ordination of the activities of the different involved parties (operation, maintenance, mechanical engineering, etc.)
- Take into account of selecting those outside companies whose equipment, methods and procedures have considered the ALARA principle.

· Task performance group, Interdisciplinary plant groups comprising representatives of RP and technical departments responsible for task performance, with these functions:

- Analysis and planning of specific tasks.
- Follow-up of the tasks.
- Review and documentation of the results of the tasks, identifying lessons learnt and proposals for improvements.

An individual such as the ALARA Co-ordinator could be assigned responsibility to co-ordinate the development, implementation, and documentation of the ALARA program.

· Regarding outside companies, they should assume the following responsibilities:

- Support and participate in the ALARA programme of the facility. According to the radiological risk they should have their own ALARA programme
- Develop and propose in their offers equipment, methods and operational procedures according to the ALARA principle.
- Participate actively within the interdisciplinary plant groups.
- Provide their personnel the pertinent training

Finally, all the personnel will be responsible:
- for collaborating with all the parties to comply with the basic rules of protection and specific instructions,
- for participating in the previous and post-task analysis.

❑ ALARA Programme

Radiological Performance Goals/Indicators

The upper Management should establish, with assistance from the interdisciplinary plant management Committee, which dose reduction and contamination minimisation efforts should be prioritised based on ALARA considerations. The Management will approve the proposed improvements and their objectives. Examples of typical quantitative performance indicators include the following:
- Annual collective dose for the facility
- Outage collective dose
- Annual collective dose for the major departments
- Maximum dose to a worker

- Percentage of internal and skin contamination

ALARA Work management

The ALARA operating philosophy implies the management of the radiological relevant jobs. This control is made trough three different stages, the so-called ALARA procedure: (1) pre-job planning and dose assessment; (2) Follow-up of activities and dose tracking; and (3) post-job review.

Pre-job planning: The Management should establish criteria to trigger the ALARA procedure. Examples of such criteria include: Individual and collective dose, dose rate surface and ambient contamination levels. The next step will be to identify the different aspects of the job and the necessity of shielding, individual protections, work place arrangement, special training, robotic tools and so on, in order to reduce the dose as far as possible.

Follow-up: During the performance of the job individual and collective doses should be tracked and periodically compared to the dose estimates to determine any drift and to implement corrective actions if needed.

Post-job review: In this stage an analysis of the actual results must be compared against the estimates in order to evaluate the effectiveness of the ALARA controls, document the lessons learned and corrective actions.

The procedures describing this view process and their associated records should be properly documented.

Source Term Control and Reduction

The source term reduction is a key element to lower the personnel exposure. Therefore to achieve an effective reduction of the radiation level all aspects must be taken into account, such as those materials capable of being activated and deposited in the Reactor Coolant System. Consequently, many plant departments must be involved in these actions.

ALARA review of design modifications

During the operation of a NPP, modifications of systems, equipment or components are necessary aiming at improving the reliability, fitting in maintenance necessities or to reduce the dose related to this system or component. The appropriate radiological design criteria and practices should be in the engineering and design process considering the following aspects:

- Review of the general configuration of the facility, considering location of the radiation areas, adequacy of space for anticipated operations, maintenance, inspection, decontamination and decommissioning.
- Verify that the design of the confinement and ventilation systems provide the required level of protection from airborne contamination, giving particular attention to patterns of air flow and to the locations of air inlets, penetrations, and exhausts. Releases of radioactive material to the workplace atmosphere shall be avoided under normal operating conditions and inhalation of such materials by workers controlled to the extent reasonably achievable.
- Evaluate and confirm the adequacy of specific control devices for reducing occupational exposures, including shielding, hoods, glove boxes, containments, and remote operations.

ALARA Training Programme

The training programme will be based on the personnel responsibilities as well as on radiological risks. The programme willm be categorised into three groups: (1) Heads of departments, (2) Personnel responsible for the job execution and (3) radiological workers. The set of topics will comprise the following common issues whose depth and extension will depend on the responsibilities of each group:

- ALARA program objectives
- Basic theoretical concepts
- Optimisation program practical implementation (Job planning, dose estimates, follow-up, means for reducing exposure)
- Specific Alara techniques (robotics, mock-up training, etc.)

Internal audits

In order to evaluate the effectiveness and the correct execution of the ALARA programme the Management should carry out periodic audits, clearly identifying the most relevant findings.

❑ **Conclusions**

The Guide provides an acceptable methodology for establishing and operating an occupational ALARA program, this way the legislation process is fulfilled in the regulatory process from compulsory Law down to the Recommendatory Guide.

This guide also reflects the result of a co-operation between the Regulatory Authority and the utilities that the CSN began in 1991 drawing up an overall strategy aimed at promoting practical implementation of the ALARA criterion which in its turn was backed up by the Spanish plants.

❑ ***A radiography incident in Sweden (Case no. 10)***

During one evening of May 1999, two radiographers, using a portable X-ray unit, examined welds on a large pipe of a steam extraction system at a Swedish nuclear power plant. Between exposures, which each took about 1,5 minutes, they moved their apparatus around, handled plates and prepared for the subsequent exposure. The used X-ray unit produces a rather narrow beam. The work was performed in a closed area, with a collimated beam, and with full control over all entrance doors. The radiographers were not aware of the cleaning work mentioned below, and they did not foresee that someone could enter the area inside of the pipe! At the same time, another work team had been ordered to perform clean-up work at the steam extraction system. One person, P, was to remove debris left inside of the pipe as the result of grinding work. P, equipped with the tube of a suction system, entered the pipe through a man-hole and two of his colleagues, positioned at the man-hole, fed him tube as he moved along. P started cleaning the inside and advanced about 20 meters forward. At that point he reached the place were the radiography work was performed. At this section the pipe opens up and P stood up, turned around, and reverted to the place were he entered the pipe. P did not hear or notice anything unusual during the 15 minutes he stayed in the pipe.

It is difficult to estimate exactly how long time P has spent at the section of the pipe were the radiography work was performed. He estimated himself that he was standing up for about 15 seconds before he again crouched down and crawled back to the man-hole. P was equipped with a thermoluminescence dosimeter (TLD) but he had removed his electronic dosimeter since he thought it would hinder his movements inside of the pipe. The radiation level at the place where the work was performed is usually neither high nor changing. P and his colleagues were not aware of the radiography work.

At one point of time, while the radiographers were rearranging their equipment, vibrations were noticed from the pipe system. They tapped on the pipe but P, inside the pipe, did not hear this. They stopped their work and when they went around the corner they saw the two workmates of P who were busy feeding the tube. Everyone now realised the seriousness of the situation and the radiation protection unit was contacted.

The X-ray plates were checked for disturbances or shadows but such were not found. The TLD belonging to P was promptly evaluated and exhibited a total dose of 0,5 mSv which compared well with the 0,75 mSv of P's electronic dosimeter. P was sent for blood tests to the nearby hospital during the same night and the result of the analysis showed normal values. A test set-up with several dosimeters was exposed at the place were the radiography work was done. It was estimated that the maximum dose received by a person situated in the collimated beam during one exposure of 1,5 minutes would be in the order of 30 to 40 mSv. (…)

(…) The Swedish Radiation Protection Institute and the Swedish factory inspection were informed about the incident in the morning of the following day. Debriefing was offered to the involved personnel.

Lessons Learnt

The incident was quickly reported and the follow-up work was performed well.

The routines for management of work permits at the power plant must be improved. Radiography work and/or clean-up work must be governed by work permits which are coupled to the work permit for the main work (construction, repair work) so that all activities can be fully co-ordinated and controlled. In the present case, the lack of information to the involved persons and the missing co-ordination was evident.

A firm which performs X-ray examinations must take full responsibility for their radiography work, regardless of whether it is performed at a nuclear power plant or not. The radiographers should have ensured that nobody could be exposed. The assumption made, unconsciously or not, that no one would enter into the beam inside of the pipe was apparently wrong.

❑ ***Exposure Incident at Tricastin NPP (France)***

Two flood lamps were installed in the reactor containment test of Unit 1, which has been undergoing an expanded outage for the "10 year inspection" since 28/11/98, for maintenance operations (TV inspection, installation of heat and acoustic sensors) at the start of the shutdown with the core loaded and the thimbles inserted (In Core Instrumentation).

Before the containment test, the reactor vessel system engineer questioned the presence of the flood lamps in the reactor pit and asked a team leader from the Radiation Protection department to make sure that the flood lamps had been installed. The RP team leader assigned one of the RP technicians to this task, instructing him to make the check from the doorway, without entering the room and that it was a delicate operation (prohibited area). He did not request an access permit from the Management.

The RP technician, accompanied by a contractor RP technician, went to the room, opened both doors and saw the flood lamps. He then decided to enter to remove them. Once in the room, his dosimeter saturated; alarms on dose and dose rates went off but, he continued removing the flood lamps. During the operation, the contractor's technician, who remained outside the room, heard alarms' signals. Once the operation had been completed, the RP technician noted that his dosimeter indicated 87 mSv. The exposure time was of the order of 3 minutes and the average dose rate in the room can be estimated at between 6 and 8 Sv/h. The film, which was developed urgently, revealed a dose of 340 mSv. The medical examinations confirmed an integrated dose of approximately 300 mSv. (INES scale: level 2).

In-Depth Analysis and Lessons Learnt are available at EDF; please contact Mr. P. Colson, EDF DSRE.

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ALARA NEWS

Feedback from EC/ISOE Malmö International Symposium

Malmö (Sweden), 16-18 September 1998

The ISOE (International System on Occupational Exposure) European Technical Centre co-organised with the European Commission the First EC/ISOE Workshop on Occupational Exposure at Nuclear Power Plants in September 1998, in Malmö, Sweden. 150 participants from 21 countries attended the meeting.

A topical session concerned the evolution of dosimetry systems. During the past three years NRPB in the UK has used an electronic dosimeter, the EPD, as a legal dosimeter with the agreement of the regulatory body, HSE. Since then BNFL Magnox Generation has made a request to HSE to do the same for all Magnox NPPs and is in the process of receiving the agreement.It is the first time in Europe that an electronic dosimeter is able to provide legal dosimetry instead of film badges (Belgium, Hungary, France…) or TLDs (Finland, Germany, Spain, Sweden, …). In most countries redundancy is required when electronic dosimeters are used for operational dosimetry.Another particularly appreciated session was devoted to the reduction of dose rates through decontamination (in the Netherlands, Japan and Sweden), purification and hot spots eradication (two papers from France) and a synthesis concerning Zinc and Noble metal injection experiences in the US. The French paper covered the whole subject from the design phase during which the origins of such contamination are raised, to the search for both preventive and curative solutions, the costing of such solutions and, finally, the political decision, taking all the different optimisation components into account with regards with the man-sievert monetary value.

Most of the other papers dealt with the management of radiological protection. The need for a strong commitment from the managers has been stressed several times.
Within all the papers devoted to ALARA management a paper from Cofrentes NPP in Spain on ALARA implementation for valve replacement is a good example of the room that still exists for many jobs for improvement through better planning, work preparation, workers and job responsible involvement and motivation… it also illustrates that often reduction of duration, cost, and dose as well as quality improvements are not only compatible but synergistic.

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2nd European Workshop on « Occupational Exposure Management at NPPs »

Tarragona (Catalonia, Spain), April 4-7, 2000

And now, after the success of the Malmö Workshop, a second Workshop is organised in TARRAGONA
Hoping to see you - again ? - over there !

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First Belgian ALARA-day

On the 23rd of November 2000, the Belgian Association for Radiological Protection (ABR-BVS) and the Nuclear Research Centre (SCK-CEN) of Mol will jointly organise the first Belgian ALARA-day. This day is intended to provide to all Belgian Nuclear partners an opportunity to exchange information and to share their experience as far as the ALARA-principle is concerned.

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Radiation Protection: What are the Future Training Needs ?

Saclay (France), September 6-9, 1999

CEA (French Atomic Commission), INSTN (French National Institute of Nuclear Sciences and Techniques) and IAEA organise in Saclay, next September, a congress on the future training needs in the field of radiological protection.

Due to changes in techniques and regulations in radiation protection, a comprehensive review of training in this field is essential. This should involve a collaborative approach of the various interested parties: employers, trainers and users/employees. Undertaking this review at an international level should enrich the discussion and facilitate the development of a common approach.

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New Decrees Adopted in the French Law Dealing with Occupational Radiation Protection

A new regulation issued on the 23rd March 1999, precises the rules, roles and status of the occupational external dosimetry. It complements the Article 20 bis of the decree 98-1185 (December 24, 1998), which was establishing the obligation for managers or employers, in order to implement ALARA:
- to evaluate individual and collective occupational doses prior to any operation (predictive approach), and,
- to measure continuously the occupational doses during operation (i.e. real-time « operationnal dosimetry »).

Particularly, this recent regulation gives the technical specifications of dose measurement devices, as well as the rules of recording and management of the feedback experience databases in that domain.

SRA Europe (Society for Risk Analysis) and TU Delft are jointly organising the 9th Annual Conference on Risk Analysis: « Facing the New Millenium »
Rotterdam (The Netherlands), October 10-13, 1999

More information at: http://www.wtm.tudelft.nl/~sra-e1999/

European Commission « Radiation Protection »

3rd EUROPEAN ALARA NETWORK WORKSHOP

« MANAGING INTERNAL EXPOSURE »

at BfS facilities, München, GERMANY
15-18 November 1999

PRELIMINARY PROGRAMME

- **Session 1:** « Setting the Scene » (chaired by R. Coates, UK)
- **Session 2:** Regulatory Framework (chaired by P. Hubert, France)
- **Session 3:** Case Studies I from the non-nuclear industry (chaired by G. Tarroni, Italy)
- **Session 4:** Case Studies II from the nuclear industry (chaired by E. Sollet, Spain)
- **Session 4':** Poster session and software demonstration
- **Session 5:** Case Studies III from NORM and others (chaired by L.E. Holm, Sweden)
- **Session 6:** Case Studies IV on operational dose management (chaired by G. Weimer, Germany)
- **Session 7:** Final Session (co-chaired by C. Lefaure, France, J. Croft, UK, & A. Schmitt-Hannig, Germany)

This workshop will allow 36 oral presentations, 25 posters communications and 4 software demonstrations.

The number of participants is limited to a maximum of eighty.

For the list of the submitted papers and further information please contact :
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