European ALARA Network
http://ean.cepn.asso.fr/

Issue 12 - February 2003

# European ALARA Newsletter

## Editorial

"International mechanisms for facilitating optimisation of occupational radiation protection – for example, ALARA Networks- should be encouraged". This is one conclusion of the international conference on occupational radiation protection organised by the IAEA and ILO, with many other organisations in Geneva (August 2002). We appreciate such encouragements and will rely on them to provide (even more) opportunities to all radiological protection stakeholders to use our Network as a communication and creative tool for improving worker protection.

## Contents of Issue #12



## Editorial Board



Recently some 80 participants from 12 European countries attended the 6th EAN Workshop on "Occupational Exposure Optimisation in the Medical and Radiopharmaceutical Sectors" which took place at Madrid last October. That Workshop pointed out that, even though the European Basic Safety Standards (BSS) are now largely implemented in the legislation of the Member States, there remain areas in the medical sector where the intent of the BSS was not being manifested in the practical implementation of radiological protection: in particular in Prior Risk Assessment, the encouragement of an appropriate Safety Culture, implementing an appropriate training programme and involvement of Qualified Experts. However, the Workshop demonstrated that many stakeholders (regulatory bodies, professional bodies…) in the different countries are developing guidance documents to facilitate an improvement of the situation for both workers and patients. In order to provide a means of avoiding groups "re-inventing the wheel", a recommendation has been issued by the participants to the Workshop that the EAN should make arrangements to have a section of its website devoted to listing (and providing links to) existing guidance documents in the medical sector. Therefore Anja Almen from the SSI (the Swedish regulatory body) has agreed to coordinate the elaboration of such a section. All readers of the Newsletter are invited to provide her with material for that section (anja.almen@ssi.se).

Following the previous workshop at Rome, the first meeting of a joint Working Group on Non Destructive Testing (NDT) technologies has been organised last December under the co-chairmanship of P. Shaw from NRPB (UK) representing the EAN and H. Hoogstraate (the Netherlands) representing the European NDT Society. EC DG ENV supports that Working Group which aims at producing guidance documents.

You will find in this issue of the Newsletter, the findings and recommendations from the Madrid workshop. In addition, the recent IAEA/ILO international conference on occupational radiation exposure covered many issues of relevance to the EAN, and therefore some excerpts of their conclusions are published hereafter. We are also pleased to open our columns to Gendrutis Morkunas who co-ordinates the second "regional" ALARA Network (the Central Eastern European ALARA Network) that has been set up in April 2002 with the help of the IAEA. They have built their own website (www.rsc.lt/alara)

C. LEFAURE

Coordinated by CEPN, on behalf of the EC DG-RESEARCH
European ALARA Newsletter ISSN 1270-9441

ROUTE DU PANORAMA, BP 48 F - 92263 FONTENAY-AUX-ROSES CEDEX TEL: +33 1 58 35 74 67
FAX: +33 1 40 84 90 34 E-MAIL: SEC@CEPN.ASSO.FR

cepn

## Summary and Recommendations from the 6th EAN Workshop: Occupational Exposure Optimisation in the Medical Field and Radiopharmaceutical Industry Madrid, 23-25 October 2002

*J. Croft, C. Lefaure*

### ❑ Structure and Content

Some 80 participants from 12 European countries attended the 6th EAN Workshop on "Occupational Exposure Optimisation in the Medical and Radiopharmaceutical Sectors". There were 31 oral presentations and 20 poster presentations. In addition to a scene setting session there were sessions on

- Exposure from new technologies in nuclear medicine,
- Exposure from new technologies in radiotherapy and radiology,
- Production, transport and distribution of radiopharmaceuticals,
- Dose monitoring equipment and strategies,
- How to encourage a positive safety culture,
- Training and exchange of information.

The opening paper provided an overview of medical occupational exposure, both in terms of national dose profiles and some of the underlying driving forces. This also identified a series of issues and questions to provide a starting point for the discussions in the Working Group sessions. There were two such sessions where the participants were split into 8 Working Groups tasked with addressing specific issues. The reports from these groups were presented and discussed in the final session in order to identify the key targeted findings and recommendations.

### ❑ Findings and Recommendations

Workers exposed in the medical sector form a very significant percentage of the European workforce that is occupationally exposed to radiation. The average annual individual doses, for all monitored and measurably exposed workers, varies from country to country by up to about a factor of 10. These differences are also evident in the numbers of people in the higher dose bands. This indicates either significantly different monitoring practices, or different types of work undertaken, or different levels of implementation of the radiological protection system.

Only limited data is available on the breakdown of the sectors of use where the doses are most significant (both in radiology and nuclear medicine). Whilst some of the higher doses are in the traditional general diagnostic area, the dose data and presentations at the Workshop indicate that the major areas of concern are in areas involving new technologies such as in interventional radiology and cardiology.

Different countries and even different medical establishments within countries have different monitoring practices. For example recorded doses may be taken from personal monitoring badges under or on top of lead protective aprons, or from an algorithm using data from both. Similarly for new techniques monitoring protocols may be poorly defined and less rigorously followed by staff who may have previously not been involved in radiological procedures.

**Recommendation 1: In order to avoid confounding factors and provide dose data that will be useful in identifying trends and areas of concern, there would be value in harmonised guidance at a European level on personal monitoring protocols.**

The European Basic Safety Standard (BSS) are now largely implemented in the legislation of the Member States. However the Workshop identified some areas where the intent of the BSS was not being manifested in the practical implementation of radiological protection: in particular in Prior Risk Assessment, the encouragement of an appropriate Safety Culture, implementing an appropriate training programme and involvement of Qualified Experts.

The concept of Prior Risk Assessment is generally well understood with respect to general safety issues in the medical sector but it was noted that radiological protection risks are often not included. This appears to be particularly so for new procedures and new technologies.

**Recommendation 2: Regulatory and professional bodies should influence managers and others responsible for safety to systematically include the consideration of radiological risks into prior risk assessments: particularly where new technologies or procedures are being used.**

The carrying out of appropriate Prior Risk Assessments is one manifestation of a good safety culture. The way Regulators encourage and/or enforce regulatory requirements can set the tone for safety cultures but it requires the involvement of all stakeholders to be a success.

**Recommendation 3**

**(a) Management, whether of a large medical establishment or a smaller clinic, should actively seek the involvement of workers; in particular workers experience should be harnessed;**

**(b) Professional bodies have the infrastructure and mechanisms to influence practical radiological protection. They are encouraged to use them to maximum effect;**

**(c) When providing new equipment or supplies, manufacturers and suppliers have a golden opportunity to influence the practical implementation of radiological protection. They are encouraged to not only provide safety information but to actively engage in dialogue with customers to further this end.**

Appropriate training of staff, at all levels, is a fundamental building block in the attainment of good radiological protection culture. Many mainstream professions that have involvement with well-established uses in the medical sector eg, radiologists and radiographers, include radiological protection training in their professional training curriculae. This introduction of new equipment and procedures provides challenges that require positive updating training provision. However new equipment and procedures often widen the scope beyond those that have had radiation protection training as an element in their professional training. The

Workshop identified that these groups of staff are a particular area of concern, often starting to use radiation without any training – Something that an appropriate risk assessment should identify.

Recommendation 4: **National Authorities, in consultation with professional bodies should:**
**(a) periodically review the radiological protection content of professional training course to ensure it meets appropriate standards;**
**(b) give advice on the need for refresher training and "Continued Professional Development"(CPD); and**
**(c) ensuring that prior risk assessments address the training requirements for those involved in new procedures.**

The BSS requires the appointment of Qualified Experts (QE). The professional input on radiological protection that a QE can provide, can be a major factor in the implementation of many of the above issues. However it is clear from the Workshop that there were very significant differences between Member States in:

(a) the perceived role of a QE in the medical sector, and
(b) the training and attributes of a QE.

The standards appeared to vary from a QE having one week's training and little power or influence, to someone having to have significant radiological protection training plus 3 years practical experience before taking on the QE function, often with the ability to directly influence senior management. A Working Group of the Article 31 Group established under the Euratom Treaty is looking at harmonising standards for Qualified Experts.

Recommendation 5: **The Workshop recognised that the participation of appropriately Qualified Experts in the development and implementation of radiological protection programmes was crucial. The EC should request the Article 31 Working Group to give priority to clarifying advice on**
**(a) the role of QEs, and**
**(b) training and qualifications required.**

During presentations and discussions at the Workshop it became clear that professional bodies, national authorities and international bodies had developed a range of guidance documents on different subjects, but that their existence was not widely known.

Recommendation 6: **In order to provide a focus and a means of avoiding groups "re-inventing the wheel", the EAN should make arrangements to have a section of its website devoted to listing (and providing links to) existing guidance documents in the medical sector.**

It is also important that when accidents and incidents occur, they are appropriately reported so that others can learn the lessons from these events.

Recommendation 7: **Professional bodies, national authorities and international bodies should liaise to ensure that there are appropriate mechanisms in place for the reporting of accidents and incidents, and the dissemination of lessons learned.**

Several presentations covered the relatively high whole body doses associated with new techniques particularly in interventional radiology and nuclear medicine. It was also noted that these situations also result in high extremity doses, not just to the hands, but to the legs of interventional radiologist. A number of papers focussed on methods for assessing extremity doses, including electronic that can enable the pattern of exposure from individual actions to be examined and the data to be available as soon as the procedure has been completed. This immediate feedback can be used to improve specific procedures but also has a secondary but important function of raising awareness of radiation protection issues and good practice.

Recommendation 8: **The EU and national authorities should support research into the development and use of electronic dosimetry systems.**

Papers were presented on the expanding range of isotopes and their uses in nuclear medicine. However it appeared that the methodologies for appropriate dose assessments were not keeping pace with these developments.

Recommendation 9: **The EU could provide a useful focus for developing and implementing appropriate methodologies for internal dose assessments.**

It was identified that there can be strong links between the profiles of patient doses and occupational exposure. The establishment and use of Reference Doses for standard procedures have been shown to be of significant value in focussing attention on radiation protection issues and optimising both patient doses and occupational exposure.

Recommendation 10: **The EU and national authorities should take measures to encourage the development of Reference Doses for new procedures.**

There was considerable discussion of approaches to controlling the occupational exposure of pregnant women. Whilst national regulations are based on Article 10 of the BSS Directive there appeared to be considerable variation in the national guidance and practices; often reflecting underlying social cultures. Whilst the issue transcends the medical sector, the scale of medical procedures and the high proportion of women in the occupationally exposed group, make the medical sector important.

Recommendation 11: **There would be value in international organisations developing harmonised approaches to**
**(a) dosimetric assessment of doses to the embryo/foetus;**
**(b) practical criteria for identifying work activities that pregnant women should not undertake;**
**(c) administrative procedures for the declaration of pregnancy.**

## Findings and Recommendations of the International Conference on Occupational Radiation Protection: Protecting Workers Against Exposure to Ionizing Radiation (Geneva, 26-30 August 2002)

*The International Conference on Occupational Radiation Protection, held in Geneva, from 26 to 30 August 2002, was organized by International Atomic Energy Agency (IAEA), with the International Labour Organization (ILO). It was sponsored by many other organizations. Due to the importance of that conference which was totally devoted to subjects dealing with the scope of our Network, it has appeared fundamental to provide our members with excerpts of the findings and recommendations from that conference. (IAEA reference: Note by the IAEA Secretariat, 6 September 2002, 2002/Note23).*

"The overall message to come from the opening presentations was that, in general terms, occupational radiation protection over the past few decades has been a success story for the international radiation protection community. Global information from UNSCEAR and the ISOE, supported by many detailed national studies, has revealed solid downward trends in many key performance indicators, primary among which are the annual average dose and the annual collective dose, but also indicators such as the number of workers exposed to high doses and the number of accidents and overexposures. It is worth noting, however, that most of these data relate to the nuclear fuel cycle; the picture is not so clear or encouraging for exposures in medicine and industry, nor for exposures to natural sources, especially in the mining of ores other than uranium. This is important, as these are the principal types of exposure globally."

**The main findings of the Conference were as follows:**

"Continuous exposures near the dose limit would, however, involve risks comparable to those in recognized high-risk occupations. These circumstances justify the attention being paid to the management of higher individual doses, but not mean that attention to routine dose levels can be relaxed. It is also relevant that there is a general downward trend in exposures to other hazards. In this respect, the continued use and expansion of international mechanisms for facilitating optimization of occupational radiation protection-for example, ALARA Networks – should be encouraged." (…) "For nuclear power plants, the ISOE is a very useful mechanism for disseminating information, examples of good practice and lessons learned. There are no similar mechanisms in other areas, and it would be helpful to develop complementary systems."(…)

"Exposures of workers in conventional radiology, both radiodiagnosis and radiotherapy, are generally well controlled. There are, however, new areas of medical practice, especially interventional radiology, in which very high exposures are received. Ensuring that sufficient attention is paid to the control and reduction of such exposure requires continued efforts in post-graduate education and awareness-raising of the medical professionals involved. The participation of health physicists in the implementation of optimization programmes in interventional radiology is strongly recommended".

"In industrial and research facilities, the average occupational doses are generally quite acceptable. There are, however, specific types of work that involved both high routine exposures and a number of accidents; predominant among this is industrial radiography, which is often carried out in difficult environments by unsupervised workers and where safety relies largely on procedures and human performances. The Conference echoed the conclusions of the 5th EAN Workshop in Rome. As a result of the Workshop an EAN Working Group on Industrial Radiography has been formed with the European Federation of Non-Destructive Testing."

"Occupational radiation protection in the nuclear fuel cycle has received more attention than occupational radiation protection in any other practice. The main driving force for occupational exposure control has been application of the optimization (ALARA) principle, which is now part of normal job planning and almost second nature. The results over the past few decades in terms of reductions of all indicators-average doses, collective doses per unit energy generated and numbers of people receiving high individual doses-are well documented. International databases and mechanisms such as the ISOE and ALARA Networks are very important in maintaining the situation. Concern is still warranted over the control of exposures of itinerant workers and contractors. They are subject to divided responsibilities as between employers and licensees, and may even work across national boundaries."

"A potential problem may arise because of the delays in decommissioning, which will result in loss of direct knowledge of facilities. Demonstration of compliance with international standards could be facilitated by international guidance on what represents good compliance in the nuclear industry, and indeed in other industries."(…) "The decreases in average and collective doses may not be sustainable in the face of changes in work requirements, especially those associates with the termination of practices currently being performed, with the decommissioning of facilities and with end-of-life provisions. Note should be taken of the increasing age of workers in many areas and of the need to manage the generation change through the recruitment and training of younger workers."

"The principle of the optimization of protection (ALARA) is the cornerstone of radiation protection in the workplace. It is important to recall that it relates not only to engineering or physical protection measures, but also to aspects such as safety organization and management, safety culture and safety training, many of which are associated with minimal costs and improvements in other areas – "win-win optimization". It is not in line with optimization to devote substantial resources to the reduction of small risks. In this respect, occupational doses below 1-2 mSv/a may not warrant regulatory scrutiny. As optimization necessarily involves social and economic factors, its objectives are related to local circumstances."

## Strategic Plans of Spanish Nuclear Safety Council to Control Industrial Gamma-Radiography Facilities

*Laura Urteaga García, Emilia Rodrigo Gonzalez, Belén Tamayo Tamayo, Blanca Alfonso Nicolás, Dolores Aguado Molina, Sofía Suarez Carrillo*
*(Spanish Nuclear Safety Council)*

### ❑ Introduction

At present, in Spain there are about 800 industrial and research radioactive facilities and about 130 out of them are in the industrial radiography field. This total includes industrial radiography installations that use X-ray machines as well as those using gammagraphy gauges (gammagraphers) and the use of these radiation sources on site.

Facilities with gammagraphy gauges are the most problematic ones. There are 49 facilities using gammagraphy gauges, about 38 % of the total of industrial radiography installations. The most usual radionuclide in gammagraphy gauges is Iridium-192 with a maximum activity of 5 TBq (135 Ci), although no more than 3 TBq (80 Ci) are generally used. The use of Cobalt-60 is less common (it is used fundamentally in enclosure installations) and only in a few cases are Ytterbium-169, Cesium-137 and recently Selenium-75 used.

Historically, this type of facilities had presented the highest risk in the industrial radioactive field, particularly when they use mobile gammagraphy gauges, so these ones show the highest operational doses and the highest number of overexposures and incidents. Given these facts, the Nuclear Safety Council decided to implement in 1993 a plan to improve radiological protection conditions in industrial activities after completion of a cause analysis.

The result of this plan was an improvement in the written procedures but not in the practice operation, as indicated by the evolution of individual doses. This analysis showed that licensees seldom adopt radiation protection provisions in a systematic way, on the other hand the competent authority has realised that it could present its requirements in a more clear way. Therefore more actions were needed and the Nuclear Safety Council implemented a second plan in 2001.

### ❑ First Radiation Protection Improvement Plan

Based on the primary cause analysis it was concluded that the following actions should be applied to improve radiation protection:

- to send a circular letter to all facilities with requirements and recommendations in order to improve safety and radiation protection ;
- to develop an audit programme for installations with the highest field gammagraphy workload ;
- to carry out a study of the routine surveillance programs of gammagraphy equipment and accessories.

The audit programme results showed deficiencies in the knowledge of the operators, regarding the practical application of the operation procedures, as well as other radiation protection aspects, so that CSN concluded the need for new actions, as follows:

- to publish a radiological protection Safety Guide on operational conditions of gammagraphy facilities (CSN GS 5.14);
- to establish specific training courses to technical operating personnel, supervisors and operators (included in CSN GS 5.12);
- to review assessment procedures of the Nuclear Safety Council;
- to focus the Nuclear Safety Council control on the application of the ALARA principle for the gammagraphy facilities.

After adopting these new actions, it has been verified that gammagraphy facilities have experienced significant improvement in their written procedures and in the acquisition of radiation protection resources.

The number of incidents reported by these facilities has increased because the reporting criteria had been clarified, rather than any increase in the actual number of incidents. This is considered very positive because incident analysis is one of the most important ways to improve radiological protection conditions in future. Moreover, actual information on incidents will be very important to develop the database on events in radioactive facilities that is being developed at Nuclear Safety Council.

### ❑ Evolution of Doses

In order to know how these facilities have improved their operation procedures, a study on annual dose trends of mobile gammagraphy workers has been carried out. This study considered the nine facilities with the highest number of exposed workers from 1995 to 2000 (annual doses below 2 mSv were neglected). A summary of the results divided across seven intervals of annual doses is shown in the table 1.

**Table 1. 1995-2000 Evolution of the Percentage of Gammagraphy Workers per Dose-Ranges in Spain**

| Dose range (mSv) | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| | % workers | | | | | |
| 2-5 | 48 | 45 | 51 | 47 | 38 | 44 |
| 5-10 | 29 | 27 | 27 | 22 | 36 | 25 |
| 10-15 | 13 | 12 | 8 | 15 | 13 | 17 |
| 15-20 | 5 | 7 | 5 | 7 | 6 | 5 |
| 20-50 | 5 | 7 | 5 | 7 | 7 | 7 |
| >50 | 0 | 1 | 1 | 1 | 0 | 1 |

This leads us to the conclusion that workers percentage with high doses, above 10 mSv/year, (overexposed workers included) has actually increased from 1995 to 2000. One of the main problems appears to be that this is a very competitive field, where some customers put high pressure on the gammagraphy facilities owners and, consequently their workers. The result is that written procedures are not applied in an adequate way, protection resources are not adequately used, operators training remains insufficient and, finally, ALARA principle is not the main objective for the managers and, consequently, for their workers.

## ❑ Second Radiological Protection Improvement Plan

Next is presented the radiological protection improvement plan, approved by CSN on 31/05/2001 after taking into account licensees comments.

*Complementary technical instructions*

✣ The owners of the installations have to develop and send to the Nuclear Safety Council an adequate ***Self-Inspection Program***. This inspection program:

- will include the surveillance by a supervisor of the performance of each operator or assistant during actual operations of radiography, at least every six months;
- will ensure that, operator performance will be surveyed where an operator or assistant has not participated in a radiography operation during the previous three months;
- will include a record by the supervisor of inspections on each operator or assistant performance noted in the operating records book.

✣ With the purpose of dose optimisation, the supervisor has to develop a ***Gammagraphy Operation Task Plan*** including the following aspects:

- it will have to define the anticipated dose per operator, task and day, that should not be exceeded, this should be made taking in account the operation experience, the type of radiography, activity of the source, etc;
- it will have to establish the necessary operator number, the number of radiographs by operator, the working time, shifts, radiation protection resources, etc;
- once finished the task, the supervisor will make a comparative study of the actual doses, received by the operator and known from the direct reading dosimeter, with the anticipated doses;
- if anticipated and actual dose difference is significant, an assessment should be performed from the supervisor. So that it will be evaluated whether procedures improvement, increase of resources of radiation protection personnel, training, etc. are necessary;
- licensee should maintain records of planning, doses and latter performances, and this have to be referenced in the Operating Records Book.

✣ With the objective to improve the ***Operation Personnel Training***, the following actions will be taken:

- all the gammagraphy facilities licenses will implement a CONTINUED TRAINING PROGRAM for all the operating personnel, directed to improve the implementation of the working procedures and follow the ALARA principle;
- the training courses should be performed every two years, the supervisor of the radioactive facility may act as trainer and records of the accomplishment must be kept;
- proof of of having received this training is required for the next renewal of the operator license;
- the training program should be incorporated in the Operating Organisation Manual of the facility;
- all operators known to have poor working practices or who have received high doses will be tested to be able to renew the licence.

✣ The complementary technical instructions will also include ***Actions on the Client Companies***.

- CSN will send an informative letter to client companies to remind them of their responsabilities in the safety of the gammagraphy workers that they contract;
- the contracts between client companies and gammagraphy licensee must include co-operation on matters of workers and public safety.

The gammagraphy facilities licensees should incorporate the requirements of these complementary technical instructions in their Operating Organisation Manual.

*Increase the control and enforcement actions by the CSN*

The control and surveillance by the CSN of the operation of the gammagraphy facilities will be increased, so that:

✣ An inspection campaign on site (field operations) will be carried out. The detailed plan of monthly work will be requested to the licensees.

✣ When as a result of bad operation, high radiation doses are received by the operation personnel, a proposal of penalty will be initiated.

✣ In cases where standards of protection fall, which in most of the cases will be consequence of a bad supervisor management, CSN will set out the temporary suspension of the installation operation permit, until the owner presents a plan to correct the situation.

✣ In extreme cases of bad performance of the operation personnel, the CSN will suspend their operation license.

*Information on operating experience and operational practices*

To increase information to owners on lesson learnt, the CSN has started the following actions:

✣ Sending informative letters to the licensees of these companies when events in gammagraphy facilities occur, from which lessons of radiation protection are learnt.

✣ Actively participating at international work groups to spread the good practices in other countries. For example CSN is member of the EAN working group on industrial radiography.

*Establishment of systematic co-operation between csn and gammagraphy companies in radiation protection matters*

✣ CSN have sent complementary technical instructions of the improvement plan for comments before its application.

✣ CSN will organise technical meetings with the licensees.

✣ CSN will organise a Forum of work with professional associations in order to get solutions to reduce the doses.

### ❑ Safety Devices

One of the most important aspects to consider for improving radiological protection in gammagraphy operations, is safety equipment. Inadequate inspection and maintenance of radiography, ancillary and safety equipment causes numerous incidents.

The gamma radiography device must be designed according to International Standard ISO 3999 (1977) "Apparatus for gamma radiography" which established the security requirements that must be considered in their construction. ISO-3999-1 (2000) has increased the requirements of security of these apparatus, in order to reduce the operational incidents.

In Spain there are in use about 308 gamma-radiography apparatus distributed in 21 different models, but the most common are *TO-660* (63%) and *NI-202* (21%), both with sources of Iridium-192. Most of the devices are imported, except a few from *Nuclear Ibérica* (NI) company. Although this company stopped manufacturing new devices the old ones are still in use. Among the ones that incorporate sources of Cobalt-60 (used generally in enclosures) the most used is *TO-680*.

The 12% remainder of the inventory of these apparatus, corresponds with the other 17 models, being the most representative the *Crawler IPSI IRIS* and the *Gammamat TI*.

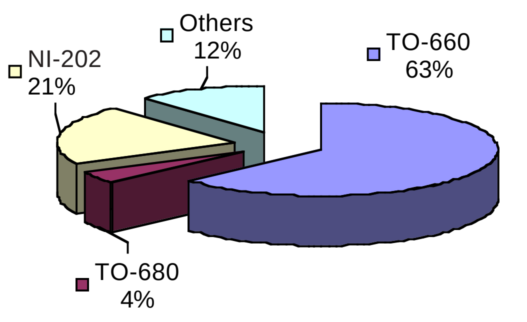


***Figure 1. Most Usual Gammagraphy Apparatus in Spain***

From the point of view of the security in the design of these apparatus, CSN is going to classify them in three levels of security:

✣ In a first level, all those apparatus that comply with ISO 3999-1 (2000) or equivalent standard, and therefore have the highest requirements of security in its design. These apparatus represent less than 1 % of the inventory and they correspond to the models: *Gammamat SE* and *Gammamat TSI-5*.

✣ In a second level, all apparatus that complies with the standard ISO 3999 (1977) or equivalent, or those other that do not comply fully, but have a secure source locking mechanism of an equivalent standard. Inside this group we find a 77% of the inventory and correspond with the models not included in the first or third safety levels.

✣ A third level, the apparatus that don't comply with the standard ISO 3999 and do not incorporate an effective locking position. These apparatus represent 22% of the inventory. Inside this group we find ourselves with the models: *NI-202*, *NI-203* and *NI-211*.

These classifications constitute the prior step to study the possibility of progressive change of those apparatus in Spain.

---

## A New IAEA Categorization of Radioactive Sources

*Brian Dodd, Tom McKenna, John Wheatley*
*International Atomic Energy Agency*

### ❑ Introduction and Purpose

The IAEA published a categorization (IAEA-TECDOC-1191) in 2000 specifically to help its Member States prioritize their efforts with regard to regaining control over orphan sources. However, it was quickly recognized that there was a need to extend both the scope and applicability of the categorization to a wider range of applications and radioisotopes, and to include unsealed sources. It was also recognized that a new categorization system was crucial to other high-priority work initiatives being carried out by IAEA, such as the revised Code of Conduct on the Safety and Security of Radioactive Sources and the preparation of guidance on the Security of Radiation Sources.
The new categorization system provides a fundamental and internationally harmonized basis for risk-informed decision making by giving a relative ranking and grouping of sources and practices. In general terms the categorization system will be relevant to decisions both in a retrospective sense to ensure that existing sources are brought, or are maintained under control, and in a prospective sense to ensure that future sources are appropriately regulated. The applications of a stand-alone categorization include:

- regulatory measures: to provide a logical and transparent basis for a graded system of notification, registration and licensing, including the frequency and level of inspections. The categorization can also act as a basis for ensuring that the allocation of human and financial resources is appropriate to the category of source;
- security measures: to ensure that security measures are appropriate to the category of source, taking into consideration the potential for

malicious use, while still allowing for beneficial use;

- national registry of sources: to optimize decisions regarding which sources should be included in a national registry of sources;
- import/export controls: to optimize decisions regarding which sources should be subject to import and export controls;
- labeling of high activity sources: to optimize decisions regarding which sources should be marked with an appropriate sign (additional to the trefoil) to warn members of the public of the radiation hazard;
- emergency preparedness and response: to ensure that emergency preparedness plans and response to accidents are commensurate with the category of the source;
- prioritization for regaining control over orphan sources: to optimize decisions relating to where efforts should be focused to regain control over orphan sources;
- communication with the public: to provide a basis for explaining the relative hazard of events involving radioactive sources.

The categorization system will also act as a basis for decisions within the IAEA, relating to its internal work programmes and the provision of assistance to its Member States.

### ❑ Basis

When radioactive sources are managed safely and securely, the risks to workers and the public will be minimal. However, if sources are not managed appropriately, as in the case of accidents, malicious use, or orphan sources, they can cause a range of deterministic health effects leading to acute radiation sickness, erythema, amputation of limbs and death.

Recognizing that human health and safety is of paramount importance, the categorization system is, therefore, based on the potential for radioactive sources to cause deterministic health effects. This potential is comprised partly by the physical properties of the source and partly by the way in which the source is used. The actual practice in which the sources are used, the provision of inherent shielding provided by the device containing the source, and other judgemental criteria are taken into consideration.

Certain factors are specifically excluded from the categorization criteria:

- socio-economic consequences resulting from radiological accidents or malicious acts are excluded, as the methodology to quantify and compare these effects is not yet fully developed;
- the stochastic effects of radiation (e.g. increased risk of cancer) are excluded, as the deterministic effects resulting from an accident or malicious act are likely to overshadow any increased stochastic risk;
- the deliberate exposure of persons for medical reasons is excluded from the categorization criteria, although the radioactive sources used for these purposes are included in the categorization system as accidents occur involving such sources.

### ❑ Methodology and Development

The following provides a summary of the methodology and development of the categorization system - a full description will be given in the IAEA TECDOC that is to be published in the near future. In essence, the new categorization is based on the normalization of radioactivity based on deterministic effects, with consideration given to specific radionuclides and quantities of activity in routine applications, together with some ranking and grouping.

Initial consideration was given to using the A1/A2 values from the transport regulations as normalizing factors for the categorization system. However, there are a number of problems with doing so, mostly related to some simplifying assumptions used (e.g.: the artificial cut-off values for the beta emitting radionuclides). The IAEA has recently developed radionuclide-specific activity levels for the purposes of emergency planning and response. These levels, hereafter referred to as the ‘D’ values, are given in terms of an activity above which a radioactive source is considered to be ‘dangerous’. A *dangerous source* is defined in Preparedness and Response for Nuclear or Radiological Emergency, Safety Standards Series No. GS-R-2, 2002 as: “A source that could, if not under control, give rise to exposure sufficient to cause severe deterministic effects.” A *severe deterministic effect* is one that is fatal or life threatening or results in a permanent injury that decreases the quality of life.

Since the decision was made to base the new categorization upon human health impacts in an uncontrolled environment, the ‘D’ values were also used in this work as normalizing factors. A summary of the criteria for the D values is given in Table 1. Final D values are being recalculated at the time of writing, but a few preliminary values are given in Table 2 for perspective.

**Table 1. Reference Doses for D Values**

| Tissue / Organ | Reference dose for D value |
|---|---|
| Bone marrow | 1 Gy in 2 days |
| Lung | 6 Gy in 2 days |
| Thyroid | 5 Gy in 2 days |
| Skin /tissue(contact) | 25 at depth of 2 cm for most parts of the body (e.g., from a source in a pocket) or 1 cm for the hand for a period of 10 hours |

**Table 2. Some Preliminary D Values**

| Radionuclide | D (TBq) |
|---|---|
| Am-241 | 1.00E-02 |
| Co-60 | 4.00E-03 |
| Cs-137 | 2.00E-02 |
| H-3 | 1.00E+03 |
| Ir-192 | 1.00E-02 |
| Ra-226 | 2.00E-03 |
| Sr-90 | 3.00E-01 |
| Tc-99m | 1.00E-01 |

### ❑ The new Categorisation Scheme

The new categorization provides a relative ranking of radioactive sources and the practices in which they are used. The sources are classified into five categories, according to their potential to cause harmful health effects should the source not be managed safely and securely. There is some benefit for grouping common practices and assigning them to one category. However, the system is also flexible enough to assign a particular source to a category solely based on its radioactivity, by dividing its activity by the D value. Similarly, accumulations of sources, such as those in a storage area, or on a conveyance can be categorized by summing their A/D ratios.

In developing the categorization system, it was recognized that some practices, such as nuclear medicine, use radionuclides with a short half-life that may also be unsealed. In these situations, the principals of the categorization system can still be applied to determine a category for the source, but a judgmental decision will be needed in choosing the activity on which to calculate the A/D ratio. These situations need to be considered on a case-by-case basis.

In plain language, the sources in each category are those, which, if not managed safely or securely, could:

- **Category 1**: lead to the death or permanent injury of individuals in a short period of time.
- **Category 2**: lead to the death or permanent injury of individuals who may be in close proximity to the radioactive source for a longer period of time than for Category 1 sources.
- **Category 3**: lead to the permanent injury of individuals who may be in close proximity to the source for a longer period of time than Category 2 sources. Sources in Category 3 could, but are unlikely to lead to fatalities.
- **Category 4**: lead to the temporary injury of individuals who may be in close proximity to the source for a longer period of time than Category 3 sources. Permanent injuries are unlikely.
- **Category 5**: cause minor temporary injury of individuals, but are unlikely to.

**Table 3. The New Radioactive Source Categorization Scheme**

| Category | Activity Ratio A/D | Examples of Practices |
|---|---|---|
| **1** | A/D>1000 | Radioisotope Thermoelectric Generators, Irradiators, Teletherapy, Fixed Multi-Beam Teletherapy (Gamma Knife). |
| **2** | 1000>A/D>10 | Industrial gamma radiography, HDR/MDR brachytherapy. |
| **3** | 10>A/D>1 | Fixed industrial gauges: -level gauges, -dredger gauges, -conveyor gauges containing high activity sources, -spinning pipe gauges, Well logging gauges. |
| **4** | 1>A/D>0.1 | LDR brachytherapy (except Sr-90 eye plaques and permanent implant sources), Thickness gauges, Portable gauges, Bone densitometers. |
| **5** | 0.1>A/D>Exempt/D | X-Ray fluorescence devices, Static eliminators, Electron capture devices. |

### ❑ Conclusions

In summary, this categorization system is:

- useful for a large variety of purposes;
- developed with its end uses in mind, but not dependent on them;
- compatible with the previous categorization scheme, and intuitively correct;
- logical, transparent and simple.

Questions and comments on the categorization can be addressed to B.Dodd@iaea.org, or J.Wheatley@iaea.org. For discussion of the D values, contact T.McKenna@iaea.org.

## Management of NORM Radioactive Residues in the Czech Republic and ALARA

*Jiri Hulka,*
*SURO (National Radiation Protection Institute)*
*Prague, Czech Republic*

NORM (Naturally Occurring Radioactive Materials) and TENORM (Technically Enhanced NORM) and their radiological impact have been studied intensively in the last few years. Managing NORM and TENORM is interesting from the point of the ALARA principle, especially if these materials are produced and used in bulk amount (e.g. fly ash, tailings from uranium mining and milling etc). There exist a lot of tailings in the countries where uranium prospecting, mining and milling were carried out in the past. We assess that in the Czech Republic there are some 30 millions tons of tailings from uranium mining, slightly contaminated by natural radionuclides (Ra-226 content in range 0.1-1 kBq/kg, in some cases up to 3 kBq/kg). On the other hand these tailings can be used as a convenient building material, e.g. for road construction outside municipalities.

Having in mind occupational and public exposure, one must think first of all about justification and limitation. It is a complex question whether it is reasonable to use NORM material in building industry or to carry out expensive site restoration only. Concerning limitation: it is not clear, if disposal of such material from previous activities should be regarded as a practice or intervention and therefore it is unclear which limits or guidance levels should be applied.

For practices involving artificial radionuclides, stringent clearance levels corresponding to an annual individual dose 10 μSv should be applied, above which authorisation is necessary and practice can be accepted only if annual individual dose of 0.25 mSv to members of critical group is not exceeded. Similar attitude and level (0.25 mSv) will be probably recommended by regulatory body for clearance of NORM and TENORM materials. On the other hand one must have in mind radiological protection principles concerning the natural radioactivity of buildings materials (EU 112 recommendation). In this case individual annual dose 0.3 mSv caused by external gamma exposure indoors is accepted as an exemption level (only excess gamma dose from building materials indoor to that received outdoors is considered). Such building materials should be exempted from all restrictions and only in case annual doses in the range 0.3 – 1 mSv some controls are recommended.

Having in mind this framework, we can consider the ALARA principle in this issue, in particular cost-benefit analysis.

For example, consider the disposal of such material via road construction. To estimate detriment (individual and collective dose), we will take into account exposure during travelling.

We suppose:

- the length of the road is 50 km (it is reasonable assumption from the point of disposal of material;
- the road is built from tailings with a Ra-226 activity concentration of 1kBq/kg. A gamma dose rate of about 0.5 μGy $h^{-1}$ in the centre of the road without shielding is estimated (2π geometry and semi-infinite layer of material are supposed);
- a shielding factor of 2 can be expected, because of top layer (concrete, bitumes) of 10 cm in depth normally covers the stone;
- time spent on the road is estimated to be about 1 hour per day (to commute between work and home max 50 km), it represents some 200 hours annually;
- 1000-10000 persons as the critical group (small or middle town in the territory of uranium mining).

Based on the above assumptions, annual mean individual dose can be estimated as some 50 μSv. (Individual dose is below 1 mSv even in the worst case anybody spent 2000 hours annually in the road). The annual collective dose is in the range 50 mSv – 0.5 Sv. For cost-benefit analysis 30,000 Euro per man.Sv (monetary equivalent of detriment used in the Czech Republic for natural exposure) was used. In such a case, annual monetary equivalent of detriment can be estimated in the range of $10^3 – 10^4$ €.

On the other hand the costs saved by tailings utilisation can be estimated roughly as follows (case of 50 km road construction mentioned above):

- the road parameters: layer of crushed rock 0.5 m, width 6 m, length 50 km, density about 2000 kg/$m^3$,
- the price of 1 metric ton of crushed rock being about 20-30 Euro (500 CZK), what corresponds to some $3.10^5$ metric tons of crushed rock and total cost 6-10 million €.

It is hard to say, of course, that this is the total saved cost if tailings is used instead of other crushed rock, because the transport of material play an important role in the issue. However the cost of other forms of tailings restoration will probably exceed the transportation cost in case of road construction.

If we compare the annual monetary equivalent of the detriment and benefit from use of tailings, we can roughly estimate that within $10^2$ -$10^3$ years to use such material for road construction outside the municipality fulfil the cost-benefit principle. Estimation was performed under conservative assumption of exposure, however it supposed scenario described above would be valid in the future.

This rough estimation must be analysed in details according local specific conditions, of course (e.g. restoration costs are not included in the calculation, exposure of worker was not calculated, etc).

*For more information, please contact the author:*
jhulka@suro.cz

# ALARA NEWS

## Presentation of the Central Eastern European ALARA Network (CEEAN)

by Gendrutis MORKUNAS

Optimization is one of the basic principles of radiation protection. This principle is well understood by the majority of regulators, radiation workers, experts and other persons dealing with radiation protection. However, the problems arise when attempts are made to apply this principle in practice. Radiation protection measures very often are not optimized, vary from country to country even with similar economical and social factors. This problem is particularly important in countries which are still creating their radiation protection infrastructure, have rather limited resources, are lacking qualified radiation protection experts and regulators.

In the Central and Eastern European region various IAEA projects aimed at the creation of national radiation protection infrastructures, according to the requirements of the BSS and other technical documents of the IAEA, are being implemented. It has been found that the co-operation among Central and Eastern European countries is very important for the effective implementation of IAEA safety requirements. Furthermore, these countries are now capable of identifying the problem areas in radiation protection. Very often it is found that these problems in different countries are similar.

In April, 2001, the first meeting to Review the Existing Information Exchange on Methodologies and Techniques for Occupational Dose Reduction in Different Industries, excluding Nuclear Power Plants, and to Plan for Future Activities was held at the IAEA. Participants from different regions agreed that regional information exchange networks would be feasible. It gave an impetus for creation of such a network in the European region.

The Central Eastern European ALARA Network (CEEAN) was established in April, 2002. Armenia, Estonia, Belarus, Latvia and Lithuania are the first members of this network. It is open to other participants. The CEEAN in its activities follows the IAEA's BSS and other guidance and their programs of work. Account will also be taken of the EC standards as these will have an impact on candidate countries and are also important in other countries.

The following activities are planned and some of them are already started:

- information exchange on operational radiation protection and other "hot" issues;
- publishing of the Newsletter. The first Newsletter has been already prepared and posted on the CEEAN website (www.rsc.lt/alara); and
- annual meetings, training courses and seminars.

One can ask "why a separate network when the EAN already exists?" In its activities the CEEAN keeps in close touch with the EAN. Mr.John Croft (UK), one of the originators of the EAN is also a member of the Steering Committee of the CEEAN, and information exchange between the two networks takes place. There are at least three special reasons for the separate existence of the CEEAN:

1. Radiation protection of patients has a particular importance in member states of CEEAN and is included in the scope of activities.

2. Members of CEEAN still need support which recently is given by the IAEA; and

3. Certain problems encountered by members of the CEEAN do not exist in developed countries such as members of the EAN.

It has to be emphasized that the CEEAN is in a state of transitionbetween the present situation and that wheremodern, self sustaining radiation protection infrastructures exist in all member countries

Many problems still exist in the CEEAN. They are typically related to the support of network activities, commitment of its members, and information dissemination among its final users. However, it is evident that there is no alternative to international co-operation in radiation protection, particularly in the field of information exchange. It is suggested that the development and expansion of the Central Eastern European ALARA Network has a key role to play in this area.

For more information on the CEEAN, please contact:
Mr. G. MORKUNAS, Radiation Protection Center,
Kalvariju 153, 2042 VILNIUS, LATVIA
Tel: +370 2 754 693 Fax: +370 2 754 692
Email: genmo@takas.lt

## British Society for Radiological Protection 40th ANNIVERSARY MEETING

### ALARP: Principles & Practices

### St Catherine's College, Oxford, 2-4 April 2003

The concept of ALARA (As Low As Reasonably Achievable) was introduced by ICRP in the early 1970s and has since been defined in UK case law as ALARP (As Low as Reasonably Practicable). As a consequence, the whole philosophy of radiological protection has changed with the notion of working down from, rather than up to, dose limits. Over the past twenty-five years, however, doses incurred from both medical exposure and nuclear industry discharges have decreased substantially, bringing a tacit understanding that below some dose *threshold* the concept of ALARP may no longer be justified, or necessary, subject to the provision that Best Practicable Means continue to be employed. There is continuing pressure to reduce dose limits and constraints ever lower, within a policy of seeking continuous reductions in occupational exposure and in discharges to the environment, irrespective of any link between cause and effect. In this context, numerical limits and the effects of uncertainty in dose estimation may undermine ALARP based considerations.

This meeting address is the continuing role of ALARP in control of dose to man and biota. The meeting will comprise both invited and proffered papers.

Online booking and programme are available via the SRP web site www.srp-uk.org
Email: admin@srp-uk.org

# EUROPEAN ALARA NETWORK Contact Persons
# February 2003

- **AUSTRIA**

Mr. Chris SCHMITZER,
Division of Health Physics, Austrian Research Centers
Seibersdorf, A-2444 SEIBERSDORF
Tel: +43 50550 2500; Fax: +43 50550 2502
E-mail: chris.schmitzer@arcs.ac.at

- **BELGIUM**

Mr. Pascal DEBOODT,
SCK/CEN, Boeretang 200, B-2400 MOL
Tel: +32 14 33 28 53; Fax: +32 14 32 16 24
E-mail: pdeboodt@sckcen.be

- **CZECH REPUBLIC**

Mr. Petr RULÍK,
SÚRO (National Radiation Protection Institute),
Srobarova 48, CZ1 100 00, PRAHA 10
Tel: +420 2 7274 1434; Fax: +420 2 67311410
E-mail: prulik@suro.cz

- **DENMARK**

Mrs. Hanne TROEN,
RISØ National Laboratory, P.O. Box 49,
DK-4000 ROSKILDE
Tel: +45 46 77 44 01; Fax: +45 46 77 44 12
E-mail: hanne.troen@risoe.dk

- **FINLAND**

Mrs. Satu KATAJALA,
Fortum Power and Heat Oy, Loviisa Power Plant, P.O. Box 23, FIN-07901 LOVIISA
Tel: +358 10 455 5011 Fax: +358 10 455 4435
E-mail: satu.katajala@fortum.com

- **FRANCE**

Mr. Christian LEFAURE,
CEPN, BP 48, route du Panorama
F-92263 FONTENAY AUX ROSES CEDEX
Tel: +33 1 58 35 74 67; Fax: +33 1 40 84 90 34
E-mail: lefaure@cepn.asso.fr

- **GERMANY**

Mrs. Annemarie SCHMITT-HANNIG,
BfS, Inst. für Strahlenhygiene, Ingolstädter
Landstrasse 1, D-85764 OBERSCHLEISSHEIM
Tel: +49 89 1888 333 2110; Fax: +49 89 18883332115
E-mail: schmitt@bfs.de

- **ITALY**

Mr. Mario PAGANINI FIORATI,
APAT, Via Vitaliano Brancati 48,
I-00144 ROMA
Tel: + 39 06 5007 2853; Fax: +39 06 5007 2941
E-mail: paganini@apat.it

- **THE NETHERLANDS**

Mr. Jan VAN DER STEEN,
NRG Arnhem, Utrechtseweg 310, P.O. Box 9035,
NL-6800 ET ARNHEM
Tel: +31 26 3563370; Fax: +31 26 4423635
E-mail: vandersteen@nrg-nl.com

- **NORWAY**

Mr. Gunnar SAXEBØL,
Norwegian Radiation Protection Authority, Grini
Naeringspark 13, Postal Box 13,
N-1345 OSTERAS
Tel: +47 67 16 25 00; Fax: +47 67 14 74 07
E-mail: Gunnar.saxebol@nrpa.no

- **SPAIN**

Mr. Juan Jose MONTESINOS,
CSN, Justo Dorado 11, E-28040 MADRID
Tel: +34 91 346 0634; Fax: +34 91 346 0588
E-mail: jjmc@csn.es

- **SWEDEN**

Mr. Birgitta EKSTRÖM,
Swedish Radiation Protection Institute,
S-17116 STOCKHOLM
Tel: +46 8 729 7186; Fax: +46 8 729 7152
E-mail: birgitta.ekstrom@ssi.se

- **SWITZERLAND**

Mr. Nicolas STRITT,
Swiss Federal Office of Public Health, Radiation Protection Division, CH-3003 BERN
Tel: +41 31 324 05 88; Fax: +41 31 322 83 83
E-mail: nicolas.stritt@bag.admin.ch

- **UNITED KINGDOM**

Mr. Peter SHAW,
NRPB, Northern Center, Hospital Lane, Cookridge, LEEDS - LSZ 6RW
Tel: +44 113 267 9041; Fax: +44 113 261 3190
E-mail: peter.shaw@nrpb.org


# First Announcement

## Objectives

The main objectives of the seventh European ALARA Network (EAN) Workshop are to review the recommendations of the first EAN Workshop (held in Saclay in December 1997), to identify progress made in the application of ALARA in decommissioning and to discuss what still needs to be done, both in the nuclear and non nuclear sectors.

## Scope of the Workshop

The Workshop will cover the following topics:

- Site remediation including occupational exposures, the impacts on population and environment, and risk perception;
- Operational aspects of decommissioning outside the nuclear fuel cycle such as accelerators, medical installations, NORM and consumer product facilities;
- Effectiveness and feedback on the use of dose and dose rate estimating tools;
- Prevention and follow-up of internal exposures.

In order to pursue the objectives, there will be oral and poster presentations. Each of the four topics will be discussed in a separate session. To gather the views of interested parties, some of the workshop will be devoted to small, facilitated, discussion groups (once again each of the four topics will be covered separately). The number of participants will, therefore, be restricted to 80.

The Workshop will take place in the NRG facility in Arnhem, the Netherlands, from the 29th to 31st of October 2003.

The final programme and application forms will be available in May 2003.

(…)


# CALL FOR ABSTRACTS

Authors wishing to provide oral and poster presentations (in English) are invited to submit an abstract of 15-20 lines (A4) typed single-spaced in Times 12 pt (Word format). Poster presentations, are especially invited. All abstracts and suggestions should be forwarded to any member of the Workshop Programme Committee (see below) by 1st April 2003.

## Programme Committee Members

| | |
|---|---|
| Belgium: | Mr. V. MASSAUT, (SCK-CEN Mol), vmassaut@sckcen.be |
| Denmark: | Mrs. H. TROEN, (RISØ), hanne.troen@risoe.dk |
| France: | Mr. P. CROUAIL, (CEPN), crouail@cepn.asso.fr |
| Germany: | Mrs. A. SCHMITT-HANNIG, BfS, schmitt@bfs.de |
| Italy: | Mrs. R. GALLINI, ARPA Lombardia, r.gallini@arpalombardia.it |
| The Netherlands: | Mr. J. VAN DER STEEN, (NRG KEMA), vandersteen@nrg-nl.com |
| Spain: | Mr. J.-J. MONTESINOS, (CSN), jjmc@csn.es |
| Sweden: | Mr. I. LUND, (SSI), ingemar.lund@ssi.se |
| Switzerland: | Mr. H.-F. BEER, (Paul Scherrer Institute), hans-frieder.beer@psi.ch |
| United Kingdom: | Dr. D. POMFRET, (BNFL), dave.g.pomfret@bnfl.com |

## Organisational Aspects

Mr. F. VAN GEMERT, (NRG), vangemert@nrg-nl.com