European ALARA Network

European ALARA Newsletter

26th Issue - February 2010

Editorial

A. SCHMITT-HANNIG, EAN Chairperson, P. SHAW, EAN Secretary and P. CROÜAIL, EAN Coordination

EAN is moving forward!

In a brainstorming seminar in 2009, a number of colleagues reflected on the work done and the results achieved by EAN in the last 5 years as well as on future challenges and activities.

Consensus has been achieved on the values shared by those actively involved in the network on the effectiveness of cooperation and networking to improve the practical implementation of the ALARA principle. However, there is still room for improving the dissemination of experience and for better harmonisation in radiation protection policies and practical procedures with regard to the ALARA principle.

New challenges for ALARA are emerging: ICRP is reinforcing the role of optimisation in the implementation of the radiation protection system; new initiatives to maintain the high level of competence and expertise in the radiation protection field are developing on the national, European and international level (see the report on the ETRAP Conference in this Newsletter); the practical implementation of the ALARA principle in the medical sector (see paper Ginjaume et al. on the ORAMED project), as well as in existing exposure situations, in particular for radon and NORM (see paper Wichterey et al. on the 2nd EAN NORM Workshop), is gaining momentum and is seen more and more as a priority. The same is true for developing the ALARA approach to radiation protection culture and the dissemination of the ALARA values through education and training in all sectors. New technologies are arising in different fields which need our attention, for example, the reinforced use of ionising radiation for non-medical purposes (e.g. for security purposes). Among other topics, this has been an issue which was discussed at the 12th EAN Workshop in Vienna (see Summary and recommendations in the Newsletter).

In order to meet these challenges, some important initiatives have been started: the setting up of an EAN Working Group on ALARA Culture, the first results of which are being reported in this Newsletter; participation to international projects relevant for ALARA, such as the EU FP7 project TRASNUSAFE; organization of the next EAN Workshop on ALARA in the Medical Sector in cooperation with EFRS, ESR, EFOMP and EANM; and the results of surveys related to ALARA. A survey on Radon is in the process of finalisation; development of specific EAN documents, etc.

All these activities and achievements show that EAN is well prepared to meet future challenges!

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Content of the 26th Issue

"ALARA issues arising for Safety and Security of Radiation Sources and Security Screening Devices" Summary and Recommendations of the 12th EAN Workshop

P. Shaw (HPA, UK), P. Croüail (CEPN, France)

Workshop background, objectives and programme

Radiation protection has always included security-related provisions (for example to prevent the unauthorised use of sources), which have contributed to the overall system of radiation safety. In recent years, however, interest in security issues has dramatically increased and the challenge is to ensure that safety and security measures are designed and implemented in an integrated manner so that security measures do not compromise safety and *vice versa*.

The aim of the workshop was to consider how the implementation of ALARA, in terms of planned and emergency exposure situations, involving worker and public doses, is affected by the introduction of security-related measures. In the case of new equipment and procedures, there is also the question of whether exposures arising from security screening devices can be justified and optimised. In addressing these issues, the workshop tried to consider how an optimum balance between protection, safety and security can be achieved.

As with previous workshops, half the programme time was devoted to presentations, and half to Working Group discussions and their findings. Participants had the opportunity to consider the findings of each group, contribute to discussions, and formulate the final conclusions and recommendations of the Workshop. There were 56 participants from 16 different countries, and a total of 24 oral presentations and 2 posters, arranged under the following sessions:

- Introduction and scene-setting,
- Security and safety measures,
- Planned exposure situations,
- Emergency situation management (especially due to malevolent acts),
- Justification and optimisation of doses in the use of security devices.

Two afternoon sessions were set aside for Working Group discussions, based on the following topic areas:

- Implementation of the Code of Conduct and HASS[1] – ensuring ALARA,
- Balancing security and safety – how to achieve an optimum solution,
- Management of emergency exposure situations from an ALARA perspective,

[1] High Activity Sealed Sources

- Justification and optimisation in the use of security devices.

On the final day, the reports from the groups were presented and discussed, and form the workshop conclusions and recommendations described later. Individual presentations (papers and slides) and the working group reports are available to download from the EAN website (http://www.eu-alara.net/).

Themes and issues arising

The introductory session focused on international developments, in particular from the European Commission (e.g. HASS), IAEA (e.g. the Code of Conduct on the Safety and Security of Radioactive Sources) and from ICRP recommendations (Publications 103, 109, and 111). The first two of these have largely been implemented successfully. It was noted that many security-related documents were originally issued as stand-alone documents, but the trend now was to integrate safety and security requirements, either into the same document, or at least into comparable document structures. Further integration is envisaged through the eventual harmonisation of HASS thresholds and IAEA D-values.

The new ICRP system of exposure situations was presented, for which dose constraints (for planned exposure situations) and dose reference levels (for emergency and existing exposure situations) should be set as an upper bound on the optimisation process. The message from the workshop is that there is still much work to do in terms of implementing these recommendations in practice. For example, there are questions about when the different exposure situations apply, what the actual values of dose constraints and reference levels should be, and how to apply optimisation below these values. There is now the opportunity to provide feedback to international bodies on many of these issues, and it was suggested that EAN should help by collating comments from its members.

The 2nd session raised a number of interesting issues on the balancing of safety and security measures. Although both can be said to share a common goal – protecting people from harm – there is a difference in approach. Safety mostly focuses on the control of the source, whereas security is concerned with controlling the actions of (certain) people. These differences have practical implications; for example safety relies on sharing information and mutual trust, whereas security may require the opposite. The workshop contained a number of presentations on the security measures being applied to different practices. Most of these described source-related controls (e.g. physical security measures), for which there would seem to be a good synergy between safety and security, even though the approach does have to be tailored to different sectors.

In contrast, people-related controls (e.g. security checks and surveillance) were not discussed in any detail, and this may well be an area where there is more potential for conflicting requirements.

The session on planned exposure situations encompassed both normal operations (i.e. in which measures are taken to counter security threats) and the recovery of orphan sources. Examples were given of training programmes for staff involved in both these activities. Such programmes can involve large numbers of persons and require much greater resources than have traditionally been devoted to radiation safety training – perhaps a reflection of the societal importance assigned to security issues.

Dose constraints for security-related staff were mentioned several times; with the consensus being that 1 mSv per year was appropriate in most cases. There was less information on dose constraints for recovery staff; further developments and exchanges of information in this area would be useful.

The same issues – staff training and dose reference levels – were raised in the 4th session in relation to emergency situation management. In this context, training is important not only for radiation protection purposes but also to ensure that the emergency response is proportionate, and that the level of risk (especially to the public) is communicated in a consistent manner. More generally, as recommended in ICRP publication 109, the national authorities should prepare plans for all type of emergency exposure situations, and relevant stakeholders should be consulted during this process. Dose reference levels for emergency responders are beginning to emerge – these are within the range of values recommended by ICRP, although there are significant differences in the values being proposed in different countries. There is also an operational need for derived reference levels, in terms of dose rate and contamination levels, to help guide the optimisation process on the ground. Again, further developments and information exchange in these areas would be useful.

The final oral session considered radiation sources used for security purposes, which continue to increase in type and number. In many cases, these new practices can be managed through the normal requirements for planned exposure situations, although there are some reservations in relation to the safe use of certain types of portable equipment. Special attention was given to the introduction of x-ray security screening devices ("body scanners") at airports and other locations. The consensus was that such devices must still be subject to controls, even if the dose per scan is extremely low (e.g. as is the case with backscatter scanners). Furthermore, each type of use/location should be subject to the justification principle, to prevent widespread and indiscriminate scanning of the public.

Workshop conclusions and recommendations

As mentioned above, the working group reports, containing details of the discussions, conclusions and recommendations, are available at http://www.eu-alara.net. A brief summary of these is given below.

Implementation of the Code of Conduct and HASS – ensuring ALARA

- EAN should assist in compiling feedback for the EC on the practical implementation of the HASS directive.
- Better cooperation and information exchange between EU regulatory authorities on the movement of sources between Member States is necessary.
- EC Regulation 1493/93 should be reviewed to ensure that it is consistent with IAEA guidance on import/export of radioactive sources.

Balancing security and safety – how to achieve an optimum solution

- The justification of a practice is a safety judgement, but security should be considered as an integral part of the licensing and inspection process.
- Safety and security can be integrated and made to work in practice, and both should be proportionate based on realistic assessments of the credible risks, both due to accidents and malevolent acts.
- As experience is gained, more could be done to establish harmonised international security levels and controls for different categories of sources.

Management of emergency exposure situations from an ALARA perspective

- The potential radiation exposures to different persons (responders, public, etc.) from different emergency scenarios should be assessed in order that a proportionate response, including practical protection and communication strategies, can be planned.
- Plans must be flexible. In the event of an emergency it is important for the actual radiological conditions to be assessed as soon as possible, to help direct the response and facilitate information exchange between the agencies involved.
- Training of responders is essential and, where possible, should be harmonized so as to develop a "common language" of protection.

Justification and optimisation in the use of security devices

- The use of ionizing radiation for security purpose should not be trivialized. Thus, even when individual doses are low, the use of security screening devices should still be subject to regulatory control, with different types of use subject to specific justification.
- Public doses should be below the 0.3 mSv/y dose constraint, with a requirement for further optimisation below this dose. In practical terms this requires much lower reference doses for individual scans, with further optimisation applied through the correct setting up, operation and quality assurance of scanning systems. To this end, draft IEC standard 62463 should be agreed and adopted.
- Where possible, persons should be informed prior to being scanned, and an alternative to x-ray scanning should be available upon request.

The next EAN Workshop, on "ALARA in the Medical Sector", is planned for 7-10 of June 2011, in Norway. Details will be announced on the EAN website.

Iodine-131 Ablation Holding Tanks in Ireland

S. Fennell (RPII, Ireland)

Introduction

In 2002 Ireland submitted its national report to the meeting of the Oslo-Paris (OSPAR) ad-hoc working group on Radioactive Substances (RSC) describing how it intended to implement its strategy with regard to the discharge of radioactive substances to the marine environment. In assisting the Department of the Environment, Heritage and Local Government (DEHLG) in preparing Ireland's submission to OSPAR the Radiological Protection Institute of Ireland (RPII) carried out a comprehensive review of the use of unsealed radioactive sources across all sectors throughout Ireland. The discharge of iodine-131 through patient excreta, arising as a result of activities administered to patients undergoing thyroid ablation treatments, was identified as one of the contributors to the total activity of unsealed radionuclides discharged to the marine environment from Ireland each year. In reviewing the use of unsealed radioactive sources in the medical sector the RPII determined that it would need to review its own regulatory requirements in relation to the installation of sewage holding tanks in hospitals. These tanks would take waste from the iodine ablation suites and store it for a number of weeks to allow for the decay of iodine-131 prior to discharge to the sewers. This action was subsequently included in the set of intermediate goals Ireland would take to implement the OSPAR strategy.

Holding tanks in a hospital in Luxembourg

Iodine ablation therapy in Ireland

Treatment for thyroid cancer using iodine ablation therapy is currently carried out in Ireland at four hospitals located on the east and south coasts of the country. Patients undergoing ablation therapy are administered between 3 and 7.4 GBq of iodine-131 and are kept isolated as in-patients in dedicated iodine suites for up to six days. During the course of their stay approximately 80% of the administered activity is excreted in urine. In the three hospitals located on the east coast, waste from patients goes directly to the hospital's main sewer for eventual discharge into the Irish Sea, while waste from patients based in the hospital located in the south of the country is piped to a small 1000 litre delay and decay holding tank, where it is allowed to decay on average for three weeks (approximately three half lives) before being discharged to the hospital's main sewer. When the RPII originally considered the licence applications for these facilities the licensees would have been required to undertake a risk assessment of the potential doses to critical groups such as hospital plumbers, sewer workers, sewage treatment plant workers, fishermen etc. For each of these critical groups the application was assessed against an annual dose constraint of 300 μSv/yr for non-occupationally exposed workers. In all cases the doses to these groups were considerably below the dose constraint and hence consideration of further optimisation such as the installation of holding tanks was not required by the RPII. The incorporation of a holding tank in the hospital located in the south was a decision taken locally.

Consultancy project

In June 2007 the RPII contracted the UK consultancy firm Enviros Ltd to assist it in evaluating the need to install iodine holding tanks in both existing and future iodine ablation facilities. The evaluation reviewed existing practices in Ireland in relation to iodine-131 ablation discharges to the sewers and made recommendations for an RPII regulatory policy, based on international best practice and forecasts of future activity. As part of the contract, Enviros Ltd was tasked with undertaking an analysis of the following items:

- A summary of international advice (e.g. ICRP, IAEA, EC) on best practice in relation to iodine ablation discharges;
- A summary of current practices relating to the provision of holding tanks in a selection of other EU countries;

- A review of current practices in Ireland;
- Through discussion with relevant parties and by reviewing existing literature, provide an overview of the likely future demand for iodine ablation therapies in Ireland and any implications these would have on doses to workers and members of the public and on discharges to, and concentrations in, the environment;
- An evaluation of the merits and demerits of utilising holding tanks in an Irish context including consideration of:
    - Installation: building requirements, cost, retrofitting, green field, maintenance and upkeep requirements;
    - Impact on radiation doses to particular groups, including patients, medical staff, hospital maintenance staff, other staff likely to be affected and the public;
    - Impact on discharges to the environment and environmental concentrations.

Findings

The final report, which is available on the RPII's website (www.rpii.ie), provides a summary of current ablation practices throughout Ireland. It notes that in 2006 91 ablation therapies were carried out using a total of 435 GBq I-131. Through discussions with relevant staff at each facility, and the Office of the National Plan for Radiation Oncology, the authors of the report estimate that over the next 5-10 years demand for ablation therapies will increase by approximately 50%. This expected increase is in part attributed to better diagnosis and increased referrals for thyroid ablation, as well as general population increase and an overall increase in the population age.

For each facility typical doses to critical groups were calculated using models developed by the former National Radiation Protection Board (NRPB) (UK) and Environment Agency (UK) through a consideration of the amount of iodine-131 administered over the course of the year and the flow rates at the relevant sewage treatment plants. The report finds that the potentially most exposed critical group is on-site hospital plumbers who may have to deal with a blocked sewage pipe exiting the ablation suite; in these cases the exposure arises from a one-off event rather than over the course of a year. Typical doses to plumbers dealing with such an incident are estimated to be in the range of 50 – 70 μSv per incident.

Other critical groups considered in the analysis include sewage workers working in man accessible pipes, workers at sewage treatment plants and coastal fishing families. After the hospital plumber the next exposed member of the public is a sewer worker who receives a dose estimated to be less than 4 μSv per year. For the projected future numbers of ablation treatments the dose to sewer workers is estimated to be less than 6 μSv per year. For all other members of the public the doses for current and projected workloads are estimated to be less than 3 μSv per year.

The report finds that there is no consistent approach to the regulation of radioactive discharges to sewers across Europe. A summary of the different practices throughout the Member States as reported in EC [1999][1] and updated as a result of consultation responses obtained during this project, is provided in Table 1.

The authors point out that projected doses that are at, or close to, 10 μSv per year are generally considered to not require further reduction unless it is clear that Best Available Techniques (BAT) are not being applied. The report also notes that overall, the risk-based approach taken in Ireland to the regulation of these activities is consistent with IAEA and ICRP recommendations and is also consistent with approaches in Great Britain and Northern Ireland.

[1] Management of radioactive waste arising from medical establishments in the European Union. Proceedings of a Workshop, Brussels, 16-17 February 1999, EUR 19254.

Table 1 Approaches to the management of patient excreta by EC Member States as of April 2008.

Country	Management approach		Notes
	Direct discharge	Delay and Decay	
Denmark	✓		In Denmark there is no limit for the total activity that can be discharge (that is controlled by limits for purchase and use). However, dilution of I-131 discharges to 0.1 MBq/l is required at the point where the hospital drain meets the municipal sewer.
Finland	✓		Discharge limits from institutions do not apply to patient excreta that may be freely discharged to sewer as long as discharges at any one time do not exceed 100 MBq and that over the course of a year does not exceed 100 GBq.
France		✓	Effluents eliminated by patients in protected rooms (iodine dose > 740 MBq) are normally collected via bi-sectional toilets. Effluents from ordinary sanitary installations in the nuclear medicine unit are usually linked to a septic tank. Due to the length of time the material stays in the septic tank and the brief half-life of the radionuclides, volume activity in the collector is greatly reduced before release into the sewage network.
Germany		✓	All facilities required to have holding tanks installed and discharges from facilities must remain below a limit of 5 Bq/l at the point of discharge into the public waste water network.
Greece	✓	✓	Direct discharge to sewer allowed, provided that the waste is readily dispersible in water and the maximum concentration of radioactive substances is not greater than 3.7 MBq/l. For I-131 thyroid post-operatory therapy waste decay storage prior to discharge to sewer is required to meet this criterion.
Republic of Ireland	✓	✓	Both direct discharge to sewer and use of holding tanks are currently employed. Hospitals are authorised on activity administered not discharged.
Northern Ireland		✓	Decay storage is used, although not a regulatory requirement. Activity concentration limit of 80 kBq/l prior to discharge to sewer.
Lithuania		✓	Waste is retained in holding tanks for between 30 and 60 days prior to discharge to sewer. Two tanks are used, one being filled as the other is left to decay prior to discharge.
Luxembourg		✓	All new treatment facilities are required to install holding tanks, with patient excreta being held for a minimum of 210 days prior to discharge. Activity concentrations of I-131 in discharges from the holding tanks to sewer should remain below 5 Bq/l.
Spain	✓	✓	Clearance levels are used to determine disposal routes. Where activities are above clearance levels waste should be stored for decay.
Sweden	✓		Free release to sewer the preferred option. Decision based on direct measurements at a large hospital. External radiation exposure to sewer worker of about 2 µSv calculated on basis of 50 GBq I-131per year direct release to sewer.

Table 1 Approaches to the management of patient excreta by EC Member States as of April 2008.

Country	Management approach		Notes
	Direct discharge	Delay and Decay	
The Netherlands		✓	Radioactive waste with radionuclides with half-lives below 100 days should be stored for up to 2 years to allow for decay. No specific mention is made of requirements for patient excreta.
Great Britain	✓	✓	Direct discharge to sewer allowed, but sites required to demonstrate BPM and that the critical group dose constraint of 300 μSv y^{-1} is not exceeded. Consideration being given to use of delay tanks for new facilities undertaking treatment of large numbers of patients with I-131.

The authors make a number of recommendations in relation to Ireland's approach for ablation waste management including:

- The benefit (on the grounds of radiological protection) of retrofitting of tanks into existing facilities is grossly disproportionate to the financial cost incurred and to the logistical issues involved. Nonetheless, appropriate work control systems should be in place to minimise any potential incidents of plumber exposure;
- Fitting of delay and decay tanks into a new facility is advantageous, particularly if only one or two facilities are established. This is particularly true where multiple ablation suites may occur in the same facility and more than one patient may be undergoing treatment at one time. However, the final requirements should be assessed on a site by site basis in line with the EC guidelines for demonstrating BAT.
- Where delay and decay tanks are installed a multi-tank vacuum system has sufficient advantages that it could represent BAT. Using such a system a factor of 500 to 1000 reduction in activity through decay is achievable. This is considered sufficient to ensure that all possible exposure scenarios would not lead to a dose of 10 μSv being exceeded.

Conclusions

Following a detailed review of the recommendations made in the Enviros report the RPII formally adopted a regulatory position on its requirements for iodine holding tanks in the context of both existing and new thyroid ablation facilities as follows:

1. In the case of existing iodine ablation facilities, licensees will not be required to retro-fit iodine holding tanks.
2. Licensees with existing ablation facilities will be required to undertake both on and off site monitoring to validate the assumptions and calculations used in their risk assessments when first applying for a licence for ablation therapies.
3. Licence applications for new ablation facilities will continue to be assessed on a case by case basis to determine whether holding tanks are required. Each licence application must be supported by a risk assessment which estimates the likely doses that would be received by critical groups (hospital plumbers, sewer pipe workers, sewage treatment plant workers, public etc) as a result of the discharges of excreta from patients having undergone ablation therapies.

In early 2009 the RPII advised the Irish Government of the findings from the review project that had been completed, and of its new licensing requirements for thyroid ablation facilities. It recommended to the Government it consider these in the context of taking a national decision on the requirements for iodine holding tanks for both existing and new ablation facilities.

In September 2009 the Department of the Environment, Heritage and Local Government formally adopted the RPII's regulatory position as national policy for Ireland agreeing that the RPII's licensing requirements were consistent with Ireland's commitments to OSPAR.

The ORAMED Project: Optimisation of Radiation Protection for Medical Staff

M. Ginjaume[1], E. Carinou[2], F. Vanhavere[3], G. Gualdrini[4], I. Clairand[5], M. Sans Merce[6]
[1] *Institute of Energy Technologies, Universitat Politècnica de Catalunya (UPS), Spain*
[2] *Greek Atomic Energy Commission (GAEC), Greece*
[3] *Belgian Nuclear Research Centre (SCK-CEN), Belgium*
[4] *Radiation Protection Institute - Ente per le Nuove Tecnologie L'Energia et l'Ambiante (ENEA), Italy*
[5] *Institut de Radioprotection et de Sûreté Nucléaire (IRSN), France*
[6] *University Hospital Center Vaudois (UPC), Switzerland*

The CONRAD project, funded by the EU within FP6 from 2004 to 2007, aimed to coordinate research on radiation protection in the workplace. One of the working groups in the network highlighted high extremity doses and a lack of systematic data analysis on exposures to staff in interventional radiology and nuclear medicine [1]. To improve the standards for protection of medical staff for procedures that may result in high exposures, a project called ORAMED, "Optimization of Radiation Protection of Medical Staff", was launched in 2008 within the framework of EURATOM FP7. ORAMED focuses on having better knowledge of extremity and eye lens exposures and developing new technologies for eye-lens measurement and for active personal dosemeters to be used in pulsed fields.

Ten Institutes, Belgian Nuclear Research Centre (Belgium), Commissariat à l'Energie Atomique (France), ENEA Radiation Protection Institute (Italy), Federal Office for Radiation Protection (Germany), Greek Atomic Energy Commission (Greece), Institute for Radiological Protection and Nuclear Safety (France), Nofer Institute of Occupational Medicine (Poland), Slovak Medical University (Slovakia), Universitat Politècnica de Catalunya (Spain), University Hospital Centre Vaudois (Switzerland) and two enterprises, MGP Instruments (France) and RADCARD (Poland), are taking part in the project. The activities are divided into 5 Work-Packages:

- optimization of radiation protection in interventional radiology,
- development of practical eye lens dosimetry in interventional radiology,
- optimization of the use of active personal dosemeters in interventional radiology,
- improvements in extremity dosimetry in nuclear medicine, with special emphasis for PET applications and nuclear medicine therapy, and
- knowledge dissemination and training.

The project is to be finished in February 2011, thus the activities are still under progress. A summary of the main objectives and activities developed until now by the different work-packages are described in this paper.

1. Optimization of radiation protection in interventional radiology

An extensive campaign of measurements and Monte Carlo calculations of extremity and eye lens doses in interventional radiology is in progress to obtain a set of standardized data on doses to staff in interventional radiology and cardiology and to design recommended radiation protection measures in order to optimize staff protection.

Figure 1 shows an image of the geometry and mathematical phantoms used for the simulation of the patient and physician during an interventional radiological procedure.

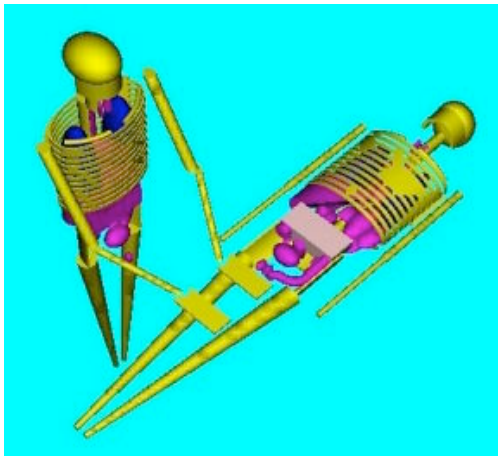

Figure 1. Mathematical phantoms and geometry used for MC simulation of interventional radiology procedures

So far, more than 660 procedures from 22 European hospitals have been analyzed. The monitored procedures are divided into three main categories: cardiac procedures; general angiography procedures; and endoscopic retrograde cholangiopancreatography procedures (ERCP). The eyes, wrists, fingers and legs of physicians are monitored and measured doses are correlated with radiological parameters such as the tube voltage and the air-kerma area product. The highest doses are often found in the left monitored finger but many parameters, such as, the availability and use of protective equipment (lead-glasses, mobile shields), tube position (above or below the table), access (femoral or radial) and a number of other procedure characteristics (use of cine/fluoro, beam projections etc) are found to influence the extremity and eye doses. A

significant dose reduction is observed when the tube is below the table and/or when shielding is used. Finally, it should be mentioned that the examples of bad practices encountered during monitoring of the above procedures (hands inside the beam, improper use of additional protective equipment) strongly indicate the need for radiation protection training of the medical staff.

2. Development of practical eye lens dosimetry in interventional radiology

Increased evidence of radiation-related lens opacities in interventional radiologists has been reported in recent years [2]. However, the eye lens doses are never measured in routine procedures and, at the present time, there is a lack of methods to measure such doses. At the moment, a protocol to calculate and reproduce the operational quantity, personal dose equivalent at a depth of 3 mm of tissue, $H_p(3,\alpha)$, in calibration laboratories has been developed and a set of conversion coefficients from air kerma to $H_p(3,\alpha)$ has been proposed [3]. In addition, on the basis of the computed quantities, a dosemeter prototype, optimized to respond in terms of $H_p(3)$ is under development by RADCARD. Figure 2 shows one of the prototypes. The overall procedure is also supported with type test irradiations carried out at the Laboratoire National Henri Becquerel, CEA Saclay.

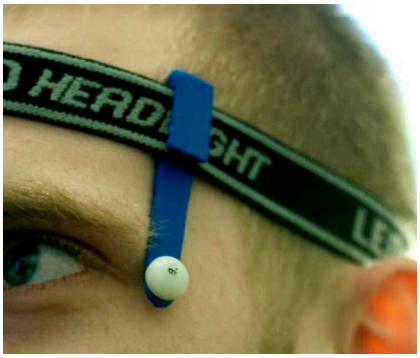

Figure 2. Eye-lens dosemeter

3. Optimization of the use of active personal dosemeters in interventional radiology

Active personal dosemeters (APD) have been found to be very efficient tools to measure occupational doses in many applications of ionizing radiation. However, their use for interventional radiology cannot be generalized. The behaviour of 7 commercial APD models, deemed suitable for application in interventional radiology, has been analyzed through several tests under laboratory conditions with reference continuous and pulsed X-ray beams. Figure 3 presents a photograph of the tested APDs.

Figure 3. APDs tested in ORAMED

Most tested APDs present a satisfactory response at low photon energies, down to 24 keV, which is sufficient for interventional radiology. However, some of them do not fulfil the ISO 61526 standard requirements [4] concerning dose rate and angular response. Tests in pulsed mode show that the limitations of several APDs are mostly due to high dose-rates rather than to pulse frequency. This point was confirmed by tests in hospitals. These results have identified those devices that can provide useful indications of personal doses during interventional procedures, and those that should not be used in this field. The development of a new prototype that would overcome the present limitations of the APDs is being undertaken by MGP Instruments.

4. Improvements in extremity dosimetry in nuclear medicine, with special emphasis for PET applications and nuclear medicine therapy

Extremity doses in nuclear medicine, especially in therapy, can be very high if adequate radiation protection measures are not followed. As in the case of interventional radiology, a European campaign of extremity measurements in nuclear medicine departments is in progress. The doses to the different parts of the hands have been systematically mapped in more than 100 workers from 31 nuclear medicine departments, with special attention paid to ^{90}Y unsealed therapy sources. Special gloves have been designed to measure the hand dose on 11 different points of the hand. Figure 4 illustrates the procedure of radiopharmaceutical administration in nuclear medicine. The technician of the photograph is wearing the ORAMED special gloves to monitor the distribution of dose in the hands.

Monte Carlo simulations are simultaneously performed to determine the main parameters that influence the hand dose distribution and the effectiveness of different radiation protection measures.

Preliminary results show large variations of skin doses across the hands depending on the radionuclide and the procedure, but also large differences are found between technicians. In some cases, skin dose equivalent limit could be

exceeded. The final analysis of the results should provide information on the real doses to nuclear medicine workers and help to identify the best practices in this field.

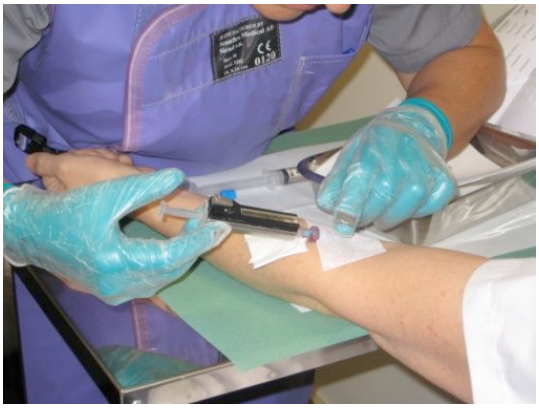

Figure 4. Radiopharmaceutical administration in nuclear medicine

5. Knowledge dissemination and training

The training material which is being prepared within the framework of ORAMED will aim to give a practical understanding on how to improve radiation protection practice in some medical applications where, at present, doses are potentially high. The problems analyzed are, in general, not included in most available training courses for medical staff. The training material will improve actual education information. The contacts and collaboration with professional societies and international organizations should enable widespread dissemination of the material.

Along these lines, ORAMED members are involved in the recently created Medical ALARA network (EMAN), which has as main objective the establishment of a sustainable network where different stakeholders within the medical sector will have the opportunity to discuss and to exchange information on different topics related to the implementation of the ALARA principle in the medical field.

In addition, in January 2011, an international workshop to present the main results of the ORAMED project will be organized in Barcelona. Round tables with the identified stakeholders will be programmed to promote good discussion and feedback of the results. The e-learning modules will be presented on this occasion and made available to collaborating professional organizations and interested institutions in the field.

For more information, you are invited to visit the ORAMED web-site www.ORAMED-fp7.eu.

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Spread of Contamination from Radiologically Controlled Area (RCA) at Forsmark NPP

S. Hennigor (Radiation Protection Manager, Forsmark NPP, Sweden)

The incident

In the beginning of May 2009 a contaminated car was discovered by the vehicle monitoring system at Forsmark NPP in Sweden. The inside of the luggage compartment was found to be contaminated, but there was no specific contaminated equipment or goods.

After a retrospective reconstruction of the actual use of the car it was suspected that goods, transported from RCA by the same car one week earlier could be the source of the contamination. Before the goods had been taken from RCA they had been used during construction work in a room where surface contamination may occur. The contamination emanates from the reactor coolant system. The goods, mainly consisting of some buckets, a concrete sack and tools for construction work, were tracked to a storage location outside RCA but within the NPP industrial area.

When measured by RP staff one of the buckets was identified as the main source of contamination. The contact dose rate in the bottom of the bucket was 11.5 mSv/h, emanating from small metal fragments. Also some contamination was found outside the door from RCA where the goods had been taken out, and outside and inside the store where the goods were found.

All the contaminated goods were transported to RCA and cleaned of loose contamination. Also the storage outside RCA and the outside areas were cleaned.

The total activity spread by this incident is estimated to 25 MBq, mainly corrosion products normally found in the reactor water system. About 6 MBq of the total activity had remained in the car when the contamination was discovered.

The incident was reported to the competent authority as soon as possible. It has by the NPP been judged to be outside the INES scale.

Figure 1. The contaminated car

The root cause

A root cause analysis has been performed which recommended a number of countermeasures in order to avoid this type of incident in the future.

Before removal from RCA the goods had been searched for contamination by the RP staff. No contamination was detected. However the goods were taken out from RCA one day after this check was performed and no repeated measurements were made. It is assumed that it was during this time the goods were contaminated, but it is not possible to say how. After this incident the procedures for taking goods out from the RCA have been changed and it is now only permitted to take out goods with RP staff present and immediately after the goods has been cleared to be free from contamination. Contaminated goods shall of course be treated as a transport of radioactive material when leaving RCA.

Other countermeasures that will be considered:

- Dedicated storage available within the RCA to avoid the need to take this type of material in and out.
- A Special locked area inside the exit door designated for material which shall be transported out from RCA.
- Transports from RCA may only be performed at specified times.
- This kind of work shall be better planned and risk assessments shall be performed.
- The work supervisors shall be present in the actual work place to monitor work performance to a greater extent.

The Management of the ^{60}Co Contamination in Lift Buttons in Italy

Lt. V. Scarfoliero (Pollution from Radioactive Sources Unit, Carabienieri Environmental Care Command, Italy)

When the paper about ^{60}Co contaminated lift buttons was drafted and published (see European ALARA Newsletter No. 25, October 2009) some Italian colleagues informed us that Italy, too, had been involved in the problem, but at that moment no information was available for dissemination, because the enquiry was still open and the public prosecutor decided both to keep media unaware of the event and to not authorise involved experts to release information on it. Now the enquiry is closed, the technical information has been unclassified and this short note was received to be published as an update to the Newsletter.

In October 2008, OTIS, a Milan-based metallurgical engineering company, informed the Italian Authority about some batches of steel lift buttons manufactured in France probably contaminated with ^{60}Co.

After investigation and inspections, the *Pollution from Radioactive Sources Unit* of the *Carabinieri Environmental Care Command*, with the technical support of ARPAs (Environmental Protection Regional Agencies) and OTIS technicians detected 254 buttons contaminated with ^{60}Co out of about 9,000 buttons monitored.

Specifically, 212 buttons were found in a subsidiary of OTIS near Bologna; another 42 buttons, which had already been installed, were retrieved from a shipping company near Bergamo.

The buttons in the notified batches containing ^{60}Co-contaminated steel from India had been produced for OTIS by the French society MAFELEC, and had reached the subsidiary company near Bologna for assembly.

At the end of the investigation, with the approval of the Bologna's Public Prosecutor and the Local Prefecture, the OTIS subsidiary near Bologna obtained the necessary permits for exporting the contaminated buttons.

On 14 September 2009 all contaminated buttons were shipped by plane through an authorised carrier to France and delivered to the OTIS headquarters.

ETRAP 2009: a new Approach to Education and Training in Radiological Protection

A. Schmitt-Hannig (BfS, Germany)

The 4th International Conference on Education and Training in Radiological Protection (ETRAP), organised by the European Nuclear Society (ENS) in cooperation with the International Atomic Energy Agency (IAEA) and hosted by Portugal's Instituto Technologico e Nuclear (ITN), was held from 8 - 12 November 2009 in Lisbon. The Conference was attended by more than 120 participants from 26 countries. Experts from leading European and international organisations, universities, research institutes and industry representatives shared their experiences in delivering education and training in the field of radiological protection during 8 sessions for oral presentations and two poster sessions.

The "Setting the scene" session featured five keynote speakers from the European Commission (EC), the International Radiation Protection Association (IRPA), the IAEA and the Organisation for Economic Co-operation and Development Nuclear Energy Agency (OECD/NEA), respectively.

S. Mundigl, EC Directorate-General for Energy and Transport, introduced the revised European Basic Safety Standards (BSS) with a special focus on education and training requirements. The results of the three EUTERP workshops have been accepted and will be considered in the new BSS. A. Jouve, EC Directorate-General for Research, presented the EURATOM framework programme for nuclear research and training activities and E. Gallego introduced the IRPA strategic plan for the next 10 years. He stated that the IRPA will encourage activities to attract young people to the profession and young professionals to the IRPA congresses. J. Wheatley highlighted the IAEA's achievements in the field and its future focus on the education and training in radiation protection. IAEA-run post-graduate education courses in radiation protection and safety of radiation sources are open to young professionals with a science/engineering degree. U. Yoshimura, OECD/NEA, raised the issue of the retention of skills and competence in radiation protection.

Very informative presentations were given on the ENETRAP project, the EUTERP platform, the role

of the Federation of Independent Organisations of Medical Physics in Europe (EFOMP), the European Nuclear Education Network Association (ENEN) and the Cooperation for Higher Education on Radiological and Nuclear Engineering (CHERNE).

In the closing session, the achievements of the past four years with regard to education and training were summarised. A considerable move forward has been made in the areas of clarification and harmonisation with the two projects: EUTERP and ENETRAP. The Qualified Expert concept has been reviewed and the definitions for Radiation Protection Expert and Radiation Protection Officer have been developed. Three workshops have been organised and all participants gave a commitment to a harmonised approach to radiation protection training. Ongoing international projects and other activities show that the level of international cooperation and commitment to achieving this goal is evolving. Network structures can meet the needs for ongoing exchange of information on training activities and developments. A rationalisation of the existing networks is necessary to develop a common radiation protection and safety culture and apply a multidisciplinary approach to radiation protection training. These points will be included in a conference declaration, which will be issued later.

EAN Working Group on ALARA Culture

A. Schmitt-Hannig (BfS, Germany)

Members of the EAN Working Group on ALARA Culture

Annemarie SCHMITT-HANNIG - BfS, Germany
Sotiris ECONOMIDES - GAEC, Greece
Georges HUNTER, SEPA, UK
Bernd LORENZ - GNS, Germany
Cristina NUCCETELLI - ISS, Italy
Serena RISICA - ISS, Italy
Caroline SCHIEBER - CEPN, France
Fernand VERMEERSCH - SCK-CEN, Belgium

The development of a common ALARA culture among radiation protection professionals and other stakeholders in Europe is one of the fundamental objectives followed and shared by all EAN members. Moreover the 10th EAN Workshop on "Experience and new Developments in Implementing ALARA in Occupational, Public and Patient Exposures" (Prague, 2006) identified that there is no universally agreed definition of what ALARA culture is, despite the wide acceptance of the need for such a culture. It was then recommended that EAN should develop a definition of "ALARA culture".

In this context, the EAN Steering Committee proposed to give its support to the work engaged by the IRPA working group on "Improvement of the Radiation Protection Culture" which was launched at the occasion of the IRPA 12 Associate Societies Forum held in Buenos Aires in October 2008 with the aim of preparing IRPA Guiding Principles on that topic. The EAN proposal was officially accepted by IRPA in May 2009.
The objective of the WG is to maintain and further develop the high level of radiation protection by

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

The EAN WG ALARA Culture will produce a document, which will reflect the EAN position on the role of ALARA in radiation protection culture. The document will be discussed and then endorsed by the Members of the network, and finally published on the EAN Website's welcome page.

The EAN position will be developed along the lines of the EAN Workshop recommendations on ALARA Culture and on the basis of the discussions of the WG ALARA Culture, the EAN Steering Committee, the subnetworks (ERPAN and EAN-NORMnet) and the input of the EAN cooperation partners (EFNDT, EFRS, ESR and EFOMP).

The first meeting of the Working Group took place 2nd October 2009 in Rome. The findings of this meting were:

- The distinction between ALARA and good radiation protection is often difficult to make, as the optimisation principle is the central concept of radiological protection.
- Thus it may not be relevant to propose a specific definition of ALARA culture beside the definition of RP culture, but to identify the specific contribution of the ALARA approach in the radiation protection culture.
- The ALARA approach is the most important element in the RP culture because of the linear no-threshold dose-effect relationship (LNT), new findings of new health effects due to ionising radiation, and the application of the precautionary principle.
- Implementation of the ALARA principle in practice is a major contribution to RP culture. The implementation involves elements such as:
  - ALARA training,
  - commitment at all levels,
  - task planning: prediction of doses likely to be received during specific tasks or specific exposure situations,
  - dose evaluation and risk estimation (potential exposure situations),
  - analysis whether or not to further reduce doses, remediation actions and feedback,
  - relationship between justification-optimisation, etc.

A short and simple definition of the ALARA approach to radiation protection culture has been developed and will be placed on the EAN homepage:

EAN Proposal - Definition of the ALARA Approach to Radiation Protection Culture *

*Based on **scientific knowledge** and characterised by **risk awareness**, optimisation of radiation protection is an ongoing and iterative process, to keep:*

- *the magnitude of individual doses,*
- *the number of people exposed and*
- *the likelihood of potential exposure ALARA,*

*taking into account **technical, economic and societal developments**, requiring **qualitative and quantitative judgements** and **involving all parties** having an interest in or concern about an exposure situation.*

*The implementation of the ALARA approach in practice is the most important element of radiation protection culture because of the **linear no threshold dose-effect relationship** (LNT), new findings of **new health effects** due to ionising radiation, and the application of the **precautionary principle.***

The implementation requires an adequate number of well trained and experienced radiation protection specialists familiar with the ALARA principle and associated procedures and ready to spread the ALARA culture within their field of activities.

** highlighted parts of the text will worked out in more detail in 2010*

Feedback from the 2nd EAN-NORM Workshop

K. Wichterey (BfS, Germany), H. Schulz (IAF, Germany), A. Schmitt-Hannig (BfS, Germany)

The 2nd EAN-NORM – Workshop, organised and hosted by IAF, was held from 24-26 November 2009 in Dresden. More than 50 experts from 17 different countries, coming from leading European and international organisations, authorities, universities, research institutes and industry representatives shared their experiences in the NORM sector.

In the 1st Session on *General Requirements of Radiation Protection against Exposures due to NORM and other natural radiation sources,* Å. Wiklund (EC) presented the provisions for NORM in the new European Basic Safety Standards and G. Proehl (IAEA) gave an Overview of the IAEA Activities to Improve the Management of NORM. The session was followed by a round table discussion where the following topics were addressed:

- Identification of exposure situations pursuant to the new draft BSS by national authorities: Which strategies, experiences?
- Should all industries listed be considered in general or only parts of them? Does the "Positive List" describe the sectors with NORM sufficiently?
- What are the issues at stake in the NORM sector related to ALARA? (Realistic dose assessment of NORM industries, monitoring of workers, discharge control, transport and waste management problems)
- What the different industrial branches in the NORM sector have in common with regard to the implementation of the ALARA principle?
- Existing or planned situations - Must work activities (resp. practices according to the draft BSS) be justified in the future? Who has to justify it and why?

Not all questions could be discussed in detail and the opinions were not always consistent, of course. Only some aspects are summarized here.

The draft BSS include in an Annex a list of industries involving NORM (the "Positive List"), which has been given as supporting guidance, although investigations of specific situations are still required. By means of ALARA, e.g. by replacement of certain materials, optimisation of technological processes, occupancy times, or paying regard to conventional health and safety measures, the need for further control procedures in some industries can also be avoided. In the future, justification should be applied to NORM, as well.

In the 2nd Session on *EAN and EAN-NORM – Experience with networking,* A. Schmitt-Hannig (BfS, Germany) presented the European ALARA Network - Experience with networking to support optimisation of protection in practice, and K. Wichterey (BfS) shared some first thoughts about the Continuation of the EAN–NORM Network and Support by the Federal Office for Radiation Protection of Germany. H. Schulz (IAF, Germany) talked about the Optimization of the EAN-NORM Webportal as a Fundament for a more active Networking and L. Geldner (Robotron, Germany) about some Technical Aspects of the EAN-NORM Network. A. Poffijn, (FANC, Belgium) presented Past and Future of NORM meetings and the Role of the Network. The round table discussion dealt with the following topics:

- Do we need the ALARA-NORM network? How to achieve self-sustainability: financing, human resources, maintenance of website etc.?
- What benefits do we expect from building a group and exchanging experiences? How can this be realized?
- Is it necessary to organize the scientific discussion (e.g. identification of issues of general interest, summarizing of the discussion results)?
- Can one expect contributions from the different industrial sectors industries (experience, solutions, dose results)?

Here it was stated that the NORM-network is a useful instrument to get information but individual contributions are still rare. Without giving input to the network no lively discussion will take place. It does not seem to be realistic to get detailed information from the industry due to competitive concerns. No support could be achieved with regard to financing in addition to the current contract with BfS which covers the period till 08/2011.

In the 3rd session *The Implementation of the BSS in the Industrial Practice* was presented by different examples. K. Gehrcke (BfS) showed a graded

approach to regulation in the NORM-sector and R. Gellermann (FUGRO-HGN, Germany) described his experiences in implementing NORM-legislation in several South Eastern European countries. Representatives from industrial branches in the Netherlands and Germany talked about practical issues for dealing with NORM, the organization of radiation protection in the oil and gas industry and guidelines for dose estimations. The discussion touched the following topics:

- Provisions for NORM in the new BSS: Is this what we need? Strengths and weaknesses?
- What is the position of the group with regard to requirements for NORM industries in the "European Commission Services considerations with regard to natural radiation sources in the BSS Directive"?
- Is a licensing procedure for NORM activities appropriate? What does it mean for NORM industries? How could a graded approach be implemented in the authorisation process?
- Application of the principle of exemption - who decides on exemption cases?
- What does "significant" mean with regard to exposures of workers and members of the public? Can a general definition be established or do we need specials ones for the types of practices?
- Does the 1 Bq/g criterion meet the requirements of radiation protection?
- Reuse options for residues: How materials with enhanced radioactivity used as additives to building materials have to be controlled?
- Do we need European Guidelines for dose estimations?

In addition to the BSS, there is a need for further guidance, e g. on dilution and mixing of materials. With regard to dose assessments, it was stated that RP 122 Part II is used in most cases.

In the 4th Session the *Experience in Radiation Protection in NORM Industry in different Countries* was discussed. Presentations from Bulgaria, Croatia, Ireland and Italy were given on the situation regarding NORM in their countries and in special fields, e.g. in thermal spas. The overview was complemented by a round table discussion on the following topics:

- Experience with implementing NORM regulations: feedback and practical radiation protection issues. Are there differences in implementing NORM regulations between different NORM sectors?
- To what extent is harmonisation within EU necessary? Are there parts of the NORM sector where harmonisation is more urgent than for other parts, e.g. measurements techniques or dose assessment methods? To what extent (for which parts) would harmonisation with IAEA be beneficial?
- What kind of experience exists with methods, programmes, results, documentation etc.?

It was shown that some countries followed a different approach regarding the consequences of the BSS. Some more harmonisation of the regulations is desirable within the EU. Especially with regard to free trade (e.g. of building materials), more clarification is needed.

In the 5th Session *Practical applications in NORM industry* in Belgium, Germany, Norway and Poland were presented. Different problems were highlighted like the analysis of radionuclides in TENORM, transport regulations, release behaviour, activity measurements in bulk quantities, end disposal options and the control of occupational exposure. Some solutions were shown which are acceptable to industries and authorities. The round table discussion addressed the following topics:

- How the interfaces from RP-NORM to waste management, soil protection, product declarations, etc. should be developed?
- What are the problems regarding transport of NORM? Criteria for safe NORM transport?
- Final disposal of NORM-residues - requirements, methods, regulatory control.
- Practice of release from the regulatory control: feedback experience from countries.
- Dose assessments in advance of authorizing discharges of radioactivity from NORM industry into the environment.
- Where are the differences in different industrial branches? Are there similarities or differences between the branches with regard to awareness of radiation protection issues?
- Inclusion of health & safety requirements: progress made, issues to be discussed.
- How do the different branches tackle the issue of education and training of personnel?

Not all questions could be answered during the discussions. Nevertheless, useful information on NORM issues was presented and exchanged and fruitful relations were established. The manager of the EAN_{NORM}-network, H. Schulz, encouraged all participants of the workshop to send their statements on the topics discussed and additional contributions on regulations, experiences, and scientific results to the EAN_{NORM}-network and to participate in further discussions.

All presentations can be downloaded from the website www.ean-norm.net.

ALARA NEWS

For more news, please visit regularly EAN Website: www.eu-alara.net

❑ The "European Medical ALARA Network (EMAN)" project

The EMAN project, supported by the European Commission, has been launched by the end of 2009. The Consortium in charge of this project is leaded by SSM (Sweden) and is composed of the European Society of Radiology (ESR), the European Federation of Organisations for Medical Physics (EFOMP), the European Federation of Radiographer Societies (EFRS), the European Radiation Dosimetry Group (EURADOS), BfS (Germany) and CEPN (France).

The EMAN project aims at establishing a sustainable European Medical ALARA Network (EMAN) where different stakeholders within the medical sector will have the opportunity to discuss and to exchange information on different topics related to the implementation of the ALARA principle in the medical field. In particular, the project includes the setup of three working group to discuss the following specific topics: "optimisation of patient and occupational exposures in CT-procedures"; "optimization of patient and occupational exposure in interventional radiology"; "radiological safety for patients and personnel un activities using X-ray equipment outside the X-ray departments".

For more information, please visit the EMAN website: www.eman-network.eu

❑ ISOE International Symposium - Cambridge, UK - 7-11 November 2010

The European Technical Centre of the international Information System on Occupational Exposure (ISOE) is organizing, in collaboration with Sizewell B NPP the 2010 ISOE International Symposium on Occupational Exposure Management at Nuclear Facilities. The Symposium will be held in Cambridge, UK, from 17th to 19th November 2010. The main aims of the Symposium are:

- to provide a large forum of information exchange on occupational exposure concerns (practices, management and procedures, dose results and reduction, improvements of techniques and tools, etc.), and
- to allow vendors to present their recent experience and developments in radiation protection (measurement techniques, operating and plant design improvements, ALARA practices during operation and outages, etc.) in a commercial exhibition.

For more information, please visit the ISOE website: www.isoe-network.net

❑ 13th European ALARA Network Workshop (June 2011, Norway)

The 13th EAN Workshop will deal with "ALARA in the medical sector". It will be held at the Oscarborg Fortress in Norway from 7th to 10th of June 2011.

The 20 EUROPEAN ALARA NETWORK Contact Persons

AUSTRIA

Mr Alfred HEFNER
Seibersdorf Labor GmbH
2444 SEIBERSDORF
Tel: +43 50550 2509; Fax: +43 50550 3033
E-mail: alfred.hefner@seibersdorf-laboratories.at

BELGIUM

Mr Fernand VERMEERSCH
SCK/CEN, Boeretang 200, 2400 MOL
Tel: +32 14 33 27 11; Fax: +32 14 32 16 24
E-mail: fvermeer@sckcen.be

CROATIA

Mr Mladen NOVAKOVIC
Radiation Protection, EKOTEH Dosimetry,
Vladimira Ruzdjaka 21, 10000 ZAGREB
Tel: +385 1 604 3882; Fax: +385 1 604 3866
E-mail: mlnovako@inet.hr

CZECH REPUBLIC

Mr Jan KROPACEK
SUJB - State Office for Nuclear Safety,
Syllabova 21, 730 00 OSTRAVA
Tel: +420 596 782 935; Fax: +420 596 782 934
E-mail: jan.kropacek@sujb.cz

DENMARK

Mr Kresten BREDDAM
National Institute for Radiation Protection
Knapholm 7, 2730 HERLEV
Tel: +45 44 54 34 63
E-mail: krb@sis.dk

FINLAND

Mrs Maaret LEHTINEN
STUK – Radiation Practices Regulation
Laippatie 4, 00880 HELSINKI
Tel: +358 9 75988244 Fax: +358 9 75988248
E-mail:mamm

FRANCE

Mrs Olvido GUZMÁN
ASN, 6 place du Colonel Bourgoin
75572 PARIS Cedex 12
Tel: +33 1 40 19 87 64 ; Fax: +33 1 40 19 88 36
E-mail: olvido.guzman@asn.fr

GERMANY

Mrs Annemarie SCHMITT-HANNIG
BfS, Ingolstädter Landstrasse 1,
85764 OBERSCHLEISSHEIM
Tel: +49 3018 333 2110; Fax: +49 3018 10 333 2115
E-mail: achmitt-hannig@bfs.de

GREECE

Mr Sotirios ECONOMIDES
Greek Atomic Energy Commission (GAEC)
P.O. Box 60228, 15310 AG-PARASKEVI
Tel: +30 210 6506767; Fax: +30 210 6506748
E-mail: sikonom@eeae.gr

ICELAND

Mr Guðlaugur EINARSSON
Geislavarnir Ríkisins, Rauðararstigur 10
150 REYKJAVIK
Tel: +354 552 8200; Fax: +345 552 8202
E-mail: ge@gr.is

IRELAND

Mr Stephen FENNELL
Radiological Protection Institute of Ireland,
3 Clonskeagh Square, Clonskeagh Road, DUBLIN 14
Tel: +353 1 206 69 46; Fax: +353 1 260 57 97
E-mail: sfennell@rpii.ie

ITALY

Mrs Serena RISICA
ISS – Technology and Health Department
Viale Regina Elena 299, 00161 ROME
Tel: + 39 06 4990 2203; Fax: +39 06 4938 7075
E-mail: serena.risica@iss.it

THE NETHERLANDS

Mr Cor TIMMERMANS
NRG Radiation & Environment, P.O. Box 9034,
6800 ES ARNHEM
Tel: +31 26 3568525; Fax: +31 26 4423635
E-mail: timmermans@nrg.eu

NORWAY

Mr Gunnar SAXEBØL
Norwegian Radiation Protection Authority, Grini
Naeringspark 13, Postal Box 55, 1345 ØSTERÅS
Tel: +47 67 16 25 62; Fax: +47 67 14 74 07
E-mail: gunnar.saxebol@nrpa.no

PORTUGAL

Mr Fernando P. CARVALHO
Instituto Tecnologico e Nuclear
Estrada Nacional 10, 2686-953 SACAVEM
Tel: +351 21 994 62 32; Fax: +351 21 994 19 95
E-mail: carvalho@itn.mces.pt

SLOVENIA

Mr Dejan ŽONTAR
Slovenian Radiation Protection Administration
Langusova 4, 1000 LJUBLJANA
Tel: +386 1 478 8710; Fax: +386 1 478 8715
E-mail: dejan.zontar@gov.si

SPAIN

Mrs Carmen ALVAREZ
CSN, Justo Dorado 11, 28040 MADRID
Tel: +34 91 346 01 98; Fax: +34 91 346 05 88
E-mail: cag@csn.es

SWEDEN

Mrs Birgitta EKSTRÖM
SSM - Department of Nuclear Power Plant Safety
Solna strandväg 96, 171 16 STOCKHOLM
Tel: +46 8 799 42 45; Fax: +46 8 799 40 10
E-mail: birgitta.ekstrom@ssm.se

SWITZERLAND

Mr Nicolas STRITT
Swiss Federal Office of Public Health, Radiation Protection
Division, 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
HPA – Health Protection Agency, Occupational Services
Dept., Radiation Protection Division
Hospital Lane, Cookridge, LEEDS - LS166RW
Tel: +44 113 267 9629; Sec: +44 113 267 9041 Fax: +44 113 261 3190
E-mail: peter.shaw@hpa.org.uk