35TH ISSUE – OCTOBER 2014

European ALARA Network

Newsletter

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PET CT – How much is too much?

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Introduction

The use of ionizing radiation in diagnostic imaging has always required clinical justification. This justification is based on risk benefit assessment for each individual patient at an individual time point within a treatment cycle. Justification for the use of high dose imaging techniques such as Computed Tomography (CT) and Positron Emission Tomography-Computed Tomography (PET CT) examination varies according to the point within the treatment cycle from diagnosis to initial staging to subsequent re-staging or response evaluation. This justification also varies between cancer indications. Various national and international societies have defined some guidelines as to the use of CT and to a greater extent PET CT within the treatment cycle according to cancer type. There has also been significant involvement from insurance companies in the formation of guidelines for imaging particularly with PET CT internationally. Often the decision of when to use PET CT and to lesser extent CT is influenced by the Government policy within the public sector and by insurance company policy within the private sector. In addition to these factors are the clinical responsibilities of the doctors involved in the health care of an individual patient being treated for cancer. In fact, this is the primary decision axis. The responsibility put on the doctor, with the back up of allied health professionals including medical physicists, is to achieve an accurate diagnosis with the minimum of ionizing radiation exposure. Within this framework Monte Carlo risk estimates the risk of a radiation-induced cancer.

COORDINATED BY CEPN AND PHE
EUROPEAN ALARA NEWSLETTER
ISSN 1270-9441
C/O CEPN - 28, RUE DE LA REDOUTE - F-92260 FONTENAY-AUX-ROSES
WEB: HTTP://WWW.EU-ALARA.NET

How many PET CT should a patient have?

A question that is rarely posed is whether there a limit to the number of C.T. examinations a patient should have in the course of cancer treatment. More specifically for this discussion is there a limit to the number of PET CT examinations a patient should have? After the accumulation of National Oncologic PET Registry (NOPR) data in the USA most national insurance covered patients in the USA are guaranteed access to at least one PET CT during the course of a cancer treatment. Using most international guide lines and insurance company coverage decisions, a significant percentage of patients are eligible for a PET CT during treatment for cancer, which could vary from one study upwards. In clinical discussions there never appears to be an upper limit of the total number of studies performed. The reason for this is obvious, basically that it cannot be defined what particular course an individual patient will have. How long a patient survives with incurable disease will determine how many investigations an individual patient will have. Essentially this is similar to a situation described in colloquial terms as "how long is a piece of string?" It would seem to illogical to define a maximum number of studies however when looking at the total number of studies and individual cancer patient has over a course of treatment of a period of 3-5 years, often the number of investigations and the total radiation exposure will seem quite high. However when individual cases are looked at, as long as the justification for each test is present, then each test is being performed for a good reason and the risk is appropriate.

The question of how many PET CT studies should a patient have arose after an internal audit in our PET CT unit. The results were surprising in that a significant number of patients had more than 10 PET CT studies performed over a period of 8 years. This finding is both surprising and unsurprising. Patients with metastatic cancer in general are surviving longer. Therefore they are having more tests done. In this setting patients will have C.T. or PET CT. The preference for PET CT will vary from country to country. In our practice I suspect we perform more PET CTs per individual patient however nationally we perform less PET CTs overall, when compared to many other countries in Europe.

Radiation dose is one significant reason for limiting PET CT studies[1]. However cost is also another major factor. The cost differential between PET CT studies and C.T. thorax, abdomen and pelvis studies has reduced substantially in recent years. Some of this is driven by market competition and some is driven by the reduction in the price of ^{18}F fluorodeoxyglucose tracer costs. Insurance companies have also been heavily involved in reducing this cost. Due to the current economic recession pressure for reductions in cost of PET CT studies and to reduce inappropriate use of PET CT has also significantly increased. In some countries the response to increased demand for PET CT has been to outsource imaging. In some European countries the response has been to provide more government-sponsored access to PET CT. The question for a practitioner is how much influence cost should have on deciding on a diagnostic pathway. Nobody can ignore cost, however as patient advocates, doctors cannot allow cost to be only factor that dictates what investigations are used.

In looking at our own internal audit we regarded this as a "washing dirty laundry in public" exercise. The reality is if most practices around Europe looked at the total number of C.T. examinations that they have performed for cancer patients I think they would also be just as surprised as we were with our PET CT numbers. I suspect that many of these hospitals

[1] For the sake of illustration : "The dose of an abdominal/pelvic CT is 10 mSv and the dose from FDG administration for the PET component of a PET/CT scan is 5.7–7 mSv. This compares to 7.2 mSv for a barium enema, 0.7 mSv for plain abdominal radiograph, and 0 for nonionizing techniques such as endoscopy" Halpenny *et al.* Inflammatory Bowel Diseases, Volume 15, Number 6, June 2009 (note from the EAN Editorial Board).

would not admit to such. Locally a set of established national guidelines for PET CT use have been in place for a period of 4 years. Similar to in other jurisdictions, these are guidelines rather than rules. However when a request for PET CT examination is received that is outside of the guidelines this does suggest that a conversation should happen between the referring clinician and the PET CT doctors. Often these indications are discussed at multi disciplinary team meetings. Some national guidelines have been very prescriptive on indications for PET CT but have considerably more vague for indications for CT. Although CT examinations in general have a lesser radiation dose that PET CT studies, they are obviously still associated with substantial radiation dose. Variation in CT guidelines probably reflects a lack of consensus from clinicians as to the exact imaging schedules that patients should have.

Different approaches and situations

In a relatively small number of centres there is a concept of the "one stop shop" PET CT examination. This is a fully diagnostic PET CT carried out with full dose CT with oral and intravenous contrast as an initial staging study. There is published research for this in certain cancers, for example pancreatic carcinoma. However in our practice we have often used this in the setting of lung cancer, oesophageal cancer, multiple myeloma and in some lymphomas, where a diagnostic surgical excision has been performed. The idea behind this is that a patient who has a very high probability of needing a PET CT study, attends for one study rather than having a CT Thorax Abdomen and Pelvis (C.T. TAP) study performed and then a subsequent PET CT study. This could lead to a lower radiation dose exposure for an individual patient who has a very high probability of needing two studies and also is more convenient for a highly anxious patient. There are arguments against the one stop shop approach including some inaccuracy with SUV measurement, the possibility of using PET CT imaging in a patient who has advanced metastatic disease where treatment will not be altered and the technical complexity of performed post contrast studies leading to higher radiation dose to staff. A "one stop shop" approach probably leads to an increased number of PET CT studies performed overall. A diagnostic related group (DRG approach) to PET CT imaging would necessitate that a "one stop shop" arrangement should not occur. This requires that the decision to perform a second test rely on the first test result. The aim is to reduce overall investigations cost however this prolongs the investigation cycle and as outlined above, in some patients will lead to more radiation exposure.

Reasonable reasons to choose PET CT for staging in general include: where C.T. identifies an abnormality with equivocal interpretation and following analysis at MDT referral is made for PET CT. In addition unexplained clinical symptoms or a substantial rise in a tumour marker where there is no abnormality or change identified on conventional CT, bone scan or MRI investigations to account for this. It may also be reasonable to perform PET CT in a situation where disease was only previously identified on PET CT as opposed to a CT TAP examination. This would not fall within guidelines but often has been more practical in our clinical practice in dealing with individual patients. There is an issue of convenience and anxiety reduction for a small cohort of patients who are under chronic treatment for incurable cancer. These patients essentially have a chronic disease, where attending for PET CT for one test achieves a diagnosis as opposed to attending for up to three alternative tests (C.T. TAP, bone scan and sometimes MRI examination) needed to achieve staging otherwise.

Inappropriate reasons for PET CT staging are the inability to get a C.T. TAP performed on time. This situation arises in the public health service where with cutbacks and at a time of significant increased demand for C.T. examinations, demand cannot be met. This introduces delays which can be from a period of one week to a number of weeks in staging. In current times it is unreasonable to ask patients at a time of major anxiety to wait a significant amount of

time to get an answer as to whether treatment is working or not. There unequivocally have been situations in our practice where the inability to access a C.T. TAP on time was matched with ready access through other routes to PET CT which could be obtained in a shorter time frame. PET CT was chosen as the staging test of choice as a result.

Where does patient choice come into this situation? Some patients demand to have a PET CT study performed, knowing that it has higher sensitivity and specificity than CT in staging certain cancers. It is not the practice of health care professionals to respond to all demands from patients, however the ability to deal with demands is influenced by the medico legal environment within a country. If a doctor is to make strong decisions regarding a patient's management, the doctor needs to be supported by relevant national healthcare service. If this backing is not strong enough the doctor may feel vulnerable and more likely to concede to potentially inappropriate patient requests. This can drive up demand for PET CT imaging. Other situations we have encountered are where a C.T. thorax, abdomen and pelvis study has been performed at an outside institution and where the referring clinician has doubt about the report. Often these doubts can be dealt with at an MDT meeting but sometimes a written finalized report can only be overturned by an alternative investigation. It is too simplistic to think that all C.T. TAP reports can be overturned by an addendum. An addendum may place the Clinician or the original reading Radiologist in a difficult medico legal situation. This nonetheless, again is an inappropriate reason for performing PET CT imaging. For certain cancer indications there are situations where an insurance company or a national provider will pay for a PET CT study, but will not pay for a C.T. thorax, abdomen and pelvis study, for the same indication in the same setting. This can lead to a PET CT study being performed instead of a CT-TAP. This situation reflects anomalies in the insurance market, which usually are resolved over time, once the problem is identified.

Despite the construction of imaging guidelines for PET CT there still is some room for interpretation. The guidelines tend to be moderately complex and there are a number of people interpreting these guidelines including the referring oncologist, the radiologist or nuclear medicine physician and insurance company administrators. This can lead to different opinions or different reasons for performing the PET study. Within our national guidelines there is a paragraph outlining some flexibility for imaging in individual cases:

> "*There are clinical indications for PET CT that do not meet specific guidelines outlined above, but where expert medical opinion indicates that the imaging procedure would have a major impact on patient management. These indications are typically discussed at a local multi disciplinary team meeting (MDT). It is anticipated that PET CT referrals for these indications would be reviewed by regional approval board, or officer or by an expert in PET CT at the PET CT centre prior to a decision to proceed with imaging. In general the process of guidelines or rules covering PET CT imaging is leading to a broader range of indications for PET CT over time rather than a smaller range*".

In our own practice, in general we perform more full dosed CT as part of PET CT than other centres in Europe. This reflects a greater use of the C.T. component of PET CT for diagnosis. Our PET CT readers are dual Fellowship level trained readers in Radiology and Nuclear Medicine. The broad consensus within our imaging group is that the C.T. component contributes significantly to the interpretation of PET CT. The use of full dose or a local protocol of medium dose C.T. as part of PET CT studies is not necessarily limited to initial diagnosis studies. There are some patients where restaging examinations are performed with full dose. Some studies have individual protocols for example a specific protocol for multiple myeloma patients involves whole body imaging with low dosed C.T.

Other factors of concern in the decision

Upon review of the total number of PET CT examinations per patient over an 8 years

period, including 14,000 patients, we identified a relatively small number of patients who have had more than 10 PET CT studies performed. On analysis of these patients the largest single group came from metastatic breast carcinoma with the next highest indication being colorectal carcinoma and the third most prominent indication was lymphoma. Other patient indications included multiple myeloma, gastro intestinal stromal tumour, melanoma, vulval carcinoma and renal cell carcinoma. On analysis of these patients 89% of cases had substantial life threatening disease where the radiation dose associated with either a C.T. TAP or PET CT study was unequivocally justified. In the remaining 11% of cases we could establish justification in most of the studies performed, but not in all cases. Following this we have decided to change our approach to protocoling patients for PET CT with more rigorous protocoling for any patient who receives more than 8 PET CT studies or referral for any more than 3 PET CT studies in a 12 month period.

If PET CT is being used for multiple studies, then very close attention must be paid to the C.T. component of the study, which contributes most of the patient dose. All modern C.T. reconstruction techniques need to be used. In addition access to the most modern PET CT imaging scanner technology helps with dose reduction. Along with manufacturers we have looked at C.T. dosage and have achieved substantial reductions in this.

Another factor that specifically causes concern, is the risk of cataract formation. With most protocols PET CT imaging is commenced at the base of skull. For certain tumours, imaging should start at the skull vertex, including head and neck cancers, melanoma and according to some protocols, for lung carcinoma. This is a problem that should be addressed by careful radiography technique and the use of low dose C.T. as much as possible. Radiation induced cataract formation is a deterministic effect, as opposed to the risks of cancer induction, which more typically preoccupies prescribers.

The cohort of patients who are suffering from chronic metastatic disease, in some cases, have assumed a risk profile that is now similar to some other serious chronic diseases, rather than the conventional perception of cancer survival. In our practice breast cancer staging is probably the most controversial indication for PET CT. A classic scenario is a patient with incurable metastatic bone disease, on hormone therapy, where there is a suspicion of progression of bone disease or development of early soft tissue disease. The development of soft tissue disease is associated with a more rapid progression of disease. The question that must be asked in each individual situation is how important is the answer that the study will give and as to what impact this is going to have on patient treatment. Often the impact of the study is a change in treatment from hormone treatment to the use of chemotherapy. This is a major treatment decision. The treatment decision has an impact on the patient in terms of side effects. Chemotherapy treatment is also potentially dangerous with both associated morbidity and mortality. The treatment is also expensive, considerably more expensive than PET CT. In our experience the level of confidence regarding the progression of disease, particularly in patients with bone metastases with breast carcinoma, is almost always higher with PET CT imaging. International guidance regarding when to use PET CT in this situation, for patients with incurable disease, is very weak. It may be deliberately weak. Often a local decision must be made.

When a local decision is made it is difficult to decide whether this decision is the right or wrong decision. Essentially when does this type of practice make you an "outlier"? The easy solution is to say "don't use PET CT in this situation", a more balanced answer would be to prove that the use of PET CT prolongs survival, or lowers treatment costs. There is very little data available on the influence of PET CT usage on survival for patients in this situation. However the cohort of patients undergoing treatment for chronic incurable metastatic disease, who require intermittent staging, is constantly increasing in size and this is an issue that should be addressed.

There are no guidelines world wide for the total number of C.T. TAPS or PET CT studies a patient with metastatic cancer should have in a lifetime. It is impractical to have such a guideline. The response to this situation is to justify each individual test at a particular point in time for an individual patient. Focus should be on particularly reducing the C.T. dose associated with C.T. TAP examinations and the C.T. component of PET CT. In this setting therefore is it reasonable to perform PET CT more than 10 times in some patient groups? I would challenge doctors in charge of imaging in Europe to look at the total number of C.T. TAPS performed on their patients with chronic metastatic disease. I think the results would be surprising to most. In looking at this you should also look at bone scans performed. Consideration should be given to time and anxiety associated with performing MRI in patients where C.T. TAP is non-diagnostic.

In summary

PET CT is an extremely useful examination in the correct clinical setting. It is a high radiation dose examination where use must be carefully justified and optimized. Justification is complex in patients with life threatening metastatic disease who survive over a number of years. The longer survival of patients is a welcome and positive development; we shouldn't be surprised that we are going to use more ionizing radiation in this patient group. ❑

How do you know you work ALARA? ALARA benchmarking visit at Ringhals and Forsmark nuclear power plants

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Introduction

In 2010, the Swedish Nuclear Authority (SSM) performed specific ALARA inspections in all Swedish nuclear power plants and including the Vattenfall-owned Forsmark and Ringhals plants. Theses inspections aimed to review the organisation of the occupational radiation protection and notably the optimization process.
At this occasion, the Authority raised this question to the utility:

> *"How do you ensure that you are focusing on the right areas to keep exposure as low as reasonably achievable (ALARA)?"*

The Vattenfall's radiation protection network – Rad-NET – reformulated the question in 2011:

> *"Are we keeping the doses ALARA? Or could another set of activities, another set of targets/objectives, another focus of ALARA-program, be more efficient and favourable for the occupational doses and radiation fields at our plants?"*

At the initiative of Vattenfall's Headquarter, an ALARA benchmarking visit was planned with the help of CEPN.

The "ALARA Benchmarking Team" consisted with one representative of Vattenfall (as the

initiator and the organiser), the Radiation Protection Managers of Forsmark and Ringhals and two representatives from CEPN. CEPN brought its experience about the concept and methodologies that govern the ALARA principle. Regarding the practical implementation of ALARA, two representatives from nuclear power plants well known for their good radiation protection results were also invited to participate through the ISOE network (www.isoe-network.net). Consequently, the Radiation Protection Managers from Biblis nuclear power plant (Germany) and Sizewell B (United-Kingdom) joined the Team.

It should be noted that this benchmarking exercise is different from others, which are made in other more formal contexts and does not specifically examine the ALARA process (e.g. OSART reviews, etc.). This ALARA Benchmarking could be labelled as a "casual benchmarking with colleagues"!

Planning the visit

The ALARA Evaluation Guide

An "ALARA Evaluation Guide" has been designed by CEPN to assess the implementation of the ALARA principle in any nuclear power plant. The Guide is divided in six chapters:

- Chapter 1. – On-site radiation protection organization,
- Chapter 2. – Organisation and management of the ALARA Programme,
- Chapter 3. – Work planning and organization,
- Chapter 4. – Factors to be addressed in work preparation (or radiation protection "in the field"),
- Chapter 5. – Work implementation,
- Chapter 6. – Management of feedback.

Most of the questions come from international reviews, good practices reports and guidelines published by IAEA, INPO, ISOE (notably *Work Management to Optimise Occupational Radiological Protection at Nuclear Power Plants*, 2009) and former questionnaires addressed to the French NPP operator *Electricité de France* by CEPN.

Each chapter is divided into topics and sub-topics, with three to four levels of evaluation. Level 1 ensures that minimum ALARA requirements are met, while the other levels assess the organization more deeply and are more focused on the qualitative and subjective implementation of the ALARA principle. A scoring system is also proposed for the evaluation, which can be used to identify on a scoring basis the strong or weak areas.

The Guide can be used for a "self-evaluation" at the plant level. In that case, it should be discussed with the radiation protection staff in close cooperation with stakeholders from other departments (*e.g.* Maintenance, Logistic, Chemistry, Operation, Planning, etc.) who are already - or could be - involved in the ALARA programmes. This review can favour the identification of weak or strong areas, good practices to be renewed and disseminated or areas of improvement, all being shared by the field staff.

As a result, beside the evaluation process, the ALARA Evaluation Guide can be seen as a list of successful procedures and current good practices from various origins that have proved their efficiency to optimize the radiation protection and perform stronger involvement and empowerment of workers.

Scheduling and performing the visit

The ALARA Evaluation Guide was sent in January 2014 to Forsmark and Ringhals nuclear power plants. Both plants performed a separate self-evaluation and choose four topics from the ALARA Evaluation Guide that would fit to their current particular points of interest.

The ALARA Benchmarking Team spent two days on each plant (3-4 March 2014 in Forsmark, 5-6 March 2014 in Ringhals). The days were divided into one-hour meetings, each meeting devoted to an interview with different kinds of employees: one meeting with Department managers, one meeting with Job

Planners, etc. (see Table 1). This approach encourages discussions *which are not topic related, but related to specific roles and functions*. The ALARA Benchmarking Team conducted the discussions, with the aim of evaluating the understanding, knowledge and feeling of the interviewees on the four topics chosen by the radiation protection personnel. Interviewees were encouraged to speak freely and formulate suggestions and areas of improvement. In addition to the meetings, a visit to the controlled area was planned in each plant (see Table 1). The goal was to assess the practical implementation of the plants ALARA programs as well as to identify good practices and ways of improvement

Table 1. – Activities during the benchmarking

Interviews	Visit into the plant
• Senior management • Supervisors various departments: Modification and project, Chemical, Planning, … • Radiation protection staff (utility + contractors) • Job planners • Maintenance • Contractors	• Reactor building (BWR) • Decontamination facility • Waste management • Mock-up building

Figure 1. – The ALARA Benchmarking Team at Forsmark nuclear power plant

Results of the benchmarking

Forsmark and Ringhals nuclear power plants have both shown a very good work management organisation to optimise the radiological protection of their workers. Indeed, the ALARA Benchmarking Team has identified several good practices in the organisation of the two plants. These good practices are related to a large array of issues: specific radiation protection training; devices used for monitoring the source term; mock-up installation, etc. The ALARA Benchmarking Team was particularly impressed by the good radiation protection knowledge of workers at Forsmark NPP and by the distribution of ALARA responsibilities among all Departments at Ringhals NPP.

With the help of the ALARA Evaluation Guide and the visits, areas of improvement have been identified (formalized in the report of the visit). To address these, suggestions have been formulated by the ALARA Benchmarking Team and by the interviewees. For example, the Team suggested a deeper involvement of contractors in the optimization process or the creation of small ALARA technical groups dedicated to specific jobs.

Many indirect contributions

Other additional contributions to the benchmarking process are worth noticing, as follows:

Before the benchmarking: The ALARA Evaluation Guide was analysed by the radiation protection staff for a self-evaluation. According to the Ringhals radiation protection section "*one can always find new ideas to implement in the Guide*". Implementing the Guide was also an excellent opportunity for radiation protection section to get in touch with other sections.

During the benchmarking: The ALARA Benchmarking gathered in total almost 100 persons at Forsmark and Ringhals. Some of these people do not frequently work with radiation protection staff or deal with ALARA issues in their job. This benchmarking also helped to reveal and diffuse ALARA issues among numerous sections.

After the benchmarking: To favour worker empowerment in radiation protection, a feedback (summary) of the report of the visit should be distributed to the interviewees and the workers. The second step is to communicate to workers about the implementation of some of the suggestions.

Conclusion

This benchmarking was unusual on several levels:

- its topic was entirely based on the ALARA principle,
- a specific ALARA Benchmarking Team was constituted, gathering radiation protection colleagues from different plants in Europe,
- a specific document (ALARA Benchmarking Guide) was drafted for the occasion,

Beside the identification of good practices and areas of improvement at the local and corporate levels, such a benchmarking is a powerful tool to disseminate and diffuse radiation protection and ALARA culture among the various departments of a nuclear power plant.

Acknowledgement

The authors would like to thank all the people of Forsmark and Ringhals that made this benchmarking possible.

The benchmarking Team is eager to perform benchmarking in other installations and can be contacted through the Editorial Board ! ❑

15th European ALARA Network Workshop and 5th EUTERP Workshop: "Education and training in radiation protection: improving ALARA culture", Rovinj, Croatia 7-9 May 2014

Summary and recommendations

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Workshop objectives and programme

This joint EAN-EUTERP Workshop considered how radiation protection (RP) education and training programmes can be delivered effectively, and, in particular, how these can improve radiation protection in practice and help disseminate ALARA culture. The Workshop was officially opened by Mr. Sasha Medaković, Director of the Croatian State Office for Radiological and Nuclear Safety (SORNS).

There were 71 participants from 22 different countries, with half the programme devoted to presentations (including posters), and half to Working Group discussions based on the following topic areas:

- Building ALARA into radiation protection training programmes
- Measuring the effectiveness of training
- The role of qualification and recognition schemes
- Training tools and methods
- National approaches to training

Some key themes and issues did emerge from the workshop presentations, and these are described below. On the final day, the conclusions and recommendations from the four working groups were presented and discussed, and these are also summarised below. All the presentations are available to download from the EAN and EUTERP websites (http://www.eu-alara.net/ and http://www.euterp.eu/).

Themes and issues arising

ALARA culture and radiation protection training

As a joint EAN-EUTERP workshop it was interesting to explore the relationship between RP education and training, and ALARA culture. These are interdependent: an organisation with a strong safety culture should identify training needs and provide motivated participants; and well-designed training should, in turn, foster this culture. Through EUTERP and the ENETRAP projects, much valuable work has been done in terms of defining and agreeing the roles of the Radiation Protection Expert (RPE and the Radiation Protection Officer (RPO), to help promote a harmonised approach in Europe through implementation of the Basic Safety Standards Directive (BSS). Through EFOMP and the MEDRAPET project similar activities were performed in relation to the Medical Physics Expert (MPE). This work has included detailed considerations of education and training requirements, especially for RPEs and MPEs.

In comparison, ALARA culture is intended to apply in all exposure situations, and should involve all stakeholders. Previous EAN and EUTERP workshops have highlighted the importance of training – not just for defined roles such as the RPE/MPE, but also for workers and other stakeholders, such as managers, equipment suppliers, and competent authorities. It was agreed that, in future, a wider focus was needed to encourage the

development of training matrices in which the training strategies, objectives and outcomes for different groups of stakeholders are defined.

Competence and culture

Traditional approaches to defining education and training requirements have started from the basis of academic qualifications, which are then supplemented with RP-specific training courses. While these approaches are still relevant, it is now recognised that the goal of education and training is to produce "competence", which is built upon acquired knowledge, understanding and skills. The Workshop strongly recommended that "soft skills", such as leadership and communication, should also be considered. For persons such as RPEs, MPEs and RPOs, who have a role in promoting ALARA culture, these are especially important skills, and it was agreed that they should form part of the competency requirements.

It was agreed that defining training outcomes in terms of knowledge, skills and competence does help underpin the practical implementation of ALARA. ALARA culture is, however, also defined by personal attitudes and behaviour. While these factors cannot be instilled through training alone, they can be encouraged, i.e. by training which is designed to promote reflection and a questioning attitude. This can provide a bridge between training and ALARA culture, and should form part of the training objectives.

Assessing the effectiveness of training

The ultimate goal of this education and training is better radiation protection. Like other protection options, training should be optimised to deliver the maximum benefit without being unduly expensive or time-consuming, i.e. it should be both effective and efficient. There was little discussion about efficiency, although it was noted that the resources generally allocated for training are increasingly limited.

In contrast, assessing the effectiveness of training was a major theme throughout the workshop. Traditionally this has relied on written tests at the end of training courses; these can test knowledge and understanding, and (to some extent) how trainees might apply these in a practical scenario. It was noted that practical skills can be more directly tested using practical assessments, done under the observation of the trainers, although the quantitative marking of performance is not straightforward.

Ideally, the effectiveness of training should be demonstrated by tangible improvements in radiation protection. Work-related benchmarks such as radiation doses or the frequency of incidents were discussed; however it was concluded that these were only useful in a few specific, well-defined circumstances. A better option would be to find a means of assessing individual attitudes to radiation protection, ideally before and after training. This approach is relatively unfamiliar to the radiation protection community, and it was suggested that expertise from the social sciences should be sought.

Methods and tools

Various presentations and posters gave details of different national approaches to training, which remain diverse even under the harmonising influence of the BSS. There was, however, broad agreement on the types of training methods and tools that are best suited to developing and sustaining an ALARA culture, i.e.:

- Training should be interesting and engaging, and directly relevant to the trainees' work
- It should include realistic practical exercises, designed to demonstrate the application of radiation protection theory
- Emphasis should be placed on problem-solving and trainee-to-trainee interaction (e.g. group exercises) to encourage reflection and a questioning attitude.
- Practical training for incidents and emergencies should incorporate an element of stress, so that human factors can be better taken into account.

The workshop also highlighted the use of computer-based "virtual reality" training tools, which can specifically consider optimisation in potentially high dose areas, and are a valuable

ALARA training and planning tool in such circumstances.

Other issues

Many other issues were presented and discussed during the workshop, and there is not sufficient space here to describe all of these. However, to give a flavour of the proceedings, these included:

- The European EQF and ECVET schemes, and approaches to mutual recognition
- The competence requirements for training providers
- Approaches to "train the trainers"
- Continued learning and refresher training

Workshop conclusions and recommendations

The four Working Groups considered many of the issues already described above, and also made some specific recommendations, which are summarised below.

WG1: How to assess the effectiveness of training?

- More work needs to be done in terms of assessing the effectiveness of training. There are several possible workplace indicators, such as monitoring results, individual doses, and reports of audits and inspections (including observation and assessment of behaviours in the workplace). These should be used to construct a framework for analysing the effectiveness of training.
- The above approach should be promoted by Regulatory Authorities, RPEs and professional societies.
- Effective training providers are critical to both the delivery and assessment of training, and there is value in exploring methods by which the quality of training providers can be assessed and recognised.

WG2: Tools to improve the effectiveness of training

- Training is a continuous process, involving multiple stages. It is useful to define the responsibilities of different stakeholders (employers, employees, RPEs, regulatory authorities, etc) for the different stages of this process.
- Training should be practical and realistic, including the use of real radiation sources, where appropriate and subject to suitable dose constraints.
- On-the-job training is an important component of the training cycle, and should be properly structured and involve suitably trained mentors.
- Training the trainers is an important concept, and should include up-to-date training techniques and technologies as well as radiation protection theory, and a basic understanding of the European E&T Qualification Frameworks (ECVET, ECTS, EQF, …).

WG3: What is achieved by recognition schemes?

- The ENETRAP project should develop guidelines for national and mutual recognition schemes, and consider whether the ECVET concepts are useful in this respect. Schemes should focus on all-round competence rather than academic qualifications.
- In turn, Member States should aim to establish clear and transparent national schemes for the recognition of RPE competence, which are then promoted by (for example) HERCA.
- A similar formal system of recognition is not considered appropriate for RPOs; however a simpler system for verifying and validating that they have received suitable training should be considered.

WG4: Incorporating ALARA culture into training requirements

- Although risk is a factor in everyday life, the risks associated with radiation exposure are not readily understood by trainees, and not easily explained by trainers. However, persons can understand the difference between good and bad practice and the impacts in terms of increasing and decreasing the doses received; training should concentrate on practical examples of this.
- There is a need to develop education and training in radiation protection for the public, and this should include providing radiation protection information and data on the Internet.

Next EAN and EUTERP workshops

The 16th EAN workshop, on "ALARA in Industrial Radiography" is planned for March 2016, in Bern, Switzerland (see article below). The 6th EUTERP workshop is currently being planned and details will shortly be posted on the EUTERP website. ❑

EAN 16th WORKSHOP

More than 10 years after the EAN Workshop in Roma, the next European ALARA Network Workshop will also be focused on Industrial Radiography and Non-Destructive Testing. One of the objectives of the Workshop is to evaluate the evolution of radiation protection in these fields since Roma.

The targeted audience is member of the national authorities and regulators, users, equipement suppliers and manufacturers as weel as training providers.

The Programm Committee first gathered in June 2014 and decided that the workshop will take place at *Kursall Berne*, Berne, Switzerland, from 14 to 16 March 2016.
The 1st official announcement will be published in March 2015 and the 2nd announcement in December 2015.
The EAN ALARA Newsletter will keep its readers posted about the program. ☐

THIS ARTICLE COULD BE YOURS!

EAN Newsletter editorial board

The European ALARA Network produces the ALARA Newsletter, which is widely distributed throughout Europe and other countries, to provide a link between all those concerned with ALARA, including health physicists, but also managers, radiation protection organisations, research bodies, regulatory bodies, trade union representatives and the medical sector.

This Newsletter intends to reflect some major aspects of the 'ALARA life': the evolution of regulations, results of research, description of existing databases, ALARA programmes, available ALARA tools, the need for ALARA improvements, lessons learnt from incidents, and recommendations.

The contenant of the ALARA Newsletter has mainly been provided by EAN representatives. However, the EAN Newsletter editoral board has decided to also encourage the recipients of the EAN Newsletter to submit articles for inclusion in future issues.

Submission

Submitted articles should aim to fit with the current editorial line of the Newsletter and will be selected on that basis; former Newsletters are available at: http://www.eu-alara.net/index.php/newsletters-mainmenu-37.html

Submitted articles should be written in English language and send electronically in doc format to sylvain.andresz@cepn.asso.fr. ☐

ALARA NEWS

EAN$_{NORM}$ announces its 7th Workshop

EAN$_{NORM}$ plans its 7th Workshop "Disposal of NORM in EU Member States" from 2nd to 5th December 2014 at Vlissingen, The Netherland. The Workshop will be followed by a topical day "Building Materials" the 5th December.

The principal objective of this Workshop is to provide a platform of exchange between EAN$_{NORM}$ network members and other experts in the field of sampling, measurements and analysis methodologies in the various encountered naturally occurring materials. The Workshop will be focusing on round table and practical exercices.
A registration form is available at www.ean-norm.net.

RPII becomes EPA – Change in the EAN contact person for Ireland

The Environmental Protection Agency (EPA) and the Radiological Protection Institute of Ireland (RPII) have merged the 1st August 2014. This merger is underpinned by the Radiological Protection Act 2014. The EPA is an independant public body established in 1992

RPII functions and staff are transferring to the EPA which will have a newly Office of Radiological Protection that will carry out RPII. The EPA mission statement has changed to reflect its functions and responsibilities. The new mission is:

> "*To protect and improve the environment as a valuable asset for the people of Ireland. To protect our people and the environment from harmful effects of radiation and pollution*."

The EPA website now includes a dedicated new section about radiological protection: http://www.epa.ie/radiation.

It shall be noted that Mr. Hugh Synnott replaces Mr. Stephen Fennel as EAN contact member for Ireland.

FAQ ALARA

The IAEA proposed a list of frequently asked questions (FAQ) which intends to provide information to radiation protection specialists sot hey can answer quickly and correclty the most frequently asked questions. The EAN Newsletter proposes a selection of this FAQ in each issue.

How does ALARA principle applies in the case of dose to extremities?

This question leads to ask what ALARA means when dealing with dose to the extremities. The answer needs to distinguish between the determinist effects and the stochastic effects.
The ALARA principle does not apply in order to avoid the determinist effects that appear above a certain dose; this dose shall not be overpassed.

For the stochastic effect, the ALARA principle should be apply by considering the risk of cancer estimated for the whole body. That implies to calculate the dose taken by the extremities to the whole body.

Example: A given exposed individual receives 500 mSv to the extremities (5 % of the surface of the body). The ω_T for the skin is 0.01, so the 500 mSv represents $500 \times 0.05 \times 0.01 = 0.25$ mSv which is below the dose limit for the whole body.

In reality, the doses to the extremities are often well below the dose limits and so the dose to the whole body particularly low. The ALARA principle should be applied commensuratly with the doses involved.

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European ALARA Newsletter
Coordinated by CEPN and PHE

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