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BROADENING THE PERSPECTIVE

IDAHO STATE UNIVERSITY RADIOLOGICAL PROTECTION EDUCATION AND TRAINING FOR THE NUCLEAR RENAISSANCE

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ABSTRACT

The need to strengthen the nuclear science and technology infrastructure in Idaho and the U.S. was recognized recently by the Idaho State Board of Education. This resulted in an assigned mission that guided Idaho State University (ISU) to expand its programming and continue leadership in the area of nuclear science. Specifically, the health physics and nuclear engineering programs have embarked on a collaboration program for strengthening its educational, research, and outreach programs through:

- Nuclear science, physics and health physics research collaborations
- New joint faculty positions
- Joint graduate fellowships
- Integration of curricula and courses, including new courses required by students of both programs
- Increased use of distance learning
- Joint outreach efforts for student recruitment

In the short time that the ISU nuclear engineering and health physics programs have established a formal collaborative effort, funding has been secured for joint faculty positions, undergraduate scholarships, graduate fellowships and research projects.

1. Introduction

Recently, there has been great emphasis on the impending human capital crisis in radiological science, nuclear science and engineering. Several professional organizations and governmental agencies have stressed the need for maintaining highly educated and skilled personnel to ensure the long-term viability of nuclear technology [1-5]. The development and maintenance of this specialized work force is needed due to the impending loss of many experienced personnel who are nearing retirement. With the loss of these employees also comes the loss of historical and collective knowledge and lessons learned. The work force dilemma will exacerbate as the “nuclear renaissance” becomes a reality in the U.S. A specialized workforce will be needed for both present and future nuclear science and technology initiatives. In addition, recruiting and training talented and motivated faculty is crucial to combat this imminent workforce calamity. In health physics, the retiring nuclear workforce (coupled with the potential nuclear renaissance and license extensions of current commercial nuclear power reactors) creates a need for trained reactor and environmental health physicists which has never been greater.

2. Background

2.1 Idaho State University (ISU)

Idaho State University (ISU) is a state-funded doctoral university, consisting of six colleges and a Graduate School. ISU is situated in southeastern Idaho in close proximity to the Idaho National Laboratory (INL). INL, administered by the U.S. Department of Energy (DOE) and headquartered in Idaho Falls, has been designated as the principal nuclear energy research laboratory for the nation. ISU has its main campus in Pocatello, 50 miles south of Idaho Falls, with a large branch campus in Idaho Falls. Total enrolment at the university is approximately

15,000 with nearly 18% of these students taking classes at the Idaho Falls University Place campus. The two campuses are connected via compressed and IP audio/video video technology to administer approximately eight interactive classes simultaneously to students located at both campuses. Instructors who teach these distance classes are expected to divide their lecture time between sites, so that both populations have routine face-to-face classroom contact.

The need to strengthen the nuclear science and technology infrastructure in Idaho and the entire nation was recognized recently by the Idaho State Board of Education. This resulted in an assigned mission that guided Idaho State University (ISU) to include in its Strategic Plan a commitment to expand its programming and continue leadership in the area of nuclear science. In keeping with the objectives of the Strategic Plan, ISU has made exemplary progress in building strong nuclear engineering and health physics programs. Specifically, the health physics and nuclear engineering programs have embarked on a rigorous collaboration for strengthening its educational, research, and outreach programs. The administration of Idaho State University recognizes the importance of its nuclear programs to both the Idaho National Laboratory (INL) and to the business community of southeastern Idaho, which is strongly tied to the mission of the INL. Consequently, success of the nuclear energy mission ISU is of considerable significance to the nuclear energy developments throughout the nation and the world. This importance is also recognized by the INL management, which has partnered with ISU, along with the other two Idaho research universities (neither of which has a B.S. health physics or nuclear engineering program).

Many of the nuclear science and engineering interactions between INL and the Idaho universities come through the new Center for Advanced Energy Studies (CAES), a public-private partnership of the INL with the three Idaho research universities (Boise State University, Idaho State University and University of Idaho). A new CAES research centre building (5,200 m^2, of which approximately one half are devoted to laboratories) has recently been erected on the Idaho Falls University Place campus within walking distance to the INL Engineering and Research Office Building. This new research centre brings INL engineers and scientists together with ISU faculty and students in conducting joint R&D programs over a wide range of disciplines involved with nuclear energy.

2.2 Health Physics and Nuclear Engineering

ISU is the only university in Idaho to provide baccalaureate and graduate degrees in health physics (in the Department of Physics) as well as the only university in the country to offer all four degrees of the Associate of Science (A.S.), B.S., M.S., and Ph.D. in health physics [6]. In addition ISU is the only higher education institution in the U.S. to have both its B.S. and M.S. degree programs recognized by the Accreditation Board for Engineering and Technology (ABET) in health physics under ABET's Applied Science Accreditation Commission (ASAC). Currently, the program has 5 A.S. students, 20 B.S. students, 20 M.S. students, and 15 Ph.D. students enrolled. The department has a faculty complement of four full-time members in the health physics program and several part-time or adjunct members that contribute to teaching. Several health physics faculty participate in research at the Idaho Accelerator Center (IAC), which is one of the largest accelerator facilities in the world.

Similarly, ISU offers B.S., M.S. and Ph.D. degrees in nuclear engineering and is the only institution in Idaho to provide both Baccalaureate and graduate degrees in nuclear engineering. Currently the department has a student population of around 95 undergraduates and 35 graduate students (25 M.S. candidates, 10 Ph.D.). Students have the opportunity to utilize the educational and research opportunities of the AGN-201 reactor at the ISU Nuclear Reactor Laboratory. The nuclear engineering faculty today numbers eight: five tenured or tenure-track, three research/affiliate faculty, and one lecturer. Nationally ISU is just one of about twenty higher education institutions with a viable nuclear engineering department.

3. Collaboration Plan

Although the nuclear engineering and health physics programs are in separate departments, the two have developed strong working relationships together over the years with the understanding that each discipline utilizes the knowledge, professional contacts, and facilities of the other. Additionally, the two departments have constructed a formal plan for collaboration. The intent of the plan is to increase student numbers at all degree levels and boost research funding. The collaboration effort includes the following key points:

- Nuclear energy research collaborations through CAES
- Nuclear science, physics and health physics research collaborations through the Idaho Accelerator Center (IAC)
- New joint faculty positions with expertise in reactor design and/or health physics
- Joint graduate fellowships
- Integration of curricula and courses, including new courses required by students of both programs
- Increased use of distance learning for recruiting of A.S.(radiological technicians), B.S., and M.S. degree seeking students
- Joint outreach efforts for student recruitment

4. Results

In just over one year since this program was initiated, several successes have already been realized. In the short time that the ISU nuclear engineering and health physics programs have established a formal collaborative effort, substantial progress has been made. First, funding (~$1,000,000) has been secured through competitive grants from the U.S. Nuclear Regulatory Commission (NRC) for joint faculty positions, undergraduate scholarships and graduate fellowships. Specifically, the scholarships and fellowships will fully fund approximately 12 students per year. Two new faculty members are currently being hired from the U.S. NRC and ISU strategic funds. In addition, substantial funding has been acquired from the U.S. DOE for research and infrastructure projects. New radioanalytical and health physics instrumentation will be purchased for the CAES centre to be used for research and educational purposes. This equipment was secured through joint grant proposals between ISU and the University of Idaho. Funding has also been secured through the IAC for research projects related to radioisotope production, nuclear forensics, and homeland security. These projects will employ faculty and students in health physics and nuclear engineering.

The collaboration efforts have also led to increased educational programs and opportunities for students. In addition to the U.S. NRC grants mentioned previously, fellowships and scholarships were also awarded by the U.S. DOE. The scholarships and fellowships will fully fund an additional 5 students per year. The compressed and IP audio/video video technology of ISU has also been improved. This improvement includes real-time video encoding and recording which allows students to view class lectures even if they are not at either the Pocatello or Idaho Falls campus. This has allowed students from all over the U.S. to enroll in the degree programs and take classes, particularly in health physics. Efforts are still being made in recruitment of students (through advertisement of research and funding opportunities) and integration of ISU health physics and nuclear engineering classes and programs. Finally, ISU and the University of Idaho are combining or jointly offering several classes so that students from both universities have a larger selection of classes to take and more exposure to diverse faculty. In particular, University of Idaho students can take health physics classes, which aren’t offered at their university.

It is the hope that continued success through funding and additional research collaborations will result. ISU believes this unique partnership will be successful in all aspects and will help in supplying a much needed nuclear science and technology workforce.

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EDUCATIONAL PROGRAMME IN NUCLEAR SECURITY

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ABSTRACT

Higher education plays a central role in the development of both individuals and societies as it enhances sustainable social, economic, technical and cultural development. Education in general and higher education in particular are not subjects of a common global policy; the competence for the content and the organization of studies remains at national level. This applies to nuclear security education as well.

The International Atomic Energy Agency (IAEA) has taken the lead and has developed together with academics and nuclear security experts from Member States a guideline for a *Master of Science and a Certificate Programme in Nuclear Security*. This guideline should assist States in adapting such academic programmes in the future and will be published in 2009.

This paper discusses the development, content and structure of the guideline entitled *Educational Programme in Nuclear Security* that aims at supporting States to establish sustainable nuclear security knowledge, skills and the related culture in a State and outlines practice in this area in States.

1. Introduction

The need for human resource development programmes in nuclear security was emphasized at a number of IAEA General Conferences and the Board of Governors Meetings. In September 2005, the Board of Governors considered and approved a new *Nuclear Security Plan* covering the period 2006–2009[1], which emphasized the importance of human resource development. This plan forecasts the development of guidance for an educational programme in nuclear security that could be used by all States. This goal is continued in the Nuclear Security Plan 2010 – 2013[2].

[1] GOV/2005/50 [1]

[2] GOV/2009/54-GC(53)/18

In spite of the recognized need for a well defined human resource development programme in nuclear security, only a few universities[3] in the world have developed technically oriented educational programmes related to this area. Therefore, the IAEA has taken the lead, and has developed — together with academics and experts from Member States — an *Educational Programme in Nuclear Security*, providing guidance for a Master of Science (M.Sc.) programme and a certificate programme to assist States in adapting such programmes in the future.

2. The IAEA Educational Programme in Nuclear Security – A Guideline for a Master of Science and a Certificate Programme in Nuclear Security

The IAEA recognizes the need for different levels of nuclear security expertise in a State. Depending on the national nuclear infrastructure, well trained people in certain areas of nuclear security are needed, as well as specialists with a nuclear security specialization, and/or well educated experts with in-depth knowledge in all areas of nuclear security. A certain specialization and in-depth expertise can only be provided through higher education, while specific knowledge and skills in some areas of nuclear security can be provided during selected training activities offered by comprehensive nuclear security training programmes. Due to the fact that no comprehensive educational programme in nuclear security so far exists, the IAEA has decided to develop – together with academics and experts from its Member States – an educational programme covering all aspects of nuclear security.

2.1. Programme development

In the past, the IAEA has assisted in the development of an academic programme in physical protection of nuclear material and associated facilities. This programme, among others, and the comprehensive nuclear security training programme, which was developed during the recent years by the IAEA, has been used as the starting point for the curriculum development.

From August to October 2007, the IAEA Office of Nuclear Security developed a first draft of the *IAEA Educational Programme* that was reviewed in a consultants meeting in October 2007 by several scholars from universities teaching nuclear engineering and law enforcement and nuclear security experts. The revised document was reviewed during a second consultants meeting in January 2008 and a workshop in March 2008. Finally, this reviewed version of the IAEA Educational Programme was presented to the IAEA Member States at the open-ended technical meeting which took place in August 2008. The document is in final draft and will be published in 2009.

2.2. Objective and content

The *Educational Programme* should be considered as guideline to facilitate the development of a comprehensive national human resource development programme in nuclear security with the purpose of building and maintaining knowledge and sustaining qualified individuals dealing with the challenges that the future will bring in this area. The programme is designed to provide both the theoretical knowledge and practical skills necessary to meet the nuclear security requirements outlined in the international framework and in the *Nuclear Security Series* of publications. Emphasis is placed on the implementation of these requirements and recommendations in States with different systems in place. On the basis of this guide, each university should be able to develop its own unique programme tailored to suit the State's educational needs in this area and to meet the national requirements.

The scope of the recommended *Educational Programme* is broad and will cover education in all areas of nuclear security, ranging from an M.Sc. programme for development of highly educated staff with in-depth knowledge in this area to a certificate programme for

[3] In the guideline, the term 'university' is taken to mean all higher education establishments, including colleges, polytechnics and the 'Grandes Ecoles'.

development of certified nuclear security specialists. Although the *Educational Programme* does not outline explicitly an undergraduate programme or a diploma programme, the recommended *Master of Science Programme* could be used as the basis for the development of such kind of programmes.

Educational programmes in nuclear security should be addressed to people interested in careers in all aspects of nuclear security working at different entities, such as e.g. regulatory authorities, nuclear industry, Ministry of Justice, Finance, Health/Environment/Science, and Transport, Customs, Police, or Intelligence Services. *Nuclear Security* is multidisciplinary and can therefore offer job opportunities at a wide range of entities.

2.3. Structure

The *Educational Programme* is divided into four main chapters and two appendices.

Chapter 1 provides an overview of the background, objectives, scope and structure of this publication and points out the relationship to existing educational programmes including nuclear security components, and training programmes in this area.

Chapter 2 focuses on the human resource development aspect of capacity building in nuclear security in general and discusses different options to establish nuclear security education at universities as well as issues to be taken into consideration.

Chapter 3 provides an overview of the recommended M.Sc. programme, including recommended prerequisite courses, and a list of required and elective courses. It proposes a pre-thesis practice and touches on the M.Sc. thesis itself. Further, this chapter indicates a possible schedule for the implementation of the M.Sc. programme, including suggested duration for each course in hours, and illustrates the interrelation between the different M.Sc. courses.

Chapter 4 gives an introduction to the certificate programme, including a list of core courses, and additional courses.

Appendices I and II provide a brief description of each course and the respective learning objectives, as well as detailed information on the different topics to be studied in the individual courses. Where appropriate, practical/laboratory exercises are listed and reference publications are recommended. The references are not exhaustive as they are limited to relevant IAEA conventions[4] and publications[5], related IAEA training material, United Nations' (UN) Security Council resolutions[6] and topic related UN conventions[7]. This allows university curriculum developers from different countries to recommend any other national or international publication considered as relevant for the individual course topic.

2.4. The Master of Science programme (M.Sc. programme)

The structure of the recommended M.Sc. programme consists of 12 required courses and 11 elective courses. The design of each course is characterized by a combination of theoretical and practical sessions, such as demonstrations, laboratory exercises or case studies which should be in line with the teaching policy of the implementing university and defined by the individual faculty.

The 12 required courses are covering the main nuclear security areas 'prevention, detection, and response' and other fundamental areas, such as nuclear security culture, legal framework, nuclear technologies and applications, and radiation protection. By selecting some of the elective courses providing comprehensive knowledge in selected topics, students can obtain a specialization in certain areas of nuclear security along with more

[4] Such as the Convention on the Physical Protection of Nuclear Material [2]
[5] Such as Nuclear Security Series No. 1 [3]
[6] Such as UNSCR 1540 [4]
[7] Such as the International Convention for the Suppression of Acts of Nuclear Terrorism [5]

advanced knowledge, such as nuclear material accountancy and control, nuclear forensics and attributions or IT/cyber security.

The successful completion of the programme includes a pre-thesis practice that should be performed in a security office of a nuclear facility, at an emergency response organization, with law enforcement agencies, such as customs authorities or at the university under the supervision of a university professor or an experienced nuclear security officer approved by the university, and the preparation and defence of an M.Sc. thesis in the area of prevention, detection or response, according to the selection of the majority of elective courses.

2.5. The Certificate Programme

The availability of qualified specialists in all areas of nuclear security is essential for the establishment of a nuclear security regime in a State. As experienced in other technical areas, the graduate certificate programme in nuclear security could be developed by various institutions, such as universities under their continuing educational programmes, professional societies or governmental organizations.

The determination of the required prerequisites for participating in a certificate programme in nuclear security should be made by the respective university or academic institution. However, applicants aiming to undertake the certificate programme should have sufficient background knowledge or relevant working experience to be able to follow the course material, as per requirement of the university or academic institution. The recommended prerequisite courses for the participation in the certificate programme are the same as for the M.Sc. programme. The recommended duration of the certificate programme is 16 weeks, which corresponds to a typical university semester. The proposed certificate programme is flexible enough to tailor duration and course contents to the specific nuclear security training needs of individual States.

3. Practice in States

3.1. Europe

In Europe, on the basis of the Bologna declaration and the European Credit Transfer System(ECTS), the European Nuclear Education Network (ENEN) Association has established, under the European Commission-EURATOM Framework Programme projects, the ENEN Certificate “European Master of Science in Nuclear Engineering (EMSNE)”[6] for the classic nuclear engineering courses covering well reactor operation and nuclear safety aspects. The main requirements of EMSNE is to complete a full two years program (120 ECTS), including at least 60 ECTS taken at purely nuclear subjects, at least 20 ECTS taken from a foreign institution, and a Master thesis. The EMSNE is implemented since 2005 based on a common reference curriculum, mutual recognition among the ENEN Members and promotion of the mobility of students throughout Europe.

The EMSNE does not include courses on nuclear security. According to the needs, however, further development of the EMSNE into other nuclear disciplines, such as a European Master in Nuclear Security is being considered based on the IAEA Guideline Educational Programme in Nuclear Security.

3.2. Russian Federation

In the Russian Federation, the Moscow Engineering Physics Institute (MEPhI) and the Tomsk Polytechnic University (TPU) offer educational programmes in *Material Protection, Control and Accounting* (MPC&A) that provide excellent background for the development of a comprehensive nuclear security educational programme.

In 2008, the Master Programme in *Nuclear Control and Regulation* was established at the Applied Physics and Engineering Department of TPU. This Programme will be based on the

IAEA Educational Programme in Nuclear Security and will use resources from the MPC&A programme.

Both academic programmes will be addressed to students and specialists working within the competent authorities for nuclear security and other institutions or organizations responsible for nuclear security in a country. The different programmes will be open to students from the Russian Federation as well as international students. Due to the geographical position of Tomsk, it is expected that in the first instance Russian students and students from Asian countries might be interested in enrolling in the academic programmes.

The TPU plans to launch the national Master Development Programme in autumn 2009 by providing courses taught by TPU experts. In parallel, the following steps will be initiated:

- The current national academic curriculum has to be modified and expanded in order to align it with the *IAEA Educational Programme*.

- The provision of international experts for pilot courses should be assured and at the same time the development of qualified nuclear security instructors needs to be organized.

- The development and expansion of existing training laboratories needs to be planned.

All works will be undertaken by the TPU in cooperation with the IAEA involving also other countries and organizations.

4. Conclusion

The *Educational Programme in Nuclear Security* is intended to be a 'tool box' that provides a comprehensive and current overview of nuclear security. It is designed to assist States to develop their own nuclear security educational programmes, based on their individual educational needs. Moreover, this guidance document, which will be published in 2009, should be useful in the development of a comprehensive national human resource development programme in nuclear security with the purpose of building and maintaining knowledge and sustaining qualified individuals dealing with the challenges that the future will bring in this area.

States from different regions in the world have already expressed their interest in developing a nuclear security educational programme in line with the *Educational Programme in Nuclear Security.* And the IAEA has received several requests for assistance in this process. The Agency stands ready to help States in their efforts to bring sustainable nuclear security knowledge to their countries and to improve the performance in preventing, detecting and responding to malicious acts involving nuclear and other radioactive material.

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INTEGRATION OF RADIATION PROTECTION INTO GENERAL HEALTH AND SAFETY TRAINING?

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ABSTRACT

Responsibility for health, safety and environment (HSE) issues at the workplace lies with the employer. The employer is advised and supported by safety experts from the various areas of HSE. German law calls for all persons involved in these activities to work together closely. This pragmatic approach enables synergies to be better harnessed and increases efficiency.
However, experience, both in Germany and elsewhere, shows that the safety experts from the different disciplines do not always “speak the same language”, which causes their collaboration, effectiveness and efficiency to suffer.
By comparing general occupational safety and health (OSH) and the specialist field of radiation protection, this paper will provide an example to highlight the important role played by the general risk evaluation, principles for action and the specific protection objectives in creating an efficient OSH management system. The need for these topics to be integrated into the training of the various safety experts will be illustrated.

1. Introduction

In 1996, Council Framework Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (1) (the “Health and Safety Directive”) was transposed into German law, along with other European health and safety directives, in the *Arbeitsschutzgesetz* (Act on Occupational Safety and Health) (2). The Act, abbreviated to “ArbSchG” in German, applies to all fields of work.
This is a pragmatic approach since workplace evaluations (e.g. in a radionuclide laboratory) encompass not only radiation protection but also areas such as fire protection, hazardous substances, workplace ergonomics, genetic engineering and explosion protection. Environmental aspects also have to be considered.

Fig 1: Example of an interdisciplinary HSE scenario (radionuclide laboratory)

Each of these areas is subject to special legislation. In the area of radiation protection, the legislation is based on the EURATOM directives.
Responsibility for ensuring health and safety at work and environmental protection lies with the employer. The employer is advised and supported by safety experts from the various areas of HSE. However, employers and employees only react positively to these safety experts if they collaborate in a constructive manner, propose joint strategies with which to solve complex problems and support both the employer and the employees in their efforts to implement those strategies. The overall evaluation should therefore also include radiation protection aspects.
German law calls for all persons involved in HSE to work together closely. This approach is pragmatic too since it makes it easier to harness synergies and increase efficiency. The elements required for a continuous improvement process in prevention can also be derived from the legislation, providing a further aid to ensure proper, consistent implementation of measures.
However, experience shows that the safety experts from the different disciplines do not always “speak the same language”, which causes their collaboration, effectiveness and efficiency to suffer. This is far from being an exclusively German problem. What causes it?
This is one of the questions with which the *Kooperationskreis „Synergien in der betrieblichen Sicherheit“* (KKSyS – “Synergies in Health and Safety” Cooperation Group) (3) is concerned.
KKSyS is a joint working group of the *Deutsch-Schweizerische Fachverband für Strahlenschutz* (German-Swiss Radiation Protection Association, FS) and the *Verband Deutscher Sicherheitsingenieure* (Association of German Safety Engineers, VDSI). It is composed of safety experts from various disciplines. The group’s very first meeting in October 2003 showed how different the safety experts’ “languages” were. To stop ourselves constantly talking at cross purposes, we decided our first task should be to analyse where our communication difficulties lay. The first disciplines we looked at were general OSH as compared to the specialist area of radiation protection (ionising radiation) since communication between these two areas had proved most difficult. The results and conclusions are presented in the following sections.

2. From analysis of the problem to the continuous improvement process in prevention

2.1 Protection objectives

A simple real-life example can help illustrate the difficulty – the “hammer and window problem” in a radionuclide laboratory.
The laboratory is located on the ground floor. As there is no second escape route to the corridor, a window has been defined as an escape route.
In Germany, the evaluation of this scenario would involve the following areas (persons):
- radiation protection (radiation protection officer),
- fire prevention (fire protection officer) and
- general occupational safety (safety specialist).

If the work of these three persons is uncoordinated, i.e. if they do **not** work in collaboration, the solution often takes the form shown in Fig 2.
Numerous pictograms and tools that would confuse those trying to escape in an emergency, a fire for instance.
Why does this situation occur?

During their training, the safety experts will have been taught all about the typical protection objectives in their specific fields. In the case described here, these objectives would be as follows:
- For the radiation protection officer:
  No radioactive substances should be released into the environment. To this end, the low pressure in the laboratory must be permanently maintained. The solution typically used to meet this protection objective is to prevent windows from being opened.
- For the fire protection officer:

In the event of a fire, it must be possible (without any aids) to leave the laboratory via a second escape route, in the case described here at least via one window.
The solution typically used to meet this protection objective when there is no window handle is to provide a hammer and brief instructions on how to use the hammer in order to make the escape route usable.

- For the safety specialist:
The second escape route must be usable without any further risks.
The solution typically used to meet this protection objective is to provide face protection and gloves to prevent cuts when breaking the glass.

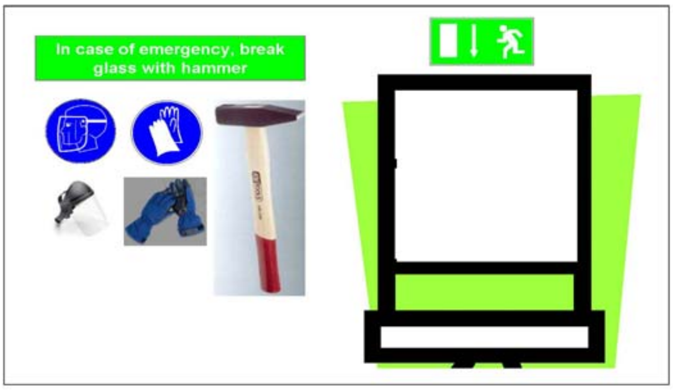

Fig 2: Poor solution of the hammer and window problem in a radionuclide laboratory

If the three experts consult with one another from the outset, the three different protection objectives will also be taken into account from the outset. The solution could then take the form shown in Fig 3.

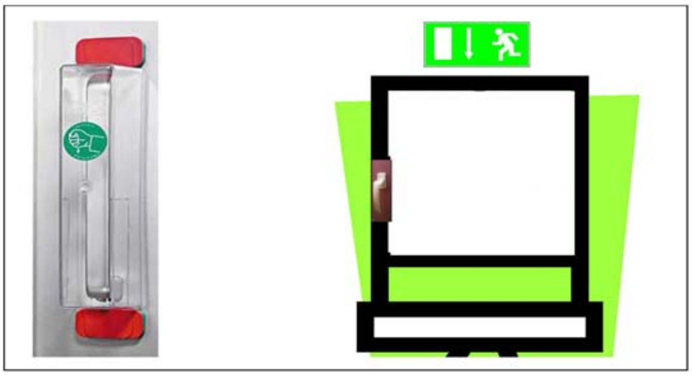

Fig. 3: Optimum solution for the named problem – installation of a cover over the window handle to be removed in an emergency.

But how do these three experts know that the scenario described here involves them?

2.2 Risk evaluation and principles to be applied when specifying the necessary measures

That question is easy to answer. The “Health and Safety” Framework Directive (1) and thus the German ArbSchG (2) stipulate that the employer must conduct a risk evaluation. The risks associated with the employees’ work have to be identified and OSH measures specified in order to minimise those risks. The principles to be adhered to when specifying said measures are shown in Tab 1. Interestingly, these principles can also be found in the area of radiation protection (Tab 1) although the national legislation is based on EURATOM directives, not EU directives.

The workflow described below has proved successful for general risk evaluations in practice:
1. Specification of the area to be evaluated
2. Identification of the risks

3. Specification of the protection objectives
4. Specification of the technical, organisational and personal protective measures
5. Implementation of the measures
6. Monitoring of initial implementation, effect and continued implementation
7. Documentation

General OSH **Principle**	**Radiation protection (ionising radiation)** **Principle**
Required action: Prevention of causes and minimisation of remaining risks	Required action: Prevention of unnecessary (contamination and) radiation exposure and minimisation even below the exposure limits
Sequence of protective measures: Technical protective measures before organisational ones and both before personal protective measures ("TOP model")	Sequence of protective measures: "Protection for persons exposed to radiation at work should primarily be provided by means of structural and technical devices or suitable work methods"
Consideration of the state of the art and other substantiated findings from the field of human factors engineering	Consideration of the state of the art

Tab 1: Principles to be applied when specifying the necessary measures

A detailed examination of items 1 and 2 reveals which safety experts should be integrated in the process. Items 3 to 5 are dealt with by those safety experts in concert. Items 6 and 7 require the specialist knowledge of the various safety experts again.

Irrespective of the general risk evaluation, the same points have to be considered for radiation protection even though the legislation is based on the EURATOM directive. Items 1 to 4 are performed during the permit application phase. Items 5 to 7 are carried out when the permit is granted and during subsequent operation. Thus, the workflow for a risk evaluation is generally familiar in the field of radiation protection – it merely goes by another name.

KKSyS also compared other aspects relating to experts from general OSH and radiation protection, e.g. specific tasks. Here too, there were a surprising number of parallels and common features.

This section can thus be summed up by saying that the communication difficulties between the various safety experts are mainly due to their different protection objectives.

2.3 The continuous improvement process in prevention

By grouping and arranging all of the aspects compared, one can create the elements of a management instrument, the continuous improvement process in prevention (Fig 4).
All of the safety experts can be integrated into this model. Its elements are stipulated by law.

3. Integration of radiation protection into general health and safety training?

There should always be safety experts for specialist areas, e.g. radiation protection (ionising radiation), genetic engineering and hazardous substances. Their training should continue to focus on the protection objectives currently identified since they are closely linked to the characteristics of the sources of risk in their fields. In radiation protection, all of the protection objectives are based on the fact that radiation is ionising. The objectives aim to minimise the dose. This requires specialist knowledge, beyond general OSH. The high standard achieved so far should not be abandoned.

What needs to be cultivated is the way in which the safety experts collaborate. They need to be made aware of the issues whilst still in training. Units should be integrated into the training to make them aware of the interfaces between and common features of their roles. Even though the objection is often raised that “These areas are already grouped together in one department in our company’s structure”, such a set-up by no means guarantees that the safety experts in the company actually talk to one another – as experience shows.

Over the past few years, KKSyS has mainly worked on raising awareness of this issue in the German-speaking world. For instance, it developed and ran a one-day seminar with practical exercises, covering all of the topics discussed in this article. This was followed by papers at internal seminars held by research institutions and enterprises, at public events, such as conferences on radiation protection and OSH and special events staged by ministries. The topic has now been permanently adopted by some providers of state-recognised continuing training for radiation protection officers. The interest in the topic shows how much there is still to be done.
An international recommendation on the integration of the topic of “Synergies in Health and Safety”, with at least “general risk evaluation”, “other safety experts and their protection objectives” and “the continuous improvement process in prevention” as sub-topics and an explanation of the links between them, into the initial and continuing training of the different safety experts would be advisable. Practical exercises, e.g. on the risk evaluation, would complete the package.

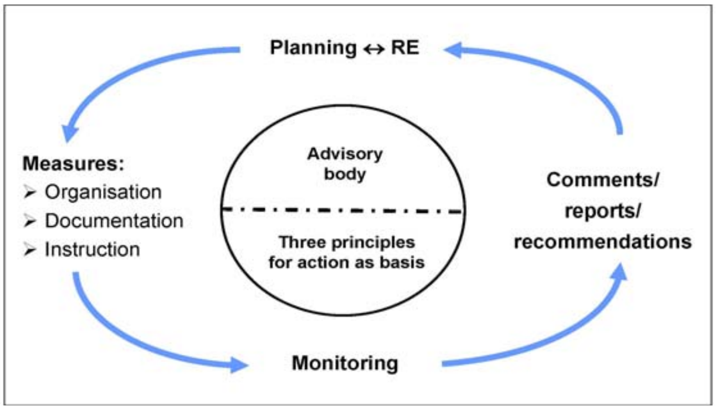

Fig 4: The continuous improvement process in prevention. RE = Risk evaluation

4. References

(1) Council Framework Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (the “Health and Safety Directive”)

(2) ArbSchG - Act on Occupational Safety and Health (Act on the introduction of OSH measures to encourage improvements in the safety and health of workers at work) of 7. August 1996.

(3) *„Kooperationskreis Synergien in der betrieblichen Sicherheit“* (KKSyS – „Synergies in Health and Safety“ Cooperation group)*“* of the *Deutsch-Schweizerische Fachverband für Strahlenschutz e.V.* (German-Swiss Radiation Protection Association, FS) and the *Verband Deutscher Sicherheitsingenieure* (Association of German Safety Engineers, VDSI)

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