Educational and Training Needs in Radioactive Waste Management

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ABSTRACT

For further safe use of nuclear technology it is highly important to maintain the achieved level of knowledge and expertise. The risk of losing nuclear knowledge accumulated in the past is being increasingly discussed in many countries. As part of this debate the knowledge of radioactive waste management is also being closely watched. The current position and future needs of education and training in radioactive waste management were investigated within the coordination action CETRAD as part of the 6th Framework Programme of the EU. Twenty partners from 17 European countries, including Slovenia, took part in this investigation. The review focused on geological disposal. It has considered the training and education needs of national radioactive waste management organisations, regulatory and government advisory organisations, and other nuclear industry organisations employing staff in this area, and also the provision of education and training by university and non-university organisations to address these needs. The results and conclusions of this research are presented in this paper. Emphasis is given to the national survey results and estimations of our E&T needs in radioactive waste management.

1 INTRODUCTION

In the last decades, management of radioactive waste has earned increased attention in many nuclear countries. Expertise in waste management principles and practice has grown and evolved, new skills and capabilities have been developed. However, with the stagnation of the nuclear industry, in many nuclear fields it has been observed that the skills and expertise are not being passed on to new generations of experts. Such a situation represents a significant risk to the community, which needs to manage present and future nuclear liabilities. Concerns are being raised also in the area of radioactive waste management. Transfer of knowledge and expertise in this area is of particular importance since the time spans of liabilities in waste management extend far into the future.
The main objective of the CETRAD project was to investigate and assess the current position of education and training in radioactive waste management (RWM) in different European countries, with the focus on geological disposal, and then to develop proposals for structuring and delivering both education and training in the management of the geological disposal of high-level and long-lived radioactive wastes and spent fuel in geological formations across Europe [1].

Within this context, a review of educational and training needs in RWM has been undertaken in 17 countries: Belgium, Bulgaria, Czech Republic, Finland, France, Germany, Hungary, Italy, Netherlands, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland and United Kingdom. Data for this review were gathered using a survey conducted across participating countries. In each country a National Correspondent was responsible for gathering data on a national level. Cardiff University from UK acted as an overall co-ordinator of the whole project and ITC School of Underground Waste Storage and Disposal from Switzerland assisted in data gathering and co-ordination activities.

The review has considered training and education needs, which were regarded to be distinct activities. Training was considered as learning a particular skill required to deliver a particular outcome, while education was understood to be broader than training since it encompasses the need to maintain the completeness and continuity of competence across generations. In addition to national radioactive waste management organisations, the review has included also regulatory and government advisory organisations, and other nuclear industries employing staff in this area, and provision of education and training by university and non-university organisations to address these needs.

2 RESEARCH METHOD

The data on training and education needs and possibilities were collected through a set of questionnaires created on the relevant topics and distributed to the National Correspondents. The first questionnaire was composed of three sections:

- training needs,
- capabilities and activities, and
- general observations.

National Correspondents collected the responses to the questionnaires from all organisations employing staff in RWM in each country. They were grouped into three categories:

- A national RWM organisation (generally agencies and universities involved in the management of nuclear waste),
- Other nuclear industry organisations employing staff in RWM (private and public organisations employing staff in RWM, e.g. consultants and contractors),
- Regulatory and government advisory organisations employing staff in RWM.

Identification of training requirements for all organisations employing staff in RWM in each country enabled the detection of training needs and requirements, thus providing a general overview of demand across participating countries.

Identification of capabilities, activities and facilities of education and training providers included non-university organisations providing education and training in RWM (private and public RWM education and training providers) as well as universities. This identification made it possible to detect the ability to meet the demand, both at the national and the European level.

In addition to these focused data, some more general information – e.g. “National incentives and national strategy to improve education and training in RWM” and “National funding provisions for education and training in RWM” - was also needed to make
evaluation. Identification of these activities at a national level provided contextual information assisting in the identification of each country’s current situation and future direction, which was used to generate the national overviews.

The responses to the first questionnaire showed some weaknesses and gaps within the data identified. As the main reasons for these gaps we can list: subjectivity regarding terminology and interpretation of questions, differences in national perceptions, provision of non specific data or lack of quantitative data to enable accurate measurement of results. Differences in education systems across Europe sometimes made common understanding difficult and responding subjective, especially in specialisation and qualification references.

In order to address such flaws, following receipt of responses to the initial survey, two additional questionnaires were produced and responses requested from the participants. These responses helped us to obtain more specific data and clarify some ambiguities, and also to improve the value of the review. Additional information was also obtained at the internal project meeting where national correspondents presented findings supplying clarification regarding terminology and interpretation.

3 RESULTS AND ANALYSIS

3.1 Training Needs

The survey has identified national RWM organisations as being well established in Europe, employing an average of 60 specialist staff per organisation and a total of almost 700 across the participating countries. The majority of specialist staff are qualified to PhD level and are between 30 and 50 years old. Broad RWM training for new specialist staff is generally required, involving a wide variety of subjects both directly and indirectly applicable to RWM and geological disposal. In-house training is usually provided through on-the-job training. Employment of specialist staff is currently at a peak but is not expected to increase significantly.

Other Nuclear Industry organisations are numerous and are closely linked to National RWM Organisations. Specialist staff makes up the majority of all staff within Other Nuclear Industry organisations, employing a total of approximately 7000 RWM specialist staff, most of whom possess technical degrees and qualifications. Education and training is typically developed in an ad-hoc manner through on-the-job training, attendance at conferences and according to organisational requirements.

The survey has identified that Regulatory and Government Advisory Organisations in all participating countries also employ staff in RWM. More than 600 specialist staff are employed in these organisations, generally possessing PhD and MSc level qualifications. Although new specialist staff requires broad training in RWM, legislation does not demand extensive education and training for specialists in this area, and on-the-job training is a key component of staff development. Where training is provided, in-house training topics are found to be broad or introductory, and specialised or focused training is usually obtained externally. Overall, Regulatory and Government Advisory Organisations anticipate little change in the numbers of specialist staff employed in both the short and medium term.

3.2 Capabilities and Activities

Both private and state owned non-university organisations provide RWM education and training in most participating countries, and many have a training centre that covers the majority of non-university training requirements of the national industry. Generally, non university courses are broad, targeted at various levels and focus on the provision of professional training through stand-alone courses, but some are noted to work with
universities (for example, Portugal, Switzerland, France and Spain) or are somehow linked to industry (for example through sharing of facilities). Non-university courses are identified as dependent on demand and have the freedom (unless contractual or legislative agreements to supply have been made) to be flexible customising services to meet client needs with various training material, classroom and laboratory facilities available. Average participant numbers range from 5 to 30 except in a few cases where much larger figures are obtained. Overall, non-university education and training in RWM provision is uncoordinated and disjointed.

There are no courses that provide a qualification in RWM, yet each country has RWM modules or lectures available. Across the participating countries, numerous courses are accepted, covering a wealth of disciplines which include elements of RWM teaching. Teaching and external practical training facilities are available and most participating countries consider it feasible to teach a universal course in English, if not already doing so. Participation numbers are higher than those of non-university courses and university courses are accredited under the Bologna process by default.

3.3 European Education and Training in RWM

The supplementary survey has identified the demand for 200 specialist staff educated to MSc level in a number of areas over the next five years to fulfil additional recruitment and natural replacement needs. The survey has revealed modest levels of demand for the courses available despite difficulties in predicting future recruitment as a consequence of uncertain national RWM programmes. Potential future demand for specialist staff in RWM and geological disposal can to some degree be estimated through the identification of anticipated dates for the creation of Underground Research Laboratories and Underground Geological Repositories.

The survey also confirms previously identified shortfalls in the number of developing specialists (under 30 years old) within the European radioactive waste management industry. The age at which individuals obtain ‘specialist’ status is found to be between 30 and 40 years old, and several National Correspondents confirmed a decline in specialists of this age group. These findings support the identification of a gap between generations as highlighted by the International Atomic Energy Agency [2], and further reinforce the need for education and training to ensure that the knowledge skills and abilities from the current generation of experienced nuclear professionals are transferred effectively to the workforce of the future.

The educational qualification profile of specialist staff currently employed ranges across all levels, from highly specialist qualifications (i.e. PhD and Licentiate) to those educated to below university level. Across the various qualification profiles and different categories of organisations employing staff in RWM, staff with expertise in the following scientific disciplines is currently employed:

− Earth sciences & rock engineering.
− Civil engineering & underground construction & mining.
− Nuclear & chemical engineering.
− Radiation protection & safety assessment.

Also, public relations and communication is found to be a growing area, with the general acknowledgement that social acceptability and inclusion issues have an increasingly important role to play in RWM.

Future demand will continue to require staff in these areas.

The survey also showed that on the providers’ side there are sufficient RWM education and training facilities available in Europe for the present needs of the industry. There are 66 universities providing education in RWM via higher level degrees with a combination of MSc and PhD programmes. Training needs are met via the non-university organisations, with 16
such organisations providing training typically via short courses - average participation ranging from 5 to 30. In the future, the sharing schemes can make these facilities available also to third parties.

Currently gaps in expertise between generations are being addressed through on-the-job training and continuous professional development training.

4 NATIONAL SURVEY

In Slovenia, ARAO – Agency for Radwaste Management - accepted the role of National Correspondent for the project. It was assisted by two experts from the “J. Stefan” Institute [3], [4]. In the survey, besides the national RWM organisation, six other organisations employing staff in RWM participated and contributed their responses to the questionnaires. These were: Nuclear Power Plant Krško, Rudnik Žirovski vrh, d.o.o., “J. Stefan” Institute with its Nuclear Training Centre, Institute of Occupational Safety, Slovenian Nuclear Safety Administration, and Faculty of Mathematics and Physics at the University of Ljubljana. They all provided responses to the initial and all supplementary questionnaires.

4.1 The National Nuclear Industry

The overall national demand for education and training in RWM is in close correlation with the size, maturity and goals of the national nuclear programme and nuclear industry. Slovenia maintains a small nuclear programme with only one nuclear power plant and the former uranium mine Rudnik Žirovski vrh, which is currently in the process of decommissioning and is expected to be liquidised once the remediation process is completed. The responsibilities and competences in the nuclear field are clearly allocated, but regulatory and government organisations have numerous complementary RWM responsibilities. The Slovenian Nuclear Safety Administration (SNSA) is the national regulatory body, and the Agency for Radioactive Waste Management is the national RWM organisation responsible for the disposal of radioactive waste and spent fuel and management of RW from small producers. The Jožef Stefan Institute and the Institute of Occupational Safety are technical support organisations authorised to oversee radiation protection practices and measurement and the transport of sources of radioactive waste.

4.2 National Policy including any specific education and training in RWM Policy

Regardless of previous decision to phase out nuclear energy after the retirement of the nuclear power plant, the nuclear component has lately been acknowledged as a viable option in the future electric supply mix. In this context the nuclear education is regaining its significance. However, E&T needs in nuclear field are adjusted to the country specific needs and to the size and capabilities of the programme. The nuclear science and engineering education has found its place predominantly at the postgraduate level. RWM issues are covered inside the wider nuclear engineering programmes. More specific and practical supplementary training is provided by institutions and companies associated with the RWM, such as the Nuclear Training Centre of the Jožef Stefan Institute and Training Department of the NPP Krško. Besides these training possibilities, some companies decide to source the specialist training abroad and practically all companies involved in RWM provide some practical on-the-job training.

Although the long-term policy adopted by the government - and subsequently by the higher education institutions - calls for coherence with the goals set forth by the Bologna Convention, no radical changes in E&T in nuclear field are expected in the future. It is anticipated that higher education covering RWM issues will remain inside the wider nuclear
engineering programmes, and the institutions and companies associated with the RWM will continue to provide for the more specific and practical supplementary training.

4.3 Education and Training Requirements

The investigation of education and training requirements showed that most organisations involved in RWM require specialist staff, however they are found to be difficult to obtain in comparison with generalists. The practical way out adopted in many organisations is to recruit generalists as an alternative to specialists and to provide RWM education and training internally or by using available courses.

Unfortunately, the insight into the future needs of specialist staff and identification of qualifications needed in the future remains unclear, since the questions regarding the number of additional specialists required in the future and the qualifications needed were not indicated by all interviewees. Only 4 out of 6 organisations sent their answers to these questions. Estimates made on the basis of received responses are therefore incomplete and not entirely representative, but nevertheless the trends are indicative. For the next 5 years the need of only about 25 new specialists was identified including both: new posts and replacements of retired specialists. Overall, the industry does not anticipate large rises in new staff, therefore no significant rise in education and training needs is expected in the near future.

New regulations regarding qualifications of specialist staff, which are expected in the near future, may change current practice, in which additional training is required only in the areas of radiation protection, NPP operation and repository operation, and influence also the needs in E&T, although drastic changes are not likely.

Ageing of the workforce has not been exposed as a serious problem. It may be that, due to the later start of the nuclear programme in Slovenia compared to other countries, the problem of ageing has not yet emerged, and will appear with some delay. But it may also be that this aspect has been ignored so far in many organisations.

4.4 Capabilities and Activities

A number of internal and/or external possibilities for E&T in RWM are available. The in-house training department of Nuclear Power Plant Krško provides numerous stand alone courses on different topics including RWM. Although they are intended predominantly for the NPP staff, participation by other organisations is possible upon request. Several training courses in nuclear technology and radiation protection are provided by the Nuclear Training Centre under Jožef Stefan Institute. They are linked to industry and are held once a year or more often, depending on the demand. Courses are mainly held in the Slovene language but some of them also in English. All courses can also be made available for use by third parties, if required.

The University of Ljubljana, Faculty of Mathematics and Physics, provides postgraduate studies (M.Sc. and Ph.D.) in Nuclear Engineering. The studies are organised in several courses covering different professional disciplines. The RWM module is within a broader Nuclear Engineering Course. The postgraduate programme at the University of Ljubljana is a member of the ENEN Association, which is a non-profit association established primarily to strengthen and further develop the higher nuclear engineering education in the European Union through cooperation between universities and through facilitation of teacher and student mobility.

The investigation shows that the existing E&T facilities in Slovenia do meet the present rather modest needs. The capacity of E&T facilities is sufficient, even if the inflow of students will increase in the future. The available capacities are open also to third parties.
4.5 Summarized results

The comparison of the results of the national survey with the results in other participating countries shows no significant differences or deviations from other countries or from average results at the European level. Due to the small size of the nuclear industry and rather unclear future development of the whole nuclear sector - and in particular long-term waste management - the demands for new recruitment of the staff and additional education and training in RWM are rather modest. For the next 5 years the need for only about 25 new specialists was identified, including both: new posts and replacements of retired specialists. The number may be underestimated because some vital organisations in the field did not provide their estimates and plans. There is also a fear that the problem of ageing of the workforce has so far not been addressed seriously in many organisations. Future retirement of experienced experts and specialists may create a gap that will require more intensive E&T. A systematic research or analysis of this problem should be performed to give more reliable predictions.

Present capacities for E&T in RWM and in nuclear engineering seem sufficient to cover the rather modest present and future needs. The quality of education is comparable with that of other European countries. Upon the request the courses can be given in English and made available for use by third parties. The postgraduate programme at the University of Ljubljana is also a member of the European Nuclear Education Network ENEN.

5 CONCLUSIONS

The survey, conducted under the CETRAD project, has identified that within the 17 CETRAD participating countries, in all 3600 specialist staff are employed by national RWM organisations, other nuclear industry organisations and regulatory and government organisations employing staff in RWM. These organisations expect to recruit, as a minimum requirement, 200 new and replacement specialist staff over the next five years.

Considering the current numbers of specialists, this is a very modest figure and would seem to indicate a future decline in overall numbers. However, the uncertain nature of some of the national radioactive waste management programmes affects the accurate projection of recruitment figures.

Investigation of education requirements has shown that most radioactive waste management organisations have national qualification requirements imposed for specialists working in RWM, particularly for nuclear safety and radiation protection. Yet there are no strong drivers for education and training in radioactive waste management as there are in other nuclear areas. The missing national qualification requirements for RWM are usually replaced by broad introductory training in RWM.

New and replacement staff are generally required to be educated to higher degree level (typically either MSc or PhD) in classical scientific disciplines and not in RWM. It should be recognised that this policy, in terms of the expected subject of a higher degree, is strongly affected by the fact that historically specialist higher degrees (MScs) in RWM have not been available. This however does not preclude the possibility that, if individuals with an MSc in RWM appeared on the job market, these same organisations might alter their position and favour such candidates. Currently there are no specific MSc level courses in RWM. MSc level training is provided by 66 Universities, but RWM is typically addressed only by individual modules within these broader courses. However a specific course, based in Germany, is planned to commence in late 2005. In this context a European level MSc in this area, based on European Centres of Excellence, is worthy of further consideration.
The requirement for training as a tool to develop and maintain the specialist staff knowledge and expertise has been clearly stated by all organisations reviewed in the survey. Training provision is achieved through on-the-job training, internal and external courses, attendance at conferences and seminars. Most organisations rely on a combination of several supplementary training methods based on a mixture of internal and externally sourced provision.

There exist both private and state owned non-university organisations supplying RWM training in most participating countries at various levels and typically provided in the form of short courses. External courses are provided by 16 non-university organisations. Regarding education and training facilities, the survey showed that there are sufficient RWM facilities available in Europe.

The main features absent from the provision of education and training are:

- the co-ordination of educational and training needs and provision at the European level, and
- mechanisms to allow recognition and accreditation of the training provided.

Both of these factors inhibit cross national use of existing educational and training facilities.

REFERENCES


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