

Knowledge Management in the Field of Nuclear Energy - How to Bridge the Gap between Retiring Workforce and Next Generations – 17101

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ABSTRACT

The current phase-out decision of the German Federal Government and the “Energiewende” – resulting from the Fukushima Daiichi Accident in 2011 – changed the nuclear market significantly. Together with the change in political and social attitude towards nuclear energy since 2002 it has contributed to a decline in technical expertise. This as well as the generation change in the nuclear technology lead to the risk of losing accumulated knowledge and experience which still are essential for the future - not only in Germany but in other countries - even though the focus in Germany will shift from operating to decommissioning, dismantling and radioactive waste management.

A long-term strategy in order to preserve technical expertise to solve the forthcoming tasks in Germany was required. This strategy should include e.g. the implementation of technical programs not only for internal training of the staff but also for authorities. Together with authorities TÜV NORD developed individual training concepts for a broad range of customers to preserve a transfer of know-how with the state-of-the-art in science and technology and even support international projects, especially in countries with less experience in the nuclear fields. Additionally, special data bases were developed in order to ensure the accessibility of long-term nuclear data storage. Furthermore technical conferences in different fields like decommissioning and radioactive waste disposal were established as an opportunity for knowledge exchange. Based on given examples it is being demonstrated how technical expertise can be preserved even though the field of nuclear energy in Germany has changed.

INTRODUCTION

In 2002, the Federal Republic of Germany agreed on the nuclear phase-out, which intended a gradual phasing out of the nuclear energy without fixed shutdown dates. After the Fukushima Daiichi Accident, the Federal Republic of Germany decided in 2011 that all NPPs will be gradually taken out of service by 2022. The nuclear phase-out is an important part of the “Energiewende”, which provides transition to renewable energies for the long-term.

In this context, a high decline in university graduates in nuclear engineering disciplines and the reduction of teaching capacities at German universities could be observed [1]. Therefore, it is difficult to find qualified young specialists in the German labor market and maintenance of the required technical competences eventually becomes the task of the industry itself. Furthermore, the focus in Germany will shift from operating nuclear facilities to decommissioning and

dismantling and therefore the requirements with regard to radioactive waste management will increase [2].

In order to deal successfully with the future challenges, the current know-how and high competences must be preserved, transferred, and enhanced with appropriate measures.

LONG TERM STRATEGY TO PRESERVE TECHNICAL EXPERTISE

In Germany, independent expert organisations are contracted by the competent authorities for technical support in the field of nuclear energy. TÜV NORD as one of the independent expert organisation has experience for more than 50 years as a full service provider in this field which includes safety assessment, process technology, electrical engineering and control systems, reactor physics, fluid dynamics, material and stress analysis, radiation protection, decommissioning and dismantling, and radioactive waste management.

After establishment of the nuclear engineering department of TÜV NORD in 1966, a rapid expansion of staff began, which led, for instance, to a tenfold increase in the number of experts from 1970 to 1980 (see Fig. 1). In the 1980ies the situation remained rather stable with still ongoing new build activities accompanied by operation monitoring for nuclear power plants on behalf of the competent authorities. The further expansion of staff from 1990 onwards can be explained by safety-related assessments in connection with facilities for nuclear supply as well as increased TÜV NORD activities especially due to the involvement in the field of radioactive waste disposal [3].

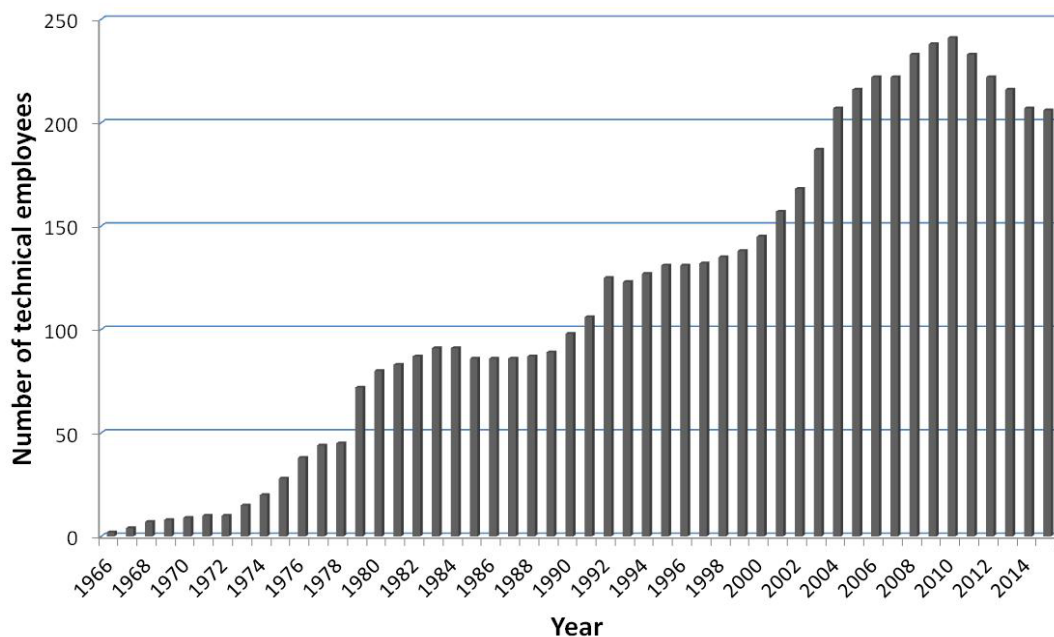


Fig. 1: Change of number of staff at TÜV NORD in Hanover over the years.

Caused by a very low fluctuation of staff in the last decades, more than 50 % of the nuclear technology workforce of TÜV NORD was older than 50 years in 2001 (see Fig. 2). Thus, more than 50 % of the senior experts of that time will retire until the year 2020. In order to counteract this process and to cope with the upcoming tasks, TÜV NORD has employed a large number of new employees. The age structure has been successfully changed until 2009 towards younger employees (see Fig 2).

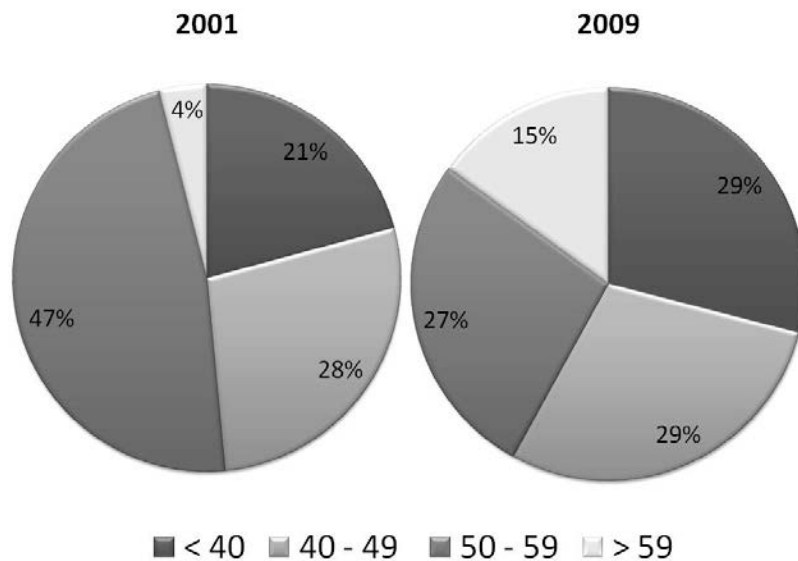


Fig. 2: Change of age distribution of staff in the years 2001 and 2009.

In order to guarantee a knowledge transfer from senior experts to young professionals, an overlap of young and older employees was envisaged. This led in total to high increase of employees until 2010. After 2010 a decline of employees arose due to the retiring senior experts which led to an aspired stable number of employees of at least 200. In 2015 the age structure shifted further to a higher amount of young employees while the number of elder senior experts (>59) decreased again.

In order to ensure safe operation until the end of the shut-down of German NPPs in 2022 and beyond and to cope with the already existing and upcoming tasks of decommissioning, dismantling and radioactive waste disposal it is necessary to maintain the existing know-how and to guarantee a knowledge transfer to the next generation. Therefore, TÜV NORD has been taken the following measures:

- a nuclear technology training centre was founded as a part of succession planning in order to cope with the decline of technically qualified young specialists,

- training programs were developed in cooperation with other companies or competent authorities nationally and internationally to guarantee a common understanding on complex issues and to ensure the transfer of know-how with the state-of-the-art in science and technology,
- a data base system was implemented at an early stage to ensure long-term data storage and to guarantee accessibility to accumulated know-how, and
- specific symposia were offered as platform for discussions of current developments and requirements in different fields of nuclear energy.

Nuclear Technology Training Centre

In the course of the succession planning and in view of the upcoming generation change, in the year 2001 TÜV NORD developed a medium-term strategy in order to guarantee knowledge transfer from the retiring senior experts to young professionals. The main point of this strategy is to hire a young professional at least three years before a senior expert is retiring, generating a platform for knowledge exchange between both and ensuring training and education in all relevant fields. That is why the "Nuclear Technology Training Centre" was established as a part of the strategy to offer and coordinate training and education measures of TÜV NORD staff (see Fig. 3). This compact and practice oriented training centre encompasses basic aspects of nuclear technology in the field of NPP operation, decommissioning and dismantling and the radioactive waste disposal as well as questions related to licensing and regulatory supervision of nuclear installations. In comparison to already existing training courses the educational objective is targeted on the requirements of technical experts working at independent expert organizations in the above mentioned fields [3], [4].

The training center is divided into a basic and a specific instruction covering a period of 2-3 weeks (see Fig. 3). Senior experts from TÜV NORD and from competent authorities give lectures on specific topics. The main scope reflects on:

- systematic mediation of basic knowledge,
- systematic placement of specialized knowledge,
- preservation of acquired competences by involving senior experts,
- expansion of methodological and social competences.

In addition to the training centre an individual professional training is initiated depending on the key activities (work field) of the trainee. Furthermore, accompanying measures are implemented via "training on the job" by involving senior experts to preserve existing knowledge.

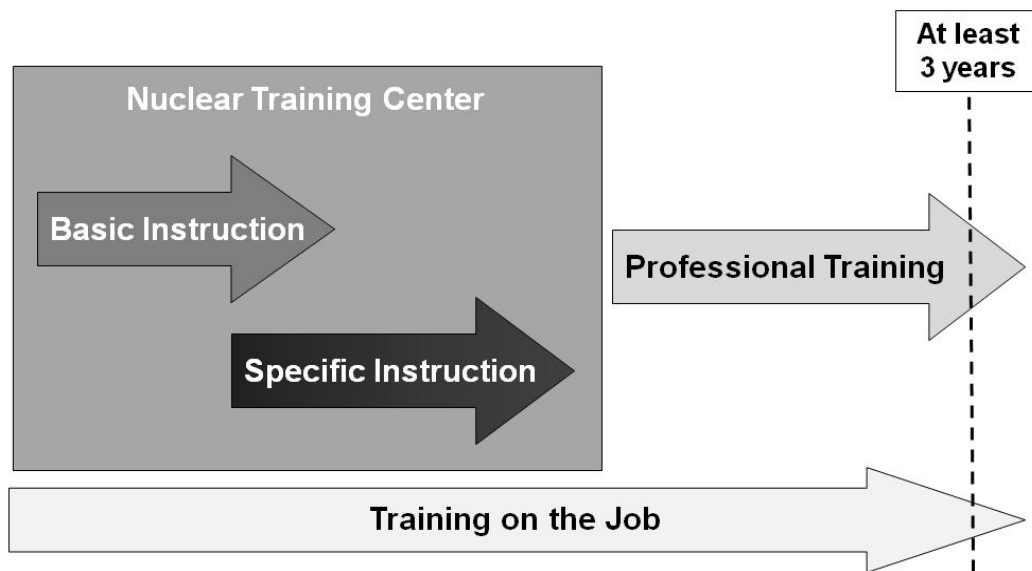


Fig. 3: Succession planning.

Based on the existing experience, the “Nuclear Technology Training Center” implemented as part of the strategy, offers the opportunity

- for education and training of young professionals even though previous nuclear specific knowledge is lacking,
- to ensure knowledge transfer to new generations of nuclear experts in all relevant fields,
- to preserve existing competences by involving senior experts,
- to raise the awareness of the need for interdisciplinary cooperation (team work) in the complex field of nuclear safety, and
- to ensure high competence and qualification in the field of nuclear safety.

Since the training centre is not only designed for TÜV NORD’s own workforce but also for experts of other expert organisations and regulators, an external knowledge transfer and preservation is also ensured. The already implemented structure represents a flexible tool in order to deal with the forthcoming tasks since teaching and learning content can be easily customized.

Development of Individual Training Concepts

Based on the experience with training of own staff mentioned above and due to the experiences as independent expert organization responsible for qualification, inspection and examination in different fields of nuclear technology, it became obvious that external knowledge exchange in consideration of own experiences plays an important role, e.g. in the field of qualification of waste packages to be disposed of in the Konrad repository.

One of the main topics to focus on in Germany is the disposal of radioactive waste with negligible heat generation (comparable to LL / ILW). This kind of waste is intended for the repository Konrad whose licensing decision was fixed in April 2007. With the aim of producing a waste package suitable for disposal in the repository Konrad, different aspects need to be fulfilled in order to prove compliancy with the waste acceptance requirements for Konrad. Based on the experience with such complex processes, regulations and requirements, it became obvious that a common understanding by authorities, operators, service companies and technical experts is essential in order to fulfill their obligation. Therefore, a co-operation with the University of Hanover and the Federal Office for Radiation Protection (BfS) – the competent authority in Germany for the construction and operation of the Konrad repository – was established in 2010 and a one week training concept was developed and implemented.

The seminar is divided into the following parts:

- basics aspects of the safety assessment of the disposal facility,
- requirements for waste packages based on the safety assessment,
- application of requirements on different processes,
- documentation and data management,
- legal basics like structure of the federal and the state law, ordinances etc., definition of roles and responsibilities.

In addition to the theoretical part of the lecture, gained knowledge is applied and increased by practical exercises. Senior experts from the BfS and TÜV NORD give their lectures and share their expert knowledge and experience. Participants who mainly attend the course are employees of operators, waste conditioners (service companies) and authorities.

Due to the implementation of such individual training concepts a transfer of experience and know-how for future senior experts is ensured and a common understanding on complex issues is enabled.

Further seminars focusing on the own staff were also established. Based on this strategy for know-how transfer and preservation an efficient tool for the forthcoming tasks in the field of radioactive waste disposal in Germany was implemented.

Beside the German specifics of waste disposal TÜV NORD has transferred training concepts upon international requests. On behalf of and partially in cooperation with other institutions individual training concepts for nuclear operators and authorities were developed in different fields of nuclear technology. With these training courses a transfer of know-how with the state-of-the-art of science and technology in the international nuclear market can be ensured as well. The following two examples show the variety of our training concepts.

On behalf of IAEA and in cooperation with KIT (Karlsruher Institut für Technologie) a one week workshop on technologies for decommissioning projects has been organized. The workshop was held within the International Decommissioning Network and was attended by staff of regulators and operators from IAEA member states. The workshop aimed at providing training on the selection and use of technologies for nuclear decommissioning projects, including associated safety and licensing considerations.

For KEPCO (Korea Electric Power Corporation) a four week intensive training course for methodology transfer comprising project management, licensing procedures, project planning, dismantling, and waste management was carried out in cooperation with EWN (Energiewerke Nord GmbH).

Implementation of Databases

In order to ensure the preservation of know-how and to guarantee accessibility of long-term nuclear data storage a central data management system (TÜV NORD-EDID) was developed and implemented which encompasses data bases in the different nuclear domains. Resulting from the different fields of our work as independent expert organization working on behalf of authorities since 50 years, these data bases cover the phase of planning, construction, commissioning, operation, decommissioning and dismantling of nuclear facilities, surveillance of interim storage facilities, as well as qualification of waste products and waste packages e.g. for the preparation for the disposal of waste packages in the German repository Konrad.

In the field of radioactive waste management TÜV NORD gained his first experience in the mid-eighties when waste products were produced for interim storage. Since then, radioactive waste qualification gained importance e.g. due to the licensing decision to dispose of radioactive waste in the German repository Konrad. Early in the nineties an electronic data base was developed following the specific German regulations in the field of radioactive waste disposal. Nearly all of the waste products and packages were produced by the waste owners within specific waste campaigns. The production of waste products and packages for disposal is approved by the BfS as the competent authority in a so called campaign-specific procedure where a sufficient documentation for the resulting waste package as well as for the waste treatment process is required.

Thus, the EDID-RADWASTE data base for radioactive waste campaigns was developed and implemented for documentation of the entire approval processes. Figure 4 shows the interface of the EDID-RADWASTE data base as part of the EDID management system for campaign related documentation of radioactive waste.

All relevant data of the specific campaigns as well as the whole correspondence are available in the data base. For all campaigns the basic data, such as waste producer, conditioner, type and amount of waste, type package, expected waste products, etc. are listed. All the correspondence such as the campaign

announcement, campaign specific quality plans, information about waste and waste treatment process, specific data regarding documentation, results of inspection and examinations, approval documents etc. is implemented in the campaign specific domain as PDF files.

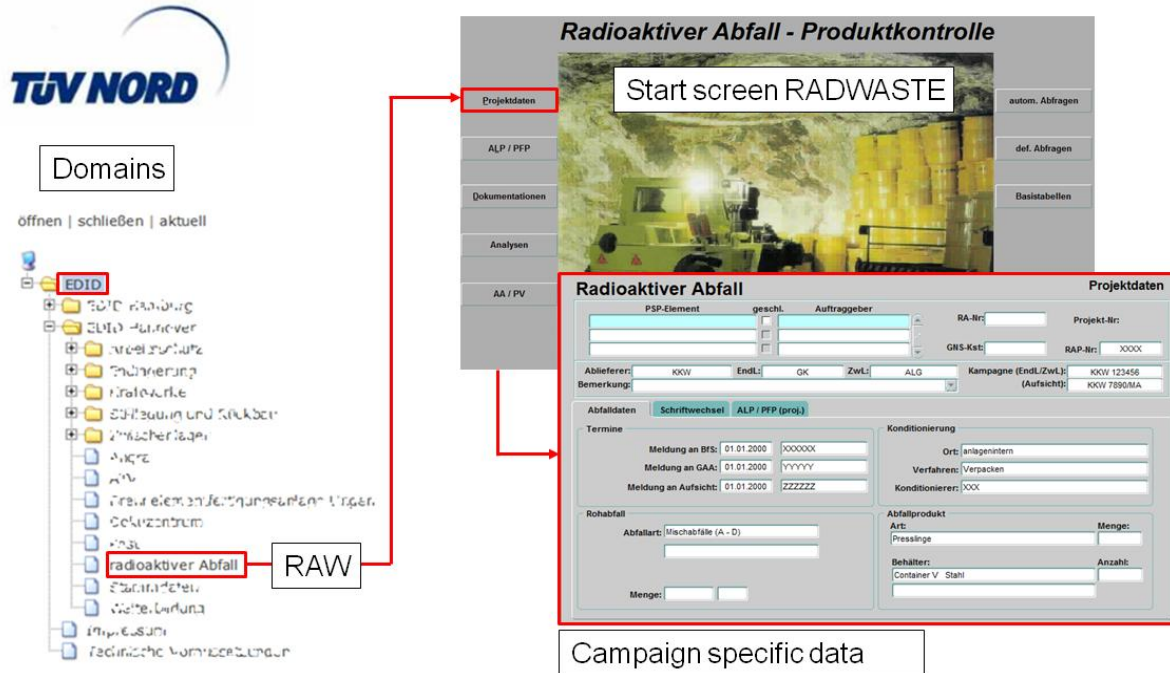


Fig. 4: EDID – Data management system; EDID-RADWASTE data base for campaign related documentation of radioactive waste (RAW).

In this way a quick access to the required information is ensured. By now a number of 70,000 data sets are available in the data base. The data base is subject of an ongoing process of optimization. Due to the constant process of optimization and expansion and the involvement of authorities and waste owners in the use of the data base extensive knowledge preservation will be ensured for the forthcoming tasks.

Since 2005 external users such as BfS as the competent authority in terms of the disposal of radioactive waste, as well as competent local state authorities use the data base for fast online access to all relevant data. Meanwhile 90 % of the waste owners and service companies use this data base as well. Each user is restricted in special user profile roles to ensure that only data for his domain can be used.

The annual amount of radioactive waste to be disposed of in the Konrad repository will increase significantly. Furthermore the preservation of the specific knowledge about this waste over a period of at least two more generations based on an estimated operation phase of the Konrad repository from 2022 until 2060 must be ensured. In this context the implemented data base represents an appropriate tool for long-term nuclear data storage and accessibility.

Symposia

In order to offer a platform for operators, authorities, consultants and other experts in Germany and also for an international audience to discuss current developments and requirements, TÜV NORD has been organizing symposia in different fields of nuclear technology such as radioactive waste disposal and decommissioning since 1997 on a regular basis.

For example symposia in the field of radioactive waste management are an essential part of the knowledge management strategy. The main scope of these symposia reflects on the waste management situation in Germany. Beside the ongoing progress in the different fields of preparation for the disposal of radioactive waste in the Konrad repository technical issues of German waste management practices as well as international approaches in the field of radioactive waste management and disposal are presented. Experts of operators and authorities in Germany and of international organisations e.g. IAEA, EU, NDA UK, ANDRA France are invited to give their lectures on the specific topics.

The scope of these symposia reflects the state of the art in decommissioning of NPPs and fuel cycle facilities, handling of nuclear waste from dismantling of nuclear installations, and radioactive waste management. More than 150 participants of industry, authorities, consultants and service companies attend this kind of meetings with great popularity every year. These meetings offer an excellent opportunity for

- professional discussions on current topics,
- establishing networking structures,
- knowledge exchange between senior experts and young professionals,
- refreshing and enhancing existing knowledge,
- enhancement of knowledge, and
- improvement of personnel qualifications.

Thus, this kind of platform is and will be an inherent part of the knowledge management strategy in order to guarantee continuous exchange between all institutions involved. It also offers the possibility for the implementation of new topics in the nuclear waste management industry to deal with in the near future.

CONCLUSION

The change in the nuclear market in Germany together with the generation change is associated with high requirements to knowledge management that need to be fulfilled in order to ensure technical expertise in the nuclear field for the forthcoming tasks and the next generation. In order to meet this challenge, a system of several tools was established in co-operation between authorities, TÜV NORD and other organizations covering general and individual training courses, symposia on many topics and the implementation of data bases as an easily

accessible source for information especially for all aspects of waste management. Together with an overlap of at least 3 years between the retiring workforce and the next generation employees, these tools are very useful to bridge this gap. To summarize, up to now the knowledge management has been successfully performed at TÜV NORD and other organizations and has even been transferred within international projects.

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