Preservation of competence in nuclear technology – Research need from the viewpoint of industry

Norbert Haspel, Michael Fuchs, Uwe Kleen, Stefan Nießen, Wolfgang Steinwarz and Hannes Wimmer

Introduction

In September 2011, the acatech (National Academy of Technical Sciences; German: Deutsche Akademie der Technikwissenschaften) presented its position paper titled “Phasing out nuclear power safely” [1]. The position paper says: “Phasing out nuclear power must not be regarded as synonymous with “phasing out” nuclear expertise. Long after Germany has completed the phase-out, such skills will continue to be essential for activities such as ensuring reactor safety, radiation protection, decommissioning, ultimate disposal of radioactive waste and crisis management, and also for maintaining a critical outlook on international developments.”

The German Government underlined this fact when passing the 6th Energy Research Programme entitled “Research for an environmentally sound, reliable and affordable energy supply” in August 2011. At the same time, however, acatech believes that it is essential to reprioritise rather than stop nuclear research and to ensure that the focus is on the challenges associated with the phasing out of nuclear power.

All research institutes in the Network for Competence in Nuclear Technology contributed to the position paper. The paper lists the most important areas which require research from the research institutes’ point of view. Accordingly the following issues need to be researched in the field of reactor safety:

- Innovative safety concepts
- Decommissioning of nuclear power plants
- International cooperation.

The industry used the acatech position paper to determine the need for research from the industry’s perspective and to agree on priorities in view of the German turnaround in energy policy. To this end, the heads of research and development of eight major German industrial companies met in October 2011 under the moderation of Stefan Niessen (Areva) and launched the initiative “Preservation of competence in nuclear technology – Research need from the viewpoint of industry”.

The participants of the initiative were jointly motivated by the following: since the available research capacities and budgets are likely to become tighter in the public domain during the phase-out, it is all the more important to use the resources efficiently. A joint proposal for research projects of the industry offers the best prospects for preserving competence. It is a sound basis for coordinating priorities between the industry and public research and for a tighter cooperation of the research teams from both sides.

In the first step, the companies agreed on the application areas where nuclear expertise will be needed in Germany over the next decades (Table 1), i.e.

- operation of the existing generation-II reactors,
- fuel assembly design and manufacturing,
- managing severe accidents (evidence, retrofitting if necessary and accident management measures),
- passive safety systems and components for (severe) accidents and post-operation,
- new construction of generation-III reactors,
- post-operation phase, shutdown, decommissioning, waste treatment,
- containers, transport, and logistics,
- concepts for interim waste storage and ultimate waste storage,
- partitioning and transmutation,
- nuclear fusion, and
- technology of generation-IV reactors.

Zudem haben die Vertreter der Industrie und der öffentlichen Kernforschung in Ergänzung zum Papier des acatech Forschungsthemen von beiderseitigem Interesse identifiziert, die im Rahmen bestehender Forschungsprogramme der Bundesregierung Aussicht auf Förderung haben. Mit der Durchführung dieser Forschungsprojekte soll die kerntechnische Kompetenz in der Industrie und in der Forschung und Lehre erhalten und weiterentwickelt werden.
The application scope of nuclear know-how is thus very extensive also for the German industry. There is a need for research in all these areas. This need results from:
- the ongoing operation of nine nuclear power plants in Germany in line with the scientific and technical state of the art,
- the premature decommissioning of German nuclear power plants and the disposall of radioactive waste in Germany,
- preserving the expertise of German enterprises in the international competition, and
- the German interest in top-notch nuclear safety abroad and the German contribution in international institutions.

The research fields associated with the application areas listed in Table 1 were specified and compiled in a matrix, where 13 research fields were arranged in lines and 11 application areas in columns. In a second step, each company awarded 100 points to determine how the resulting 143 topics were weighted. The outcome showed a clear prioritisation of topics for the operation of today’s reactors and for severe accident management, as shown in Table 1. The evaluation of the competence matrix according to application areas reveals that 50 % focus on topics concerning existing nuclear power plants (Figure 1). 27 % opted for topics for decommissioning and waste treatment. Secondly, the assessment showed demand to keep up research and expertise in the fields of new construction, generation-IV reactors and fusion technology. The German economy should aim to keep pace with developments in view of the considerable international activities to further develop generation-III reactors (passive safety systems also for small- and medium-sized reactors) and to open up the breeder reactor technology in order to fully utilise the uranium and thorium resources. Dealing with these topics enables particularly junior engineers to learn and refine methods and tools which are basically useful for other application areas as well.

Evaluation of the research areas shows that the core topics are thermohydraulics and fluid dynamics with 24 % and materials technology with 19 % (Figure 2). Although thermohydraulic issues scored most points in the context of managing severe accidents in light of the events in Fukushima, other topics are also considered important as the distribution of the points in the matrix shows.

The matrix reveals that nuclear technology requires know-how from a wide range of very different research fields. Many of these research fields are also needed for other, non-nuclear applications, however, the focus was on topics which are of major importance for nuclear technology when the project ideas were worked out.

In a third step, the industry’s preparatory work was presented to the universities and research institutes organised in the Network for Competence in Nuclear Technology (German: Kompetenzverbund Kerntechnik) [2] in January 2012. They declared their willingness to cooperate. The industry and research institutes resolved to create the following competence clusters which both the industry and universities are interested in (Table 2).

A task force installed for each cluster, worked out 43 tangible project proposals until late April 2012 (Table 1). Altogether, 107 persons participated in the task forces, 46 of whom from the industry and 61 from research institutes, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), and universities.

These proposals were compiled in the 68-page reference document “Forschungsbedarf und Kompetenzerhalt auf dem Gebiet der Kerntechnik in Deutschland” [3] (Research Need and Preservation of Competence in Nuclear Technology in Germany). This document outlines the project proposals and names the partners from industry and research that have an interest in participating.

Subsequently, the work process and its results were presented to the project administration agencies in Karlsruhe and Cologne that act on behalf of the Federal
Ministries in charge. (The Karlsruhe project administration agency of the Karlsruhe Institute of Technology is responsible for research projects in the fields of nuclear waste disposal, shutdown, and decommis-
sioning of nuclear facilities and radiation research. The Cologne project administration agency of the GRS is in charge of reactor safety research.) They verified on short
notice which project ideas had good pros-
tpect of receiving funding from the existing
grant programs:
– “Basic Energy Research 2020+” of the
Federal Ministry of Education and Re-
search for the topics of safety research
for nuclear reactors, safety research for
nuclear disposal and radiation research
– “Priorities of Future R&D Work Regard-
ing the Final Disposal of Radioactive
Waste” of the Federal Ministry of Eco-
nomics and Technology
– “Reactor Safety Research” of the Federal
Ministry of Economics and Technology.

Joint project proposals are presently being
prepared for the topics for which there has
been a positive feedback from the project
administration agencies. The progress and
the current procedure will be discussed in
the next meeting of the Network for Com-
petence in Nuclear Technology.

Win-win strategy

The initiative “Research Need and Preserva-
tion of Competence in Nuclear Technology
in Germany” is beneficial for both sides—the
industry and public nuclear research:
– Both sides define focal topics and agree
on close cooperation in tangible research
projects which results in maximum ben-
efit while efficiently using the tight
budgets.
– By including research capacities of the
public domain, it is easier for the indus-
try to keep pace with the advancing
progress of science and technology and
industry can continue to make its contri-
bution as in the past.
– Funds from the industry enable universi-
ties and research institutes to finance ad-
ditional scientific staff. On the one hand,
this is beneficial to the universities’ own
research, and on the other hand it al-
lows more junior scientists to be trained,
which in turn is positive for the industry.

The adopted strategy is thus of advantage
for all parties involved.

German research institutes act in close con-
cert with the German nuclear industry and
contribute to keeping up the high standard
of nuclear know-how and know-why in
Germany with this initiative. At the same
time, it opens up interesting long-term pos-
sibilities for young scientists and engineers
to work and qualify in the nuclear sector.
The initiative is an important contribution
to the continuing safe operation of German
nuclear facilities and the upcoming chal-

Received

Fig. 1. Evaluation of the competence matrix according to application areas.

Fig. 2. Evaluation of the research areas reveal focus on thermohydraulics,
Fluid dynamics and materials.

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[3] Forschungsbedarf und Kompetenzerhalt auf
dem Gebiet der Kerntechnik in Deutschland.
Ein gemeinsames Papier von Industrie und
Forschung, status May 23, 2012
The DAtF (German Atomic Forum) and the KTG (German Nuclear Society) invite you to attend the 44th Annual Meeting on Nuclear Technology – one of Europe’s leading industry meetings – from 14 to 16 May 2013. This is a key date for companies, organisations and experts from the worlds of economics, science, politics and administration. As an international platform, the meeting offers ideal opportunities for presentations, information and exchanges.

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