Creating Symbiosis in Research and Education: Preserve Nuclear Competencies for Germany and Provide Highest Safety Standards to International Markets

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There is a clear goal for German energy policy: the safe operation of the nuclear power plants until the phase-out, the decommissioning of the plants and the implementation of the final repository. All these tasks shall be mainly performed with domestic resources. Moreover, there is no phase-out decision beyond nuclear electricity production. The use of nuclear technology for medical treatments is set to continue; also the activities for research and science are set to persist after 2022.

Today Germany can rely on a nuclear industry and research landscape that belongs to the most comprehensive in Europe. This landscape comprises internationally acknowledged research institutions, embraces an industry fully able to support new build, maintenance, modernization but also decommissioning of nuclear plants. The industry also pursues fuel cycle activities including enrichment and fuel manufacturing. Manifold public institutions, technical safety organizations, consultants and certification companies round up this landscape. A number of countries are currently striving to create such a cluster of capabilities. One example is our neighbor Poland who heads to start nuclear power generation within the next decade.

The situation in Germany is complementary to these evolutions. The phase-out decision puts the entire nuclear infrastructure under pressure. The interest of young people to study subjects related to nuclear declines, the operators are lacking profitability and reduce investments, the industry has to adapt to a shrinking domestic market and decreasing political support. Without active counter measures it would only be a matter of time until also public institutions and certifiers will be concerned and cannot longer effort their duties. This development also risks drying out the scientific landscape.

More than four years after the decision to phase-out nuclear power, more and more responsible decision makers in politics and industry realize that it is a tremendous challenge to preserve the knowledge and the resources of nuclear infrastructure while the domestic market is declining.

The industry has found one answer and joins all its forces on that: internationalisation. With 186 operating nuclear power reactors, the European continent still holds the world record, followed by 118 in North America (source: International Atomic Energy Agency IAEA). It looks as if most of these will continue to operate beyond their original design life. With extending operating life, these plants will increasingly need safety upgrades, modernization and maintenance. This evolution provides a good basis for the necessary internationalization of the German-based nuclear industry.

For future experts from countries with an emerging nuclear sector, Germany has the potential to offer great opportunities to learn, do research and work. If a foreign expert spends some time in a German organization or company, he or she can learn cutting-edge know-how and experience a unique safety culture in practice. At the same time the German host will benefit from a highly motivated colleague who sees a personal future in the nuclear industry. These experts then have the potential to be bridge-builders for the internationalisation of the industry. From a political point of view such an exchange program will allow Germany to contribute actively to nuclear safety beyond our borders.

In addition to such very valuable hands-on experience, the German nuclear industry today offers a broad range of training and exchange programs. These training and cooperation activities with research institutions are illustrated by concrete examples in the following chapters.

Going international: The Nuclear Professional School at the Karlsruhe Institute for Technology (KIT)

The AREVA Nuclear Professional School was established in 2009 in order to provide bridge courses to experienced engineers and physicists who are new to the nuclear industry (Figure 1). These courses provide in-depth nuclear knowledge through a range of topics covering thermo-hydraulic modelling, seismic analysis, material studies and neutronics in the format of one-week seminars. The morning classes focus on the theoretical background, while the afternoon sessions offer the opportunity to practice the learnings using state-of-the-art professional simulations codes and laboratories. Industrial experience combined
with KIT’s expertise in teaching and research offers advanced scientific training with strong practical application. As part of the cooperation, doctoral theses are sponsored as well as an endowed professorship at the KIT. The program is based at the university in Karlsruhe, and the teaching staff also includes professors from the Technical Universities of Stuttgart and Munich. All courses are taught in English and they are also offered abroad in countries that are committed to nuclear new build programs, such as Great Britain, Finland, Saudi-Arabia or the USA.

Through the AREVA Nuclear Professional School, an alliance was built which helps to secure Germany’s extensive nuclear competency on the highest scientific level and guarantees top-quality education. This program offers experienced engineers and future specialists from all signature countries of the non-proliferation treaty an opportunity to broaden their nuclear competencies.

Endowed Professorship at Technical University Dresden (TU Dresden) in Germany
In 2005, the research and training reactor at TU Dresden was modernized and equipped with Teleperm XS digital safety I&C (instrumentation and control). It was the last nuclear facility to obtain an operating license in Germany. The reactor primarily serves for training and teaching purposes. The joint research activities address the integrated functioning of cooling loops and heat exchangers. The nearby Helmholtz Research Center in Dresden Rossendorf has been making significant contributions to safety research. The center builds and operates unique high-pressure testing facilities to test the flow conditions in pressurized cooling circuits of nuclear power plants. Their test facilities and ultra-fast x-ray and wire-mesh imaging technologies are also used to study the fundamentals of passive safety systems.

Since 2012, AREVA funds an endowed chair for imaging measurement methods for energy technology and process engineering at the faculty of mechanical science and engineering at the TU Dresden. Currently, about 800 students are enrolled in energy technology and process engineering at the TU Dresden. Interested students can complete internships at AREVA or work on their diploma theses and put their newly acquired knowledge into practice straight away.

Cooperative Studies with Integrated Training at University Zittau/Görlitz in Germany
AREVA funds cooperative engineering education for 30 students at the University Zittau/Görlitz. The course program combines university studies leading to a graduation as Diplom-Ingenieur (FH) or as Bachelor with a vocational training including a diploma from the Chamber of Commerce and Industry respectively from the Chamber of Crafts. This course of studies is an intensive combination of theory and practice, forging an early relationship between the students and the company. In 2015 five new students have joined the program.

Research and Development Cooperation within the German Competence Network for Nuclear Engineering
The German Competence Network for Nuclear Engineering is a network of research institutions and universities with the aim to preserve nuclear competencies in Germany by bundling research projects, especially those concerning nuclear safety and repository issues. Together with other German companies within the field of nuclear industry, AREVA participates in the network. In 2011 and 2012 the initiative “Needs for Further Research Concerning the Preservation of Nuclear Competencies in Germany” was established. Thereby the representatives of eight companies from German nuclear industry identified important research issues and prioritized them according to their point of view and discussed the results with the research institutions and universities within the network. In consequence they jointly defined different competence clusters. Within each cluster project ideas were collected and initiated. In 2015 the initiative was relaunched in order to assess the research and development needs related to a possible prolonged intermediary storage.

This approach has several advantages for both nuclear industry and the research institutions. The efficient use of research funds is essential for pushing the technological progress. In times of narrow means for research objectives in nuclear engineering collaboration helps to focus on the most relevant issues. Furthermore the universities get the possibility to enhance their budget by means from industrial companies whereas the companies can shape the state of the art in science and technology and profit therefrom.

Cooperation with Warsaw University of Technology (WUT)
In context of the official report “Polish Energy until 2030” which treats the introduction of nuclear energy and the education of nuclear technology engineers in Poland, AREVA launched a collaboration with Warsaw University of Technology (WUT). The collaboration was affirmed and extended in 2012. Today, the educational and scientific cooperation comprises a regular exchange between researchers from WUT and experts from AREVA as well as joint workshops, student visits, Master and PhD theses at AREVA and lectures by AREVA experts conducted at WUT.

The cooperation addresses the challenge that nuclear education at universities usually focuses on the theoretical basis. This is necessary but alone not sufficient for the needs of the nuclear industry and therefore AREVA has an extensive training program to bridge this gap for new recruits to complement the basis university education. Parts of this training program are now transferred to the Warsaw University of Technology.

These transferred training courses are part of AREVA’s so called University Knowledge Package. The package offers modules on three different levels of detail ranging from introductory over technology to expert level. It covers scientific subjects and also addresses practical issues like system design, nuclear operation or instrumentation and control. It provides a deep insight in most modern nuclear power plant technologies of the 3rd Generation based on AREVA designs meeting the requirements of strict nuclear regulatory bodies.

In total, 265 students have participated in the lectures of over 300 hours given by AREVA’s trainers. The trainees are not only from Warsaw University of Technology but also from the following institutions: National Atomic Energy Agency, National Center for Nuclear Research, Gdańsk University, Institute of Nuclear Chemistry and Technology and Wrocław University of Technology.

Already 17 students have written their master thesis at AREVA or in nuclear facilities in France and Germany with AREVA’s facilitation.

The very positive feedback from trainees shows that these lectures and internships are very fruitful for their education and future work in the nuclear sector.

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The feedback from academic personal of WUT concludes that the cooperation is very important for the university because this allows to have a larger variety of lectures and a closer contact to the nuclear industry.

In this partnership AREVA is committed to sharing the company’s expertise with the Polish scientific community to help build a sound and self-reliant nuclear industry in Poland.

Cooperation with Slovak University of Technology (STU) Bratislava

AREVA has an agreement with the Slovak University of Technology (STU) to support the development of nuclear technology courses (Figure 2). Under this partnership, AREVA will contribute to a teaching program dedicated to instrumentation and control (I&C) systems. Designed for the operation and control of a nuclear power plant, the I&C system is a key component for reactor operations. STU contacted AREVA NP Controls, s.r.o. in Bratislava, a subsidiary of AREVA GmbH with focus on engineering for digital safety I&C and electrical systems for the global nuclear power plant market, regarding a cooperation covering the preparation and possibly delivery of specialized lectures and practical exercises for an upcoming new lecture on “Measurement and control in nuclear power plants”. The AREVA experts will ensure the training program will provide relevant information and offer the operational skills required to work at nuclear plants. A master course will start in September 2015 and will be taught in English, thus improving STU graduates’ position on the international job market.

To date, the safety-related I&C system from AREVA has been installed in or ordered for 80 nuclear power plant units in 16 countries for 14 different reactor designs. It is the most widely deployed digital instrumentation and control system in the world. Therefore the university can rely on state-of-the-art technologies for its education activities, expand its lecture offer and establish an international scope. Students will gain a deeper comprehension of current issues in nuclear I&C and they will be better prepared for their future job positions and career perspectives. AREVA will profit from the students’ enhanced specific knowledge on nuclear technology and access to well-educated and motivated graduates.

Agreements with Universities for the Saudi Nuclear Program

A series of agreements signed with Saudi universities are intended to contribute to the development of nuclear expertise in the country.

The agreements include internship offers made to Saudi students. In summer 2014 AREVA hosted Saudi engineering students in France and Germany. In the scope of Saudi Arabia’s energy diversification program and as a contribution to the effort of developing the country’s industrial competences, AREVA welcomed 40 Saudi students from three universities (King Saud University, Al Faisal University and King Fahd University for Petroleum and Minerals) for long-term engineering internships, 13 of them in Germany.

Thanks to the program, the students gained significant experience in the nuclear facilities and engineering centers. This professional immersion will enable them to benefit from European excellence in nuclear power not only in terms of safety, quality and operational performance.

(Figure 3)

Before beginning their internships, the students had the chance to acquire a basic technical understanding of nuclear energy during training seminars organized jointly by AREVA and EDF in Riyadh in late 2013, and in Al Khobar in May.

The initiative followed the signing of memoranda of understanding (MoUs) with the Bahra National Institute of Technology and four Saudi universities in 2013.

Conclusion

Excellent cooperation with universities and research centers is crucial for any industrial company. In order to bear fruit for all sides, this cooperation has to be long-term. Such a long-term university-industry partnership can bring innovation to the industry and help to focus research on issues that are most relevant.

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