German Repository Engineering in International Markets – DBE TECHNOLOGY GmbH Success Story

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The early years: DBE Technology’s roots, Spain and the European Union

DBE Technology GmbH was a logical spin-off from the Technology and Development Division of DBE, the German Company for the Construction and Operation of Repositories for Wastes (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH). The German Federal Government created this specialized engineering company in 1979 in order to concentrate, consolidate, and further develop the expertise needed to design, build, and operate the German radioactive waste repositories. DBE Technology was originally established as a focal point for concentrating DBE’s scientific and engineering know-how into a more accessible format for conducting work in both the national and international radioactive waste markets. DBE Technology began operations as a fully owned subsidiary of DBE in 2000.

Ten years after founding DBE, in the late eighties, the Technology and Development Division of DBE became heavily involved in a large-scale R&D program for the development of spent nuclear fuel direct disposal technologies. A major focus of this assignment was the detailed design of underground repositories, including all the required equipment; the program as a whole aimed at demonstrating the technical feasibility and safety of spent nuclear fuel direct disposal. This work, carried out in close cooperation with a number of renowned institutions under the leadership of the Karlsruhe Nuclear Research Center, provided the science and technology basis for the German Government to accept direct disposal as a valid option for closing the nuclear fuel cycle. With the 1994 amendment of the Nuclear Energy Act the Federal Government defined spent fuel direct disposal as an accepted alternative to reprocessing and disposal of vitrified high level waste (HLW), the previous reference technology for the nuclear fuel cycle back-end. Especially important for later international activities was the fact that the repository design went well beyond previously conducted conceptual design work, down to detailed design of facilities and components, and included the demonstration at 1:1 scale of the required machinery and systems that were beyond the then state-of-the-art as considered in the early nineties (Figure 1).

As a worldwide first-of-a-kind, the mentioned project included the demonstration of safe shaft hoisting of payloads up to 85 metric tons, a weight twice the amount that the largest hoisting machines in use at the time could handle; furthermore in application of safety levels consistent with the nuclear industry, i.e., well above that typical of international mining standards (Figure 2).

The repository design work conducted by DBE caught the attention of waste management organizations in Europe and overseas. The then young Spanish waste management agency ENRESA (National Enterprise for Radioactive Waste) placed an important contract with DBE to supply the advanced conceptual design of a repository in a salt formation, one of two host rock options considered in the country. The assignment included on-the-job training of five young Spanish professionals who were to continue the work in Spain after returning to their home country. The contact with these colleagues, which became quite positive during their two-year assignment working with the Technology and Development Division of DBE in Germany, has persisted until present.

The early 1990s were a time during which Europe underwent the most remarkable transformation in modern times. The fall of the iron curtain brought not only German re-unification, but also an enormous momentum for the countries of Central and Eastern Europe to become members of the European Communities, the predecessor of today’s European Union (EU). Joining the EU also meant joining EURATOM so that concern arose on the status of nuclear facilities in the former Central and Eastern-European countries. The executive branch of the European Union, the European Commission (EC) promoted the creation of CASSIOPEE, a consortium of the Waste
Management Organizations (WMOs) from Belgium, France, Germany, the Netherlands, Spain and the United Kingdom to assist the membership applicants in the field of radioactive waste management and disposal. A fact-finding mission that included comprehensive study visits to Poland, Estonia, Latvia, Lithuania, Czechoslovakia, Hungary, Romania, Bulgaria and Slovenia provided the basis for identifying the most urgent issues requiring swift attention. These issues were later to become the basis of a large program to improve the safety of nuclear installations and the safety of waste management and disposal for countries in the process of accessing the present European Union (EU).

Support to Japanese partners
In 1996, a Japanese partner, the Ishikawajima-Harima Heavy Industries (IHI) contracted DBE for the peer review of a repository conceptual design. In the framework of repository concept development for disposal of vitrified HLW, IHI had developed an innovative buffer system for the waste container near field, consisting of two monolithic bentonite elements: a sort of container overpack for the waste canister and a lid, both produced from bentonite powder by high-pressure isostatic pressing. IHI’s wide breadth of experience as a heavy machinery and equipment developer and manufacturer had been instrumental in this remarkable development. However, emplacing the heavy but fragile bentonite “cup”, the waste, and finally the lid in a repository excavation proved to be a technical challenge. IHI lacked experience in underground work and thus turned to DBE for a comprehensive evaluation of the two proposed repository concepts and of the conceptual design of the machinery for implementation of the technology in a future HLW repository. Unfortunately, one of the two proposed concepts, specifically waste disposal in a long, small diameter drift, appeared to be hardly feasible. Moreover, it would not have been compatible with mining regulations as enacted in Germany to protect the health of the repository staff. In Japan, underground mining had virtually ceased long ago; therefore, such regulations are no longer part of the common engineering practice and knowledge. In addition, recovery from a malfunction would require remote handling due to high radiation levels and would be very difficult because of a lack of maneuvering space. DBE therefore recommended abandoning the proposed concept of disposal in a narrow drift and refocusing all further design work on disposal in boreholes drilled in the floor of drifts with dimensions adequate for the easy movement of personnel and heavy equipment. IHI followed the recommendation and the borehole disposal concept became the reference technology for HLW disposal in the so-called H12 report, the second progress report published in November 1999 by JNC (now JAEA) entitled “H12: Project to Establish the Scientific and Technical Basis for HLW Disposal in Japan”.

Later work for IHI and through the Radioactive Waste Management Research Center (RWMC) for the then Ministry of International Trade and Industry (MITI) focused on specific aspects of repository technology and on institutional arrangements for the organization and financing of waste disposal. A comprehensive review of the schemes implemented to this purpose in European countries, including an evaluation of the advantages and disadvantages, financing, and taxation aspects, was one of the bases for a new law aimed at re-organizing the waste management sector, the “Specified Radioactive Waste Final Disposal Act”, enacted in June 2000. The Government then created the Nuclear Waste Management Organization of Japan (NUMO) in October 2002 as the implementing body for HLW disposal as specified in this Act.

Central and Eastern Europe and the Community of Independent States with CASSIOPEE
Based on the previously mentioned fact-finding missions carried out by the CASSIOPEE Grouping in Central and Eastern Europe for the European Commission, Brussels launched a series of projects in the framework of the TACIS and Phare programs. The work aimed at achieving improvement on the most urgent issues identified during the situation review missions. A first important mission developed an inventory of the waste accumulated in the Kola Peninsula region of North-West Russia. There, the Kola NPP with its four reactors, the icebreakers of the Murmansk shipping company and, more important, the cruisers and submarines of the Northern Fleet with their more than 300 nuclear reactors had given rise to a significant amount of radioactive waste of all categories. The report issued by DBE on behalf of CASSIOPEE suggested a series of essential works to improve the radioactive waste situation. At the request of the Federal Ministry of Economy DBE Technology later prepared the dossiers for several projects, which were presented for decision at the 2002 G8 summit in Kananaskis, Canada. Among them was the on-shore storage facility in the Saida Bay for the storage of 150 submarine reactor sections and a further 25 reactors from surface ships of the Russian Northern Fleet. The facility, delivered by EWN GmbH, is currently in operation as is the recently completed, adjacent waste management facility (Figure 3).

An important field of activity was the support in the field of radioactive waste management given by the CASSIOPEE consortium to new member states in their EU accession process. None of these countries had a dedicated Waste Management Organization (WMO), as was the case in Western Europe. The consortium, with leading involvement of DBE, provided guidance to the Czech Republic, Romania and Bulgaria in the process of creating the WMOs RAWRA, ANDRAD, and SERAW, respectively. The first such project, carried out in close cooperation with the responsible ministries in Prague, started in 1997. It led to the submission to parliament and subsequent enactment of an updated Nuclear Energy Act. This law set up the basis for founding the Radioactive Waste Repository Authority (RAWRA or SURAO in the Czech acronym) and for creating the Nuclear Account as a mechanism for financing radioactive waste management and disposal in the Czech Republic. The work also included a detailed proposal for the development of the authority’s staff from a founding team to an operational WMO, a personnel training
program, as well as the basic documents and internal rules governing the activities of the authority. The experience gained from this project formed a basis to provide support to Bulgaria and Romania in the process of creating their national Waste Management Organizations in 2001 and 2003 respectively.

In 2000, the group conducted a safety analysis for the Baldone near-surface repository for Latvia and recommended a series of measures to improve the site safety and security. For the local WMO, ALARA in Estonia, DBE Technology and Partners prepared in 2002 a concept for management of the waste from the former Paldiski nuclear submarine training center. For RAWRA in the Czech Republic in 2003 and ANDRAD in Romania in 2005 DBE Technology, supported by a Czech specialized software designer, provided an Internet-based waste tracking system to manage and store all required waste data and information.

From the middle of the last decade, DBE Technology has been leading a follow-up consortium to CASSIOPEE joined by five European Waste Management Agencies (ANDRA of France, COVRA of The Netherlands, ENRESA of Spain, NDA of UK and SKB of Sweden). The consortium was subsequently contracted by the European Commission to assist Russia and Ukraine in upgrading their national radioactive waste management systems to international state-of-the-art standards and to overcome Soviet-era drawbacks. The underlying strategy for this assistance was developed under the framework of two core projects, carried out in close cooperation with the responsible authorities in both countries, which outlined the overall national radioactive waste management strategies for the Russian Federation and Ukraine. As in both countries waste management activities had been limited in the past to waste storage at the producer’s sites or in centralized facilities, the strategies now needed to focus on streamlining the entire waste management process with view to its very end, the safe final disposal of all radioactive waste. Special attention was paid to the institutional framework of radio-active waste management, including appropriate regulatory context, sufficient and sustainable financing of all activities and to establishing national waste management organizations. Following the consortium’s recommendation, the Russian Duma adopted a new law on radioactive waste management, and the Ukrainian parliament passed a major revision of the corresponding Ukrainian law. In these contexts, in both countries, national waste management organizations (NO.RAO – National Operator for Radioactive Waste Management in Russia and SSE-CERWM – Specialized State Enterprise for Radioactive Waste Management) were established and State Waste Management Funds were implemented.

The success of both Strategy Projects provided an incentive for the European Commission subsequently to launch a wider assistance program that is now providing worldwide specific advice on radioactive waste management within the EU International Nuclear Safety Cooperation (INSC) program with similar projects planned or already implemented in a number of countries. The Ukrainian radioactive waste management portion of the INSC program includes a roadmap of projects for implementing the national waste management strategy.
DECOMMISSIONING AND WASTE MANAGEMENT

Since 2001, several demonstration projects DBE’s operational concept and equipment design philosophy, which moved all complex operations requiring careful quality assurance to the surface facilities and reduced all underground processes to the simplest possible actions, was fully confirmed. Consistent with this approach, DBE Technology had previously recommended that ONDRAF/NIRAS change their container concept to incorporate adequate radiation shielding surrounding the waste packages to facilitate contact handling should the need for equipment repair or malfunction recovery arise.

For this purpose ONDRAF/NIRAS had developed the so-called Super-Container, a simple but effective shielded waste package for vitrified HLW or spent nuclear fuel. Because of the shielding, the waste package was exceptionally heavy and an air cushion system was considered for underground transport. In view of the expected long repository operation and characteristics of the host rock, the so-called Boom Clay, using an air cushion system would have required comprehensive and costly maintenance of the floors in all of the underground drifts and galleries (Figure 5). Therefore, DBE Technology later recommended replacing the air cushion by a conventional multi-wheel cart especially designed for operation under the constrained space conditions in the planned underground repository.

Further issues covered by the technical support provided to our Belgian colleagues included providing solutions for underground repository ventilation as well as both shaft and drift transportation solutions for the heavy payloads in the underground. Moreover, DBE Technology also developed an appropriate cement-based mortar mixture for use as backfill material in the repository that fulfills all required conditions, including the allowance of retrieval should the need arise.

Over the years, DBE Technology has become directly involved in the long-term repository development effort of ONDRAF/NIRAS. Both companies jointly identified some feasibility issues requiring resolution to enable implementing the Belgian repository concept. DBE Technology has systematically addressed all identified issues and provided viable solutions to all technical aspects involved. The repository design has substantially evolved from the original concept so that currently no fundamental showstoppers remain unresolved. The work will continue in the years to come eventually resulting in a comprehensive repository design that can be safely implemented and operated and that will provide the required long-term safety after its decommissioning and closure. In fact, a new multiple-year technical support contract was recently awarded to DBE Technology that will allow a continuation in the fruitful cooperation between ONDRAF/NIRAS and DBE Technology in developing repository solutions.

In 2000, the French WMO, ANDRA, entered into a cooperation agreement with DBE in the field of deep geological disposal of radioactive waste. At that time, ANDRA was starting to develop a repository concept for the large inventory of HLW and ILW expected in the country that is not amenable for surface disposal and thus must go to disposal in a deep geological repository. Germany, with the Gorleben, Konrad, and Morsleben repository projects had acquired a broad experience in such matters. From the very beginning, France was greatly interested in the technology to be used in the transport of the shielding overpack containing the vitrified HLW to the subsurface repository level. While all existing deep repositories at that time (the WIPP (US Waste Isolation Pilot Plant) and

As regards the Russian Federation, the European Union has not been able to enter into a financial agreement with the country in support of the INSC program because the Ministry of Finance rejected the requested tax exemption for the assistance projects. Therefore, DBE Technology focused its activities in Russia on participating in the bilateral R&D cooperation between and the Federal Ministry of Technology and Energy. Since 2001, DBE Technology has been entrusted with the technical coordination of the bilateral cooperation in radioactive waste disposal research. Over the past 15 years numerous bilateral R&D project have been implemented and successfully completed with participation from all of the most relevant R&D organizations in both countries.

Support to Western European partners: Belgium and France

Work for the Belgian Waste Management Organization ONDRAF/NIRAS started in 2004. DBE Technology’s first assignment was a peer review of the national concept for the disposal of HLW. The experience gained from the above-mentioned 1:1-scale disposal equipment demonstration was instrumental in this work. Over the course of

Fig. 4. Chernobyl reactor block 4.

Fig. 5. Belgian geologic repository concept (Source: ONDRAF/NIRAS).

adopted by the Ukrainian Parliament. Together with its consortium partners, DBE Technology has been awarded several of the corresponding contracts, including contracts for dealing with improvements in the waste classification system, developing disposal concepts for all kinds of radioactive waste, and for providing assistance to ministries and organizations involved in radioactive waste management (Figure 4).
Morsleben as well as the planned Konrad repository, awaiting a long-overdue license) used shaft hoisting for this purpose. Sweden’s SKB was considering using a ramp to achieve this aim. At the request of ANDRA, DBE Technology prepared two reports describing the technology for the Konrad and for Gorleben repositories, addressing specific requirements for ANDRA, and explaining the rationale behind the technological decisions. However, despite the fact that later Finland, Canada and Belgium, also selected shafts for hoisting waste packages to the underground repository level, following German advice, ANDRA chose to follow the Swedish example. In the most recent times, DBE Technology has become part of the team led by the GDF/Suez Engineering Company Tractebel that won the contract for the design of the underground repository facilities in France as well as the shafts and ramps for accessing them. Unlike the repository projects in Germany, the French repository project, CIGEO, does not suffer from the political obstruction that has accompanied all repository work in Germany over the past nearly twenty years. Therefore, ANDRA expects to meet the current time schedule, which anticipates the start of operation by the middle of the next decade.

The United States and Canada

The efforts to enter the US repository market dated back to the year 2004 at which point DBE Technology contracted a local consultant to support its endeavors. The intention was to provide support to the Yucca Mountain Project, especially in the field of repository equipment, in which the company had unique experience derived from the German equipment development and demonstration program. In the US regulatory environment, a design of a nuclear disposal facility is developed in clearly defined steps for each major milestone, i.e., the design maturity increases steadily from the nuclear license over the construction license to operational license and the level of detail follows the requirements for each license. For the initial licensing purpose, the design as submitted by DOE (US Department of Energy), primarily focuses on long-term safety aspects and the science and engineering needs required to substantiate the repository performance following the requirements prescribed in 10CFR63. Correspondingly, engineering solutions addressing operational details regarding the ways and means of transporting and disposing of waste, and recovery from malfunction had received less attention when compared to the licensing process as required in Germany. Following German licensing requirements a demonstration program is developed, which includes the manufacture and testing at full-scale of all safety related equipment. DBE Technology offered exactly this experience.

The Yucca Mountain Project at the time involved a working force of more than 2000 staff members deployed primarily in Las Vegas and managed by a Management and Operation (M&O) contractor for the project. The companies interested in participating formed competing consortia that later submitted bids during the tendering procedure. The M&O contracts for Yucca Mountain typically consisted of an initial five-year contract with the possibility of extensions up to a total of an additional five years before being re-competed. In 2008, the M&O contract was re-competed. DBE Technology participated in the bid as a “designated subcontractor” of the consortium led by the engineering company URS, who eventually won the M&O contract as USA Repository Services, Company LLC.

Unfortunately, the Obama administration, which had won the swing-state of Nevada in the 2008 election with substantial support from Senator Harry Reid with the promise to discontinue the project, decided to stop site development arguing that Yucca Mountain “was not a workable option”. It is very peculiar that a President, the highest official of the US executive power, chose to ignore the Nuclear Waste Policy Act (NWPA), by which Congress in 1982 and 1987 entrusted the realization of a repository at Yucca Mountain to the executive branch. As could be expected, several federal courts have since ruled that the Executive Branch, and therefore ultimately President Obama, does not have the authority to ignore an act of Congress, which is a co-equal branch of government, and therefore does not have the authority to ignore the prescriptions of the NWPA. More recently, the District of Columbia Court of Appeals, the competent federal court, directed the Nuclear Regulatory Commission (NRC) to finish the review of the license application. The NRC’s review, as anticipated by the scientific community, delivered a positive result: a repository at Yucca Mountain would meet the safety requirements of the applicable regulation, as codified in Title 10 of the Code of Federal Regulations, Part 63 (10CFR63). In view of these very new developments, DBE Technology is once again looking forward to participating in future Yucca Mountain work.

In addition to its efforts to engage more fully in the US spent fuel and HLW disposal program, DBE Technology currently cooperates with the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico (Figure 6). At this location, the Office of Environmental Management of the US Department of Energy (US DOE-EM) operates a deep geological repository for long-lived radioactive waste originating from defense programs. Interestingly, the WIPP and the German repositories are the only existing deep geological disposal facilities, so that only these two countries actually have experience in repository construction and operation. In the framework of a staff exchange program, a high rank member of DBE Technology’s staff spent three weeks in Carlsbad, a corresponding visit from the US in Germany is expected in the near future.
In the next years, research activities to be located at a future underground research facility in at WIPP will study more intensely the effects from the disposal of heat generating waste on bedded salt. In support of this goal DBE Technology has contributed, under contract with the Sandia National Laboratory and with the Carlsbad Field Office of DOE (CBFO), to research work on disposal of very heavy waste packages and to the planning of a heater test in the proposed Underground Research Laboratory at WIPP. In Canada, the Federal Government entrusted the Nuclear Waste Management Organization (NWMO) with the implementation of the country’s deep geological repository program for spent nuclear fuel. In addition, the waste producers (mostly the provincial electricity utility Ontario Power Generation – OPG) are responsible for the disposal of the low and intermediate-level waste (LILW). The founding team of NWMO was the former Waste Management Division of OPG, so that NWMO currently also develops an LILW repository on behalf of OPG. The selected site is located in the Kincardine municipality, inside the secure perimeter of the Bruce Nuclear Generating Station not far from the shore of Lake Huron. The host rock is limestone, the repository level is completely dry and the rock sufficiently stable for underground repository construction.

In view of the DBE Technology’s wide experience in designing and peer-reviewing underground repositories, OPG placed a contract with the company to carry out an in-depth analysis of the layout, the ventilation system, and the prospective operational safety of the repository. The review resulted in some recommendations to simplify the systems and operations, to modify the layout and, especially, to abandon the proposed disposal of a large waste item containing historical waste without further processing. In the following OPG decided to open said waste packages, the so-called tile-equivalent, and to process and repack the waste before disposal. Later, OPG recovered most other recommendations in a comprehensive redesign of its so-called DGR project, which now carries the clear imprint of DBE Technology. The repository is now in the licensing phase and OPG will construct the DGR in the next years.

From concepts to engineering to realization: Czech Republic, Romania, Slovakia, and Bulgaria

In Czech Republic and Romania, specialized engineering by DBE Technology has provided significant contributions to enhancing the safety of the existing repositories. DBE Technology also provides engineering for safe, cost-efficient disposal capacity for early decommissioning of Nuclear Power Plants in Slovakia and Bulgaria. The previously mentioned Czech WMO, RAWRA, operates a final disposal facility for radioactive waste from research, medical applications and industry at the Richard repository, in the outskirts of the city of Litoměřice, on the River Elbe about 30 km from the border to the German state of Saxony. The repository chambers are located in a former underground limestone mine, which was subsequently used by the German Wehrmacht during World War II as an underground military production facility. The repository portion of the mine lies underneath a small hill, a horizontal tunnel provides access to the disposal areas, and the waste disposal chambers are about 70 m below the hill surface above them.

From historical practices, the site contains waste contaminated with americium and plutonium. The corresponding activity levels are currently considered not amenable for near-surface disposal. Due to this activity content, and in view of the site conditions, one specific scenario of the safety analysis for Richard rendered calculated future radiation exposures above the regulated limits (Figure 7). Despite the fact that the conditions modeled for the so-called “mine water (consumption) scenario” were overly conservative, DBE Technology, the Czech nuclear regulator SÚJB, and RAWRA decided to rule out this scenario by implementing appropriate engineering measures. To this aim, DBE Technology proposed the construction of a hydraulic cage in a dedicated group of chambers and later, after a compaction of the historical waste, originally packed in 50 l drums with low density, to emplace the repackaged waste in a cement vault surrounded by a high hydraulic conductivity enclosure. After waste package emplacement, the void space between the drums was filled with cement mortar. The waste is now embedded in a cement monolith, surrounded by the high-hydraulic conductivity enclosure, more than 20 m above the water table. All water percolating through the marl layers above the waste flows down through the hydraulic cage, bypassing the waste, thus preventing any radionuclide lixiviation and transport out of the repository. DBE Technology devised the technical solution and planned it in detail, including the radiation protection and ventilation measures implemented in the repository for the waste treatment by compaction. DBE Technology also carried out the designer supervision role during the implementation of the hydraulic cage concept by a local construction company.
Due to the significant safety advantages of the hydraulic cage isolation concept, RAWRA later decided to implement this concept for the entire repository. Currently, the planning for the extension of the repository is under way to accommodate the institutional waste expected to arise in the Czech Republic over the next decades, using DBE Technology’s hydraulic cage concept.

In a separate project, DBE Technology with CASSIOPEE and a local subcontractor provided RAWRA with a specifically developed, internet-based Waste Tracking System to manage the information transfer and storage necessary for, and resulting from, the operation of the Richard repository. DBE Technology later provided the same system, adapted to the specific country needs, to ANDRAD, the Romanian WMO, in the framework of a further EU support project assigned to CASSIOPEE.

In late 2007 the Romanian Ministry of Finance placed a contract with DBE Technology for providing assistance to the Romanian Nuclear Regulator CNCA in the evaluation of the Safety Analysis Report for the Baita Bihor repository in Transylvania. In the framework of this project, DBE Technology not only provided specific training to CNCA scientific staff to enable them to evaluate in depth the repository safety case, but also identified a series of improvements to the operational and long-term safety of the repository. As recently presented in the framework of an international symposium of DISPNET, the IAEA’s network for LLW near-surface disposal science and technology, all the proposed improvements have been implemented in the meanwhile.

A significant milestone in DBE Technology’s international involvement in the near-surface disposal engineering was a comprehensive feasibility study for the enlargement of the Mochovce Repository in the Slovak Republic. In the framework of the EU accession, the European Commission required Slovakia to phase out two older, Soviet-designed reactors of the Bohunice Nuclear Power Plant due to safety concerns. As compensation, the EU set up the Bohunice International Decommissioning Support Fund to assist the country’s efforts in decommissioning and radioactive waste management. In 2007, the Consortium of DBE Technology and INITEC Nuclear SA of Spain was awarded a contract to explore different variants of enlargement of the existing national LLW Repository at Mochovce (Figure 8). The study covered different possible enlargement options at the existing site as well as at other locations, and led to introducing the new waste category of Very Low-Level Waste in the Slovak Republic. The proposed approach followed previous work in France and Spain and offered a cost-efficient solution for bulk decommissioning waste with very low activity content but above free release levels.

A noteworthy highlight of DBE Technology’s current project portfolio is the development of the Technical Design and the Interim Safety Report for the Bulgarian Low- and Intermediate-Level Radioactive Waste repository located adjacent to the Kozloduy Nuclear Power Plant. A Consortium of DBE Technology, Westinghouse Electric Spain SAU as Consortium leader and the Spanish radioactive waste management agency ENRESA, with local expert support provided by EQE Bulgaria AD is carrying out the design and licensing project for the Bulgarian State Enterprise Radioactive Waste (SERAW). DBE Technology, as the technical lead for the project, is especially responsible for the delivery of the Technical Design of the facility, and contributes to the Safety Assessment Report performing the long-term assessment (Figure 9).

**Summary**

It has been a long way from DBE Technology’s modest beginning as a spin off from the Technology and Development Division of DBE to becoming an internationally recognized and renowned science and engineering partner. Outside Germany, the name DBE Technology GmbH is recognized as another of the very many examples of German excellence in engineering and technology. It is quite rewarding to see that all this was achieved in spite of the rather adverse context of nuclear energy and waste management within the borders of Germany itself. Yet after many years of politically motivated roadblocks and obstacles, slow progress is now being achieved, and it is not too optimistic to think that within a limited lapse of time a radioactive waste repository will again become available in Germany. Meanwhile, other institutions and DBE Technology have managed to preserve and expand the German expertise in the particularly challenging but amazingly interesting field of radioactive waste disposal. DBE Technology is firmly committed to continue being a key international player in its field of activity.

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**Fig. 9.** Illustration of concept for the Bulgarian repository.