

STATUS OF HLW AND SPENT FUEL MANAGEMENT IN THE FEDERAL REPUBLIC OF GERMANY

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ABSTRACT

More than twenty years ago, in the late seventies an integrated concept for closing the nuclear fuel cycle was agreed upon between the then Social Democratic Government under Chancellor Helmut Schmidt and the nuclear power plant operators. In the two decades elapsed since then, the concept was permanently further developed to fit the state-of-the-art. It anticipated spent fuel reprocessing, AFR interim storage in centralized facilities, and final disposal of all radioactive waste in deep geological formations. Upon a later decision of the electricity utilities, domestic reprocessing was abandoned in favor of reprocessing by foreign service providers. With three operational centralized interim storage facilities for spent fuel and vitrified HLW, a pilot conditioning facility for encapsulating spent fuel and/or HLW for final disposal ready to be commissioned, and worldwide pioneering progress in geological disposal, the concept is now nearly technical reality. With the available body of knowledge and technical expertise, with all the facilities existing or in advanced construction, and with nearly three decades of experience in operating deep geological repositories Germany has one of the worldwide most advanced waste management and geological disposal programs.

The new German Government has committed itself to phasing out nuclear power use after a transition period necessary to avoid compensation claims by the electricity utilities. The waste management and disposal plan is also being reconsidered. With this, the program for waste management and disposal could suffer delays due to a new political view of nuclear affairs.

RADIOACTIVE WASTE MANAGEMENT IN GERMANY

Basis of the German spent fuel and radioactive waste management concept is an unanimous decision by the Council of heads of the Federal Government and the Governments of the Federal States adopted on September 28, 1979. This decision directed operators of nuclear power plants to provide assurance for a period of six years in advance as to where the spent fuel will be stored and/or processed and as to how the radioactive waste will be later disposed of. Further on, in agreement between the Federal Government and the waste producers, the latter were declared responsible for all steps of waste management with the only exception of final disposal. This last activity had always been considered as belonging into the sphere of responsibility of the Federal Government.

In fulfillment of governmental directions, in Germany all elements of the HLW and spent fuel management system to close the nuclear fuel cycle have already been realized or are in an advanced stage of development. The system comprises the following steps:

- Spent fuel short-term interim storage in power plant's spent fuel pools
- Eventually, reprocessing in France and the United Kingdom on the basis of service contracts
- Long-term interim storage of vitrified waste and spent fuel in centralized facilities in dual purpose casks (transportation and storage)
- Conditioning of spent fuel by rod consolidation and repackaging into disposal casks for direct disposal
- Conditioning of vitrified waste by repackaging into disposal casks
- Deep geological disposal of all kinds of radioactive waste

The knowledge basis for realization of the waste management system is considered as basically available. The necessary technological components for disposal of vitrified HLW and conditioned spent fuel have been developed and demonstrated, most of them on a 1:1 scale under conditions relevant for a real-life repository. The facilities already available or under construction as part of the German waste management concept include:

- The centralized interim storage facility for spent nuclear fuel at Ahaus
- The centralized interim storage facility for spent fuel and vitrified waste at Gorleben
- The pilot conditioning facility at Gorleben
- The Morsleben repository for low and intermediate-level waste
- The planned Konrad repository for non heat-generating waste
- The Gorleben exploration mine.

With all these facilities either existing or under construction, and with decades of experience in operating the deep geological repositories at Morsleben and Asse, Germany has one of the worldwide most advanced waste management and geological disposal programs.

AHAUS AFR STORAGE FACILITY

At Ahaus, a centralized interim storage facility is currently in operation. At this site, spent fuel is stored in transport/storage casks, namely CASTOR[®]s, of which by now more than 600 have been built and are worldwide in use. The Ahaus interim storage facility is owned by the German utilities via their subsidiary GNS, which is also DBE's main shareholder. A further subsidiary, GNB, is responsible for development and fabrication of the Castor transportation and storage casks.

After a licensing procedure, construction started in 1984. An initial license for storage of up to 1500 tHM spent fuel was later extended to cover storage of spent fuel from the German High Temperature Reactor. Spent fuel storage at Ahaus started in June, 1992. Currently, 305 Castor casks with spent high temperature reactor fuel are in storage there, as well as a 6 further casks with PWR and BWR fuel.

A further capacity extension was granted in November 1997 allowing to store up to 3960 tHM of spent fuel in previously licensed and in the new Castor V/19 and V/52 casks until end of December of 2036.

GORLEBEN AFR STORAGE FACILITY

At Gorleben, near the site of the exploration mine and next to the pilot conditioning plant, a further AFR dry interim storage facility is being operated by GNS. The license allows for storing here spent fuel as well as vitrified reprocessing waste. A first storage license for a capacity of 1500 tHM was granted in 1983.

A further license application for capacity enlargement up to 3800 tHM for spent fuel with higher burn up as initially considered was later submitted to the Authorities. This application asked for permit to store vitrified waste, mixed oxide spent fuel, and other waste containing fissile materials. The new license was granted in 1995. Spent fuel storage started at Gorleben in April 1995. A first TS-28-V cask with vitrified waste canisters was stored in May 1996. Currently there are three cask in storage containing 28 vitrified waste canisters each and 5 casks containing spent fuel.

PILOT CONDITIONING FACILITY

After a decade of intensive R&D work on spent fuel direct disposal the results were evaluated by the Federal Government in 1989. In view of the positive results achieved, the Government concluded that the direct disposal option was to be further developed to technical maturity and convincingly demonstrated. This goal was achieved with a successful technology development and demonstration program, leading to an amendment of the Atomic Energy Act by Parliament in 1994. Since then, direct disposal of spent fuel is allowed as an alternative to reprocessing.

To demonstrate the feasibility and licensibility of spent fuel and vitrified waste conditioning for final disposal, a pilot conditioning facility, the PKA, was constructed at Gorleben by GNS.

The plant license application is for a yearly capacity of 35 tHM. The PKA is basically a multipurpose hot-cell facility with capability to process spent fuel and vitrified waste and condition them into waste packages acceptable for final disposal. Construction was immediately started after receiving the first license in 1990. The plant, which is now ready, will receive the operation license in the very near future.

MORSLEBEN DEEP GEOLOGICAL REPOSITORY

The Morsleben repository is located in a former salt and potassium mine. In 1970 the mine was selected to be converted into a final repository for low and intermediate-level radioactive waste. After a stepwise licensing procedure and a short waste disposal campaign in 1971, routine waste disposal started in 1978 in rock cavities below the 500 m horizon. In the wake of German reunification in 1990, Morsleben became a Federal facility, site operation was assigned to DBE.

In this worldwide pioneer deep geological repository radioactive waste went on until a stop in September 1998. The technologies used were essentially stacking of LLW in drums in chambers as well as discharge of waste with higher activity content through shielding lock systems into closed chambers below a drift.

As of end of October 1998, the radioactive waste disposed at Morsleben amounted to:

- 36,752 m³ radioactive waste and
- 6,621 sealed radiation sources.

The Morsleben repository operation license, originally valid until June 30, 2000, was later extended for five more years. Since this license did not cover repository sealing and closure, a licensing procedure for this activity was initiated in 1992.

KONRAD REPOSITORY PROJECT

Mining started at the former iron ore mine Konrad in the sixties, and was phased out for economical reasons in 1976. In this year, the Konrad site was selected for investigation as a possible repository because of the great depth of the ore horizon, the fact that the mine is extraordinarily dry, and the complete isolation of the planned disposal areas from groundwater by clayish overlying rock.

After a positive site suitability statement in 1982, DBE was entrusted with developing the repository technology, carrying out the licensing procedure in cooperation with the Government, and later transforming the mine into a repository and operating it.

Konrad will be a repository for waste with negligible decay heat, and will consist of emplacement fields at different levels between 800 and 1,300 m depth. A net disposal capacity of approximately 650,000 m³ of waste packages will be available. Due to its unique isolation capability the site can accept waste with much higher content of long-lived activity than a near-surface repository.

After the Konrad repository license will be granted, transformation of the existing mine into a repository will begin, involving construction of completely new surface facilities. Conversion of the mine itself will cover excavation and equipping of necessary infrastructure areas, disposal chambers, and access drifts and will require approximately four years.

GORLEBEN EXPLORATION MINE

After an extensive siting process, the salt dome near the village of Gorleben was selected by the Government in 1977 as the site for a deep geological repository specially for spent fuel and HLW.

The site is being surveyed since 1979. This work is aimed at providing all information about the geological and hydrogeological conditions in and around the salt dome needed for a final suitability statement and for the repository licensing procedure.

Surface survey lead in 1983 to a first suitability statement in an extensive interim report by the responsible governmental bodies. After some preparatory work, construction of the exploration mine by DBE started in 1986 with the excavation of two shafts in the central part of the salt dome.

After reaching the repository level at 840 m depth, the mine construction continued with excavating the infrastructure rooms, which are currently being equipped. The rock volume excavated hitherto amounts to approx. 200,000 m³. Among others, refurbishment of shaft 1 is now close to be finished. Drifts and crosscuts are being driven to explore a first prospective waste disposal area. The survey work being carried out includes mapping of strata crossed, evaluation of drilling cores, and non destructive methods as seismic profiles, borehole radar and geoelectric scanning, and the like.

If the underground exploration keeps yielding positive results as up to now, the exploratory mine can be later turned into a final repository. Its future licensing and operation is highly dependent on consensus between the main waste producers and the Government.

A virtual visit to the Gorleben site, using Internet technology, can provide a realistic impression of the progress already achieved in site development. At present, continuation of site exploration is one of the topics being discussed between the utilities and the Government.

CONCLUSIONS AND OUTLOOK

Ladies and Gentlemen, the new German Federal Government has announced the intention of phasing out nuclear power use after reaching the service life end of the country's nuclear power plants.

Despite all decisions regarding the future use of nuclear power, construction of the facilities for waste management and disposal remains a must. This basic fact is recognized by all stakeholders. And the reality is much more positive than it might appear to observers:

- Planning of Morsleben sealing and closure goes routinely on. This will be the worldwide first deep geological repository to be decommissioned following a full licensing procedure.
- The license for the Konrad repository is expected for the very near future. Abandoning this project upon a governmental decision will render the Federal Government liable for substantial compensation claims.
- The operation license for the pilot conditioning facility will have to be issued in the current year. It is clear to all involved parties that the applicant is fully entitled to receive the permit. Failing to grant a license will render the Government liable for substantial compensation claims.
- Construction of the Gorleben exploration mine shows up to now very favorable results regarding site suitability, confirming the soundness of the site selection made two decades ago.

It stands to reason that the German electricity utilities respect the governmental will to phase out nuclear power use. And all involved parties have repeatedly stated their intention of achieving this in consensus to avoid compensation claims by the power plant owners. But coming to a consensus between the Government and the utilities is proving to be more difficult than expected by some of the involved parties. A swift phase out of nuclear power, as demanded by some groups, would violate the plant owner's property rights, which are granted a high level of protection by the German constitution. On the other hand, it seems to be legally sound to limit the plant licenses to some 30 to 40 years of operation without affecting the owner's property rights. The Government and the utilities are now seeking a consensus about the remaining plant operation time in line with such figures. This will entail that approximately until the year 2020 nuclear power plants will continue being operated in Germany.

Fulfilling a further governmental request very recently the electricity utilities have submitted license applications for ten new interim storage facilities to be constructed at or near the nuclear power plants. The near future will show whether decentralized interim storage, aimed at minimizing spent fuel transports, is more accepted by the public than the former strategy with two existing centralized facilities at Gorleben and Ahaus. Opposition at the new sites is now forming, and could at least substantially delay the projects.

In the last weeks the permit for transportation of spent fuel from several power plants to the Ahaus interim storage facility has been finally granted. It is also expected that in the course of the year transportation of vitrified waste currently at the La Hague reprocessing plant in France to the Gorleben interim storage facility will be carried out.

With regard to the repository projects, no final decisions have yet been made. The subject is one of the issues being discussed between the Government and the utilities. Development of the Gorleben site will most likely suffer a slow down, in spite of the excellent survey results hitherto obtained. A commission has been set up to develop new criteria for repository site selection. It is intended to later revisit the issue of selecting a HLW repository site in a screening process covering all of Germany with the help of these new criteria. Obviously, this repeated screening will include Gorleben as one possible site.

Ladies and Gentlemen, the very advanced German concept and achievements I presented constitute a unique basis for further progress. I really hope that all these achievements help persuade the public and decision makers that it is meaningful to protect the investments already done and to go ahead with the existing projects.